ECONOMIC COMMISSION FOR EUROPE
Committee on Environmental Policy

ENVIRONMENTAL PERFORMANCE REVIEWS

CROATIA

UNITED NATIONS
New York and Geneva, 1999

Environmental Performance Reviews Series No. 7

NOTE

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city of area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

UNITED NATIONS PUBLICATION
Sales No. 99.II.E.37
ISBN 92-1-116736-1 ISSN 1020-4563

Preface

The Environmental Performance Review of Croatia began with the preparatory mission in June 1998. The agreement on the structure of the report was followed by the constitution of the review team, in which national experts from Armenia, Israel, Italy, Slovakia, Slovenia, Switzerland, Turkey and the United Kingdom participated together with the ECE secretariat, experts from UNEP and from the Bilthoven Division of the WHO European Centre for Environment and Health. The costs of the participation of experts from countries in transition, as well as the travel expenses of the ECE secretariat, were covered by extrabudgetary funds from Austria, Italy and the Netherlands. All contributions were essential for the conclusion of the project.

This report was prepared on the basis of the team's review mission to Croatia in March 1999. Its draft was submitted to the ECE Committee on Environmental Policy at its annual session in Geneva on 22 September 1999. A high-level delegation from Croatia attended this evaluation, which was prepared in-depth by two reviewing countries, the Netherlands and Slovakia. At the end of its evaluation, the Committee approved the recommendations as set out in this report.

The review of Croatia's environmental performance identified a number of strengths and weaknesses in the implementation of environmental policy and management. The systematic and professional preparation of environmental management measures in the State Directorate for the Protection of Nature and the Environment is often impressive. However, their implementation and enforcement suffer from a lack of institutional weight and cooperation throughout State institutions. Therefore, improving the cooperation with all key partners is an important task. Furthermore, greater involvement of the general public in environmental management might help to strengthen the overall recognition and results of environmental management. Finally, the review also found impediments to better performance with regard to remediation of the environmental consequences of the war – a problem that can be successfully dealt with only if sufficient funds are allocated for that work.

The ECE Committee on Environmental Policy and the ECE review team wish the Croatian Government success in their tasks, including the implementation of the recommendations contained in the present report.

LIST OF TEAM MEMBERS

Mr. Andreas KAHNERT	(ECE secretariat)	Team Leader
Ms. Martina PALM	(UNEP)	Chapter 1 and Project Coordinator
Ms. Cvetka KRAJIC-TOMIN	(SLOVENIA)	Chapter 2
Mr. Mervyn RICHARDSON	(United Kingdom)	Chapter 3
Ms. Sabine HOEFNAGEL	(UNEP)	Chapter 4
Ms. Katarina MAGULOVA	(SLOVAKIA)	Chapter 5
Ms. Catherine MASSON	(ECE secretariat)	Chapter 6 and Project Coordinator
Mr. Branko BOSNJAKOVIC	(ECE secretariat)	Chapter 7
Mr. Eliezer FRANKENBERG	(ISRAEL)	Chapter 8
Ms. Zerrin LEBLEBICI	(TURKEY)	Chapter 9
Mr. Ivan NARKEVITCH	(ECE secretariat)	Chapter 10
Ms. Nune DARBINYAN	(ARMENIA)	Chapter 11
Mr. Christophe CLIVAZ	(SWITZERLAND)	Chapter 12
Mr. Michal KRZYZANOWSKI	(WHO/ECEH)	Chapter 13
Ms. Marina PENNA	(ITALY)	Chapter 14
Mr. Lovorko BARBARIC	(CROATIA)	Technical Advisor

The preparatory mission for the project took place from 10-14 June 1998. The review mission was organized from 9 to 19 March 1999. The Peer review was held on 22 September 1999 in Geneva. The ECE Committee on Environmental Policy adopted the recommendations set out in this publication.

Information cut-off date: 23 September 1999

TABLE OF CONTENTS

ANNEXES

LIST OF FIGURES

LIST OF TABLES

PART I: THE FRAMEWORK FOR ENVIRONMENTAL POLICY AND MANAGEMENT

Chapter 1

LEGAL INSTRUMENTS AND INSTITUTIONAL ARRANGEMENTS FOR ENVIRONMENTAL PROTECTION

1.1 The legal framework

General legal instruments

After Croatia's establishment as an independent republic, it started to develop a new legal system, including new laws and regulations on the environment and nature protection. Around 900 new laws have been enacted in total. Croatia's variety of legal acts has the following hierarchy:

- Constitution;
- International treaties approved by the Parliament; they take precedence over domestic law;
- Laws and codes;
- Presidential decrees;
- Governmental decrees;
- By-laws, rule books, orders, ministry or State directorate instructions.

Presidential decrees are reserved for extraordinary circumstances, e.g. in times of war; they are in force only for one year.

Usually, the competent ministry or State directorate prepares a draft law, which is, at first, informally coordinated with other relevant State directorates, ministries and county authorities (if their interests are affected). The State Directorate for the Protection of Nature and the Environment (SDEP) receives feedback from the authorities concerned, decides whether it can accept their comments and proposals or not and defines its own position. Since a decision of the Government in early 1999, a proposal for new legislation must also state whether the relevant EU legislation has been taken into account. The whole documentation is then officially sent to the Government, which passes it on to a governmental committee where all competent authorities are represented, and a formal draft is prepared. The draft bill is sent to the Croatian State Parliament, first to the House of Counties and subsequently to the House of Representatives.

The 1990 Constitution of the Republic of Croatia and its 1997 amendments accord the right to propose laws to each Member of the House of Representatives, committees of the House of Representatives, the House of Counties, and the Government.

Environmental legislation

The Constitution (22 December 1990) includes an obligation to protect the environment and nature and ensures the right of citizens to a healthy environment. The Government, the public and economic entities should, within their respective competence, pay special attention to the protection of human health, nature and environment.

Following the United Nations Conference on Environment and Development, the Croatian State Parliament, on 5 June 1992, passed the Declaration on Environmental Protection in the Republic of Croatia. It called for the establishment of a legislative system in accordance with international treaties and European and global standards that would ensure permanent, systematic and effective environmental protection and create conditions for sustainable development.

In October 1994, the Law on Environmental Protection (EPL) was adopted. This "umbrella law" is, along with the Constitution, the legal basis for regulating environmental protection. It determines environmental protection objectives and principles, sets out the rights and responsibilities of actors in the environmental sector, stipulates who is liable for environmental pollution and has to clean it up, and defines environmental inspections. Occasional criticisms are levelled against the lack of enforcement mechanisms in the law, and amendments are under discussion.

Map of Croatia

The following selected major environmental laws are in force:

Act	Official Gazette No.
Law on Environmental Protection	82/94
By-Law on Conditions for Issuing Permits for Performing Professional Environmental Activities	7/97
Contingency Plan for Accidental Marine Pollution in the Republic of Croatia	8/97
By-Law on Beach Water Quality Standards	33/96
By-Law on Environmental Impact Assessment	34/97, 37/97
By-Law on Quality Standards for Liquid Oil Fuels	76/97, 66/99
Law on Air Quality Protection	48/95
By-Law on Recommended and Limit Ambient Air Quality Values	101/96, 2/97
By-Law on Limit Values of Pollutant Emissions from Stationary Sources into the Air	140/97
By-Law on Substances Depleting the Ozone Layer	7/99, 20/99
Law on Waste	34/95
By-Law on Requirements for Handling Hazardous Waste	32/98
Law on Nature Protection	30/94, 72/94

The following laws regulate specific nature and environmental protection issues:

Act	Official Gazette No.
Physical Planning Act	30/94, 68/98
Law on Water	107/95
Law on Performing Tourist Business	8/96, 19/96, 76/98
Law on Agricultural Land	54/94, 48/95, 19/98
Law on Forests	52/90, 5/91, 9/91, 61/91, 26/93, 76/93
Law on Hunting	/94
Maritime Code	17/94, 74/94, 43/96
Law on Marine Fisheries	46/97
Law on Freshwater Fisheries	18/86, 43/86, 34/89, 19/90, 26/93
Law on the Structure and Competence of the Ministries and State Administrative Organizations	48/99

The above covers only laws. The large majority of regulations on environmental protection have been brought in line with the new constitutional order and the Law on the Protection of the Environment. Some, however, still need to be adjusted to the State administration's new structure and competencies. Some nature protection issues also need to be developed in greater detail, in particular biodiversity and landscape diversity issues, and they have to be harmonized with international conventions.

Liability

Liability for environmental damage caused by pollution is regulated in the Law on Environmental Protection. Its provisions regulate only specific liability issues. The Law on Obligations contains provisions concerning "ecological lawsuits", aiming at eliminating hazards associated with particular sources of damage. The same Law also applies when the damage has already been done. The Law on Obligations and the Law on Ownership and other Positive Rights are further acts that can be applied in cases of damage caused by environmental accidents.

According to article 50 of the Environmental Protection Law, a natural or legal person having caused environmental pollution is liable for the damage done. This also applies to the person having enabled or permitted environmental pollution by an illegal or unsuitable activity. The liable persons must, without delay, take the measures envisaged by the Environmental Protection Intervention Plan to reduce environmental damage or to prevent further environmental risks, threats or damage.

The natural or legal person having caused the damage must cover all expenses related to mitigating measures, and the environmental inspectors have to be informed immediately. If the polluter cannot be identified, the SDEP undertakes

any necessary clean-up, in cooperation with relevant ministries.

1.2 The policy framework

Privatization of economic units

In early 1991, Croatia embarked on the privatization of the former "socially-owned enterprises", starting with the Law on the Transformation of Social Enterprises. This Law was amended several times and consolidated in its present form in the Law on Privatisation (14 March 1996).

With the exception of ten State-owned enterprises in the utility and energy sectors -- like INA Oil Industry joint-stock company, Croatian Railways Ltd, Croatian Electricity joint-stock company, public enterprise Croatian Radio and TV Broadcasting -- and some others, most small, medium-sized and big companies were privatized. The share of the State-owned enterprises in the Croatian economy in 1997 amounted to 10 per cent of national income, 21.5 per cent of total assets, and 12 per cent of all employees. The Law on Privatization stipulates that the above-mentioned large enterprises will be privatized on the basis of separate laws.

Croatia's process of privatization was different from that of other former socialist countries. To begin with, Croatian enterprises were not all State-owned, but "self-managed" since the 1950s. That system granted them a high degree of autonomy in all spheres. In particular, they organized and managed their business activities independently. As a result, the privatization of Croatian enterprises was to a great extent influenced by the enterprises themselves.

The Law on Restructuring Socially Owned Enterprises defined two phases of privatization. In the first phase, Croatian citizens and employees were offered shares at a discount. They were allowed to buy up to 50 per cent of their enterprises. National pension and disability insurance and the Croatian Privatization Fund were entitled to the other 50 per cent. As the workers and war victims have not fully used their entitlement to buy shares, large parts of enterprises remained in the hands of the State, and have subsequently undergone voucher privatization. Furthermore, the State became owner of the land (construction, agricultural, forest land) which used to be socially owned. Also during this first phase, war veterans were either given ownership or a 30-years lease of certain facilities, or agricultural land.

In the second phase, which has recently been completed, vouchers were given to certain groups of people (war veterans and invalids, war widows and orphans, displaced people, refugees, and similar social groups). They then gave the vouchers to the Privatization Investment Funds (PIFs) that manage the portfolio on their behalf. Foreign companies may buy real estate without any restrictions. Individual foreigners may also acquire property according to procedures defined by the Law and other regulations.

Of the total agricultural land, 36 per cent is State-owned, 64 per cent is in private hands. Often, the State-owned arable land is left fallow. 80.2 per cent of forests are State-owned and managed by "Hrvatske Sume", 18.5 per cent are in private hands and 1.3 per cent is other public land. All houses are privately owned, and there are no longer restrictions on the number of houses a single owner can own.

It is fairly undisputed that the Croatian privatization process was neither rapid nor transparent. Although Croatia was one of the first countries in transition to start the privatization process, its programme has been facing a number of difficulties, such as the war (1991-1995), severed economic ties after independence, and the need for economic restructuring. The most important goals of the privatization programme were: to encourage entrepreneurship, develop capital markets, boost economic growth, increase employee productivity, modernize technology, introduce efficient management and facilitate foreign investment. By autumn 1998, 2 650 enterprises entered the privatization process, of which 1991 (75.1 per cent) were fully privatized and 471 in the process of voucher privatization. There are still (according to data from the autumn of 1998) 659 enterprises partially available for privatization. In the period from 1993 to 31 July 1998, the sale of shares within the privatization process generated DM 3.47 billion.

Environmental policy

On the basis of the Environmental Protection Law (art. 18), the Government will propose an environmental protection strategy to Parliament (*Sabor*) to set long-term environmental management directives. The strategy will have the dual objective of:

- strengthening the legal framework of environmental protection, by building capacity in public institutions to develop it further, and enforcing its application; and
- defining a strategy for environmental protection in all areas of human activity, including quantified objectives for specific sectors, regions and natural resources.

The strategy will serve as a basis for the preparation of a national environmental action plan. 30 working groups on different subjects have been established. They involve all competent authorities, including the local level, scientists and experts from academies and the law faculty, depending on the working group's subject. Consultations with NGOs are planned. Although the strategy will be only politically but not legally binding, its development follows that foreseen for the drafting of laws. At present, the strategy is still being discussed within the SDEP. The aim is to present it to Parliament by the end of 2000. The Physical Planning Strategy and Programme, the Sustainable Agricultural Development Strategy (1995), the Strategy for the Long-Term Development of Croatian Tourism (1993, revised 1998) and the Long-Term Plan for the Development of Water Management(1995) have been adopted. The Energy Strategy is going through the parliamentary adoption procedure (second reading); and NEHAP is being prepared as well. A Biological and Landscape Diversity Strategy and Action Plan are currently being considered by coordination bodies of the Government.

Participation in the European integration process is one of Croatia's political priorities. Its Deputy Prime Minister (Minister for European Integration since March 1998) coordinates all activities pertaining to Croatia's accession to Western institutions, a task which had so far been rather decentralized and unsatisfactorily coordinated (see Chapter 4).

1.3 Basic structure of environmental management

The overall structure of State administration, including environmental management responsibilities is the subject of Figure 1.1. The main institution for environmental protection is the State Directorate for the Protection of Nature and the Environment (SDEP). Its organizational chart is reproduced in Figure 1.2. At present, it employs a total of 109 staff.

SDEP is in charge of developing general environmental policy and creating conditions for sustainable development, participating in international environmental cooperation, implementing laws, approving enforcement regulations, performing administrative control and other administrative and expert duties in environmental protection, carrying out environmental inspections, monitoring, and promoting environmental education and research. Water protection and management are not part of SDEP responsibilities but are dealt with by the State Water Directorate. The same is true for radiation protection under the Ministry of Health.

As a State directorate, SDEP has no seat in the Cabinet of Ministers and may participate only at the Cabinet's explicit request. Usually, the Ministry for Culture represents environmental concerns in the Cabinet. The Ministry of Development, Immigration and Reconstruction plays an important role, as it has funds, which, in some cases, can also be made available for environmental purposes. Moreover, the Ministry of the Interior, the Ministry of Physical Planning, Building and Housing, the Ministry of Agriculture and Forestry, the Ministry of Maritime Affairs, Transport and Communications, and the Ministry of Health deal with environmental issues. Tourism, a major economic sector, is dealt with by the Ministry of Tourism (for details, see Chapter 12).

The State Directorate for the Protection of Nature and the Environment, the State Water Directorate, and the State Hydrometeorological Institute are involved in State administration of environmental issues. In particular, the State Water Directorate has a large number of environmental responsibilities, probably partly because it was founded before the SDEP, and partly because it commands more funds.

This division of tasks among the different State bodies means that competencies for the protection of the environment are scattered, thus weakening the SDEP. In particular, its lack of competencies in tourism and, crucially, in water management and protection makes it very difficult for the SDEP to develop a stringent and comprehensive environmental protection policy. On the other hand, physical planning, water and tourism management should include environmental protection components, which are difficult to coordinate with the environmental strategy of the SDEP in the present compartmentalized structure (for details see Chapters 6 and 12).

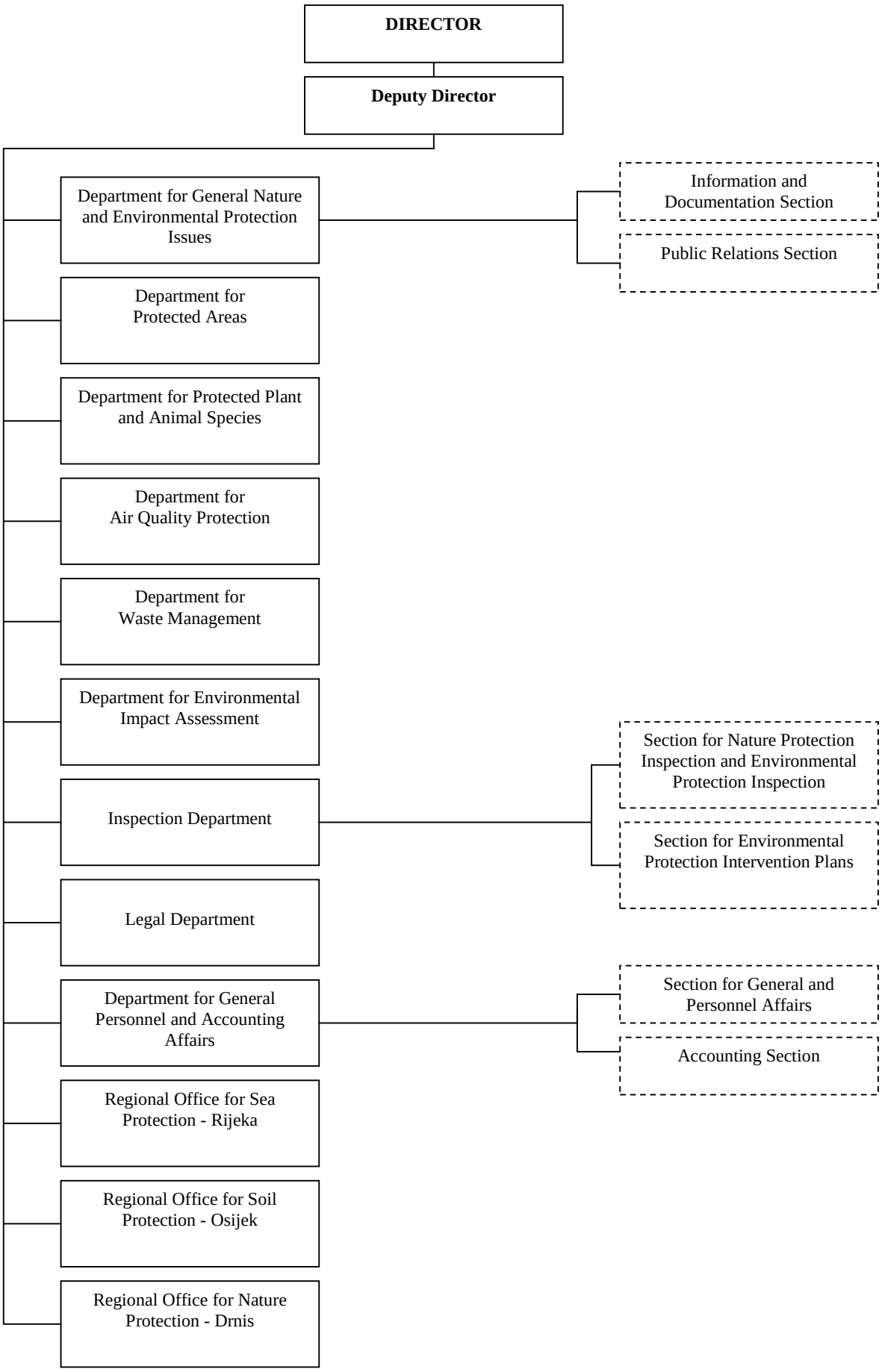
Figure 1.1: Structure of State Administration*

THE CROATIA STATE PARLIAMENT (HRVATSKI DRZAVNI SABOR)
THE GOVERNMENT OF THE REPUBLIC OF CROATIA (VLADA RH)

STATE MINISTRIES	MINISTRIES	STATE ADMINISTRATION ORGANIZATION
1. Ministry of Finance	1. Ministry of Economy	1. State Geodetic Administration
2. Ministry of Foreign Affairs	*2. Ministry of Agriculture and Forestry*	*2. State Directorate for the Protection of Nature and Environment*
3. Ministry of Internal Affairs	*3. Ministry of Maritime Affairs, Transport and Communications*	*3. State Water Directorate*
4. Ministry of Defence	*4. Ministry of Culture*	*4. State Hydrometeorological Institute*
5. Ministry of Development, Immigration and Reconstruction	*5. Ministry of Physical Planning, Building and Housing*	5. State Standardization and Measurement Institute
	6. Ministry of Tourism	6. State Statistics Bureau
	7. Ministry of Health	7. State Institute for Intellectual Property
	8. Ministry of Education and Sport	*8. State Hydrographic Institute*
	9. Ministry of Science and Technology	9. State Inspectorate
	10. Ministry of Justice	10. State Institute for the Protection of Families, Motherhood and Youth
	11. Ministry of Labour and Social Welfare	11. State Directorate for State Administration and Local Self-Government
	12. Ministry for Croatian Homeland War Defenders	

* Administrations with responsibilities in environmental management are marked with italics.

Figure 1.2: Structure of State Directorate for the Protection of Nature and Environment



In Parliament, the Physical Planning and Environmental Protection Committee, the Agriculture and Rural Affairs Committee, the Maritime Affairs, Transport and Communications Committee and the Tourism Committee, all deal with environmental issues. In the House of Counties, the Economy and Finance Committee discusses budgetary needs for environmental protection.

The local level -- there are 415 municipalities, 106 towns and 21 counties, including Zagreb -- has an important function in implementing the environmental laws and regulations. The Law on Local Self-Government (1 January 1993) regulates its relationship with the national authorities. Municipalities and towns are supervised by the counties, which are themselves under the supervision of the national Government. On average, each county should have two environmental inspectors. Today, there are only 25 such inspectors. Towns and municipalities, except Zagreb, do not have any.

Environmental inspection is organized within SDEP, pursuant to the By-law on the Internal Structure of the State Directorate for the Protection of Nature and the Environment of 26 March 1998. The Environmental Inspection Department is constituted of the Department Head, two nature inspectors and two environmental inspectors. At the county level, environmental inspectors are attached to each Physical Planning, Housing and Municipal Affairs, Construction and Environmental Protection Bureau, with the exception of the County of Zagreb, which, despite repeated requests, does not have an official environmental inspector of its own. For inspection activities, see section 1.5 below.

Counties and municipalities are on one side bound by national laws, but they can introduce stricter standards or a more stringent monitoring system. If this is envisaged, the SDEP is informed of the plans, which it has to approve before they may be carried out. Cooperation between the various levels does not present any major problems. It is perceived to be satisfactory, probably due to the relatively clear competencies.

1.4 Environmental impact assessment

Scope and functions

Environmental impact assessment (EIA) has a long tradition in Croatia. The new by-law, based on the Environmental Protection Law, replaced the "Regulations on Environmental Impact Assessment Study" of 1984, amended in 1990. The objective of environmental impact assessment as laid down in EPL, and specified in the respective by-law, is to give effect to the prevention principle by coordinating and adjusting the planned activity with the environmental carrying capacity of a given area. EIA is defined as a procedure to evaluate the environmental acceptability of a project and identify necessary environmental protection measures. EIA considers the project's possible adverse impacts on soil, water, sea, air, forest, climate, human health, animals and plants, landscape, physical and cultural values and their interactions. It also takes into account other planned projects and their possible interactions with regard to the existing or anticipated activities in the area.

Currently the EIA procedure is only partially used in physical plans (i.e. through the preliminary study for developments not specified in physical planning documentation). Croatia intends to introduce strategic impact assessment (for plans, programmes and strategies) into physical planning as well as into other sectors in the near future.

Procedure

At the core of the EIA regulations is an obligation to assess the environmental impact of the 'spatial interventions' listed in an annex which is an integral part of the by-law. The Physical Intervention List comprises, for instance, electric power plants, facilities for the storage and transport of crude oil and gas, etc.

The central piece of the environmental impact assessment is the Environmental Impact Assessment Study. It must include:

- A description of the project and the site, including the purpose of the project, data from the physical planning documents, and a description of the vicinity;
- An evaluation of the project's acceptability, including its environmental risks, alternative solutions, proposals to protect the environment, including measures to prevent or mitigate environmentally negative effects.

The study evaluates among other things the meteorological, climatological, hydrological, geological, social and urban impact of each project. The study itself is assessed by a Commission for

the Evaluation of EIA, appointed by the Government. The number and professional profile of its members are usually determined according to the nature of the project and the characteristics of the affected environment. But there are also two permanent commissions: one for roads and one for airports. Standing commissions are established for recurrent or numerous developments within a single programme. The members of the commissions are independent experts as well as civil servants from the ministries or State directorates concerned.

Two official bodies are involved in informing the public of EIA studies: the coordinating body (territorially competent body within the local self-government in charge of environmental protection) and the enforcing body (either the executive body of the local government, or designated in the statute of the local government). An EIA study that is accepted by the Commission for the Evaluation of EIA is forwarded to the coordinating body, which has to submit it to a public hearing, which lasts at least 15 but not more than 60 days (for details of the procedure, see Figure 1.3). The documentation to be presented at the public hearing encompasses the entire EIA study documentation as well as relevant summaries.

The public is entitled to put forward opinions, proposals and suggestions in writing or orally. The Commission for the Evaluation of EIA is obliged to explain why opinions, proposals or suggestions made by the public were not taken into consideration. There is an elaborate procedure for public participation, but in practice NGOs or citizens rarely make use of this opportunity.

If the proposed project is publicly accepted, the Commission formally draws a conclusion, at the latest 30 days after the public hearing and within 6 months after the Commission's first session. The conclusion and all the documentation are then forwarded to the SDEP, which will decide whether or not to approve the planned project, within 30 days after receiving the conclusion. Only in exceptional circumstances would the SDEP reject the Commission's conclusions. The decision to grant or refuse permission to go ahead with the project cannot be appealed, but it is possible to initiate administrative litigation.

All other permits, e.g. for air emissions or waste (see Chapter 2) can be obtained in parallel with this procedure, the siting permit can be issued, and the project may start.

If an EIA is not necessary according to the by-law, the county where the project is to be carried out can nevertheless require an EIA. On average, there are 50 EIAs on the national and around 50 EIAs on the county level each year.

1.5 Enforcement and inspections

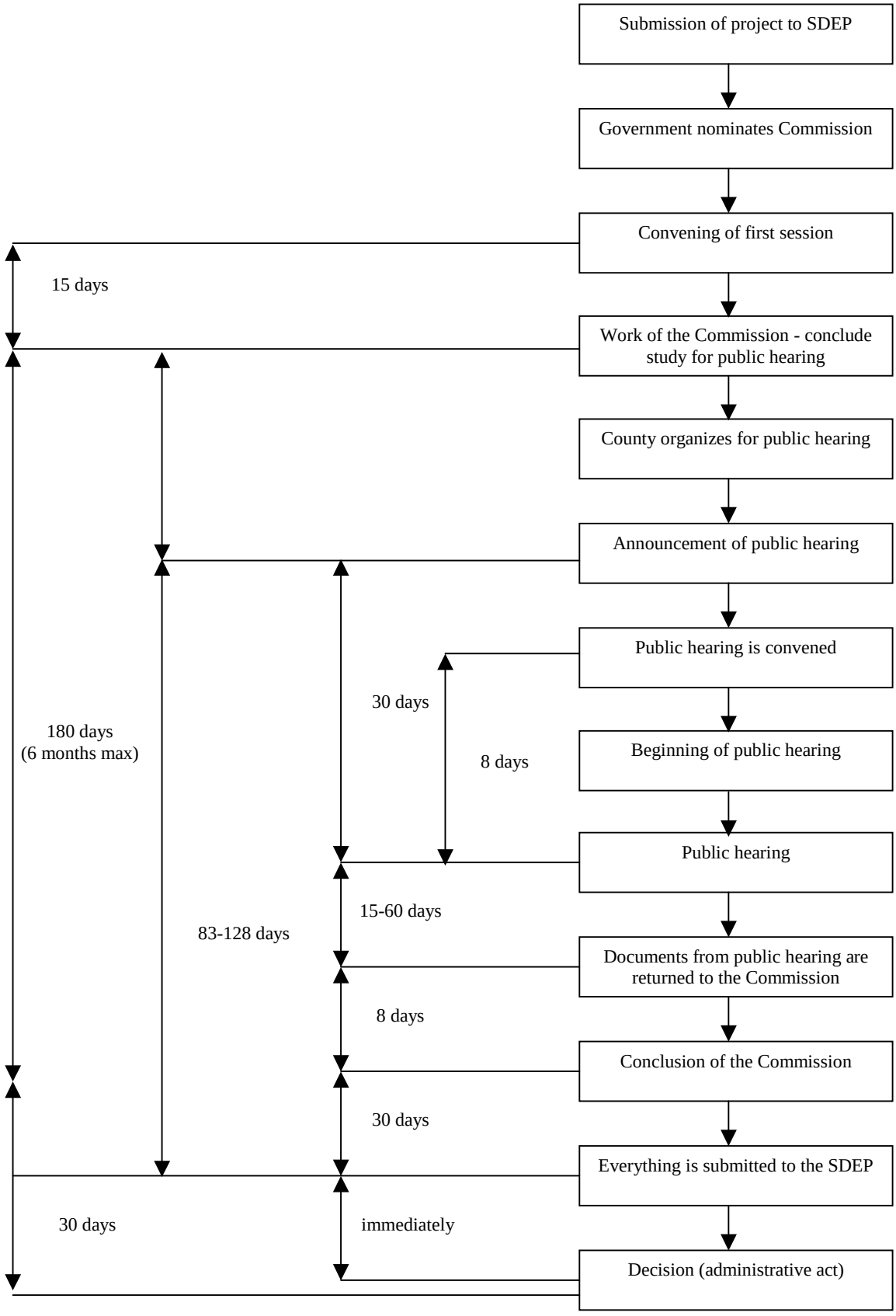
The county environmental inspectors' duties include verifying the application of environmental standards, monitoring, emission and immission measuring, implementation of environmental measures, keeping of records, etc. Major polluters are checked regularly, the smaller ones from time to time, especially if irregularities have occurred. The SDEP inspectors can also perform all these duties, e.g. supervise the county inspectors and ensure the same interpretation and application of the laws and regulations nationwide. In addition to these duties, SDEP inspectors monitor the implementation of international environmental treaties, deal with complaints about decisions by the county inspectors, and propose measures to improve the environment.

According to article 66 of the EPL, the inspector draws up a report on his/her inspection, describing the state of the environment and the measures taken to protect it. If laws or regulations have been violated, administrative measures with deadlines will be imposed. A polluting operation or production by a legal person can be temporarily stopped. An appeal to the SDEP against the inspector's official decision is possible, but does not suspend its execution. In 1998, there were around 2 000 examinations with a report per county, and 200 inspections at the State level. 25 complaints against inspectors' initial decisions were made.

The EPL contains penalty clauses according to which – for a specified behaviour – a legal or natural person can be fined up to 80 000 kunas. If an inspector thinks a fine is warranted, he presents his report to an administrative court, which rules on the fine. In some cases, the fines foreseen by law are so high that the respective enterprise would go bankrupt if it had to pay the full amount. Therefore, fines are sometimes not collected. In the long run, this reduces the role of inspectors to advisory bodies, preventing them from using fines as an effective means of enforcement.

Cooperation and communication with the enterprises are usually considered to be

Figure 1.3: EIA Procedure



satisfactory. Apart from environmental inspections, there are other environment-related inspections under the control of other State bodies, e.g. on water management (State Water Directorate), health inspections (Health Ministry), or occupational safety. This often leads to a duplication of work for the inspected enterprises. They claim that they could save time, manpower and paperwork if inspections were combined where feasible (mainly environment and water). This, however, is not provided for officially but left to the personal initiative of the inspectors concerned. Therefore, combined inspections are the exception.

Inspections also have to be coordinated with physical planning. In 1997 the Parliament adopted the Strategy for Physical Planning. It is based on the principles of sustainable development and has to be extended to the local level with the help of the local administration. The role of the county offices of the SDEP is to ensure the integration of environmental legislation into the physical plans of the county and, with the help of inspectorates, to supervise the practical implementation. The permitting procedure for the siting of new facilities or for the reconstruction of old ones has to be done in accordance with the Physical Planning Law as well as the environmental legislation. The procedure is harmonized and the competencies clearly defined. Feasibility studies and EIA are parts of the procedure. Since 1998 public scrutiny has also been included into the procedure. After obtaining the siting permit, the new/reconstructed facility receives its operating permit, which also includes all the environmental conditions it must fulfil.

1.6 Environmental information and monitoring

Environmental information

The public has access to the environmental data collected by the State administration, other public authorities and the polluters themselves, unless a special law classifies them as a State, military, professional or commercial secret. The SDEP must reply to any inquiry or petition from Croatian citizens within one month. There is no particular restriction as to who may receive environmental information; institutions, organizations and individuals are all entitled.

Article 49 of the EPL states that ”a special regulation… may set the fees to be paid for the data provided, in relation to the actual expenses of the data provider.” Since there is no such special regulation, it is difficult to determine to what extent such fees would be an obstacle for a person requesting information.

The Environmental Protection Law makes the preparation of a report on the state of the environment every four years to Parliament obligatory.

The national Emergency Information Centre and the counties’ Emergency Information Services warn the public in the event of ecological accidents and emergencies. The following information is disseminated by the public authorities:

- Violation of pollution limits/standards established by law (public must be informed promptly)
- General information on pollution of the environment (public has to be informed periodically)
- Emergency situations leading to a major environmental risk (the public must be informed as soon as possible)
- Information on adverse ecological impact.

Since June 1991 SDEP has issued a monthly bulletin ”Okoliš” (Environment) to keep the public informed of environmental protection issues. It informs more than 6 000 Croatian and international readers of the tasks and priorities of the SDEP and other relevant bodies, of international cooperation, and of recent environmental problems and their solutions. From May 1999, the information is also published in English, and the circulation will be increased to 10 000 copies. More information can be found on a special web site (http://www.ring.net/duzo). The Croatian Public Waterworks has published a monthly newsletter (about 3 300 copies) since 1992. It covers not only water issues but also other subjects related to environmental protection.

Environmental monitoring

Environmental State monitoring is financed from the State budget. According to the Environmental Protection Law, SDEP has established an Environmental Protection Information System. It contains emission inventory data, selected administrative data on the state of the environment, expert and scientific data from local and foreign institutions and international organizations, metadata and other vital environmental information. The Government prescribes the monitoring contents and methodologies, the

reporting obligations and the procedures for both data transmission and management (including processing and disclosure).

If a company plans a project that requires an EIA, it must measure its emissions and immissions and keep records. It must also take part in the monitoring of natural and other phenomena caused by its environmental pollution. The Government prescribes which pollutants, natural and other phenomena have to be monitored. It also prescribes the measurement and sampling methodology, the deadlines for transmitting the data to the State bodies and the format of the databases, unless they are otherwise regulated.

As part of the Environmental Protection Information System, an *Environmental Emission Cadastre* (EEC) has been established. In 1995 SDEP started with its establishment and in 1997 it expanded EEC to the counties and towns. EEC is an integrated pollution register, as it comprises data on air emissions, solid waste and waste-water generation, as well as general information about the respective pollution sources. It is supported by an ACCESS database. The emission sources are obliged to provide data to their county office. The data may be provided in paper form or by means of special software designed for this purpose. Also, towns with a population of over 40 000 are obliged to maintain the EEC. They have special software for entering data on collective sources. The data from towns are also provided to the respective county offices.

The verified primary data from the counties are integrated into a central database (ORACLE) at State level, maintained by SDEP. This integrated database will ultimately be used by all institutions, SDEP, SDW and others as a decision-making instrument. To better coordinate the EEC, the SDEP has established an inter-sectoral body consisting of representatives from various State administrative bodies including the SDW. All those involved, including representatives from industry, have received training to strengthen the project's implementation. The first complete data file should be ready by the end of 1999. This system will comply with the data requirements of the EU.

To facilitate the EEC implementation and to raise overall awareness, SDEP organizes seminars, for instance, for county offices, municipal offices, inspectorates, as well as production enterprises in all counties. Although the business sector considers the requirements of the by-laws, in particular continuous monitoring, to be unrealistic, there is an overall agreement that things have to change. Thus, producers are at work to meet the requirements of the law. The State-owned leading power-producing companies HEP and INA, as well as the already privatized cement plants, are a good example (see also Chapter 10). Management practices according to ISO 9000 are common and environmental management practices according to ISO 14000 are taking hold (see also Chapter 2).

1.7 NGOs, public awareness and participation, environmental education

NGOs and public participation

Environmental initiatives in Croatia date back to the beginning of the 20th century. They have focused mainly on the protection of natural and cultural assets, such as the Plitvice Lakes or the Paklenica National Park. The Environmental Protection Law obliges the State to disseminate information on the state of the environment and to allow the public to participate in environmental decision-making, even including a "Public Participation Principle". It guarantees citizens the right to timely information on environmental pollution and on the measures taken to protect the environment and the right to free access to related data. When solving environmental protection issues, the bodies of the State administration and of the local government and self-government units must ensure the participation of the interested parties.

Today, there are some 150 to 200 environmental NGOs in Croatia. Most operate locally and have little money. They fall roughly into the following three categories:

- Expert-based societies (already formed under the former Yugoslav regime). Their members have a mainly scientific background. Some of them advise the Government, such as the Croatian Ecological Society.
- NGOs founded before 1990 whose members are often older, locally influential people. They deal with local issues and environmental education (e.g. Green Istria, Friends of Nature Dubrovnik, Green Osijek).
- Younger NGOs, focusing on raising awareness. They deal not only with local issues but also with global environmental protection. They

want to contribute to a democratic and environmentally friendly society (e.g. Green Action).

Environmental NGOs are not exempted from taxes, whereas non-profit cultural and sports organizations are. The Croatian Green Alliance has brought together ecological organizations, professional societies and other non-political organizations with ecological programmes. NGOs and the Government have only periodic contacts. Cooperation with local authorities is sometimes perceived by NGOs as being more satisfactory. The cooperation between NGOs and SDEP consists mainly of the discussion of important documents prepared by SDEP, and press conferences. There is, however, a significant exception. Some NGOs have government connections, such as 'Our Beautiful Homeland'. A few staff of the SDEP and other State directorates and ministries are members of these NGOs, which are therefore thought to be privileged in terms of information and funding. A State office for Associations has been set up in late 1998, and it is hoped that the SDEP will have a real and transparent funding policy soon.

To remedy the situation, in 1998, the Government founded the Associations Bureau, in charge of organizing and monitoring the work of NGOs, and not only those engaged in environmental activities. The criteria are prescribed in the Law on Associations. The hope is that the Associations Bureau will become the place where also environmental NGOs can find information, data and financial support for their projects. The Associations Bureau, upon tender and competitive bidding, allocates annual sums to NGO programmes.

The Parliamentary Committee for Physical Planning and Environmental Protection invites NGOs to major thematic sessions, in particular law-making. The most common obstacle to ensuring the conditions for public participation in the parliamentary legislative procedure is that the materials for discussion (proposals for laws and regulations) are frequently delayed when reaching Parliament. Consequently, this may not leave enough time for due notification of the interested persons or NGOs.

Several laws and regulations that include provisions on or related to public participation have been adopted and implemented (e.g. Environmental Protection Law, Law on Waste and its by-laws, Regulation on Environmental Impact Assessment, Law on Physical Planning). For public participation in EIAs, see section 1.4 above. As Croatia has signed the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, its laws, in particular the EPL, will have to be brought in line with it, e.g. with respect to definitions and terms.

Public awareness

Since 1993, SDEP has granted national awards and prizes for environmental achievements on the occasion of World Environment Day. Awards and prizes are seen as an important stimulus for environmental protection. They are granted only if an achievement is not purely the result of professional or legal obligations, but presupposes additional work and efforts. The award categories are: pollution prevention, environmentally sound solutions for production processes, capacity building, environmental education, contributions by individuals or associations (including NGOs) to the improvement of the environment, and contributions to international cooperation for the environment. The jury is composed of representatives of SDEP, selected ministries, environmental NGOs and the media.

As practically no general relevant opinion polls are available for the whole of the country, the level of public interest in environmental issues remains a matter of speculation. NGOs are often frustrated, because they get the impression that the public takes no real interest in environmental issues. On the other hand, there is evidence that the public is sensitive to the detrimental environmental effects of the war and, on the local level, projects with environmental consequences do draw public attention (e.g. on the occasion of the planned construction of another coal-fired power plant, Plomin II).

Environmental education

The NGO "Nature Friends Movement" has been conducting national environmental education programmes for several years. It has been nominated National Coordinator and Operator for the European Blue Flag Campaign and the Eco-Schools Project in Croatia, which started in 1997. The Croatian authorities have joined this project because its objectives are similar to its own, improving environmental education as part of the official school curricula. The Commission for the Blue Flag Project and an Eco-Schools Project have

been established. The two projects are carried out in cooperation with the Ministry of Education and Sport and the Ministry of Tourism. The Blue Flag Project involves beaches and marinas (the first flag was received in 1998- See more in Chapter 9), and the Eco-Schools Project is targeting both elementary and secondary schools. SDEP also takes part in the implementation of the Eco-Quiz show "Our Beautiful Homeland" and Days of Bread – Days of Gratitude for the Fruit of the Earth, involving elementary and secondary school students throughout Croatia.

At the level of tertiary education, there is a lack of training in ecotoxicology (see Recommendation 3.4) and civil sanitary engineering (particularly in the design and operation of water supply and waste-water treatment facilities/see Recommendation 6.5). The scientific community does however organize various activities. For example, the Croatian Academy of Art and Sciences has a Scientific Council for Nature Protection, another one for Agriculture and Forests, and a third for Scientific Adriatic Sea Research. In some cases, SDEP supports their publications financially.

1.8 Conclusions and recommendations

Environmental protection is not considered a top political priority in Croatia. However, the scarce resources allocated to it are, in general, used efficiently to improve the quality of the environment. The different administrative levels - national, county and local - deal with this subject in a way that yields results. The cooperation between the different levels of administration within environmental protection also appears to be well developed.

By contrast, cooperation between and coordination with other State directorates and, in particular, ministries appear to be somewhat complicated by two facts. First, the administrative level of a State directorate makes it difficult to negotiate about environmental concerns on an equal footing with other ministries or their sub-structures. Secondly, the current institutional structure does not sufficiently bring together environmentally relevant activities under one ministerial responsibility, so that a considerable number of essential environmental coordination and cooperation functions could be supervised and consistently managed within the same ministerial budget.

This situation should be reviewed. In general in Croatia the functions of the administrations for tourism, environmental protection and spatial planning overlap to a very large extent. As a result, it seems advisable to combine these administrations into one ministerial unit. It is also suggested that the State Water Directorate, including the associated water institutions, should be added to this ministerial unit, despite the country's long history of 'independent' water management. The coordination and cooperation between water administrations and other administrations would benefit from such a merger.

In addition, there is no governmental authority in charge of monitoring implementation of environmental education projects, whether institutionally or extra-institutionally. Instead, individual activities are organized and carried out by various governmental authorities – e.g. SDEP, Ministry of Education and Sport, Ministry of Development and Reconstruction. SDEP has shown a particular interest in environmental education. It may therefore be worthwhile to establish a separate unit for the coordination of environmental education projects at all levels of education, as well as for raising public awareness through contacts with the media, enterprises, NGOs, etc.

Recommendation 1.1:
The organization of environmental protection, physical planning, tourism and water protection, hunting, fisheries and forest protection in a combined ministry should be considered This ministry should also include an organizational unit to coordinate environmental education projects and raise environmental awareness among the public.

The Environmental Protection Law as the basic law for the protection of the environment provides the legal framework for activities in this field. It shows how much importance is given to the protection of the environment and its enforcement. Other laws that regulate specific issues of environmental protection must be in line with this fundamental law. In its present form, the Environmental Protection Law does not yet meet the requirements of the Aarhus Convention, to which Croatia is a signatory. Thus, the Law will need to be revised. In particular, more attention should be paid to the incorporation of stronger enforcement mechanisms. This revision will also make amendments to other laws and regulations necessary.

Recommendation 1.2:
The Environmental Protection Law should be revised to meet, inter alia, the requirements of the

Aarhus Convention. Improvements in public access to information, public participation and access to justice in accordance with the Convention will also strengthen enforcement mechanisms for environmental protection.

Public participation will in all likelihood grow in Croatia, also in environmental protection activities. The EIA procedure is an important process to include public interest in decision-making. This can be expected to improve public acceptance of individual environmental protection projects. The environmental authorities should develop initiatives that foster a cooperative attitude among the public towards environmental management. This would help people's feeling of 'belonging' and strengthen the status of the environmental protection institutions.

Recommendation 1.3:
The public should receive further information on the EIA procedure, encouraging it as well as NGOs to make use of the public participation procedure. Information about planned developments should be published at an early planning stage to facilitate public participation.

There are not only environmental inspections, but also various other inspections under the supervision of other State departments and ministries, e.g. on water management (State Water Directorate) or health issues (Health Ministry). Often, these inspections are based on the same documents, examinations or presentations of facts, but joint inspections happen only on the basis of ad hoc initiatives. This means that the inspected enterprise has to present the same documentation and state the same facts to each inspector all over again. This procedure seems to be unnecessarily time-consuming and, thus, expensive for the enterprise. It is also important that each county should have environmental inspectors, who are close to the actual problems, and who can carry out instructions from the national level. Inspections should be made more efficient by increasing the professional skills of inspecting staff.

Recommendation 1.4:
Inspections should be systematically combined as much as possible. This is particularly true for environment and water protection inspections. An environmental inspector should also be appointed in the county of Zagreb.

The level of fines for violations of environmental regulations presents a problem, as it is sometimes so high that a court ruling is ignored to prevent the enterprise going under. This kind of practice makes a mockery of the whole fining and inspection system. Fines should be deterrent but not destructive. Also, the procedure -- the necessary involvement of a court -- appears to be unnecessarily cumbersome. It might be preferable to allow the SDEP to impose the fines, at least in "normal" cases, which could be clearly defined.

Recommendation 1.5:
The level of the fines legally prescribed should be examined and adapted, taking into account the economic situation. The fining procedure should be simplified.

For the survival and development of NGOs, the question of tax deductions or exemptions is critical. It should be possible to define NGOs and their activities in the relevant legal instruments in a way that minimizes the risk of misuse of any privileged tax status.

Funding can be vital for environmental NGOs, as they can rarely live on donations alone. The newly created Associations Bureau may alleviate the situation, but its effect will have to be monitored carefully. The SDEP modestly funds projects or provides financial support to some NGOs. However, doubts are expressed by a large number of observers about the criteria used in the SDEP funding decisions. If the doubts are justified, they should give rise to an urgent revision of the criteria. If they are not justified, more transparency appears to be necessary in order to allay misgivings.

Recommendation 1.6:
Legal provisions should be developed to exempt NGOs from paying taxes and allow donors to deduct their financial contributions to NGOs from their taxable revenues. The SDEP should clearly define its funding policy towards NGOs and improve its transparency.

It is not clear which importance the Croatian population attaches to environmental protection and what the most pressing issues are according to public opinion. The general belief that environmental protection does not figure among society's priorities may be right – but it may also have to be qualified. At the same time, it is crucial for the independence, self-reliance and, ultimately, the success of environmental protection policies to know what the public's basic attitude is and what its reaction is to declared environmental priorities and actions.

Recommendation 1.7:
Periodic and "state-of-the-art" representative opinion polls should be carried out on questions regarding environmental protection, including the general relative ranking of environmental protection among the priorities of the population (nationally, regionally, by age group and socio-economic category of the respondents), and the most pressing specific environmental problems.

Chapter 2

ECONOMIC AND REGULATORY INSTRUMENTS

2.1 Economic instruments for environmental protection

General overview

In recent years Croatia has introduced substantial changes in its taxation policy and system. The changes to the taxation system were harmonized with EU legislation. The adoption of major new laws (the Law on Income Tax, the Law on Profit Tax and especially the Law on Value-added Tax (VAT) of January 1998) introduced negative changes for some environmental issues. For example, when VAT replaced the turnover tax, the previous exemptions for environmentally friendly equipment and packaging, as well as for some other items relevant to environmental protection, were cancelled. On the other hand, there are several excise taxes, primarily intended to raise revenues for the State budget, that indirectly affect the environment. Also, the liberalization of foreign trade did not abolish allowances and exemptions from import duties for certain environmental protection equipment.

Environmental charges are not widespread in Croatia. Nevertheless, a number of examples exist and the water management sector has developed a comprehensive system of charges. With these qualifications, the following economic instruments are available in Croatia for the integration of economic and environmental decisions:

- Taxes and subsidies, customs duties
- Charges and grants
- Sanctions, penalties, fines

Taxes, subsidies, customs duties

Excise taxes contributed 17.8 per cent of public revenues to the State budget in 1997. Some of them affect the environment indirectly, like those on oil derivatives, on tobacco products and on passenger cars and other motor vehicles (vessels and aircraft) sold in Croatia. Excise taxes are reflected in prices. The development of retail and wholesale prices of petrol between 1994 and 1997 shows that the prices of leaded petrol have risen faster (+7.5 per cent) than those of unleaded petrol (+4.7 per cent).

Taxes on road motor vehicles and on vessels are paid annually to the county budgets, pursuant to the Law on Financing Units of Local Government and Self-government. The tax on vessels depends on length, tackle, and year of manufacture; the tax on road motor vehicles depends on motor power and year of manufacture. Exempted from excise tax are vehicles registered for transport activities, fire-fighting, medical, military and police vehicles, hearses and vehicles for disabled persons.

A tourist resident tax (tourist tax) is collected on the basis of the Law on Resident Tax . It is payable by all tourists, except children under the age of 12, and is paid per night spent in tourist facilities. The revenues accrue to the tourist societies, which invest into the development of the tourist areas, including environmental investments.

The use of mineral fertilizers for agricultural purposes is subsidized. The difference between the market price and the producer price is paid to the Croatian producer from the State budget. The average subsidy is 0.25 kuna per kg of fertilizer.

Among the products exempted from excise tax are residual fuel oil, jet fuel and aircraft kerosene, oil derivatives for export, as well as electricity, coal and other fossil fuels. Exemptions from customs duties can be granted for the imports of equipment for drinking water purification, operational centres for urgent interventions in the event of accidental pollution of the Adriatic Sea, and incinerators and similar installations for the treatment of hazardous waste that are not produced in Croatia. I approved, such customs exemptions amount to between 5 and 20 per cent of the price, depending on the type of equipment.

Charges and grants

The most developed system of charges is practised in water management. Charges for air and noise

emissions do not exist (although there are fines for violations of standards – see below). Water protection charges (effluent charges) are around 25 per cent of the average purification price (contrary to the Law on Water Management financing, which stipulates full cost coverage), because of the severe economic difficulties of the country and the substantial war damage. Effluents are subject to permits, which prescribe the measurements, as well as the characteristics of the effluent. Water inspectors control effluents, and may initiate a court procedure in case of violation of the permit. The charge is determined in accordance with the amount of discharged waste water and its impact on the quality of the receiving water body. The charge is payable to Hrvatske Vode (the State water management agency). In 1997, 85 per cent of the invoiced charges to households were actually paid (74 per cent in 1994). Total actual revenues from this charge amounted to about 257 million kunas in 1997 (140 million kunas in 1994).

In addition, water use charges (abstraction charges), a sand and gravel extraction charge, a basin water management charge, municipal charges prescribed by local government for financing investments into land improvement and drainage systems, and household water protection charges are levied. Water use charges vary between regions, water user, type of water use, and source of supply. Water use charges for households are typically between 0.7 and 1.1 kunas (i.e. DM 0.20 and 0.30) per m^3; charges for industrial users are 10 to 30 per cent higher. The Law on Water Management Financing also foresees a 'water contribution' to be paid by the enterprises operating under the Law on Commercial Companies, which amounts to 0.76 per cent of the gross payroll of the enterprise. This charge was abrogated in 1998 due to the economic difficulties faced by industry. Quarrying charges are 2 kunas (for gravel) and 3.5 kunas (for sand) per m^3 . For more details on water charges, see Chapter 6.

In waste management, charges on the generation of hazardous waste (payable by the producer, earmarked for financing the construction of hazardous waste landfills) are foreseen but should be defined by a special law. Charges are levied on the generation of municipal waste (as part of the municipal service prices, which are determined by local self-government and partly serve for construction and maintenance of municipal landfills, waste collection, removal and disposal), and waste management at county level (for compensation to real estate owners for reduction in the market value of their property in the vicinity of hazardous waste storage, treatment and disposal sites). The charges for municipal waste collection and disposal are calculated per m^2 of the flat or real estate of the waste generator. Prices differ between municipalities in accordance with the cost structure of the service and the municipal enterprise concerned. In Zagreb, the monthly price (end of 1997) per m^2 was 0.27 kuna for households and 0.80 kuna for other users of the service.

Charges exist for the pollution of agricultural land. Compensation is due to the owner or manager of agricultural land, if pollution impedes the potential for agricultural production. The charge in case of reduction in production possibility is determined case by case. Compensation may reach the market value of the land, if pollution makes the continuation of agricultural use impossible. If the use of the land is changed from agricultural to another use – such as extraction of sand and stones, strip mining, building etc. - charges have to be paid by the owner of the land. The charge may not become due, if the change of land use is caused by the construction of a house, commercial or public facility after issuance of the corresponding siting permit. The charge is payable to the Ministry of Agriculture and Forestry. A total of about 3.5 million kunas was collected from this charge in 1994 – a sum that grew to 11.8 million kunas in 1997 (first nine months of 1997).

15 to 20 per cent of the sales proceeds of timber cut in Croatia is allocated to special accounts earmarked for reforestation. The public forest management enterprise "Hrvatske sume" dedicates 3 per cent of its revenues from timber sales to afforestation. The non-timber use of forests is charged to companies and legal persons (except Hrvatske sume) at 0.07 per cent of the total revenue of the company and is deposited, on a quarterly basis, in a special account of Hrvatske sume for multiple non-timber forest functions. Furthermore, charges for transfer rights on forest land and forests (i.e. previous forest land transferred to another use and owner) have to be paid to Hrvatske sume or to the legal manager of the forest concerned. Finally, a forest contribution, a charge on solid forest products (2.5 per cent of sales price), has to be paid to local government by businesses involved in such sales for financing municipal infrastructure development. The fees obtained from hunting licences are used in game management and damage compensation.

Charges for the permissible exploitation of mineral raw materials (normally 2.5 per cent of the sales revenues) for commercial companies and tradesmen (oil, gas and other mineral raw materials) are paid to the State budget and transferred to the town and the county budgets (each 50 per cent) on whose territory the mineral raw material is exploited. The revenues from the charge are used for economic development and for nature and environmental protection. Companies exploiting mineral raw materials are also obliged to contribute a minimum of 3% of their total incomes from selling mineral raw material. These charges are used for research into the regeneration and preservation possibilities of mineral raw materials.

The economic use of natural resources, as well as certain activities of national interest, are subject to concessions. The granting of a concession entails payments of charges to the State, county or municipal budgets.

Transport activities are subject to charges and fees for the use of public roads (paid upon registration of the vehicle), for the use of highways (depending on the number of vehicle axles), for special transport purposes, for public road overuse, for the use of road land area, and for performing secondary activities on public roads. The proceeds from these charges normally accrue to State or county budgets.

Sanctions, penalties, fines

Payments of fines are foreseen in all fundamental environmental laws like the Law on Environmental Protection, the Law on Air Quality Protection, the Law on Waste, the Law on Nature Protection and in the special laws: Laws on Water, on Physical Planning, on Noise, on Forests, etc. They are conceived as non-compliance fees, i.e. payments that become due in case of non-compliance with legal provisions. Revenues collected through fees primarily accrue to the State budget, but can also go to county budgets.

Payments relate to air emissions, excessive noise pollution, generation of waste water and sewage, generation of hazardous waste, and infringement on protected areas. Regarding air emissions, the obligation to measure was prescribed only at the end of 1996, and no payments for excessive emissions have as yet been enforced. Payments for waste water and sewage non-compliance payments go to the account of Hrvatske Vode. They are earmarked for financing activities to regulate watercourses and other water bodies pertaining to the basin within which the violation was committed.

A penalty rate is applied to the amount of pollution emitted above the prescribed limit values. The violator is responsible for compensating for the damage caused. The Law on Environmental Protection prescribes that the polluter pays the repair of the damage done by environmental pollution (sanitation costs), as well as a fair compensation for the damage done. The application of this principle is just beginning. Payment is usually determined by a court, on submission of the case by environmental inspectors. However, the fines foreseen are too high and in general the court ruling is ignored in order to prevent the enterprises of bankruptcy (see also Chapter 1).

The new Penal Law in the Republic of Croatia deals with criminal offences against the environment (environmental pollution by noise, waste, proliferation of radioactive or other hazardous waste in Croatia, deforestation, etc.), providing for both fines and imprisonment. However, implementation of these legal provisions is hindered by the adverse overall economic situation. Also, inspectors often do not obtain feedback on the fate of the cases which they submit to the courts.

2.2 Regulatory instruments

Environmental standards

Environmental quality standards are defined in the Law on Environmental Protection, in the form of ambient limit values. Fragile or endangered areas are determined by special regulations. In regard to products, machinery, equipment and production technologies that might cause a risk to the environment, special regulations set technical environmental protection standards.

Croatia has observer status in the Technical Committee on Environmental Management in the International Organization for Standardization (ISO) and is preparing or has already prepared ten standards of the ISO14000 series. Employees of the SDEP take an active part in the work of ISO/TC at the National Office for Standardization and Metrology (NOSM).

Permits and licences

Permits (specified in the Water Law) for the use of waters, purpose of the use, location of the use activity, discharge of raw or preteated waste water are issued by the counties'/City of Zagreb's administrative bodies, after approval by Hrvatske Vode. Exceptionally, a permit is issued by Hrvatske Vode, after approval by the State Water Directorate. The permits are issued for discharging waste water into public sewerage systems or into natural water bodies, and prescribe monitoring of emissions and water quality.

A zoning permit is required for the siting of a built structure. It is issued by the counties'/City of Zagreb's administrative bodies, in special cases by the Ministry for Physical Planning, Building and Housing. Upon receipt of the application for a zoning permit, the authorized body is obliged to obtain comments, certificates, opinions, and other documents from the State administration (including on the environment, see Environmental Impact Assessment, Chapter 1).

The import and export of ozone-depleting substances require permits, which are issued by the Ministry of Economic Affairs, with the prior approval of the State Directorate for the Protection of Nature and the Environment.

Pursuant to the By-law on Substances that Deplete the Ozone Layer, SDEP grants approval to legal persons for the maintenance, repair and/or recovery of refrigerants from cooling and air-conditioning devices when these are decommissioned.

Eco-labelling

One of the legally set objectives of environmental protection in Croatia is the promotion of the use of environmentally acceptable products and manufacturing procedures, and striking a balance between environmental protection and economic development. An environmental label was created as one of the instruments for achieving a change in consumption patterns. It has been awarded since 1993 to the manufacturers of consumer goods who market environmentally friendlier products – either in terms of their use, or in terms of their waste characteristics (Rule Book on Environmental Label, 1996). The Environmental Label has a commercial character, but is not accompanied by fiscal incentives. So far, 14 commodities have received the eco-label, but there are no data on its commercial effect.

2.3 Financing of environmental expenditures

Public budgets

The Croatian legal system foresees three major public financing instruments for environmental protection: State and local budgets, special accounts, and an extrabudgetary fund. In practice only two of them are used: the State and local budgets, and the Croatian Water Management Agency Hrvatske Vode operates a special account for financing water management. The State and the local budgets are the most important instruments for financing environmental protection expenditures. In addition, funds from environmental charges and fees (see section 2.1 above) are in the vast majority of cases earmarked for financing environmental expenditures.

The role of local government and self-government units is significant. Local government units organize various public services, some of which are directly connected to environmental protection (street cleaning, water and waste management, etc.). Budgeted expenditures of selected public authorities are shown in Table 2.1.

Table 2.1: Environmental budgets of selected public authorities, 1999

	Total budget	Environmental share	
	1 000 kunas		*as % of total*
State	49 047 850	608 343**	1.24
County "Sisacko - Moslavacka zupanija"	2 500 000	2 800	0.10
Zagreb City	3 875 000	4 650	0.12
Sisak City	102 587	520*	0.50

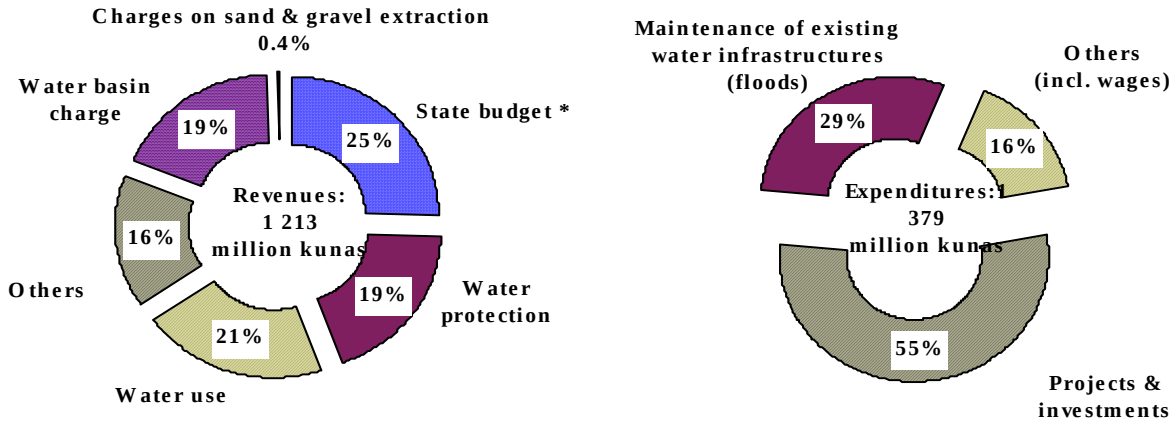
* Including 200 000 kunas for waste treatment.

** The Official Gazette reports 590 753, or 1.20% of total, not including environmental activities in other ministries and institutes.

Sources:
Budget of the Republic of Croatia, Official Gazette 167/98;
Official Gazette of the City of Zagreb 20/98;
Official Gazette of "Sisacko - Moslavacka zupanija" (31 December 1998).
Unofficial data gathered during EPR Mission (March 1999).

Public utilities are managed either by private companies on the basis of concessions, or by public enterprises, which are owned and managed by local

Figure 2.1: Croatian Waters (Hrvatske vode) special account, 1998



Source: Narodne Novine (Official Gazette), n° 43188/167.

* Protection against floods/maintenance.

governments. At this time, only part of the funds needed to finance these services come from the fees charged for public utility services, compensation and other sources. By contrast, the enforcement of the polluter-pays principle in cases of compensation for damage caused by pollution appears to be satisfactory.

Special accounts

Figure 2.1 depicts the special account of Hrvatske Vode. The account reflects water management income and expenditure. Financing of deficit is covered by credits and loans from national and foreign banks.

In the period 1992-1996, a number of international institutions financed projects, programmes and various other environmental activities through credits and/or grants. The amount of grants awarded to public authorities rose in the period from 1992 until 1995, but decreased in 1996. Grants given to NGOs have increased every year throughout that period.

Croatia participates in the regional Environmental Programme for the Danube River Basin, partly financed by GEF, amounting to US$ 12 690 000 in the period 1992-1996 (the Programme as a whole is also financed by PHARE, but these funds are not available to Croatia). In addition to the grants, loans were obtained from the World Bank and the European Bank for Reconstruction and Development. These loans finance sustainable development projects in the Croatian economy and agriculture. Some projects include environmental investments like industrial waste-water treatment facilities. In the years to come, the volume of loans is expected to grow significantly. (See also Chapter 4 on financing assistance).

Environmental expenditures

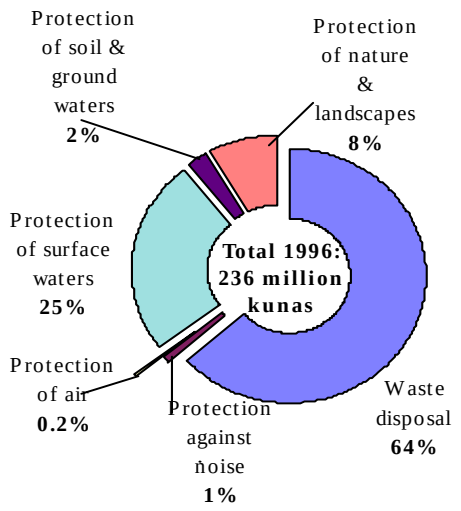
Data on total public environmental expenditures by sector (air protection, waste, land etc.) are not available. By far the most important expenditures are water-related. Also, the funds available to Hrvatske Vode are twice as high as the combined funds of the SDEP and the State Water Directorate. Also not available are comprehensive data on investments in environmental protection, particularly not from industry. What is available is the structure of current expenditures for environmental protection. It is given in Figure 2.2.

2.4 Main policy objectives and institutional responsibilities

Policy objectives

The overall policy of Croatia in the development of economic and regulatory instruments has three fundamental objectives. Firstly, the country is determined to adapt the European practices in environmental regulations to its special conditions. Secondly, the progressive introduction of a developed public revenue system entails consequences for environmental management.

Figure 2.2: Total current expenditure for environmental protection, 1996



Source: Statistical Yearbook, 1998.

Croatian environmental managers are seeking to remedy these drawbacks by new ad hoc instruments. Thirdly, the extremely precarious funding situation for environmental protection is being coped with by activating the available mechanisms.

Like for most other measures, progress in environmental regulations towards general European practices is conditioned by the availability of resources. They are scarce in the light of the difficult economic situation and the need to cope with urgent and severe consequences of the war. While the pace of progress is therefore slow, the overall direction is clear. It does not only include changing practices with regard to ambient quality. It also includes the development of environmental management in enterprises.

The creation of a modern public revenue system is one of the most important but also one of the most difficult tasks during the current period of socio-economic change. Croatia uses 'European blueprints' in this task. In the absence of reliably documented public priorities for environmental protection, and owing to the necessary efforts for coping with the consequences of the war, the Croatian strategy seems to be primarily to earmark certain revenues for environmental expenditures on an ad hoc basis.

Regarding actual sources of finance for environmental expenditures, the Law on Environmental Protection foresees the creation of an extrabudgetary environmental fund. The fund must be established by a separate act of the Government, which is not yet ready. For similar reasons, the legal provisions for covering the cost of municipal environmental services entirely from related charges are only partly enforced.

Institutional responsibilities

Numerous institutions are involved in environmental regulations. Eight of the seventeen ministries and four of the eleven state administrations are involved in environmental protection. In accordance with the structure of the State administration, responsibility for individual aspects of environmental protection and sustainable development are scattered among different ministries and State directorates.

The State Directorate for the Protection of Nature and the Environment has the leading role in coordinating environmental activities. At the same time this Directorate has a lower status than a ministry, which results in coordination difficulties with the ministries in charge of various issues of environmental protection. Coordination of governmental bodies has not yet been achieved completely and is exercised on a case-by-case basis. Various institutions issue different licences and permits.

Local governments and local self-government units and citizens (constitutionally guaranteed rights) decide on local interests and needs, especially concerning physical planning and housing, municipal activities and protection and improvement of the natural environment.

The responsibility for standardization in Croatia lies with the National Office for Standardization and Metrology (NOSM).

2.5 Conclusions and recommendations

At a theoretical level, Croatia clearly, and rightly, aims at integrating environmental objectives into its economic development. Through the Declaration of Environmental Protection in the Republic of Croatia of the Croatian Parliament, the country has opted for sustainable development. The determination to ensure a complete, ecologically and economically balanced development, aiming at the preservation of the national heritage for present and future generations, is clearly expressed. However, this basic declaration of intent has little relevance today to environmental management.
Such management appears - in the very conception and creation of its necessary regulatory and

economic instruments - over-influenced by three circumstances. Firstly, there is a very widespread conviction that environmental protection is not among the priorities of the Croatian population. This circumstance has been dealt with in some detail in Chapter 1, where it has given rise to Recommendation 1.7.

Secondly, the overall economic situation, together with the need to fund the urgent repair of war damage, acts as an important delaying factor for the enforcement of existing legal provisions. It also explains the extremely cautious approach to the development of a strategy for funding necessary environmental protection measures. In particular, the approach chosen is very technical in nature, and does not include either a strategic realignment of institutions that have a common interest in environmental protection (like the tourism administrations and the administrations of environmental protection), or a closer association of institutions whose sectoral separation makes the determination of overall environmental priorities very difficult or impossible (like the organizational separation of SDEP, the State Water Directorate and Hrvatske Vode). Also this subject is elaborated in Chapter 1 and gave rise in particular to Recommendation 1.1.

Thirdly, enforcement of legally existing financing schemes is hampered by the country's current economic situation. The charges paid by households for environmental services are very high by any standard. Payment is rarely enforced. . However, this decision should be matched by (a) the formulation and publication of a decision setting out the conditions that have to be met in order to enforce environmental payments in their full legally foreseen form, (b) the mobilization of all socially acceptable sources of funds for environmental protection, and (c) the organization of the financing of environmental expenditures in the most efficient way, leaving the maximum possible volume of funds for actual environmental management expenditures (as opposed to overheads). The proposal included in Chapter 4 to consider creating a special project management unit for overseeing the acquirement and the use of foreign assistance would be part of this last suggestion (see Recommendation 4.2).

Recommendation 2.1:
A time schedule for the full enforcement of all environmental payments should be set and published, including the social conditions that have to be met for the implementation of its steps. Creating an environmental fund with a clear and transparent management is recommended as a measure for improving the funding and efficiency of environmental payments and expenditures during the transition period.

The clear strategic orientation towards the development of more and well-adapted economic instruments for use in environmental management should be encouraged. However, there is as yet only little experience with the actual effects of economic instruments – hence the need for more extensive research in this domain, as environmental payments, in order to be efficient, need to be set at such levels that they effectively stimulate the intended protection of the environment, without crippling economic activity.

The use of economic instruments has so far been limited to the use of mostly traditional instruments. At the same time, the 1994 Law on Environmental Protection creates the possibility of determining allowances and exemptions from taxes, duties and other public revenues, by means of special laws on the following:

- use of cleaner production processes and of more environmentally friendly products
- use of renewable energy sources
- use of equipment and machinery contributing to environmental protection
- improved recycling or organized disposal of used equipment, devices, products, packaging material, etc.

At present, there are no laws or governmental decisions that would establish such incentives - except in one part of the customs system.

Recommendation 2.2:
The necessary and sufficient economic instruments and their levels should be identified with regard to those measures that are already envisaged in existing legislation.

Encouraging recycling and reuse should be seen as a major strategy. In this connection, economic incentives seem to be both possible and necessary. This could stimulate the recycling industry. For example, some part of the environmental funds available could be transferred to licensed recycling enterprises operating in accordance with technological and environmental protection requirements. Also, if an enterprise collects, handles, recycles or reuses waste, goods or

packaging material, its related charges could be refunded.

Recommendation 2.3:
A special mechanism should be designed to help create a market for secondary products. The charges related to industrial waste collection, transport and disposal could be increased, if refunds are introduced at the same time for recycling and reuse.

The implementation of the preceding recommendations and the enforcement of the measures involved require statistical information, notably financial information. Any economic analysis needs to involve an assessment of the environmental expenditures concerned. The data on collected taxes, charges, fees and other possible sources of funds for environmental protection should be collected and analysed, as should the environmental expenditure data of industrial sectors. This task should be tackled with priority as a joint project of the institutions involved (Ministry of Finance, Ministry of Economic Affairs, SDEP). Particular attention should be paid to obtaining reliable information on environmental investments and their sources of funding, as well as on foreign financial assistance to environmental projects.

Recommendation 2.4:
The statistics on environmental expenditures as well as their sources of funding should be improved as a matter of priority.

Chapter 3

ENVIRONMENTAL CONSEQUENCES OF ARMED CONFLICT

3.1 Early effects on environmental media and their evolution over time

Effects on air

The effects of armed conflict in Croatia have been reported in reports of the United Nations Industrial Development Organization (UNIDO) and the scientific literature. There were very considerable adverse effects on the *atmospheric environment* during the conflict from the burning of oil (e.g. the Sisak oil refinery), chemical and related industries (likely to have caused emissions of highly toxic TCDDs, etc.), ammunition stockpiles, forest fires and, not least, uncontrolled exhausts from inadequately maintained military vehicles. Such atmospheric emissions dissipated when the war ended. Their overall contribution to global warming and ozone depletion is now no longer assessable.

Effects on soil

There was very considerable contamination of *soil*, from the conflagration of buildings, chemical facilities in particular, forest fires and munitions residues. Due to the explosions of munitions there may be increased fissures and fractures in underground strata. In some areas these may have caused groundwater levels to fall by 1.0–1.5 m. In some cases, soil erosion could be a factor to take into consideration in the future.

Of paramount importance were the adverse effects from burnt chemical facilities, varying from:

- Cosmetics (Osijek);
- Pesticides (oakovo, Osijek);
- Wheat (Vinkovci, including the potential formation of fungi, microtoxins and proliferation of vermin);
- Oil spillage (Sisak oil refinery, oil storage, Karlovac and many other facilities including heavy fuel oil storage at thermal power plants, e.g. Osijek);
- Plastics (Zadar);
- Munitions (Bjelovar, Delnice, Karlovac, Ostarije, Rijeka, etc.).

A major concern is polychlorinated biphenyls (PCBs) used in electric condensers and transformers and as hydraulic fluids in military vehicles.

The fire at the Sisak oil refinery left an area of ~1.0 km x 3.5 km of soil saturated with polyaromatic hydrocarbons (PAHs). It is still black. Indirect effects of the armed conflict included inadequately and poorly managed landfill sites at almost all rural locations. Even towns that suffered little from the armed conflict, like the capital Zagreb, now find that their waste dumps are severely contaminated with heavy metals (cadmium, lead, mercury, etc.) and with many toxic and persistent organic substances, including pesticides and pharmaceutical chemical waste. All these chemicals have the potential to leach into *ground* and *surface waters*. To date no serious research has been made into the contamination of soils, caused by heavy metals and organic substances.

Effects on water

Many *fresh waters* were also very heavily contaminated with polluting substances, e.g. oil from the Sisak oil refinery observed in the Danube delta near the Black Sea in 1994. In the Lipa region, in particular, the contamination of *groundwaters* will be extremely costly to rectify, especially bearing in mind the very considerable migration (even to the coast) via fast flowing underground rivers.

During the armed conflict no remedial measures were feasible and there was very considerable potential for contamination of *ground* and *surface waters*, including the sea. Surface water contamination, e.g. contamination of wells with oil,

pesticides, paint and animal remains, will in the long term contaminate *drinking water* resources.

It is likely that the microbial population in underground strata is capable of xenobiotic transformation/degradation of polluting chemicals. It is not known if such strata are aerobic or anaerobic.

A positive side effect however was that the destruction of industry meant little or no polluting discharges to rivers. As a result, e.g. at Pakrac, the Pakra river, having been polluted for decades, was again supporting fish in 1993. If in 1999 it is not too late, the greatest care is required to ensure by adequate effluent and sewage treatment that river pollution is strictly controlled. The Faculty of Veterinary Medicine, Zagreb, had examined fish for hermaphrodism, but found no evidence.

Effects on nature parks

In 1993, it was not possible to visit any of the parks, as they were either occupied and/or mined. The short-term effects of armed conflict on nature parks include:

- Direct disturbance through fighting
- Suspension of conservation measures
- Destruction of villages and expulsion of inhabitants, and
- Attacks on industrial areas and serious environmental pollution.

The following pose threats of lasting damage to the development and protection of nature parks:

- *De facto* removal of protection status by occupation
- Fragmentation of the area
- Long regeneration periods for some ecosystems, e.g. forests
- Pollution of parts of the parks through oil and other chemicals
- Destruction of traditional agriculture
- Halt to tourism
- Damage to the area's image abroad
- Obstruction to the area's development and
- Severe economic losses for the communities in the parks.

Lonsko Polje Nature Park (Ramsar site). These Sava river wetlands are of enormous importance for European conservation. Within central Europe, only the flood plains of the Biebrza and the Nerew in north-eastern Poland are larger. Two of the other important characteristics of these wetlands are:

- The autochthonous forests, which are probably Europe's largest alluvial forests, and
- The traditional use of flood plains as wet pasture and meadows mowed once a year, unique in Europe.

The effects of armed conflict on fauna, including many bird species and the unique 'woolly pig'--the 'sarena' -- can be grave. Hunters' shots cause disturbance in a radius of up to 500 m of the hunter. Along the whole front and due to low-flying aircraft and shooting in and around towns, no undisturbed resting places were available. This included a tank fire battle in the virgin forest reserve, Prasnik. There was a risk that the last remaining section of the original 350-year-old Slavonian oak forest might have been destroyed, but many trees have survived.

There were numerous reports and photographs pointing to the threats to wild animals by mines. Soldiers stationed on the front regularly hunted in the forests. This uncontrolled shooting may well have damaged the parks, which may take years to recover.

The destruction of several villages has had severe consequences for the surrounding countryside. As the extensive, traditional agriculture regime is an essential aspect of the Sava wetlands' value, the destruction of the villages and the expulsion of the farmers is a great loss to conservation.

The destruction of industrial areas brings with it massive threats to man and the environment. In 1992, the refinery at Sisak was attacked 26 times and in 24 cases caught fire. Over 100 000 tonnes of oil products were spilt into the surrounding area — much of which burnt. The effects of the oil on the river are unknown. The sewage works was completely destroyed during the fighting and has not yet been rebuilt. As a result, there is a lack of waste-water treatment and this also has adverse effects on the wetlands. In 1993, no water analytical data were available.

As the Sava river flooded in 1991, it is probable that pollutants from the industrial zone reached some of the flooded parts of the river plain in Mokro Polje and Zelenik, which are not separated from the Sava river by dams. The oxbows along the

Sava river also contain a very rich flora and fauna, which in all probability have been seriously affected by industrial pollutants.

The war has shattered long-standing efforts to support the protection measures with eco-tourism.

Plitvice lakes (Unesco Natural Heritage). Although the infrastructure damage is considerable, very fortunately, little or no damage was caused to the extremely fragile and unique gypsum barriers. There was considerable damage to the diversity of the forest as trees were felled in large quantities and in a haphazard manner. Damage largely through dilapidation was caused to the small bridges, and the 3-km-long wooden pedestrian bridge was completely destroyed. The greatest damage was to the hotels, catering establishments and accommodation facilities. At present, these are in an advanced stage of refurbishment. In the meantime some research into water quality was carried out.

Krka National Park. There was significant damage to both the forests and the waterfalls. Reports are scarce, as the area remains very heavily mined.

Paklenica National Park. It too suffered similar damage. Of particular concern is the disappearance of the griffin vultures. They might have died by poisoning after feeding on wolves that were poisoned by local residents. The jackals were poisoned because of their uncontrolled population growth, after hunters were denied access to many areas in the Zadar hinterland, which are still mined.

Kopa ki Rit Nature Park. Part of this park (a Ramsar area and a region with significant ornithological reserves) was the scene of direct combat. On average, this area is flooded for 99 days a year, whilst almost the entire area is flooded 32 days a year. During this time vast reeds, marshes, shallow lakes and groves provide ideal living conditions for about 275 bird species. Kopa ki Rit is also a very important source of fish (around 44 species) and one of the most important fish hatching areas for the Drava and Danube rivers. There are also approximately 50 mammal species, including otters, wildcats, pine martins, red foxes, boars, roe-deer and European deer. Kopa ki Rit was only reintegrated into Croatia on 15 January 1998. It was heavily mined and hence to date the extent of the damage has not been assessed.

Obsolete drugs and chemicals

Unfortunately, the conflict has also led to a stockpile of some 2 000 tonnes of unusable pharmaceutical chemicals — mostly inappropriate medicines, e.g. anti-malarial drugs, sent by ill-advised donors (often at high cost).

The safe disposal of these chemicals is now a matter of urgency, as many were donated back in 1992. They need to be segregated from usable medical and other equipment, protective clothing, etc. Then their ecotoxicology should be studied, ideally by a registered professional water chemist or a chemist experienced in the ecotoxicology of pharmaceutical chemicals, so that the pharmaceuticals that are readily or ultimately biodegraded can be treated in sewage works with secondary treatment. This operation will require extremely strict supervision. The remainder can then be incinerated at Puto at a cost of around HRK 5/kg. Again, this will require a very high level of management input (see Chapter 7).

Landmines

Croatia has a big problem with landmines. It affects some of Croatia's efforts to return to normality in the wake of the war. The return of refugees, the reconstruction of homes, tourism, the regeneration of industry, efforts to reconcile the former warring factions and, above all, the economy, are all negatively affected by the presence of more than 1 million landmines over 6 000 km^2.

Since 1991, about 1 000 people, including 300 children, have either been killed or injured by landmines. Until recently there were relatively few casualties among the civilian population as the war zones were sparsely populated. However, in 1998, as displaced people began to return to previously occupied areas, the risk of civilian mine casualties increased. Mines are one of the biggest obstacles to their safe return.

In addition to the humanitarian problems, the land contaminated with explosives in the karst areas is likely to have adverse environmental effects, e.g. emissions of toxic metals, including lead and mercury from exploded detonators, emissions of organic nitrates and nitrogen oxide gases. Because of the nature of the tasks, these effects are uncontrollable. Furthermore, the repeated detonations, especially in the karst regions, are

likely to lead to an increased number of fractures and fissures in the underground limestone regions.

3.2 Effects on environmental protection facilities and industrial safety

Domestic and industrial waste management

Waste management problems were aggravated by the armed conflict, including the migratory flow provoked by it. Zagreb's municipal waste landfill had been poorly managed since the mid-1980s. However, modern techniques are being introduced, including the collection of leachate, for which biological treatment is being considered. Methane is being collected, but flared. Plans for energy recovery are in hand. Similarly, the municipal waste facility at Sisak is well managed by an Austrian company.

The measures for hazardous waste separation and treatment are inadequate. In particular, an infrastructure for recycling (excellent in Zagreb, but little evidence elsewhere) should be considered in liaison with nearby States, including Hungary, Slovenia and possibly Austria (see also Chapter 7).

The armed conflict made this situation worse by the destruction of:

- Refuse collection vehicles in many towns, including Gospi and Osijek
- Access to designated landfill sites, e.g. Dubrovnik and Vinkovci, and
- Landfill compactors.

This led to domestic and industrial waste, together with a very significant quantity of building debris, being dumped at roadsides, lay-bys, rivers, and in the sea. The safe (environmentally sustainable) disposal or the recycling of building debris remains one of the biggest problems.

Water and sewage treatment

The conflict also destroyed the infrastructure for water treatment -- a regime that was not strong prior to 1990. One of the greatest long-term adverse effects was the destruction of (secondary) *sewage* treatment facilities. These are of paramount importance in the inland areas, in Ota ic-Gospi , and the discharge of untreated sewage may well have resulted in both chemical and biological pollution of underground rivers. This may take decades to rectify by natural action — the only feasible and affordable option.

Industrial safety

Safety measures in industry were destroyed, e.g. at Slavonski Brod and at Pakrac. The large timber yards lost their dust extraction systems, and in 1993 workers were exposed to wood dust (both hard and soft woods).

3.3 Possible remediation requirements and strategies

Needs and priorities for remediation

As the air pollution generated by the war has dissipated, the biggest problems now requiring remediation are pollution of the soil and, to a lesser extent, of all compartments of the aquatic environment. As most severe cases of water contamination have largely dissipated, the highest priority should now be given to soil contamination (with heavy metals and persistent organic chemicals). However, remediation of land contaminated during the war could lead to further water contamination, if not managed adequately. For example, the devastating ammunition explosions and smaller explosions from mine clearance can pollute underground drinking water resources with heavy metals, e.g. cadmium and mercury, and organic chemical contamination, including organic nitrates and perchlorates. Indirectly, they can also lower the water-table because of the increased number and size of fissures.

Perhaps the most dramatic sources of pollution were the fires at petroleum facilities and oil storage tanks of thermal power stations. These occurred at many towns, Osijek, Karlovac, Vinkovci and, in particular, at the Sisak oil refinery in 1991–1994. Upwards of 50 000 tonnes of either crude or refined petroleum products were burnt, contaminating soil with polyaromatic hydrocarbon (PAHs), causing oil slicks in the Sava river. These were reported to have been visible at the confluence with the Danube at Belgrade. In 1991–1994, there were reports of high levels of hydrocarbons being measured by the Ukrainians in the Danube delta. INA has largely repaired the damage sustained by the Sisak oil refinery. In 1998 the Sisak oil refinery refined 2 million tonnes of oil, 25 per cent above target. It plans to refine 2.2 million tonnes in 1999.

The attacks on the Sisak oil refinery and the oil spills into the Sava river have serious transboundary consequences. The majority of downstream countries, including Bosnia and Herzegovina, Yugoslavia, Bulgaria and Romania, abstract drinking water from the Danube and it is unlikely that the so-called 'bank-side' filtration can remove all hydrocarbon residues. In 1995, Vasilescu, in reporting on pesticide residues in the Romanian reach of the Danube, found that there were no facilities to measure hydrocarbon residues in drinking water.

One of the most widespread sources of chemical contamination during the armed conflict was spillage of polychlorobiphenyls (PCBs). These originated from two principal sources:

- Electrical condensers and transformers, and
- Hydraulic fluids in military vehicles (as high as 30 l/vehicle).

In March 1999, residues of PCBs in samples taken at a limited number of locations were mainly low. Where substantial levels had been found there was no evidence of remedial action being taken. Nevertheless, scientists are systematically monitoring the contamination of water by PCBs.

Quite substantial damage was caused during the war to waste management and treatment facilities (both domestic and industrial, whether hazardous or otherwise). As a result of the war and the new borders, the city of Dubrovnik lost its major landfill facilities, because these are located in what is now the independent country of Bosnia and Herzegovina. Consequently, in 1993, all categories of waste, domestic, industrial and even hospital waste were dumped in the sea. In 1996 and 1999, the situation was a little bit better, with at least domestic and a very considerable quantity of construction waste being clearly visible.

The presence of obsolete drugs in the country is also largely related to the war. However, since incineration is the best option for other hazardous wastes as well as for at least part of the obsolete drugs, the solution to the drug problem should cover these other wastes, too. In the longer term, Croatia needs to provide high-temperature incineration of both domestic and (hazardous) industrial waste with combined heat and power. Hospital and infectious waste may be disposed of more appropriately by microwave disinfection. A mobile unit can travel between the more remote locations and is totally self-contained.

Croatia has one hazardous waste incinerator, Puto at Zagreb. It has a capacity of 10 000 tonnes a year, but is currently under-used at about 2 500 tonnes a year. This incinerator burns hazardous chemical waste and some healthcare waste. A number of hospitals have their own incinerators but these are old and may be causing air pollution. The incinerator at the Dubrava hospital in Zagreb (operating 5 years prior to Puto) cannot accept glass. This means that blood and other infectious waste have to be washed from sample tubes with a hypochlorite solution, which is subsequently discharged to drain. This procedure is a hazard both to hospital technicians and to the sewage system and receiving water, especially bearing in mind that Zagreb city is still without sewage treatment facilities and that the drinking water bore holes are very near to the Sava river.

There is capacity at Puto for the incineration of hazardous chemicals, hospital waste and the obsolete pharmaceuticals. The only observable environmental problem at Puto is the accumulation of toxic ash and effluvia — this is a growing problem necessitating action. As there is currently adequate incineration facility for the foregoing tasks, there is no logical reasons to consider the use of cement kilns, thermal power stations or metallurgical furnaces for the safe destruction of the unusable pharmaceuticals (see Chapters 7 and 10 for related issues).

The reconstruction of waste-water treatment works with secondary treatment is a matter of very high priority. Moreover, tertiary treatment should be foreseen from the very beginning in those areas where eutrophication risks are particularly high and undesirable, as for instance in protected areas. This is the case of the Plitvice lakes, regarding the settlements discharging to the upper lake. The increase in eutrophication and growth in sewage fungi (since 1972) is of considerable concern and a survey of the sources of the contamination should be undertaken as a matter of priority. For towns in the interior and lying on limestone karst, the destruction of sewage treatment works is a very serious threat to the aquatic environment.

War damage to water installations is estimated (by Croatian Waters) to be around DM 260 million: flood control structures DM ~100 million, irrigation systems DM ~70 million and water supply and water pollution control systems DM ~90 million. In addition, at least US$ 3.5 billion, as estimated by the World Bank in 1992, would be required for the construction of adequate sewage, drinking water

treatment and flood defence facilities, which were inadequate already prior to the war. As tourism returns, the provision of at least secondary sewage treatment is essential to avoid microbial and toxic chemical contamination of bathing waters.

The situation of the mined areas is critical and will have a long-term effect on both the economy and the environment. Due to the very high cost of mine clearance and its seriousness, it can be expected that, at the current pace, mine clearance will take at least 15 more years. The Croatian Mine Action Centre is giving priority to de-mining housing, so that homes can be re-established first; its second priority is communal infrastructure, then farmland and tourist areas and, finally, forests.

The priorities for concern in 1999 include:

- Monitoring of soil and relevant water bodies for residues of chemical contaminants. This can usually be achieved by simple generic monitoring techniques. These should be used to produce contamination maps.
- Provision of well managed waste treatment and disposal facilities, well managed and well operated landfill sites, ideally with methane recovery, or high-temperature incineration facilities with energy recovery. For hospital and other infectious healthcare waste microwave disinfection is a highly recommended alternative.
- Waste-water (sewage) treatment facilities with at least secondary treatment should be available to cover the requirements of all (major) towns. In the coastal areas these should include ample provision for marinas, hotel complexes, campsites, etc. In marinas, sewage from boats must be given at least secondary treatment.
- Urgent action is needed to rectify the inadequate quality of drinking water supplies. Between 28 and 40 per cent of drinking water samples from individual wells are reported to fail bacteriological or chemical tests. This is of particular importance for tourism.
- The long-term effects on areas in Eastern SlavoniaWestern Slavonia, Lika, Kordun, Banovina and Dalmatia, which are heavily mined, mean that the displaced population (mainly farmers) will be reluctant to return from major cities even after the mines are cleared. The migration of the rural population to urban areas should be reversed — this would be accomplished progressively with mine-clearing operations. Also, UNDP has contributed US$ 4 million to rehabilitating war zones by building hospitals, schools, etc.

Planning for remediation should also include a strategy for industrial reconstruction. It appears that, in the foreseeable future, there will be considerable opportunities for SMEs in the chemical and related industries. The prospects seem especially good for the synthesis of special chemicals and for special formulations, ranging from detergents to novel intermediates for use in the pesticide, pharmaceutical and chemical industries, i.e. low-volume, high-value products, which are produced by means of high technology processes incorporating best environmental options.

In the industrial reconstruction process, environmental impact assessments should be undertaken. For example, it is important that pesticide warehouses and processing units are not rebuilt on ground contaminated with incompletely burnt pesticides and related products, whose toxicity and ecotoxicity are in all probability greater than that of the parent products. Factories should not be reconstructed on land contaminated with chemical residues (burnt or otherwise) without thorough remediation. Also, attention should be paid to the interaction between the environmental media in the process of industrial development, and note should be taken of best practical environmental options (BPEO).

Assessment and remediation techniques

As reported by Gasparovi *et al*, both the then (1993) Ministry of Civil Engineering and Environmental Protection (later subsumed into the State Directorate for Environmental Protection) and the Hazardous Waste Management Agency (APO) are considering the following techniques in the preparation of remediation of war effects:

- Hazard identification
- Dose-response assessment
- Exposure assessment
- Risk characterization

These could be supplemented with the following remedial technologies:

- Aeration
- Biodegradation
- Chemical treatment
- Dehalogenation
- Soil vapour extraction
- Soil washing
- Solidification
- Stabilization
- Solvent extraction
- Thermal treatment

To ascertain the extent of the environmental damage to the natural environment and to prevent damage during reconstruction and new industry, at least the following five techniques should be considered:

- Cleaner production techniques and the formal incorporation of a cleaner production centre (see also Chapter 10).
- Calculate predicted environmental concentration (PEC)/predicted no-effect concentration (PNEC) ratios as a simple means of risk assessment for chemicals discharged to, or predicted to enter, the aquatic environment.
- Development of a pollutant release and transfer register (PRTR) as a tool for current and new developments. The principles of PRTRs will be difficult to apply in war zones. Little accurate or reliable knowledge exists on the original lists of chemicals used (many records were burnt and the staff killed) and many chemicals may have been modified by burning at low temperature or by microbial action (often with an increase in toxicity).
- Best practical environmental options (BPEO).
- Integrated pollution prevention and control (IPPC).

Training requirements of experts

These might include:

- Training in ecotoxicology, based on the IPCS Training Module No. 1. There are a number of internationally highly recognized toxicologists in Croatian academic institutions, but their expertise in ecotoxicology is likely to be limited.
- Training in the use of generic ecotoxicology techniques, which can be used for the production of ecotoxicology/contamination maps of polluted soils.
- Training in advanced sewage treatment techniques.
- Training in cleaner production techniques.
- Training in predicted environmental concentration/predicted no-effect concentration (PEC/PNEC) ratios in order to provide simple risk assessments, especially to the aquatic environment.
- Training in pollutant release and transfer register (PRTRs). This is available from the United Nations Institute for Training and Research (UNITAR).
- Training in best available techniques not entailing excessive costs (BATNEEC), best practical environmental options (BPEO) and integrated pollution prevention and control (IPPC).

Any training programme in ecotoxicology should provide knowledge useful for the evaluation of metabolic mechanisms in micro-organisms (see section 3.1 above, effects on water).

There is a particular requirement for training in multi-disciplinary, multi-processor techniques, so that experts can advise on the cross-utilization of product wastes from one plant as raw materials at another. This type of application helps to ensure that materials badly damaged and having little or negative value at one location can be either put to good use at a second location or discarded in an installation currently lacking at the first facility.

To facilitate this type of approach, and to strengthen the risk assessment/risk management concepts, a thorough knowledge of the hazardous properties of the chemicals, their metabolites/degradation and especially their ecotoxicology products, is essential.

Environmental monitoring and information

Environmental remediation strategies and projects will have to be based on information that is only partly available. The following institutions can be trusted to hold some of it:

- The State Directorate for Nature and Environmental Protection
- Hazardous Waste Management Agency
- State Water Directorate
- Croatian Waters (Hrvatske Vode)
- Ministry of Health
- Academy of Sciences and Arts/ Universities/ Ministry of Science and Technology/Ministry of Agriculture and Forestry.

Among the more urgent information requirements is a major ecotoxicological mapping campaign of *water* (and soil) pollution, initially using simple and field generic techniques. The majority (~90 per cent) of Croatia's drinking water is extracted from underground sources. In view of the almost total lack of control of leachates from landfill sites and intensive agriculture, with the exception of nitrates, there are few observed cases of pollution of water

resources. However, it was reported that 28 – ~40 per cent of water samples from individual wells failed for either bacteriological and/or chemical parameters. Far more care also needs to be exercised over the non-agricultural use of agrochemicals and of veterinary pharmaceuticals. Underground water in areas where large-scale detonations have occurred (including the demined areas) should be monitored for heavy metals, organic nitrates and their decomposition products.

3.4 Relevant management issues for remediation

The following national institutions are of special relevance to the management of the environmental consequences of the armed conflict in Croatia:

- State Directorate for Environmental Protection
- Hazardous Waste Management Agency (APO)
- State Water Directorate and the Water Agency (Hrvatske Vode)
- Commission for Safe Management of Chemicals

Many of the tasks of remediation will have to be undertaken at the local levels of administration.
The Croatian Mine Action Centre in Sisak, with the assistance of the United Nations and the Government, has developed the infrastructure and a system for mine clearance throughout the affected areas within Croatia. The Croatian Parliament adopted the Law on Mine Clearance in March 1998. The Centre in Sisak has a number of basic tasks including:

- Maintaining a mine database
- Proposing the Mine Clearance Plan to the Government
- Development of mine clearance projects
- Organizing public (international) tenders
- Quality assurance
- Marking of mined areas
- Mine awareness campaigns
- Mine victim assistance
- Support of internal technologies for mine clearance, and
- Coordinating the work of international experts involved in mine clearance activities.

The development of comprehensive and systematic remediation programmes requires (environmental) information. The Law on the Environment recognizes the necessity of high-quality and readily available environmental information. The SDEP has established an Information System for the Environment Programme designed to support decision-making in environmental regulation and protection. The system contains information on pollution levels, selected information on the state of the environment, expert and scientific information from various institutes and documentation and information related to environmental protection. Furthermore, priority is given to protection of sea and surface water, consistent with the fact that the most extensive parts of environmental legislation are dedicated to water protection.

3.5 Conclusions and recommendations

Repairing the war damage is undoubtedly a major challenge for Croatia. At present, only rough estimates exist of the funds required for remediation, in particular that related to water protection. Most of the adverse effects can only be guessed at from eyewitness accounts, some of which may be distorted, as little systematic monitoring has been reported. Detailed and rigorous estimates will be required, if and when funds become available for remediation. As it will be economically advisable not only to restore the damaged structures to their pre-war state, but to consider going further, such funds should be made available also for advancing environmental protection as such. Also, funding schemes for individual projects should be developed as required by the project, so that the appropriate mix of sources of funds (Croatian and international, different public budgets in the country) can be determined in each case.

Any convincing remediation programme will have to start from information on actual damage, which will have to be used in a remediation strategy. For this strategy, it is indispensable to quantify, or at least semi-quantify, the effects of the war on the environment. This could be achieved most effectively by the use of generic monitoring techniques to produce *contamination maps*. The strategy of remediation should be extended to cover also environmental protection concerns that were not created by the armed conflict, if and where this is economically reasonable.

In areas undergoing mine clearance, underground waters should be monitored for heavy metals, including lead and mercury, and also for organo nitrates and their decomposition products. Additionally, the geological effects of repeated

explosions require investigation, especially relating to increases in fissures and fractures in the limestone karst areas.

Recommendation 3.1:
The effects of the armed conflict on the environment should be quantified to the maximum possible extent, to become the basis for a comprehensive remediation strategy. Monitoring practices should be widely extended to prepare the strategy.

There is a very considerable requirement to strengthen local capacity and capabilities to cope with the existing situation on a medium- to long-term basis. This may require multilateral and bilateral assistance. At the same time, improving institutional management is a high priority (see Recommendation 1.1). A decisive factor for the future will be greater transparency and closer liaison between Government ministries, inspectorates, agencies, industry (both State-owned and private), universities, institutes and NGOs. Cooperation should involve finding funds for each project that repairs war damage.

Recommendation 3.2:
Local capabilities should be strengthened to cope with the environmental consequences of the armed conflict on a medium- to long-term basis. Strengthening should involve making finances available as required, including possibly from international assistance.

Croatian scientists should evaluate the xenobiotic mechanisms and metabolic processes occurring in underground strata used for the extraction of drinking water to ascertain the microbiological processes apparently degrading the chemicals polluting such waters. Initially, it should be ascertained if these strata are aerobic or anaerobic.

Recommendation 3.3:
Scientists should evaluate xenobiotic and metabolic processes occurring in underground strata used for the extraction of drinking water, in order to ascertain the microbiological processes that may be causing degradation of chemicals polluting such water. These metabolic processes are of particular importance when such metabolites increase the toxicity of the pollutants. Expertise in anaerobic metabolism will have to be developed.

Croatia's efficient and well-established education system makes major training efforts to repair war damage redundant. This is certainly the case among the medical profession and its expertise in toxicology. However, there may be a lack of knowledge in ecotoxicology. Such training could include:

- Principles of ecotoxicology;
- Metabolism and mechanisms in non-mammalian species, especially in anaerobic systems and the importance of xenobiotic transformation;
- Simple risk assessments, especially for aquatic systems including predicted environmental concentration (PEC) and predicted no-effect concentration (PNEC) ratios;
- Development of a pollutant release and transfer register (PRTR);
- Development of generic monitoring and direct toxicity assessment.

Recommendation 3.4:
Training in environmental health risk assessment, ecotoxicology and related topics should take place, specifically at regional and local levels. It should be extended to both industrialists and academics.

To anticipate possible risks to economic development from the environmental consequences of the armed conflict, environmental impact assessments should be undertaken in the maximum number of development projects. Risks may be more or less pronounced. For example, it is important that pesticide warehouses and processing units are not rebuilt on ground contaminated with incompletely burnt pesticides and related products, whose toxicity and ecotoxicity are in all probability greater than those of the parent products.

Recommendation 3.5:
Ground contaminated with incompletely burnt pesticides or related products (including PCBs) should be examined and, as necessary, remediation measures proposed, and no new warehouses, production units nor, in particular, any dwellings should be built in those areas.

Also, although the armed conflict came to an end a few years ago, it is not always clear what its real environmental impact is in the medium and long term and to what extent the corrective and remediation actions that were to be undertaken rapidly after the war have effectively and fully been carried out.

Recommendation 3.6:
Croatia should be invited to actively contribute to the regional assessment of environmental impacts of armed conflicts, in the context of the Stability Pact for South Eastern Europe.

Chapter 4

INTERNATIONAL COOPERATION

4.1 General objectives for international cooperation

The Declaration of Environmental Protection in the Republic of Croatia, passed by the Parliament on 5 June 1992, stresses that Croatia aims to realize sustainable development and states that it shall sign up to international treaties in the area of environmental protection. The Declaration is of little practical relevance at present. Croatia's main environmental law, the 1994 framework Law on Environmental Protection, was developed according to EU standards and international environmental conventions.

Croatia has ratified numerous international environmental agreements, some by notification of succession to the ratification of agreements by the former Yugoslavia. The main obstacles to compliance with international agreements are the lack of political will and the lack of finances. Capacity in natural sciences is strong in Croatia, capacity in more modern disciplines and concepts, such as public participation, is less well developed.

On an international level, Croatia is especially active in issues related to the Mediterranean, air pollution and, with neighbouring States, freshwater bodies. It actively participates in international meetings, workshops, etc. Croatia has become a member of the United Nations and the Council of Europe. It participates actively in the work of the ECE, including the "Environment for Europe" process, the European Environment Agency on the preparation of the Reports on the State of the Environment in Europe (such as the Dobris Assessment), and the Food and Agriculture Organization of the United Nations (FAO). Membership of the World Trade Organization (WTO) is being prepared and the final WTO assessment can be expected in the autumn of this year.

The SDEP's priorities in international cooperation are:

- integration of international principles into Croatia's national legislation;
- ratification of more international environmental treaties; and
- attracting international funding/technical assistance to improve implementation.

However, a very clear strategy on international environmental cooperation has not yet been developed.

Apart from the State Directorate for the Protection of Nature and the Environment, many other ministries and governmental bodies are involved in international environmental cooperation. They include the Ministry of Foreign Affairs, the Ministry of Finance, the Ministry of Physical Planning, Building and Housing, Ministry of the Economy, Ministry of Health, the Office for European Integration, the State Water Directorate, the Ministry of Agriculture and Forests and the Ministry of Maritime Affairs, Transport and Communications. Coordination between all these agencies on international cooperation is not yet well developed.

With support from the World Bank, the SDEP is currently developing Croatia's national environmental protection strategy. This work will include a review of the mandates and responsibilities of all governmental bodies involved in environmental issues. Improving international cooperation in general is one of the needs that will be emphasized in this strategy. Also, acceptance of EU environmental standards and EU integration have a high priority.

Membership of the European Union is a long-term objective and an economic priority for Croatia. In March 1998, the Deputy Prime Minister was appointed Minister for European Integration. The specifically created Office for European Integration effectively coordinates European integration matters within the Government. It has a department for strategic planning and

harmonization of legislation; it provides technical support to the Ministry of Foreign Affairs; and it has a department for information, translation and education. The Office is preparing an integration action plan that includes all legislative, economic and political reforms needed to make effective functional adjustments to the EU. A database on foreign assistance is being set up and an attempt will be made to coordinate requests for international funding. In line with a decree passed in January 1999, every new law will have to be consistent with EU legislation. The Office assesses the conformity of the new laws with the *acquis communautaire*.

4.2 Regional cooperation in the framework of UN/ECE

Convention on Long-range Transboundary Air Pollution

Croatia ratified the Convention on Long-range Transboundary Air Pollution and its Protocol on Long-term Financing (EMEP) in 1991 by notification of succession. Croatia also ratified the Protocol on Further Reduction of Sulphur Emissions in 1998. Croatian experts take part in many of the Convention's expert groups and actively participate in the drafting of new protocols. An inventory of emissions is being drawn up to further comply with the Convention.

Croatia hopes to ratify the Protocol on Volatile Organic Compounds this year (Croatia already complies with its provisions). It signed the Protocols on Heavy Metals and on Persistent Organic Pollutants in Aarhus in 1998 and expects to ratify them within the next two years. Croatia is unlikely to ratify the NOx Protocol as it already complies with its provisions and is more interested in the development of the new protocol to abate acidification, eutrophication and ground-level ozone.

The constraints in the implementation of the Convention are financial. In particular, Croatia has difficulty keeping up with EMEP due to a lack of resources for monitoring. Croatia's main policy objectives under the Convention are: to cooperate further with the international community; to modernize its activities under EMEP; to ratify the three above-mentioned protocols; and to adjust its national legislation to international standards where still needed.

Croatia has prepared annual reports on air pollutant emissions since 1993, and has done some air quality monitoring since 1964. The reports cover: SO_2, NO_x, N_2O, CH_4, CO, CO_2, NH_3, NMVOC and heavy metals (Pb, Cd and Hg). Croatia participates with three local air quality monitoring stations in the Global Environmental Monitoring Systems (GEMS), with two tropospheric ozone monitoring stations in the EUROTRAC Monitoring Network, and with two background air pollution monitoring stations in EMEP.

Transboundary air pollution makes it hard to maintain air quality. In some areas such as Rijeka, pollution from neighbouring Italy further aggravates local air pollution problems. Croatia imports more air pollution than it exports. From 1990-1996 air pollution decreased. This was due to the war and the connected economic crisis, but not because of ecological measures. Since 1997 it has again picked up. The main emitters are refineries, the petrochemical industry, the cement industry and power plants (Chapter 10).

Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Transboundary water issues are very important to Croatia. Many of its borders either follow the course of rivers or are located on major aquifers, and all its major rivers (the Sava, Drava, Danube, Mura, Neretva, with the exception of the Kupa river) either rise abroad or flow downstream across its borders – or both. Most of Croatia is part of the Black Sea watershed, with most rivers flowing into the Danube or one of its affluents. 10 per cent of Croatian river basins drain to the Adriatic Sea (see Chapter 6).

Pollution from non-point agricultural sources in Slovenia, Hungary and Austria has transboundary effects on the Drava as it flows into Croatia. Also, the construction of hydropower plants in Slovenia, Austria and Hungary has an impact on Croatian water regime. Transboundary impacts on the Danube basin result, *inter alia*, from hazardous waste disposal at Györ (Hungary). Transboundary monitoring of the impact of the hydropower plant Varazdin shows increased radioactivity and heavy metals. Waste water and non-point agricultural sources in Bosnia and Herzegovina and Slovenia pollute the Sava River. The nuclear power plant on the border with Slovenia also causes pollution.

Croatia itself contributes to the Sava's transboundary pollution with nutrients as a result of discharges of industrial and municipal waste without pretreatment and agricultural runoff .

Croatia ratified the Convention on the Protection and Use of Transboundary Watercourses and International Lakes in 1996. The State Water Directorate is the focal point for this Convention and Croatia participates in the Convention's implementation within the following working groups: sustainable development in the management of waters; point and non-point pollution sources; monitoring and laboratory practice; and regulations.

Croatia has organized various international meetings on water issues, including an international workshop on water and agriculture in 1996 and an international conference on water protection in nature parks in 1998. Croatia is lead country for the subproject "best Agricultural Practices" of the Programme on Land-based Pollution carried out in the framework of the work plan 1997-2000 under the Convention.

In 1993, an agreement between the Government of Croatia and the Governments of Austria, Italy, Hungary, Poland and Slovenia was concluded on Mutual Cooperation in Predicting, Preventing and Mitigating Natural and Technical Incidents.

Convention on Environmental Impact Assessment in a Transboundary Context (Espoo)

Croatia ratified the Convention on Environmental Impact Assessment in a Transboundary Context in 1996. Croatia's first environmental impact assessments (EIA) were carried out in the early 1970s. The first legal basis for EIA procedures has existed since 1984. The 1994 Law on Environmental Protection and the Decree on EIA further enforced and enlarged the existing framework. The regulations take international norms and EU standards into account. However, amendments to the regulations will be prepared this year to fully comply with the Convention and to better link the EIA procedure to the procedures contained in the physical planning laws which run parallel to the EIA procedure (see Chapter 1). In an international context, Croatia has carried out an EIA procedure together with Italy for the construction of a gas platform in the Adriatic.

In the future, Croatia aims to introduce the concept of strategic environmental assessment, promoting a more integrated approach. Ideally, the related sectoral ministries (e.g. transport, economic affairs and health) would ensure the assessment with assistance from the State Directorate for the Environment. To reach this goal, it is important that all these sectors should be involved and should build their capacity.

Convention on the Transboundary Effects on Industrial Accidents

Croatia has recently ratified the Convention on the Transboundary Effects of Industrial Accidents, and its national legal framework has been adjusted accordingly. By law, all industrial facilities need to draw up contingency plans. Strategies have also been formulated to promote pollution abatement in industry and incentives to use cleaner production technologies are being developed. Eco-labelling has also been introduced. In October 1997, the Czech Republic concluded an agreement with the United Nations Industrial Development Organization (UNIDO) on National Cleaner Production Centres. In this context a project was set up to finance a three-year environmental programme for Croatia. It involves the training of Croatian managers and scientists in cleaner and low-waste technologies and pollution abatement techniques (see also Chapter 10).

The Commission for Safe Management of Chemicals was set up in 1996. Its tasks are to establish a programme of risk reduction measures, improve work on chemical risk assessment and on preventing the illegal trade in toxic substances, exchange information on the safe management of chemicals and coordinate the classification, packaging and labelling of chemicals.

Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters

Croatia signed the Convention during the Aarhus Conference in 1998 and considers its ratification to be a priority. A new regulation on publicizing statistical information and collecting and sharing data is being prepared. It provides for sharing information with international institutions or with other countries.

There is presently no legal obligation to cooperate

with non-governmental organizations (NGOs) or to allow NGOs to participate in decision-making. NGOs sometimes consider cooperation with the State Directorate to be troublesome and not always transparent (see section 1.7 in Chapter 1 for details).

"Environment for Europe" process

Croatia has been actively involved in the "Environment for Europe" process since the Conference in Lucerne, Switzerland, in 1993. In this context, Croatia is involved in the Task Force for the Environmental Action Programme for Central and Eastern Europe. In addition, Croatia is the lead country for the Initiative on the Application of EIA (EIA initiative) under the Espoo Convention, established at the Sofia Conference. Under this Initiative bilateral cooperation is being promoted by way of sharing experience and case studies between east-west and east-east European countries.

The activities under the EIA Initiative are being supported by the Regional Environmental Centre (REC). Croatia signed a memorandum of understanding with REC in Budapest. With its support, a workshop was organized in 1998 on strategic environmental assessment (SEA) in countries in transition, chaired by Croatia. Croatia and REC submitted a joint work report to the fourth Ministerial Conference "Environment for Europe" in Aarhus in 1998. The report presents activities in:

- use of strategic environmental assessment
- public participation in EIA procedure
- quality assurance by accredited experts and institutions
- use of social factors in EIA procedures.

It was recommended that the activities should continue, with special emphasis on the further introduction and development of SEA. The Oslo Ministerial Declaration of the first meeting of the Parties to the Espoo Convention on Environmental Impact Assessment in a Transboundary Context (May 1998) encouraged cooperation with the Sofia Initiative on SEA. Similarly, the Declaration of the third Ministerial Conference on Environment and Health (June 1999) also recommended that NEHAP should be implemented in tandem with the Sofia Initiative regarding SEA. The Sofia Initiative will continue to be conducted in close cooperation with the three pan-European environmental health programmes, namely the Environmental Action Plan (EAP), the Environmental Health Action Plan (EHAP) and the Espoo Convention's work plan. Croatia, as lead country, was given recognition for its successful work. Through their involvement in this work, Croatian experts have also enjoyed access to state-of-the-art knowledge and achievements, and had opportunities to share experience in SEA and EIA.

4.3 Other regional cooperation

Danube cooperation

The Danube (coming from Hungary) flows through Croatia over a length of 188 km. The country's major rivers, the Sava and the Drava (both coming from Slovenia, and flowing through Croatia for 562 km and 505 km, respectively), are affluents of the Danube. In the large Danube catchment area in Croatia, covering some 282 000 ha, there are four important wetlands: forest areas along the Drava; Kopacki Rit national reserve; alluvial marshy land and wetlands along the Sava where the Lonsko Polje nature park is located; and the Turoploje area, which is a nature reserve for drinking water, fish ponds and wildlife (for details see below, section 4.5, other global conventions and also Chapter 6 on Water).

Croatia signed the Convention on Cooperation for Protection and Sustainable Use of the River Danube in 1994. The Convention aims at achieving sustainable and equitable water management and covers matters such as forms of cooperation; emission limitation; monitoring programmes; information exchange; public information; research and development; emergency plans; dispute settlement; best available techniques; hazardous substances; and best environmental practice. The International Commission for the Protection of the Danube River provides a framework for regional cooperation under the Convention. Croatia is a member and participates in all activities related to the Convention's bodies.

The Strategic Action Plan 1995-2005 of the Environmental Programme for the Danube River Basin of 1992 (EPDRB) identifies the main problems affecting the health of the Danube basin: high nutrient loads, changes in river flow patterns and sediment transport regimes, contamination with hazardous substances including oils, competition for available water, microbial contamination, and contamination with oxygen-depleting substances. Major pollution sources, or hot spots, whose mitigation would need considerable investments, have been identified in all Danubian countries. The

Strategic Action Plan provides direction and a framework for achieving goals of regional water management and riverine environmental management set out in the Danube Convention. The proposed actions will be implemented through national action plans to be drawn up by the Danube basin countries assisted by the EPDRB.

In Croatia, a National Planning Workshop was held in September 1998 as part of the planning process to develop the Danube Pollution Reduction Programme in line with the policies of the Danube Convention. UNDP/GEF gives technical and financial support to organize country-driven planning processes which will help to define transboundary issues and to develop sector-related regional strategies and actions for the revision of the Strategic Action Plan of the EPDRB.

The Workshop was organized and its report written in cooperation with the Programme Coordination Unit of the EPDRB. The report identifies the insufficient number of treatment plants for municipal waste water from public sewerage systems, as well as the low percentage of the population connected to public sewerage systems as the main problems in water pollution control in Croatia. International funding to improve this situation will have to be sought. In addition, a strict enforcement of the National Water Pollution Control Plan would improve both the Danube and the Adriatic basin.

In addition and based on sector analysis, the report identifies the following causes of transboundary water pollution of the Croatian part of the Danube river basin: unsustainable agricultural practices, ecologically unsustainable industrial activities and inadequate municipal waste management. The effects of these activities include reduced oxygen levels, increased levels of nutrients and eutrophication, contamination of water and degradation of water quality, soil pollution and landscape degradation.

In September 1999, a US$ 1.9 million UNIDO project is expected to start for five Danubian countries (Bulgaria, Hungary, Croatia, Romania and Slovakia) on the “Transfer of Environmentally Sound Technology in the Danube River Basin”. The State Water Directorate will be the Croatian partner.

Mediterranean cooperation

International cooperation on the Mediterranean Sea is important to Croatia, as its coastline corresponds to one third of its border. Croatia ratified the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and most of its protocols by notification of succession in 1993. Its priorities for international cooperation are related to the protection of the Adriatic Sea from maritime transport of oil and oil products and of harmful and hazardous substances; protection from accidents; and protection from industrial waste and waste waters.

Croatia is very active in the Mediterranean Action Plan (MAP), the framework for the implementation of the Barcelona Convention, is a member of the Bureau of the Barcelona Convention and attends all its meetings. It has hosted the Priority Actions Programme Regional Activity Centre (PAP/RAC) in Split since 1977. The principal activity of the Centre is integrated planning and management of coastal areas. The Centre has developed intensive and fruitful cooperation with all of the Mediterranean countries and their governmental and non-governmental institutions, through the organization of seminars, workshops, conferences and training courses as well as through the exchange of experts. With regard to the other regional centres, particularly good cooperation has been established with the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) in Malta. Croatia actively participates in the work of other UNEP-MAP bodies, such as the Mediterranean Commission for Sustainable Development, and is also a signatory to Agenda 21 for the Mediterranean. In addition, Croatia is involved in the Blue Flag programme (see also Chapter 12 on Tourism).

The Mediterranean Technical Assistance Programme (METAP) financed several studies aimed at resolving important environmental problems (waste waters, solid waste, environmental management). The studies included projects on an environmental management plan for the Cres-Losinj Archipelago, completed in 1995 (US$ 110 000), and a waste management study for Kvarner Bay, completed in 1996 (US$ 100 000). Currently, a METAP study on EIA procedures is being prepared with support from the EIA Centre at the University of Manchester.

A grant and a loan (DM 65 million) were provided by the World Bank for the construction of a wastewater treatment plant in the Kastela Bay area, one of the largest hot spots in Croatia (see also Chapter 6).

The state of the Mediterranean is monitored under the Programme for Pollution Assessment and Control of the Mediterranean Sea (MED POL). MED POL Phase III (1996-2005) covers pollution control and monitoring States' compliance with existing legislation. As part of MEDPOL, the Contracting Parties adopted a Strategic Action Programme to address pollution from land-based activities, leading to the formulation of related national action plans, in November 1997.

Croatia has been involved in the Trilateral Commission on the Adriatic with Slovenia and Italy. The Commission acts through various working groups: cooperation on joint activities in case of accidental pollution of the Adriatic Sea; separate navigation systems, i.e. establishment of navigation routes; monitoring the state of the Adriatic and protecting it. Work under this Commission has been slow over the past few years. The aim should be to re-establish monitoring activities among all institutes working on Adriatic issues.

Croatia participates in the activities of the European Association for Sustainable Development of Islands (INSULA), in the GILDA project, an initiative for economic and ecological cooperation of the countries of the Adriatic basin with regard to passenger and goods traffic in the Adriatic Sea.

Alpe Adria Commission

Croatia has actively participated in the Interstate Commission on the Adriatic (Alpe Adria) since its creation in 1970. Its members, Austria, Hungary, Italy, Slovenia and Croatia, meet annually. In the period 1995-1997, Croatia presided over the first Commission on Physical Planning and Environment. In 1993, a Master Plan for the Northern Adriatic was drawn up. The Interstate Commission has agreed that its various working groups and commissions need to step up their activities, and that it needs to develop cooperation with international organizations.

4.4 Bilateral cooperation

Croatia has signed a number of bilateral agreements on environmental issues with its neighbours. The most important deal with water management:

- Agreement on Water Management Relations between the Government of the Republic of Croatia and the Government of the Republic of Hungary (1994). Under this Agreement a standing commission has been set up with various sub-commissions on such topics as: Drava and Danube water management; Mura river; water use and pollution control; water quality control.
- Agreement on Water Management Relations between the Government of the Republic of Croatia and the Government of the Republic of Slovenia (1996). Under this Agreement, *inter alia*, joint research into transboundary groundwater influences on the karst area is being carried out. Also, a standing commission with various sub-commissions, which recently started operating, has been set up.
- Agreement on Water Management Relations between the Government of the Republic of Croatia and the Government of Bosnia and Herzegovina (1996). A joint project on assessment and protection of groundwater resources will be carried out. It is hoped that international financial support will be forthcoming.
- Negotiations with the Federal Republic of Yugoslavia are under way to establish a similar agreement on water issues.

Through the Permanent Croatian-Bavarian Commission, Croatia also cooperates with Germany on a number of issues, including natural resources protection. In this context, assistance for the reconstruction of war-torn agricultural areas and annual water management workshops should be mentioned.

In addition, Croatia receives grants and technical assistance for research or small projects related to environmental issues from various countries, including Austria, Germany, Italy, the Netherlands and the United States.

4.5 Global cooperation

Implementation of Agenda 21

Croatia took an active part in the United Nations Conference on Environment and Development in 1992 and signed the Rio Declaration. Agenda 21 guidelines are referred to in the Declaration on Environmental Protection as well as in the 1994 Law on Environmental Protection.

A review of progress on implementation of Agenda 21 was prepared in 1997. The SDEP was the Working Group Coordinator for the preparation of this report and many other ministries and agencies were consulted and involved. The Croatian

Government accepted the report and forwarded it to the Commission on Sustainable Development in April 1997. A more permanent national body to promote the implementation of Agenda 21 has not been established. The World Bank is helping to develop a national environmental strategy. Parliament adopted the National Programme on Sustainable Island Development in 1997. The Ministry of Agriculture developed the Strategy on Sustainable Agricultural Development with FAO assistance, taking Agenda 21's norms on sustainable agriculture and the Guidelines of the GATT Uruguay Round into account.

Climate change

Croatia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 and signed the Kyoto Protocol in 1999. Climate change is an important issue for Croatia as it has a large coastal area and also valley areas in the North that could be affected.

As Croatia is an Annex I party (countries with economies in transition), it has to stabilize its CO_2 emissions at 1990 levels before the year 2000. There are no problems with meeting this target. At present, CO_2 emissions are approximately 15 per cent lower than in 1990.

Two projects were carried out in cooperation with UNEP to survey the consequences of global climate change for the Adriatic Area, in Cres-Losinj Archipelago and in Kastela Bay. Croatia received a first GEF grant (US$ 345 600) in February 1999 for drafting its national communication to meet its commitments under the UNFCCC. This report is being worked out together with an action plan, which will be ready in 2000..

With respect to the Kyoto Protocol, the choice of the base year is still open for Croatia, as it is an Annex I party. Under the Protocol, Croatia will have to reduce its CO_2 and other greenhouse gas emissions by 5 per cent in relation to the base year. Its emissions per capita were the lowest in Europe in the years around 1990 that can be chosen as base years. Consequently, it is expected that it will be very difficult for Croatia to comply strictly with the Protocol unless extreme efforts and investments are made. The new energy strategy takes the Kyoto Protocol into account. The Energy Institute undertakes several energy efficiency projects with international assistance. One of these projects involved a US$ 200 880 grant to remove barriers to the implementation of energy efficiency measures. It will be finalized this year. (see also Chapter 5 and Recommendation 5.7).

Protection of the ozone layer

Croatia ratified the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer in 1991 (by notification of succession). Croatia also ratified the London Amendments in 1994 and the Copenhagen Amendments in 1997 and participates in many international meetings and workshops on ozone depletion.

Croatia does not produce any ozone-depleting substances (ODS) but it imports some. Since 1991 ODS consumption has been monitored and annually reported to the Secretariat of the Vienna Convention and its Montreal Protocol. A by-law passed in 1999 sets the end of 2005 as the deadline for phasing out ODS consumption, and full compliance is expected. As Croatia operates under Article 5 of the Montreal Protocol (countries with low consumption/production of ODS), it has access to finance from the Multilateral Fund. In cooperation with and with financial support from the Multilateral Funds implementing agency, UNEP, Croatia completed its National Programme for the Phase-out of ODS in 1996. Consequently, the Multilateral Fund approved a further US$ 101 200 for institutional strengthening and the Ozone Office was established at the State Directorate for the Protection of Nature and the Environment as the National Programme Body.

In accordance with the National Programme, several projects funded by the Multilateral Fund have been carried out, including: CFC12 replacement projects in the aerosol (UNIDO project worth US$ 89 779 to be completed in 1999) and foam sectors (UNIDO project worth US$ 110 780 completed in 1998); phase-out of methyl bromide in an agricultural demonstration project (UNIDO project worth US$ 288 200 to be completed in 2001); and a refrigerant management project (UNIDO project worth US$ 398 160 to be completed in 2001).

Transboundary movement of hazardous waste

Croatia ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal in 1994. The SDEP is the national focal point for all matters related to the implementation of the Convention

and monitors all imports/exports and transit of waste. The 1995 Laws on Waste and on Air Protection respect the international principles (e.g. polluter pays principle, definition of hazardous waste) contained in the Convention.

The import of waste for disposal or for energy recovery and of hazardous waste is prohibited by law. The import of waste that can be treated in an environmentally sound manner is permitted. Croatia exports waste mainly to Austria, Belgium, France, Germany and Slovenia. In recent years several tonnes of PCBs have been exported, as have some 150 tonnes of equipment contaminated with PCBs for incineration abroad. Also, exports of about 100 tonnes of galvanic sludge and a few tonnes of pharmaceutical and medical waste have been recorded. No cases of illegal waste traffic have been recorded.

Croatian delegates have participated in training in the implementation of the Convention in Slovenia and the Russian Federation during recent years.

The compliance problems that do occur relate to the fact that industry sometimes hides certain wastes and the fact that not all hazardous waste as a consequence of the war has been investigated yet. It is a priority for Croatia to have a good information and monitoring system for all hazardous wastes by the end of this year, as there is no reliable inventory at the moment.

Convention on Biological Diversity

Croatia signed the Convention on Biological Diversity in 1992 and ratified it in 1996. Croatia has a rich biodiversity with ecosystems ranging from mountainous to marine and freshwater ecosystems and caves. There are 175 protected areas, divided into 7 different categories. Croatia has not yet drawn up an inventory of biodiversity data.

Nature protection is governed by the Law on Nature Protection (1994), which covers the protection and use of natural resources and the management of national parks, nature parks and other protected areas. The Law on Nature Protection, the Laws on Freshwater Fisheries and Marine Fisheries, and the Law on Hunting regulate species protection. However, the current lists of protected species are not complete. Moreover, enforcement is lax because of a shortage of inspectors and a lack of sanctions for violations. In addition, there are no plans to fund the protection of species.

The World Bank/GEF is assisting in the development of a national strategy and action plan for biological and landscape diversity conservation (US$ 102 000), which should be ready in the summer of 1999. To strengthen this project, the Croatian Government has provided US$ 90 000 to prepare a report on biodiversity status and threats. The Law on Nature Protection is being reviewed according to the principles of the Convention on Biological Diversity and a new law is expected to be drawn up in the autumn 1999. Croatia aims to adopt a more integrated approach instead of the current focus on protected areas. The forestry and agriculture sectors should be involved as well.

The draft strategy promotes the following principles: biodiversity should be recognized as a fundamental asset and a major resource for development; existing biodiversity should be preserved and improved; national legislation has to be improved enhancing sectoral integration; nature conservation should be decentralized to the local level; Croatia should coordinate with international conservation efforts.

Apart from the GEF grant, Croatia does not receive much international assistance to protect biodiversity. Sometimes small grants are provided, such as the 1999 grant worth US$ 10 000 from the Government of the Netherlands for a botanical reserve. More cooperation and assistance are needed as the national budget is not sufficient.

Other conventions related to nature protection

The former Yugoslavia ratified the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) in 1977 and Croatia ratified it by notification of succession in 1993.

Croatia has four wetlands of international importance:

- the forest areas along the Drava river;
- Kopacki Rit, situated in Eastern Slavonia, which is a large specially protected area (17 700 ha). It is a swampy and forest-covered flood plain with numerous lakes and side branches of the Danube, rich in bird species, fish, herds of wild boar and deer, and other animal and plant species;

- the protected area on the lower stretch of the Neretva River, for which Croatia received some funds in 1997 as part of a five-country project on the social aspects of wetland protection through the Ramsar MedWet Programme; and
- the nature park Lonsko Polje/Middle Sava, which houses threatened waterfowl and the common otter.

The former Yugoslavia ratified the *Convention for the Protection of the World Cultural and Natural Heritage (Paris, 1972)* in 1974 and Croatia adopted it in 1993. UNESCO has classified the region of the Plitvice lakes as a World Natural Heritage site. The Velebit mountain is on the Biosphere Reserves List of UNESCO.

Croatia has ratified the *International Convention for the Protection of Birds (Paris, 1950)* and the *International Plant Protection Convention (Rome, 1951).*

Croatia has not yet ratified the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), but has registered the import and export of CITES species since 1995. The papers for the ratification procedure are being prepared and regulations in line with the Convention are being developed. Customs officials are not sufficiently informed about the trade in endangered species and the principles of the Convention. They have not received any training. Some cases of illegal export (in reptiles) from Croatia have been discovered in other countries.

Croatia is expected to ratify the *Convention on the Conservation of European Wildlife and Natural Habitats* (Bern Convention), although probably with some reservations as certain species that fall under the Convention are less endangered in Croatia (e.g. bears).

The *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention) is not a priority for Croatia at the moment, but it is expected to ratify it eventually.

Croatia has not yet ratified other biodiversity-related international agreements such as the 1991 Agreement on the Conservation of Bats in Europe (Eurobats), the 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds and the 1996 Agreement on the Conservation of Small Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area.

Marine pollution

In Croatia, international marine issues are being managed jointly by the Rijeka branch of the SDEP and the Ministry of Maritime Affairs, Transport and Communications. The Rijeka branch is mainly responsible for work related to the Barcelona Convention (see section 4.3 *Mediterranean Cooperation).* All other matters fall under the responsibility of the Ministry of Maritime Affairs, Transport and Communications except for the Protocol for the Protection against Pollution from Land-Based Sources to the Barcelona Convention, which falls under the responsibility of the State Water Directorate.

Croatia aims at preventing pollution from ships and land-based sources. One corresponding priority is therefore to build waste-water treatment facilities for settlements and industry in the coastal areas.

Croatia has been a member of the International Maritime Organization since 1992 (by succession to the former Yugoslavia) and has ratified many international agreements related to marine pollution. In addition to the Barcelona Convention and its protocols, it ratified the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter in 1995. The former Yugoslavia signed a Yugoslav-Italian Agreement on Cooperation in the Protection of Adriatic Sea Water and Coastal Areas from Pollution in 1977. Croatia ratified the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1992 and its 1978 Protocols in 1992. It ratified the International Convention on Civil Liability for Oil Pollution Damage in 1999 and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage in 1999. It ratified the International Convention Relating to Intervention on the High Seas in Case of Oil Pollution Casualties in 1992. Finally, Croatia ratified the United Nations Convention on the Law of the Sea in 1991.

In 1998 Croatia and Italy concluded a memorandum of understanding to further collaborate on marine pollution issues. Croatia has concluded various other memorandums of understanding with Italy and Slovenia, dealing with, for instance, common routing systems, traffic separation schemes, mandatory ship reporting systems, search and rescue operations.

Nuclear issues

Croatia and Slovenia have started discussions about a possible agreement on the co-ownership of the nuclear power plant in Krsko, which is located in Slovenia. In the past year significant progress has been achieved. Today, the nuclear power plant operates safely under Slovene jurisdiction and according to good performance practices within the permitted levels of all potential pollution parameters (temperature, radionuclides, waste, etc.).

If the agreement is concluded, both countries will share responsibilities and obligations for the future safe operation of the installations, including management and disposal of waste and decommissioning of the Krsko nuclear power plant.

4.6 International funding

In the first half of 1998 foreign investors invested about US$ 560 million in Croatia. This means that the level of foreign direct investment (FDI) in 1998 relative to GDP was about 3 per cent. From 1993 until mid-1998, according to the Croatian National Bank, about US$ 1.7 billion were invested in Croatia, mainly by Austria, Germany and the United States. Pharmaceuticals, financial businesses and cement production took the lion's share. However, compared to other countries in the region like Slovenia or the Czech Republic the figures are very low. Croatia still has problems attracting FDI. The legal framework, including a new taxation system, is in place but most foreign investors are still reluctant. This is due to the slow privatization process, the slow development of capital markets, the financial crisis and the soft political sanctions. The Croatian Investment Promotion Agency was set up in 1998 and progress is expected in 1999.

EU assistance

In 1995, negotiations with the EU regarding a trade and cooperation agreement were suspended after the resumed military conflict in Eastern Slavonia, Western Slavonia, Lika, Kordun and Banovina. After the Ministerial Committee of the Council of Europe had rejected Croatia's application for membership, Croatia was admitted in late 1996 even though it did not fulfil all the conditions. This decision allowed for new negotiations on a trade and cooperation agreement. However, Croatia has not yet been reintegrated into the PHARE programme and negotiations on a cooperation agreement are suspended. The European Commission is still not satisfied with the Croatian compliance with the political and economic conditions laid down by the EU.

At their meeting on 29 April 1997, the EU Foreign Ministers agreed to adopt a policy towards south-eastern Europe. It is directed at four of the successor republics of former Yugoslavia as well as Albania. The policy lays down the conditions that these countries must fulfil in order to qualify for trade, aid and closer relations with the EU. It aims to improve political stability as well as economic development and relations in the region. An important element of this policy is that these countries must be ready to engage in cross-border cooperation with their neighbours. This overall EU policy is known as the "regional approach". Links have been revived and reinforced through the adoption of the Stability Pact for South-East Europe on 10 June 1999.

World Bank and EBRD

The main partner for the World Bank and EBRD in Croatia is the Ministry of Finance. This Ministry has the following priorities for attracting funds from the international development banks: infrastructure development, reconstruction, development of capital markets, private sector development, nature protection and preservation of cultural heritage.

In total the World Bank has disbursed US$ 754.7 million in loans since 1990. Although most projects focus on emergency reconstruction, infrastructure development, mine clearing, privatization and investment recovery, some projects have significant environmental components:

- In 1990, a US$ 28 million loan for water supply and sewerage systems in Istria was signed. This project included the building of a water treatment plant.
- A loan worth US$ 0.16 million for a management plan for the Kopacki Rit nature reserve within a larger loan for the reconstruction of Eastern Slavonia (total US$ 40.6 million) was signed in 1998. This five-year (1999-2003) project has four aims: mine clearing, water works renovation, waste-water management and the management plan for Kopacki Rit. A GEF grant for Kopacki Rit worth US$ 750 000 was also disbursed.

- In 1998 a US$ 36.6 million loan for municipal environmental infrastructure was signed. This project includes the establishment of waste-water treatment facilities in Kastela and Pula Bays. The project will also improve the safety, reliability and delivery of drinking water and the operational and financial performance of the water utility. It should be finished in 2002.
- A US$ 42 million loan for a coastal forest reconstruction project was signed in 1996, aiming to restore and protect natural vegetation and improve biodiversity in coastal areas.
- A loan for a cultural heritage project in Kastela Bay worth US$ 13.4 million is under preparation.
- In 1999, the World Bank/IDF granted US$ 238 000 for the preparation of the NEAP.

The World Bank has also provided grants for research and various studies: e.g. US$ 102 000 for the development of the NBSAP in 1998; a US$ 200 000 grant (from Japanese funds) for a flood control project in Eastern Slavonia; a US$ 476 000 grant (Japanese funds) for a flood control project on the Sava river; a US$ 500 000 grant for a pre-study for the above-mentioned waste-water treatment project for Kastela Bay in 1996; and a US$ 276 580 grant, signed in 1999, for environmental policy development and regulatory capacity building.

The World Bank is finalizing its 3-4 year Country Assistance Strategy for Croatia. It is expected that US$ 800-1 000 million in loans will be disbursed over the next four years.

Over the period 1994-1998, the EBRD signed loans worth a total of ECU 517.15 million with Croatia. The EBRD policy priorities for Croatia are to support FDI, privatization, small and medium-sized enterprises and the tourism industry. Most loans are related to private sector development, few are devoted to the environment. Projects in the public sector target mainly infrastructure reconstruction - air navigation systems, road construction, electricity grid and waste water. An ECU 45 million loan for a waste management project in Zagreb was signed in 1998. The EBRD also contributes DM 105 million in loans to the joint World Bank/EBRD municipal environmental infrastructure project.

Apart from the assistance, loans and projects mentioned in this chapter, funds were allocated directly to scientific research institutes and to governmental bodies, as a means of supporting research and participating in international training, meetings and conferences. Also, considerable funds were disbursed through channels with other ministries or government agencies for projects with a clear environmental component. However, it is not possible to have a clear overview of these projects and assistance.

4.7 Conclusions and recommendations

In general, Croatia has succeeded in building up a network of international environmental cooperation. Especially on issues like air pollution, international/regional cooperation related to water and environmental impact assessment, Croatia has established a clear position internationally. By signing, ratifying and applying many international environmental agreements, Croatia has also had to develop or improve its national legislation related to the protection of the environment and the sustainable management of natural resources. International cooperation has been developed to ensure the efficient application of international norms. While Croatia should further strengthen its activities in the framework of regional cooperation under the UNECE, bilateral cooperation, especially on freshwater, has nevertheless been initiated to better coordinate the protection of shared watercourses from pollution and to maintain a uniform water regime. Cooperation with the World Bank, EBRD and the IMF provides funds for reconstruction and development projects.

However, the main obstacle to the further development of international cooperation and attracting foreign funds seems to be the fact that, except for some obvious issues, the priorities are not entirely clear. Many international agreements require the application of national action plans. In this context, it is necessary to clearly define the national priorities and objectives in relation to international guidelines and to define clear starting points for developing more efficient international cooperation in the future.

Recommendation 4.1:
Implementation, compliance and enforcement of environmental norms and action plans following existing international commitments should be a priority for all actors in Croatia's environmental policy. National priorities should be defined for international environmental cooperation, preferably as part of the National Environmental Strategy and the National Environmental Action Plan, which are currently being developed.

In addition, no governmental body is currently responsible for coordinating environmental improvement programmes or projects funded by foreign sources or for ensuring acceptable reporting to donor institutions. There is no overview of current international assistance for the environment, nor are there strategies for attracting new funding. An assessment of costs and benefits of all international cooperation efforts developed so far could form the basis for such priorities and strategies.

Recommendation 4.2:
An analysis of all existing international cooperation for environmental protection should be undertaken. A strategy for attracting funds involving all governmental bodies related to environmental protection should be developed. The creation of a unit for project management in the State Directorate for Environment should be considered.

Coordination and cooperation between the State Directorate for the Environment and Nature Protection and other ministries or agencies in Croatia involved in international cooperation are not always satisfactory. Each sector seems to identify its own priorities without much consultation or cooperation with other governmental bodies. Also, in some subject areas international cooperation is much further developed than in others, but it is not clear why certain areas receive less attention. For instance, international cooperation on ozone depletion is quite successful, but international cooperation on biodiversity is not. Some initiatives appear to be well structured, others not. Some are under-used or seem too 'ad hoc'. For example, the working group set up to prepare the progress report on the implementation of Agenda 21 in 1997 was disbanded after the report was completed. However, such a working group could be a useful forum for further information sharing and collection, coordination and cooperation for all partners involved in sustainable development.

Recommendation 4.3:
The State Directorate for the protection of Nature and the Environment should consider creating a national coordination body which can serve as a forum for information exchange, coordination and cooperation on sustainable development.

Although Croatia is already a party to many international environmental agreements, there are several agreements that it has not yet ratified. They include some important conventions on biodiversity such as the Convention on the Conservation of European Wildlife and Natural Habitats and the Convention on the Conservation of Migratory Species of Wild Animals.

Recommendation 4.4:
The ratification procedures for the Bern Convention on the Conservation of European Wildlife and Natural Habitats and the Bonn Convention on the Conservation of Migratory Species of Wild Animals should be initiated. See also Recommendation 5.7.

As mentioned above, Croatia still has to ratify several international agreements. Environmental awareness among the population as a whole and even among decision makers is not very high at present. It would be good to make more explicit and visible the implications of international environmental conventions for social and economic issues at the national level. Croatia should devote special efforts to this.

Recommendation 4.5:
Awareness about international environmental conventions and policies and their importance for social and economic issues at the national and regional levels should be raised, with special programmes targeting decision makers as well as the public.

Climate change would widely affect coastal areas and some valleys in Croatia. Therefore, the upcoming strategy and action plan which will set national objectives should be accompanied by the necessary economic instruments that will allow for the implementation of the recommended actions.

Recommendation 4.6:
The forthcoming action plan on climate change should include suitable economic instruments in order to support the respective objectives.

PART II: MANAGEMENT OF POLLUTION AND OF NATURAL RESOURCES

Chapter 5

AIR MANAGEMENT

5.1 State and determinants of air pollution

Air emissions

Since 1990, air emissions of the main pollutants from stationary and mobile sources in Croatia have decreased as a consequence of the overall economic recession, the economic reform, and the war (Table 5.1). Gross energy consumption dropped 22 per cent between 1990 and 1995, but is picking up again. Similar trends are evident also in the emissions of the main pollutants: a significant drop between 1990 and 1995 followed by a slow increase. The emissions of all pollutants were nevertheless lower in 1997 than in 1990. SO_2 emissions decreased by 55 per cent, NO_x by 16 per cent, NMVOC by 24 per cent, CO by 44 per cent, CH_4 by 24 per cent, NH_3 by 35 per cent and CO_2 by 16 per cent.

Apart from the lower energy demand, the emissions of sulphur dioxide (SO_2) have also decreased mainly due to the approximately 50 per cent reduction in the sulphur content of fuel oils (from 2.5 to 1.2 per cent), which cover 44.4 per cent of the primary energy supply. The oil refineries have reduced the sulphur content of their extra light fuel oil to less than 0.3 per cent from the previous 0.7 per cent. The sulphur content of diesel fuels has also been reduced. Industrial heating and co-generation

Table 5.1: Trends in emissions of selected pollutants, 1990-1997

1000 t

		1990	1991	1992	1993	1994	1995	1996	1997
SO_x	**Total**	**180**	**108**	**107**	**114**	**89**	**70**	**66**	**80**
	Stationary sources	167	98	99	105	78	60	57	72
	Mobile sources	13	10	8	9	11	10	9	8
NO_x	**Total**	**87**	**64**	**56**	**59**	**65**	**64**	**68**	**73**
	Stationary sources	38	25	24	25	25	25	25	26
	Mobile sources	49	39	32	34	41	40	43	47
NMVOC*	**Total****	**105**	**86**	**63**	**69**	**75**	**74**	**82**	**80**
	Stationary sources	64	55	35	42	44	42	49	45
	Mobile sources	41	31	28	27	31	32	33	35
CO	**Total**	**655**	**565**	**417**	**375**	**367**	**346**	**389**	**365**
	Stationary sources	227	205	122	116	123	126	192	193
	Mobile sources	428	360	295	259	244	220	197	172
CH_4*	Total**	169	160	145	147	138	134	134	128
NH_3*	Total	37	31	27	25	24	25	23	24
Cd	Total *(t)*	3.23	..	..	..	..	1.62	1.56	1.62
Pb	Total *(t)*	466	..	..	..	..	264	268	190
Hg	Total *(t)*	1.15	..	..	..	..	0.29	0.30	0.32
CO_2	Total *(million t)*	23	19	17	18	18	17	18	20

Sources: SDEP, 1999; EMEP emission database.

* NMVOC - Non-methane volatile organic compounds.
CH_4 - Methane.
NH_3 - Ammonia.

** Without nature.

plants use mostly gaseous fuels. The only coal-fired power plant, Plomin I, now uses imported coal with a lower sulphur content than the domestic coal (with 12 per cent sulphur) it used in 1990. The shutdown of the Bakar Coke Oven Plant (1994) and of the war-damaged Siemens-Martin furnaces of the Sisak Ironworks (1996) further cut SO_2 emissions.

Some 40 per cent of nitrogen oxide (NO_x) emissions are traffic-related, so there was a decrease during the war. Emissions from combustion processes (35 per cent of total) also decreased slightly until 1995, but are on the increase again. Traffic-related emissions are increasing, but the 13 per cent increase in the number of registered cars in 1997 compared with 1990 was partly compensated by the growing share of cars equipped with catalysers (2.6 per cent in 1990 compared to 42.2 per cent in 1997). Also the already mentioned shutdown of some plants using obsolete, heavily polluting technologies contributed to the decrease in NO_x emissions.

Due to Croatia's comparatively warm climate, the share of emissions of non-methane volatile organic compounds (NMVOC) from nature is relatively high (49.2 per cent). Anthropogenic NMVOC emissions are caused mainly by solvent use (26.5 per cent in 1997), road traffic (40 per cent in 1997) and by crude oil production. The emission trend is similar to that of NO_x emissions.

Emissions of CO and CO_2 also show similar trends -- decreasing until 1995 with a slight increase thereafter. However, the growing share of cars equipped with catalysers contributes significantly and measurably to the drop in CO emissions from traffic.

Ammonia emissions have been falling gradually since 1990. The main reasons are the decrease in the use of fertilizers, the splitting-up of large animal farms and the overall decrease in livestock numbers. Also, the emissions of heavy metals such as Pb, Cd and Hg have decreased by 50 to 70 per cent since 1990. The decrease in the metal content of car fuels, the shutdown of the Siemens-Martin furnaces of the Sisak ironworks, the ferroalloys and

electrodes factory as well as the non-ferrous metals factory in Sibenik and the Hg emissions abatement at the Molve gas-extraction plant are the main reasons.

As an Article 5 Party to the Montreal Protocol on Substances that Deplete the Ozone Layer, Croatia is bound to phase out CFC consumption by 2010 (HCFCs by 2040). In the period 1990-1996, consumption of CFCs fell 54 per cent, that of halons 27 per cent, that of carbon tetrachloride 25 per cent and that of methyl chloroform 19 per cent. Consumption of Annex A ozone-depleting substances (ODS) was 0.041 kg/capita in 1996, and consumption of Annex B ODS 0.030 kg/capita.

Table 5.2: Annual total emissions of selected pollutants by source category, 1990 and 1997

1000t/year

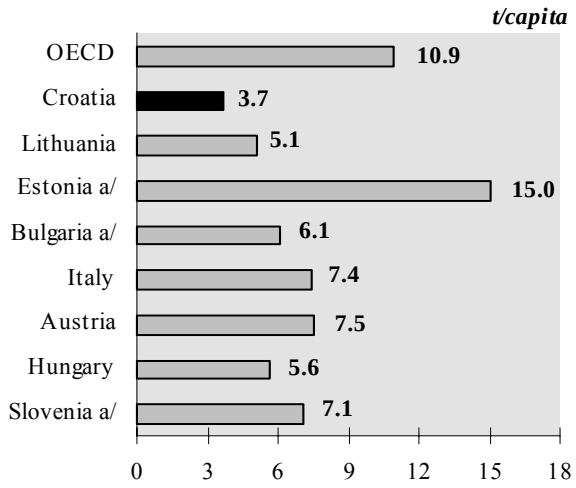
	1990				1997				
	SO_x	NO_x	NMVOC	CO	SO_x	NO_x	NMVOC	CO	
Total	**180.10**	**87.60**	**104.96**	**655.24**	**80.40**	**73.30**	**79.50**	**365.60**	
- Public power, cogeneration and district heating	69.43	9.28	0.14	0.85	35.80	8.30	0.10	0.70	
- Commercial, institutional and residential combustion plants	19.57	4.76	12.64	205.06	7.00	4.60	8.60	141.30	
- Industrial combustion plants and processes with combustion	75.23	22.55	1.24	2.10	28.30	11.10	0.40	39.90	*
- Non-combustion processes	0.92	1.33	12.49	21.39	1.00	1.70	9.00	11.30	
- Extraction and distribution of fossil fuels	-	-	6.63	-	-	-	5.20	0.00	
- Solvent use	-	-	31.24	-	-	-	21.10	0.00	
- Road transport	6.58	27.82	36.99	393.12	4.80	34.10	32.00	141.60	
- Other transport	6.31	21.52	3.59	32.69	3.30	13.40	3.00	30.80	
- Waste treatment and disposal	1.970	0.300		0.004	0.200	0.040	-	0.003	
- Agriculture	-	-	-	-	-	-	-	-	

Source: SDEP, 1999.

* From 1996, the Black Carbon Plants in Kutina are included in the inventory.

Croatia's emission inventory is drawn up in accordance with the CORINAIR methodology, which does not include particulate emissions. Therefore, no data on particulate emissions are available. It may be assumed, however, that due to the low use of coal for power production, the four cement plants together with the obsolete ironworks in Sisak and other metallurgical plants (ferroalloys, aluminium) were the major contributors to particulate emissions. The most polluting coke oven, ironworks and aluminium plants were shut down. The cement plants have been upgraded and equipped with precipitators. Also, the efficiency of the electrostatic precipitator in the coal-fired power plant Plomin I has improved, thanks to its reconstruction and the use of coal with a lower sulphur and ash content. It can therefore be assumed that particulate emissions have fallen about 70 per cent since 1990. The remaining particulate emissions stem mainly from heavy fuel combustion and traffic.

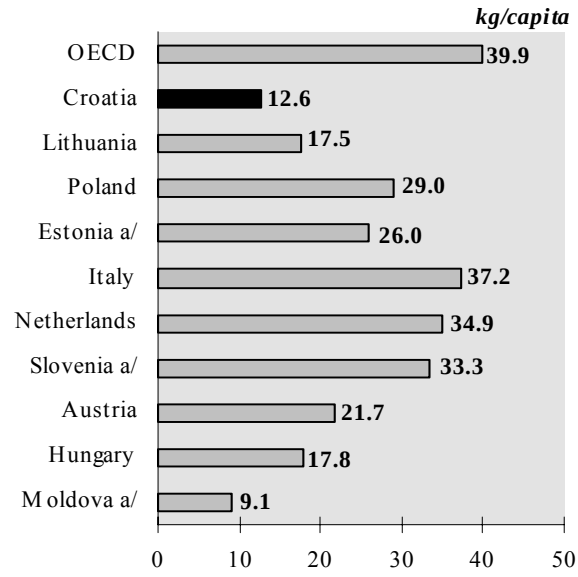
Figure 5.1: Emissions of CO_2, 1996



Sources: SDEP, 1999; OECD, Environmental data, Compendium 1997.

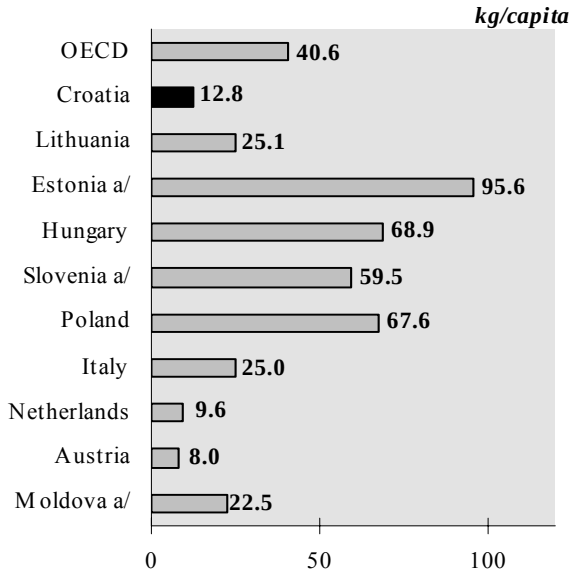
Note:
a/ Data refer to 1995.

Figure 5.1: Emissions of NO_x, 1996



Note:
a/ Data refer to 1995.

Figure 5.1: Emissions of SO_x, 1996



Note:
a/ Data refer to 1995.

Compared to other European countries, Croatia has relatively low per capita emissions (Figure 5.1). Its SO_x emissions per capita are 70 per cent below the OECD average and more than 80 per cent below those of Slovenia, Poland or Hungary. Its NO_x and CO_2 emissions per capita are about 70 per cent below the OECD average.

In transboundary terms, Croatia is a net importer of SO_x and NO_x (Table 5.3). More than 90 per cent of its total oxidized S and N deposition comes from abroad. 56 per cent of its reduced nitrogen deposition is also imported. The main contributors are Italy, Hungary, Germany and Poland.

Table 5.3: Transboundary import/export budgets of air pollutants, 1986-1996

100t and %

Croatian territory	Oxidized		Reduced
	S	N	N
Export mass *(100 t)*	568	198	182
Exported *%* of emissions	87	94	57
Import mass *(100 t)*	790	270	173
Imported *%* of deposition	90	96	56
Net import *(100 t)*	222	72	-9

Source: EMEP/MSC-West Report 1/98.

Sectoral pressures and underlying factors

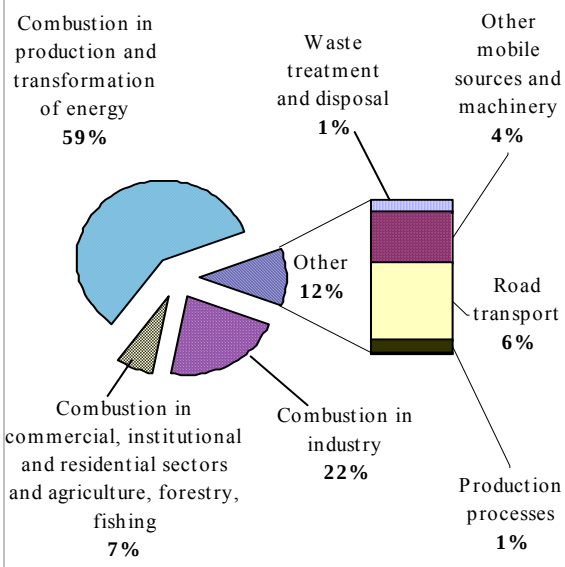
The most polluting sectors are combustion processes and traffic (Figure 5.2). 88 per cent of SO_2 emissions, 63 per cent of CO_2 emissions and 32 per cent of NO_x emissions come from combustion processes, while 64 per cent of NO_x emissions, 25 per cent of CO_2 emissions and 10 per cent of SO_2 emissions are traffic-related. In 1997 the share of traffic-related pollution increased on average by 20 per cent compared to 1990, while that of combustion process pollution decreased by 11 per cent on average.

This trend indicates that in the future the heaviest pressure may come from the transport sector. The total number of registered vehicles increased by 13 per cent in the period 1990-1997. The growing share of unleaded petrol may lead to a decrease in lead emissions, but to a simultaneous increase in emissions of organic matter such as benzene and polyaromatics, mainly if unleaded petrol is used in cars with a defective catalyser. Croatia is a transit country from western Europe to south-east Europe. The road network has not kept up with the geo-political changes in recent years. The Strategy for Transport Development is now being reviewed by the Parliament. However, due to the unstable political situation in the Balkan region, the strategic planning of transit routes is complicated.

The relatively low per capita emissions are due to the fact that about 50 per cent of Croatia's primary hydropower, natural gas and wood (Table 5.7).

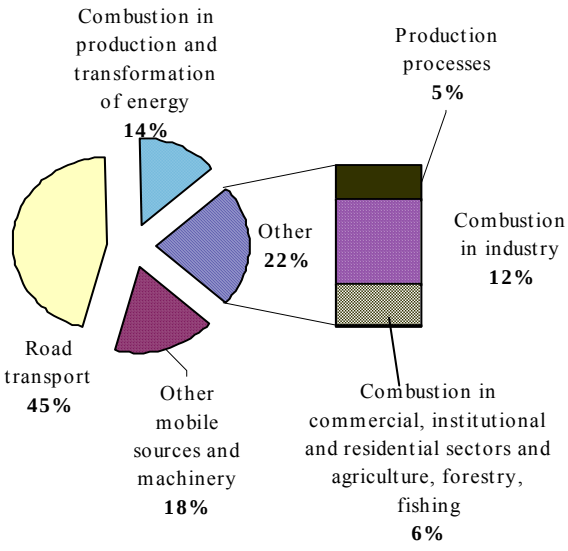
The rest of the primary energy is supplied from coal (2.8 per cent), liquid fuels (44.4 per cent) and nuclear power (4.1 per cent). A significant SO_2 emission reduction was already achieved due to the reduction in the sulphur content of all fuels used. A further reduction is expected due to the obligation on existing air pollution sources to meet new emission limits by the year 2004. Also the By-law on Quality Standards for Liquid Oil Fuels will help to further decrease the sulphur content of fuels.

Figure 5.2: Emission of SO_2 by source category, 1997



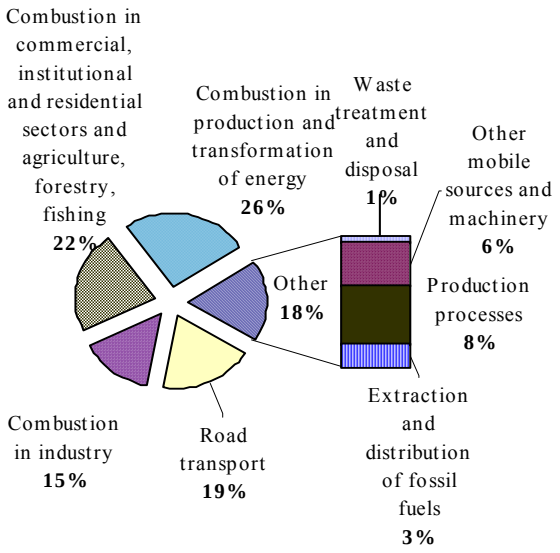
Source: SDEP, 1999.

Figure 5.2: Emission of NO_x by source category, 1997



Source: SDEP, 1999.

Figure 5.2: Emission of CO_2 by source category, 1997



Source: SDEP, 1999.

Even if the particulate emissions are assumed to be low, they nevertheless represent a health risk due to the prevailing thoracic fraction and adsorbed organic substances as they originate mainly from traffic and heavy fuel combustion (see Chapter 13 for more details on health risks related to particulate matter).

All new or reconstructed sources have to comply with the new air pollution legislation. Therefore, the new coal-fired power plant Plomin II, which should be put into operation this year, will be equipped with a desulphurization unit (limestone wet scrubber with efficiency over 95 per cent), low-NO_x burners and an electrostatic precipitator.

80 per cent of industry is located in the central part of Croatia (Sisak-Zagreb region), 10 per cent in Rijeka and the rest is scattered all over Croatia, with a further industrial centre in Split. Croatia has about 24 large sources, which produce the majority of emissions. Six of them are power plants, three are refineries, four are cement plants, four are petrochemical plants, one is a gas extraction facility and the others are chemical and metallurgical plants. After their privatization one of them stopped operating (Umag) and the others are being upgraded step by step.

The Koromacno cement plant already meets the emission limits for new sources, introduced ISO 14000 and is regarded as a good example of environmental protection management. Both the cement plant in Pula and the cement plant complex in Split have been upgraded as well. The cement plant in Umag is not currently operated.

The refineries, all of which belong to the State-owned company INA, will also be upgraded step by step. However, only the refinery in Rijeka has been upgraded so far. The refinery in Sisak, the oldest in Croatia, still has problems with obsolete technologies; upgrading them requires large investments. All INA plants introduced ISO 9000 and are now preparing to introduce also ISO 14000.

Croatia has few waste incineration plants. Two fluidized bed furnaces for the incineration of sewage sludge and waste oil in the Sisak and Rijeka refineries (a rotary kiln incinerator in Sisak will be put into operation soon), one hospital waste incinerator in Zagreb and the new hazardous waste incinerator PUTO in Zagreb (see Box 7.2 for more information on this incinerator).

Ambient air quality

Table 5.4: Ambient air quality trends in selected towns, 1990-1997

	Zagreb		Split		Rijeka	
	SO_2	TDM	SO_2	TDM	SO_2	TDM
	$\mu g/m^3$	mg/m^2	$\mu g/m^3$	mg/m^2	$\mu g/m^3$	mg/m^2
RV/LV	*50/80*	*200/350*	*50/80*	*200/350*	*50/80*	*200/350*
1990	71	230	31	501	105	130
1991	49	171	27	556	83	110
1992	48	152	..	289	46	179
1993	32	124	37	377	47	173
1994	23	130	42	338	50	171
1995	22	137	42	319	38	201
1996	22	164	37	311	25	177
1997	22	148	34	315	27	159

Source: SDEP, 1999.

* **RV** - Recommended concentration value.
** **LV** - Limit concentration value.

In general, the ambient air quality in Croatia has significantly improved in the past ten years and is good (Table 5.4). Most settlements have achieved the first or the second category of air quality according to the criteria set in the By-law on Recommended and Limit Ambient Air Quality Values. No pollutant concentrations at levels causing acute harmful impacts on human health

Table 5.5: Comparison of selected Croatian air quality standards with recommended WHO guiding values and present and future EU standards

Substance	Croatia		WHO guiding value / averaging time	EU standards / averaging time	
	RV*	LV**		Present	According to IPPC Directive a/
	ng/m³,24h annual				
Carbon monoxide	1.00	2.00	60 mg/m³, 30mn 10 mg/m³, 8h		
Ozone	0.11	0.15	0.120 mg/m³, 8h	0.11 mg/m³, 8h, to protect health 0.2 mg/m³, 1h, to protect vegetation	
Sulphur dioxide	0.05	0.08	0.5 mg/m³, 10 mn 0.125 mg/m³, 24 h 0.05 mg/m³, annual	0.08 mg/m³, annual, median value if BS>40 and b/ 0.12 mg/m³, annual, median value if BS ≤ 40	0.125 mg/m³, 24 h, exceeded not more than 3 times annually to protect human health; c/ 0.020 mg/m³, annual and in winter to protect ecosystems d/
Nitrogen dioxide	0.04	0.12	0.2 mg/m³, 1 h 0.04 mg/m³, annual	0.2 mg/m³, annual, exceeded not more than 2% time	0.2 mg/m³, 1 h, exceeded not more than 8 times annually (50% margin of tolerance) e/ 0.04 mg/m³, annual, (50% of tolerance) both to protect human health; 0.03 mg/m³, annual, as $NO + NO_2$ to protect vegetation
Particulate matter	0.075	0.15	0.06-0.09 mg/m3 f/	0.08 mg/m³, annual median value 0.13 mg/m³, winter median value 0.25 mg/m³, maximum value not to be exceeded more than 3 times annually	0.05 mg/m³, 24 h, (50% margin of tolerance to protect human health) 0.03 mg/m³, annual, (50% margin of tolerance to protect human health)
Lead	0.0010	0.0020	0.0005 mg/m³, annual	0.0002 mg/m³, annual	0.0005 mg/m³, annual (100% margin of tolerance)

Sources: SDEP; WHO Air Quality Guidelines for Europe and EU Directive 96/61 on IPPC.

***** **RV** - Recommended concentration value.
****** **LV** - Limit concentration value.

Notes:
a/ IPPC: Integrated Pollution Prevention and Control.
b/ BS: Black smoke.
c/ Attainment date: 01-01-2005.
d/ Attainment date: 2 years after entry into force of the IPPC Directive.
e/ Attainment date: 01-01-2010.
f/ Risk estimates for 24 hours and annual PM 10 concentrations

have been detected in the past five years. However, Croatia's air quality standards, i.e. recommended concentration values (RV) and limit concentration values (LV) for long-term as well as short-term concentrations, are exceeded for some specific pollutants, mainly in big cities, due to traffic-related emissions and those from the largest industrial stationary sources located on their outskirts. Table 5.5 compares selected Croatian ambient air quality standards with recommended WHO guiding values and EU standards.

According to the monitoring data for 1990-1997, the SO_2 concentration in the most polluted cities, Zagreb and Rijeka, decreased by 69 per cent and 74 per cent. The decrease in total deposited matter ranges from 54 per cent in Pula to about 36 per cent in Zagreb and Split. NH_3 concentration has also dropped at most monitoring sites, as has smoke concentration. NO_2 monitoring data are too scarce for a trend evaluation, nevertheless a slightly upward trend can be observed in Zagreb.

Although the overall air quality has improved significantly in recent years, some air pollution problems remain. In 1996 Zagreb, Rijeka, Split and Kutina (category III) recorded the poorest air quality. In Zagreb the lead content of the deposited matter exceeded the LV at four measuring sites, which may be caused by the use of leaded petrol. It may be assumed that if the monitoring sites were more appropriately located and traffic-related pollutants such as CO, NO_x and particulates were measured, these would definitely not meet the RV. While in Rijeka the LV for H_2S was not met at three sites, in Split the LV for sediment was not met at four sites and in Kutina the LVs for NH_3 and H_2S were not met either. In Osijek, Karlovac, Šibenik, Labin and Pula sediment values are above the RV and in Pula the RV for NO_2 was not met. Therefore, the air in these cities is considered to be moderately polluted (category II). According to the monitoring results, the air quality in other towns is good (category I). The main air pollution problem in residential areas is particulate pollution, followed by SO_2. It may be assumed, however, that traffic-related pollution is also significant, but due to the selection of monitoring sites and pollutants monitored it is not yet manifest. Neither PM_{10} nor CO data are generally available (see also Chapter 13). Data on atmospheric pollution by NO_x or hazardous organic and inorganic substances are also scarce. No data on benzene concentration are available at present. (See Recommendation 14.5)

The Ruder Boskovic Institute has since 1975 continuously measured ground-level ozone for scientific research within the EUROTRAC project. Measurements in Zagreb and Puntijarka (Medvednica mountain) show that ground-level ozone reaches values considered harmful for health about 10 per cent of the time, whereas in Puntijarka it reaches values harmful for vegetation as much as 90 per cent of the time. Periodic measurements in coastal towns (Split, Rovinj, Makarska, Malinska) with very intensive sun, show concentrations that could present health hazards for several hours a day during the summer months.

Deposition

Table 5.6 shows the mean weight of wet deposition of the main ions at selected locations. The critical loads of sulphur range from 1.447 to 3.649 g/m^2/year for the coastal-mountain Gorski Kotar region and from 0.946 to 2.854 g/m^2/year inland (north-west Croatia). The measured nitrate deposition ranges from 0.3 to 2.5 g/m^2/year and the critical loads are estimated to range from 0.531 to 1.794 g/m^2/year in the Gorski Kotar region and from 1.085 to1.814 g/m^2/year inland. The trend shows a reduction in sedimentation at most stations in the period 1981-1992.

Table 5.6: Mean weight values of wet deposition for period 1981-1992

Towns	Wet deposition of the main ions			
	H^+	SO_4^{2-} - S	NO_3- - N	NH_4^+ - N
	mg/m^2	*g/m^2*		
Osijek	2.3	1.5	0.6	1.0
Varaždin	3.0	3.3	0.9	1.1
Puntijarka	12.1	2.1	1.9	0.8
Ogulin	11.5	2.3	1.1	1.1
Plitvice	39.3	6.9	1.8	1.3
Pula	2.1	2.5	1.0	0.7
Rijeka	25.6	3.1	1.4	1.8
Senj	6.2	2.1	1.4	0.5
Zaviža n	10.1	2.5	0.8	0.8
Gospić	3.2	3.6	1.1	1.6
Zadar	4.4	2.4	0.9	0.6
Dubrovnik	6.2	3.3	0.8	0.7

Source: SDEP, 1999.

The concentration of sulphur ions in precipitation measured at the two EMEP stations has significantly decreased in the period 1990-1997 (about 60 per cent). The concentrations of

oxidized and reduced ions of nitrogen have remained unchanged or are slightly increasing.

Energy reserves, production and use

Although Croatia has few primary energy sources, approximately 57 per cent of its primary energy supply is covered by domestic sources (see Table 5.7 on fossil reserves – i.e. excluding notably potential for hydropower - and Tables 5.8 and 5.9 on production and supply). According to Table 5.8, 19 to 25 per cent (depending on the hydro-potential available) of the primary energy supply is covered by renewable sources and another 29 per cent by natural gas. Hence, about 50 per cent of Croatia's primary energy comes from clean energy sources (compared to the European average of 23.6 per cent). The rest of the primary energy is supplied from coal (2.8 per cent), liquid fuels (44.4 per cent) and nuclear power (4.1 per cent).

Hrvatska Elektroprivreda is 100 per cent State-owned. It is responsible for the generation, transmission and trade of electricity and dominates Croatia's power system. It comprises the following capacities:

- 20 hydropower plants (HP) with an installed production capacity of 2 076 MW (3.4 MW in small HPs), representing 47 per cent of the total in 1997 (see Chapter 6);
- 8 thermal power plants (TP) with an installed production capacity of 1 306 MW, representing 30 per cent of the total;
- a share of 332 MW in the nuclear power plant (NP) Krško in Slovenia, representing 8 per cent of the total;
- a capacity of 650 MW at TP in the territories of Yugoslavia as well as Bosnia and Herzegovina to which Croatia currently has no access, representing 15 per cent of the total.

A small part of power generation comes from industrial power plants, and 340 MW are produced by industrial co-generation. In terms of energy transformation, the input into the four petroleum refineries is the largest (60 per cent), which is in line with the more than 40 per cent liquid fuel demand for primary energy supply (Table 5.7) and the growing energy demand for transport. Croatia's total consumption of crude oil in 1997 was 5.112 million tonnes; it produced 4.538 million tonnes of oil derivatives, of which 1.647 million tonnes was exported. The average efficiency of all energy conversions was 81 per cent in 1997. Table 5.8 shows the primary energy demand by sector. The growing energy demand of *transport* and *other sectors* (comprising 68 per cent household, 19 per cent services, 8.5 per cent agriculture and 4.7 per cent construction) is evident.

The country is crossed by 200 km of gas transmission pipelines, 7437 km of gas distribution pipelines and 504 km of the international oil pipeline JANAF, which has a capacity of 20 million tonnes per year. Underground gas storage with a capacity of 500 million m^3 and crude oil storage with a capacity of 820°000 m^3 are available.

In conclusion, the main advantages and drawbacks of Croatia's energy sector can be summarized as follows:

- High capacity of hydropower plants
- High share of clean energy sources
- 57 per cent of the primary energy supply covered by domestic sources
- High use of fuel oil
- Low share of coal use
- 23 per cent of power generating capacity located in other countries (15 per cent currently not accessible and 8 per cent of nuclear power with still unsolved problems regarding the burden sharing with Slovenia) as a consequence of the break-up of the former Yugoslavia
- High energy intensity and low efficiency as compared to the developed countries.

5.2. Policy objectives and management practices

Objectives and legislation

The general objective of Croatia's air protection policy is to achieve the first category of air quality - clean or slightly polluted air - over the entire territory within the next ten years. The general objectives of the Law on Environmental Protection and the international treaties concerning air protection ratified by Croatia are incorporated into the Law on Air Quality Protection and the relating legal documents. At present, the following

Table 5.7 : Energy reserves and production

	At 31/12/1996		At 31/12/1997	
	Reserves	Production	Reserves	Production
Oil and condensate *(1 000 m^3)*	18 239	1 807	15 766	1 840
Natural gas *(million m^3)*	36 677	1 786	33 926	1 717
Coal *(1 000 t)*				
- Pit coal	3 833	...	3 782	...
- Brown coal	3 646	...	3 646	...
- Lignite	37 787	...	37 787	...
- Hard coal	...	64	...	49

Source: Ministry of the Economy.

Table 5.8: Primary energy production, 1993-1997

	1993		1994		1995		1996		1997		1997/93
	PJ	*%*	*PJ*	*%*	*PJ*	*%*	*PJ*	*%*	*PJ*	*%*	*%*
Total	**207.0**	**100.0**	**197.8**	**100.0**	**203.3**	**100.0**	**217.7**	**100.0**	**198.4**	**100.0**	**-4.2**
Coal	2.7	1.3	2.5	1.3	2.0	1.0	1.6	0.8	1.2	0.6	-55.5
Fuel wood	12.9	6.2	13.1	6.6	13.5	6.6	16.1	7.4	16.7	8.4	29.3
Crude oil	72.3	34.9	66.0	33.4	62.8	30.9	61.5	28.3	62.6	31.6	-13.4
Natural gas	75.6	36.5	67.1	33.9	73.3	36.0	68.1	31.3	66.1	33.3	-12.5
Hydro power	43.5	21.0	49.1	24.8	51.8	25.5	70.3	32.3	51.7	26.1	19.0

Source: Annual Energy Report 1993-1997, Ministry of the Economy.

regulations directly or indirectly govern air protection:

- The Law on Environmental Protection (1994);
- The Law on Air Quality Protection (1995);
- By-law on Recommended and Limit Ambient Air Quality Values (1996);
- Rule Book on Environmental Pollutants Inventory (1996);
- The Physical Planning Law (1998);
- By-law on Environmental Impact Assessment (1997);
- By-law on Limit values of Pollutant Emission from Stationary Sources into the Air (1997);
- By-law on Quality Standards for Liquid Oil Fuels (1997);
- By-law on Conditions for issuing Permits for Performing Professional Environmental Activities (1997);
- By-law on Substances Depleting the Ozone Layer (1999).

The regulations that indirectly govern air quality, based on the Laws on Standardization, on Road Safety, on Inflammable Liquids and on Measurements, are:

- Rule Book on Jet Engine Fuel Quality (1995);
- Rule Book on Fuel Supply Stations for Vehicles (1998);
- Rule Book on Vehicle Certification, with accompanying by-laws (1996, amended 1997 and 1998);
- By-law on Certification of Compression Engines and Vehicles with Such Engines Regarding Their Harmful Emissions (1998);
- By-law on Certification of Vehicles Regarding Harmful Compound Emissions in Accordance with Engine Fuel Types (1998);
- Rule Book on Technical Requirements for Vehicles in Road Traffic (1998);
- Rule Book on Vehicle Testing (1993);
- Rule Book on Technical Inspections of Vehicles (1993);
- Rule Book on Measuring Requirements for Devices Measuring Concentrations of Exhaust Gases from Internal Combustion Engines Running on Petrol (1997);
- Rule Book on Measuring Requirements for Devices Determining Exhaust Gases Turbidity in Compression Engines with Self-ignition - Diesel Engines (1997);
- Law on Excise Tax on Oil Derivatives (1994);

- And other laws on agricultural land (1994).

Croatia is a party to the following international agreements concerning air protection and its national policies are partly based on them:

- Vienna Convention for the Protection of the Ozone Layer (1991)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1991)
  - London Amendment (1994)
  - Copenhagen Amendment (1996)
- United Nations Framework Convention on Climate Change (1996)
- Convention on Long-range Transboundary Air Pollution (1991)
- Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) (1991)
- Protocol on Further Reduction of Sulphur Emissions (1998)

Croatia also signed the Protocol on Heavy Metals and the Protocol on Persistent Organic Pollutants (POPs) in June 1998. But it has not yet ratified either the NO_x or the VOC Protocol (ratification planned for the near future). Croatia has collaborated actively in the development of the new Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.

Croatia's obligation in accordance with the Sulphur Protocol is to cut SO_2 emissions 11 per cent by the year 2000, 17 per cent by 2005 and 22 per cent by 2010 compared to their level in 1980. This obligation has already been fulfilled in advance.

As a party to the United Nations Framework Convention on Climate Change (UNFCCC), Croatia has pledged to fulfil its obligations as an Annex I country and keep CO_2 emissions at their 1990 levels until 2000. Pursuant to the Kyoto Protocol, Croatia is bound to reduce its greenhouse gas emissions in the period 2008-2010 to 95 per cent in relation to the base year, which can be any year between 1985 and 1990. Defining the base year emissions is a problem for Croatia, as in that period power produced outside its present territory, generated from heavily polluting coal-fired power plants, was also used – but the corresponding emissions are not attributed to Croatia. The first national communication is being prepared and should be ready by the end of this year.

Legislation on the transport sector complies with the respective EU directives. It is expected that, in 2010, 75 per cent of the vehicles will fulfil the EC91 norm.

Institutional framework

At present, the following institutions have air quality management tasks and responsibilities:

- State Directorate for the Protection of Nature and the Environment – Department of Air Protection (4 staff): development of air protection strategy, policy and legal instruments; administrative supervision of the application of legislation, responsibility for international treaties and their integration into the national legal system; responsibility for monitoring and reporting at the national level;
- Units of local self-government (County assemblies and the Assembly of the City of Zagreb, town and municipal councils): local level implementation of air quality protection legislation, in particular translation of the national environmental strategy into physical plan of the county; developing air quality protection and improvement programmes and obliging air pollution sources to set up restoration programmes in the category III air quality areas; establishing regional air pollution monitoring networks; local level reporting and data submission to SDEP; proposing stricter air quality standards and limit emission values than the national standards;
- County Offices and the Office of the City of Zagreb – governmental authorities in charge of environmental protection (21 offices, approximately 40 staff dealing also with industrial and municipal management): maintaining environmental emissions cadastre, including data on air emissions; cooperation in the process of issuing permits; forwarding data to SDEP;
- Municipal offices for environmental protection: maintaining databases of and reporting on collective sources' emissions to the County Offices;
- Environmental protection inspectorate (6 national inspectors, 25 county inspectors): Inspection of compliance by environmental polluters with air protection legislation; supervising implementation of air protection

measures as specified in the EIA and the siting permits; supervising implementation of restoration programmes and programmes for air quality protection and improvement and the efficiency of air pollution reduction.

The State administration cooperates on the national as well as on the local levels with different expert institutions, for example with the Institute for Medical Research and Occupational Health, the Meteorological and Hydrological Service and the Ruder Boskovic Institute, which are all involved in air quality monitoring. Other institutions such as universities, research institutes and consulting companies are consulted, depending on the subject.

The implementation of the new air protection legislation at both national and local levels of State administration is stretching resources. The insufficient financing of the respective implementing institutions seems to be the main implementation constraint. In general, cooperation between the different levels of State administration seems to be well organized and efficient, as is that between the different offices (e.g. for environment and physical planning) at the regional level, including the local inspectorates. Again, the lack of resources there, financial as well as human, seems to be the main constraint.

Management of air quality

Air quality is monitored at both the national and local levels. On the national level, background air pollution, transboundary air pollution (within the scope of international obligations), air quality in national parks as well as in selected residential and industrial areas are measured continuously. The national network is part of environmental State monitoring and is financed through the State budget. With the approval of the State Bureau for Standardization and Metrology, SDEP lays down the methodology of sampling, measurement, data processing and presentation and their quality assurance/quality control (QA/QC). A special regulation will be adopted on the coordination of all bodies involved and on the reporting of air quality information to the public. SDEP may authorize certain legal persons to perform activities within the scope of the National Monitoring Network.

The Meteorological and Hydrological Service operates an air quality monitoring network, measuring background air quality and the air quality in rural area. It comprises 22 meteorological stations, measuring also the concentration of SO_2, smoke and NO_2. Some of them additionally measure Cl^-, NH_3 and the chemical content of precipitation. Two (Zavižan and Puntijarka) are included in EMEP. However, due to the lack of financing they fulfil only part of the programme (measuring chemical content of precipitation). Moreover, their current sampling method does not meet the requirements of EMEP.

The Institute for Medical Research and Occupational Health and the Health Protection Offices of certain cities (Zagreb, Sisak, Karlovac, Osijek, Rijeka, Pula, Šibenik, Split, etc.) conduct measurements in urban and industrial areas, most of them are part of the planned Regional Air Quality Monitoring Networks. One station operated in Zagreb is included in the GEMS, BAPMON and MEDPOL networks. Local self-government units must establish and operate regional air quality monitoring networks in their areas that are coherent with the national network.

Many of the 135 urban stations (covering the homes of 35 per cent of the population) measure sediments (84), smoke (56), SO_2 (52), NO_x (17), and NH_3 (18). Some of them also measure O_3 (5), particles (4), Pb, Cd and Zn (2). TSP is measured only rarely – except in 1 station in Zagreb, where it started in 1972. $PM_{2.5}$ and PM_{10} monitoring started in Zagreb at the end of 1998 (see Chapter 13). The suburban stations commonly measure SO_2, smoke and NO_2; some stations additionally measure Cl^-, NH_3 and the chemical content of precipitation. Some specific heavy metals and organic substances continue to be measured in industrial areas like Kutina, Molve, Rijeka, Split and in the area of the thermal power plant in Labin. O_3, CO and PM_{10} have not so far been regularly monitored. Mean daily concentration values are determined using classic analytical methods. Deposited matter is sampled monthly.

Some plants operate monitoring stations in their vicinity. The location of the monitoring sites is determined in cooperation with the Meteorological and Hydrological Service and the selection of site-specific pollutants is done with the help of the

Institute for Medical Research and Occupational Health or the health protection office of the respective town. The results are reported on a yearly basis to the Institute for Medical Research and Occupational Health, which is responsible for integrating data from all monitoring stations (including those operated by the Meteorological and Hydrological Service) into a yearly report, which is open to the public. SDEP publishes a summary of this report in the journal OKOLIŠ.

Sampling devices are usually manual or semi-automatic. Most pollutants are determined as daily means and deposition is sampled monthly. Samples are determined by the usual analytical methods such as gravimetry, titration, spectrophotometry, atomic adsorption spectometry (AAS). Meteorological parameters are also measured in the 22 meteorological stations.

At present, only four monitoring stations are equipped with automatic monitoring devices (in Pula (SO_2, NO_x, CO), Rijeka (SO_2, ozone), Kutina (NH_3, NO_x)). The station in Zagreb has since 1996 measured NO_x, SO_2 and ozone with both automatic and manual methods for the purpose of correlation setting, which is rather good (0.9). A privately owned mobile monitoring station is also equipped with automatic measuring devices for all major pollutants, including meteorological parameters. PM_{10} and $PM_{2.5}$ measuring has been introduced only recently in one station in Zagreb and no data are available at present.

According to the monitoring results, the air quality is assessed and categorized and air quality management performed. Recommended and limit values of air quality are prescribed in a by-law. RVs are based on EU guide values, WHO guidelines and Swiss Ambient Air Quality standards, while LVs are based on EU limit values, German ambient air quality standards and WHO guidelines. For pollutants from motor vehicle exhaust (NO_2, CO, Pb), there are more tolerant RVs and LVs for concentrations measured at street level. RVs and LVs to limit some carcinogenic substances from fuel combustion are based on recommended United Kingdom Air Quality standards (benzene, 1,3-butadiene) and German practice (3,4-benzo∀pyrene). There are also RVs and LVs for suspended particulate matter and their components (Pb, Cd, Mn, sulphates and fluorides), for mercury vapours and for inorganic compounds.

The present monitoring network makes it possible to assess the application of these recommended and limit values only to some extent. Suspended particles, their heavy metals content, CO, organic matter and mercury are not measured. There are no specific monitoring sites for monitoring traffic-related pollutants. An air quality-measuring programme will be adopted in accordance with the (future) by-laws. According to a preliminary assessment from 1992, a DM 4 million investment is needed to meet the air quality monitoring requirements of the new legislation.

Management of air emissions

Owners and/or users of air pollution sources are obliged to:

- report on their air pollution sources and any reconstruction of them to the county authority
- reduce the air emissions to be in compliance with the relevant legislation
- regularly monitor air emissions and keep records
- submit the data to the Environmental Emission Cadastre (EEC – see Chapter 1 for a brief description) on a regular basis.

The discharge of emissions and the compliance with emission limit values set out in a by-law must be determined by measuring the emissions. Depending on the ratio between the mass flow emitted ($\mathbf{Q_{emitted}}$) and the limit mass flow ($\mathbf{Q_{limited}}$), the frequency of measurements is determined:

$Q_{emitted}/Q_{limited}$	Measurement frequency
less than 1	No measurement required
1 to 2	Every three years
2 to 5	Once a year
more than 5	Continuous measurements

The by-law also prescribes which pollutants are to be measured. For combustion installations, the following measurement frequency is prescribed:

Combustion plant	Measurement frequency
Very small<0.1 MW	Every three years
0.1<Small<5MW	Every two years
5<Medium< 50 MW	Once a year
Large>50 MW	Continuous measurements of SO_2, NO_2, CO, TSP

Only legal persons authorized by the SDEP can measure the emissions. Until now, 25 legal

persons have permits to measure emissions and ambient air quality (the by-law does not distinguish between them). The permission procedure assesses the applicant's general ability and possession of adequate measuring devices (most successful applicants have experience in such measurements). Permits are not granted for particular pollutants measurement but applicants have to show that they have the relevant instruments. Until now only capacities for measuring classic pollutants such as SO_2, NO_x, CO and particulate have been available. The possibility to measure organic matter emissions is rather limited. Only health services, which measure pollution at the workplace, have some experience. However, stack emission measuring is much more complex and requires sophisticated sampling devices. There is no capacity for measuring organic matter such as dioxins or polyaromatics from combustion or incineration processes.

The way in which the measurements are to be carried out will be determined in a by-law which is currently under preparation and is expected to be approved by the Government in the second half of 1999. As a general rule, ISO standards, which have been adopted as Croatian standards, have to be applied.

The costs of both complying with emission limit values and measuring emissions are to be covered by the respective sources of emissions. The implementation costs were not assessed by the Government prior to the adoption of the by-law in Parliament. According to a study by the power-producing company Hrvatska Elektroprivreda, equipping all its facilities with continuous monitoring devices would require investments worth about DM 4 to 4.5 million. The first emission measurements were scheduled to be carried out by the end of April 1999. It is expected that about 80 per cent of emission sources will carry out their first measurements by the end of 1999.

The By-law on Limit Values of Pollutant Emission from Stationary Sources into the Air is based on the principle of applying the best available technologies not entailing excessive costs (BATNEEC). It proposes technologies that have been accepted by the EU countries and limit values derived from the Protocol on Further Reduction of Sulphur Emissions. Where no common EU standards were available, German legislation and Netherlands legislation were consulted.

The By-law entered into force on 1 January 1998 and prescribes general ELVs for total particulate matter, inorganic and organic compounds and carcinogenic substances. Each substance is put in a risk category (I-IV) depending on its toxicity, persistence and accumulation potential and the technological possibilities for emission reduction. For some selected technological processes, e.g. production of non-ferrous mineral raw materials, production and processing of metals, chemical industry, food-processing industry, heating installations, gas turbines, internal combustion engines, waste incinerators, ELVs are prescribed for certain process-specific pollutants. Combustion installations have different ELVs according to their size and fuel used. Since 1 January 1998, all new or reconstructed stationary sources have to comply with the By-law.

Existing sources have to comply with the prescribed ELVs by the year 2004. In the transition period, existing stationary sources may exceed the prescribed limit values by a factor of three.

It is expected that the upgrading to apply the by-law will be predominantly financed by internal funds, according to the "polluter pays" principle. The power-producing company Hrvatska Elektroprivreda, for example, will invest US$ 260 to 390 million to implement the legislation and fulfil international treaties.

Economic instruments

The Law on Air Quality Protection anticipates that economic instruments will also be used. A special regulation or a governmental decision should be adopted to prescribe the allowances and exemptions from taxation, custom duties and other levies for: purchasing equipment/techniques for air emission abatement, cleaner technologies/raw materials, developing and using renewable energy sources, waste recycling and monitoring instruments. These economic instruments were included in the Law on Tax on Turnover of Products and Services, valid until the end of 1997. However, the current Value-added Tax Law does not foresee such exemptions. Only a case-by-case exemption from custom duties is still possible (see Chapter 2). The desulphurization unit for Plomin

II, the hazardous waste incineration plant PUTO, or the Claus process equipment in the Rijeka refinery are examples.

Physical planning and inspection

The local environment inspectorates verify the implementation of the legislation on the plant level. They are supported by the physical planning inspectorates, which verify compliance with the respective physical plans. Environment inspectorates also verify compliance with the operating conditions set in the operating permits. There is a mandatory annual inspection of exhaust gases from mobile sources. Although the environmental inspections and the environmental legislation on air pollution do not have a very long tradition, the system seems to work well. The lack of financial and human resources is a general problem. (See also Chapter 1 on inspections).

Cleaner technologies

Since Croatia's economy is currently facing problems with its obsolete and ineffective technologies, war damage and recession, it is improbable that the requirements of the air protection legislation will be met within the prescribed time period. The driving force behind the introduction of new/cleaner technologies is the need to improve overall production efficiency rather than environmental concerns. Some examples of successful implementation of cleaner technologies with regard to air emissions are:

- Hazardous waste incineration plant PUTO: incineration in rotary kiln at a temperature of 950-1 000^{o}C, equipped with abatement techniques (activated carbon injection, wet NaOH scrubber or dry sodium bicarbonate dry scrubbing, urea injection for NO_x scrubbing, bag-house filters) which ensure compliance with emission standards.
- Refinery in Rijeka: high-efficiency plant meeting all air emission limits, including Claus process for elementary sulphur production and low-NO_x burners.
- Gas exploration facility in Molve: separation of gas impurities (CO_2, H_2S and mercury).
- Installation of dry low-NO_x burners in the reconstructed gas combined cycle power plants in Zagreb and Jertovice, ensuring NO_x concentration below 100 mg/m^3.

Croatia has a large crude oil processing sector, where high VOC emissions occur -- representing at the same time material losses. Nevertheless, vapour recovery units (VRU) have not been installed so far, nor are there plans to do so in the near future. Some new petrol stations are prepared for vapour recovering, but without a complete system, comprising a closed system of vapour capturing, distribution tank-trucks with bottom loading and VRU at the distribution points, this particular system may not be operated properly.

Air protection in the energy strategy

The general aspects of the Energy Sector Development Strategy are described in Chapter 10. Its aims for the protection of ambient air are:

- Keep the NO_x emissions at their 1990 level
- Mitigate the increase in CO_2 emissions
- Increase the share of natural gas in total energy consumption
- Develop systematic and continuous energy production from renewable sources
- Keep the nuclear option
- Integrate resource planning on a local, regional and national scale
- Energy conservation
- Clean production and BAT implementation

There are different energy emission scenarios possible in the future, depending on the success of present legislation. SO_2 emissions should decrease further, NO_x emissions are expected to increase slightly after 2020, but CO_2 emissions are expected to increase significantly after 2020 compared with the year 1990. This is due to the specific situation after the break-up of the former Yugoslavia. Croatia used to use energy produced outside its territory, but the associated emissions were not included in its emission inventory. The dependence on energy imports will be reduced.

5.3 Conclusions and recommendations

The emissions of all air pollutants have decreased and Croatia's ambient air quality has improved since 1990. The main reasons for this were the overall economic recession, the start of the economic

reform and the war. Several heavily polluting sources, equipped with obsolete inefficient technologies, were shut down.

Croatia has modern air protection legislation, harmonized with that of the EU and in line with the requirements of international treaties. It comprises effective legislative measures such as ambient air quality standards, BATNEEC-based emission limit values, monitoring requirements, permitting procedures including EIA, as well as an institutional network for implementation and inspection at the local level. An integrated information system on polluting emissions and their sources is being introduced as well.

Due to the specific situation, caused by the geopolitical changes and the war, the formulation of basic strategic documents and the adoption of the environmental legislation were not always done in a logical sequence. In 1997 the Strategy for Physical Planning was adopted. Air protection issues are included also in the Strategy for Energy Sector Development and the Transport Sector Strategy, both currently under discussion in Parliament. However, the environmental protection strategy and the industry sector development strategy are only in the preparatory stage. There is no environmental action plan.

Recommendation 5.1:
The National Environmental Strategy, the National Environmental Action Plan and the Industry Development Strategy should be drafted in broad collaboration with all those concerned. An implementation strategy taking into account the generally accepted priorities and a realistic assessment of the available resources should be included in the strategic documents. Whenever possible, economic and legislative instruments should support the strategies' implementation. See also Recommendation 5.6.

Along with the creation of the legislation, the institutions for its implementation at the local level were also established. County environment offices are responsible for applying legislation and the county environment inspectorates for verifying implementation in industry. The role of both is essential to the legislation's success, but difficult.
There is only a relatively short tradition in air protection management, and both of them have many tasks to initiate and then carry out regularly. In this respect, the present human resources of the county offices (2 staff per county dealing with waste management) and the county inspectorates (2 staff per county dealing with nature protection) seem insufficient. Moreover, they are facing high initial costs, for launching the new activities implied by the legislation and for their basic equipment. Furthermore, the legislation requirements are developed on the national level, but the implementation on the local level has to be financed from the respective county budgets.

Recommendation 5.2:
Sufficient funds for the county offices and inspectorates should be secured from the county budgets. Priorities should be set on the national level, and their implementation on the local level coordinated systematically. The staff of the offices and inspectorates should be strengthened at least in counties with a high concentration of industry.

Although Croatia has a large air quality monitoring network and a relatively long tradition in air quality measurements, the present network does not fulfil the requirements of the new legislation. Not all required pollutants are monitored, nor are all of the monitoring sites appropriately located and equipped. A special regulation enabling the coordination of all bodies involved and the establishment and maintenance of coherent ambient air quality monitoring networks at the national as well as local levels should be adopted (including selection of the sites/pollutants/methods/QA/QC/data processing/data reporting, definition of the responsible coordinating institution). Whenever possible, the existing monitoring network should be incorporated. Until now only a conceptual design has existed (from 1992), which is reflected in the Law on Air Quality Protection. The national network should be financed from the SDEP budget and the local networks from the budgets of the respective counties/municipalities. In addition, plant-specific pollution should be measured in the vicinity of the plants and financed by them. Again, the lack of financial resources is the main constraint for the upgrading of the monitoring network. Further problems may arise from the fact that several organizations are involved in establishing/operating parts of the network.

Recommendation 5.3:
A detailed concept for a national air quality monitoring network should be established. If appropriate, automatic continuous measuring devices could be used for monitoring traffic-related

pollution. The introduction of benzene measurement is essential. *See also Recommendation 14.5.*

They were practically no emission measurements available in Croatia until the By-law on Limit Values of Pollutant Emissions from Stationary Sources into the Air (1997) was adopted. According to this By-law, all air pollution sources have to conduct their first measurements by 31 March 1999, and selected sources have to introduce continuous emission measurements by 1 February 2000. Only legal persons authorized by SDEP (currently 25) may conduct emission measurements. However, the by-law detailing the emission measurement procedures is still being prepared and will probably not be ready before the end of 1999. Although the Law on Air Protection also envisages calculations being used as a monitoring method, the By-law on Limit Values strictly requires measurements. Moreover, the conditions for introducing continuous monitoring are extremely stringent. Given the relatively short deadline for implementation and the fact that Croatia's industry is currently facing serious problems with obsolete and ineffective technologies, war damage and recession, it is highly unlikely that this requirement can be met. Transition measures are therefore required. More time should be given to introduce continuous monitoring, and calculation methods (mainly for SO_2) should also be used in the transition period. The measurement of SO_2 should be required only for desulphurization units, in general. Other possibilities such as simultaneous use of one monitoring device for several emission points in switching mode should also be considered.

Recommendation 5.4:
The by-law on the methodology of measuring pollutant emissions from stationary sources into the air should be prepared in collaboration with expert institutions as well as industry, and, prior to its adoption, the cost of applying it should be assessed. For sulphur dioxide, also mass balance estimation should be possible.

The air quality can be improved nationally and locally with the help of physical planning and the introduction of air protection legislation in the local physical plans. The main instruments arising from air protection legislation are the emission limit values. Existing sources have to comply with them by 1 July 2004. Implementation of the air protection requirements depends on plant-specific conditions. Some facilities already comply, or soon will. Some, especially those equipped with obsolete, inefficient technologies, will probably be shut down in the future. Others are step by step upgrading their technologies, but face considerable financial problems. It may be assumed that not all facilities will comply with the legislation by the deadline. For a limited time period, plant operators should be allowed to reduce pollution gradually, and find the most cost-efficient way of cutting pollution during this time.

Recommendation 5.5:
Remedial programmes for particular non-compliance sources should be set up in accordance with local environmental protection documents, with which the local physical plans should comply.

Departments of Physical Arrangement within units of local self-government, in accordance with the Law on Air Quality Protection, have the task of issuing site, building or utilization permits for a new pollution source or the reconstruction of an existing one. They do not give their approval if this new construction or reconstruction does not replace the existing inappropriate facility with a new one which reduces air pollution or if the increase in air pollution near the facility exceeds 1 per cent of the Air Quality Limit Value. The implementation of a rehabilitation programme for existing pollution sources is already in progress.

The biggest general obstacle to applying air protection legislation in industry is the overall lack of financial resources. Although the Law on Air Protection envisages also economic instruments to this end, only case-by-case exemption from custom duties is currently possible. It has to be underlined that environmentally friendly technologies are modern and generally more efficient, so they can improve industry's competitive position on the international markets. Croatia does not have the capacity to produce either monitoring devices or abatement/cleaner technologies; it therefore relies fully on imports.

Recommendation 5.6:
Economic incentives encouraging the purchase of cleaner technologies, abatement techniques, monitoring devices, techniques for the development and use of renewable energy sources, waste recycling, rational energy production/use etc.

should be introduced in the taxation and custom system.

Croatia is a party to several international agreements and is integrating the respective obligations into its legal system. A By-law on Substances Depleting the Ozone Layer was adopted recently. It has already fulfilled its obligation under the Sulphur Protocol. Croatia has signed the Protocols on VOCs, NO_x, Heavy Metals and POPs to the UNECE Convention of Long-range Transboundary Air Pollution, but not yet ratified them. Croatia is a party to the UNFCCC as an Annex I country. Pursuant to the Kyoto Protocol, its greenhouse gas emissions have to be reduced in the period 2008-2010 to 95 per cent in relation to the base year. But defining its base year emissions is a problem, as until 1990 it used 650 MW of coal-firing capacities located in other republics of the former Yugoslavia, but the associated emissions were not included into its emission inventory. According to the Energy Strategy, the dependence on energy imports should be reduced. Its first national communication should be ready by the end of this year.

Recommendation 5.7

Croatia should ratify the VOC Protocol to the Convention of Long-range Transboundary Air Pollution*. Croatia should actively prepare for the possible implementation of the new Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. Its first national communication should be drawn up in broad collaboration with the economic sectors concerned, and realistic baseline emissions negotiated with the responsible international body.*

Chapter 6

MANAGEMENT OF FRESHWATER RESOURCES AND QUALITY

6.1 Quantity and quality of freshwater resources

Determinants of the water balance

Croatia lies on the edge of two major climatic regions: the Mediterranean and the Central-European Continental region. The Mediterranean climate of the Adriatic coast is characterized by mild, rainy winters and dry summers. It is more humid in the north-west (1 500 mm precipitation per year) than in the south (500 mm at Hvar). Northern and eastern Croatia have colder winters and more precipitation.

The Croatian territory can be divided into four geomorphological units (see Figure 6.1). The Pannonian area comprises the lowland and hilly part of northwestern Croatia (average altitude less than 500 metres). It is bounded by the rivers Drava, Danube, Mura, Sava (with its tributaries, the Kupa, Korana, Glina and Una). The Croatian highland area, with peaks at about 1750 metres, separates the Pannonian from the coastal zone. This is a karst area, with temporary springs, sink rivers, deeply incised river courses such as the Dobra and the upper Kupa rivers and deep canyons. The Croatian Adriatic area includes the narrow coastal belt separated from hinterland by high mountains (Dinara 1821 metres). This coastal area can be further divided into Istria in the north and Dalmatia in the south. These areas are also of karst nature, with some surface streams, strong karst springs and abundant underground rivers and pools draining from the hinterland's mountains.

Croatia is endowed with abundant water resources. Renewable resources amount to some 45 billion cubic metres a year or 9 500 m^3/cap/year, which places Croatia amongst the best endowed countries in Europe, on a par with its neighbour Slovenia. Available surface water stands at 39 billion cubic metres a year. The surface hydrographic network and flow-rate characteristics are shown in Table 6.1. 60 per cent of these water resources are generated within Croatia, while 40 per cent are external contributions from upstream neighbouring countries (mostly Slovenia, Austria, Bosnia and Herzegovina and Hungary). Most of the river basins, including their underlying groundwater resources, have to a large extent a transboundary character. Therefore all actions for the management of these waters, regarding the regulation of their water regime, the protection of their quality, their regime of use, are tightly interconnected and have consequences in the other neighbouring countries.

Croatia is also rich in groundwater of various kinds, as shown in Table 6.2. About 6 billion cubic metres are available a year, though they are unevenly distributed. A slight decrease in the water table has occurred in the aquifer below Zagreb and a more important one in the Drava river aquifer (a 4-metre drop in the level over the past 20 years). This could become a source of concern unless its users set up a concerted plan.

In spite of this general abundance of water, problems do occur locally. For instance, the Adriatic islands (1 185 islands, 66 of them uninhabited) have poor surface water resources and not enough wells. As a result, they suffer water shortages in the summer.

Groundwater and springs

There are essentially two geologically different zones, with very different groundwater resources and regimes:

- the Pannonian plain with underground aquifers under the main rivers. Most of the groundwater is stored in the alluvial aquifers of the Drava and Sava valleys, in a zone of tectonic depressions where thick quaternary deposits have sedimented. These aquifers, from 10 to 100 metres deep, are covered with poorly permeable clayey-silty deposits of several tens of metres. They replenish with rainfall infiltrating through these layers, which cover almost the entire surface area. An estimated 8 to 30 per cent of precipitation infiltrates the aquifers.

Figure 6.1: Hydrographic network and water basin boundaries

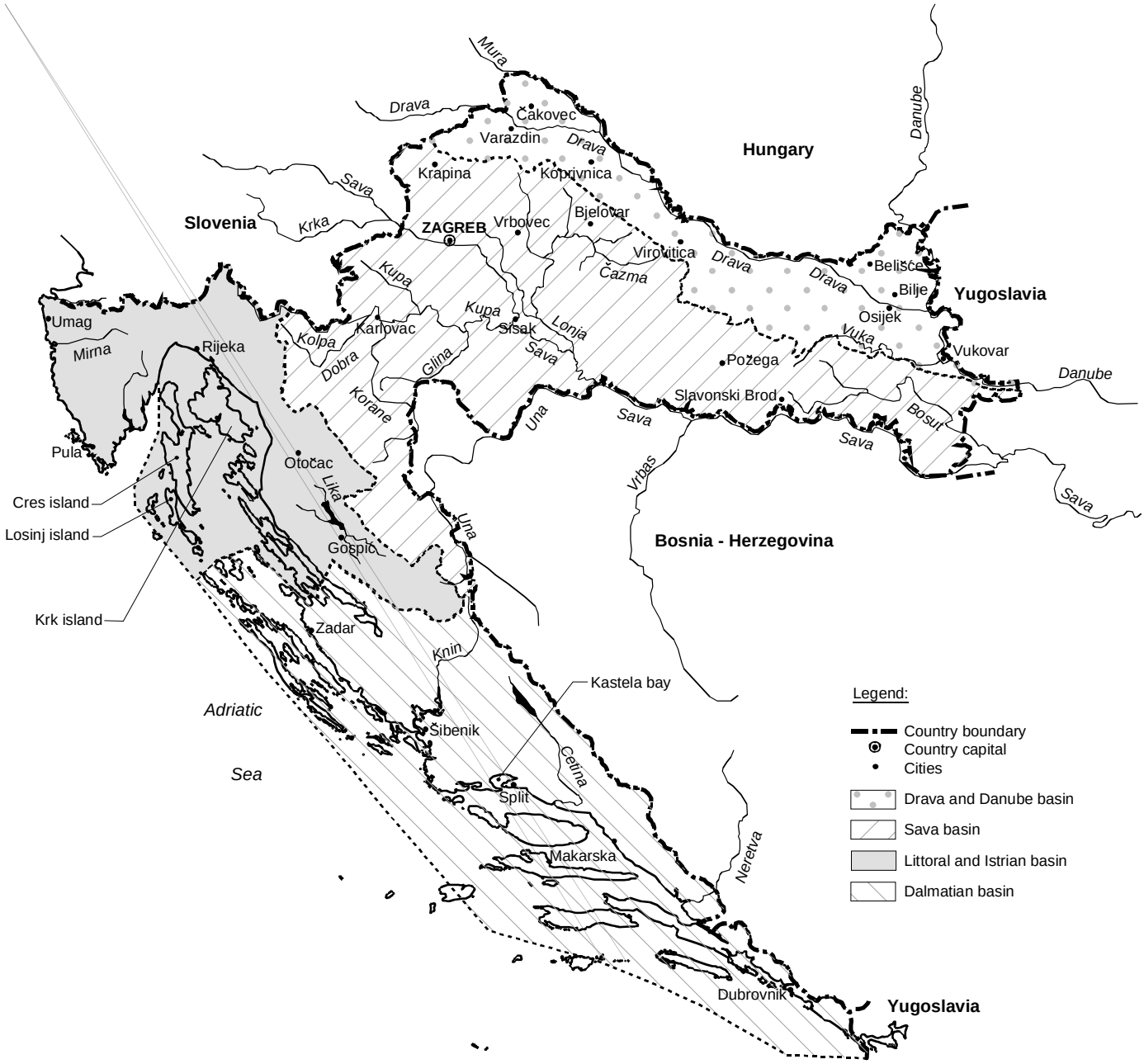


Table 6.1: Characteristics of Croatia's largest rivers

Basins and rivers	Length		Catchment area		Average annual discharge a/		
	Total	In Croatia	Total	In Croatia	Minimum value b/	Mean value	Maximum value c/
	(km)		*(km^2)*			*(m^3/s)*	
Black Sea and Danube basin							
Danube	2 857	188	817 000	1 872	…	6 430	…
Drava	707	505	40 150	6 038	…	625	…
Mura	438	…	13 800	…	…	210	…
Sava	945	562	96 328	23 243	…	1 209	…
Sutla	92	89	582	343	…	…	…
Krapina	75	75	1 123	1 123	…	…	…
Trebez, Lonja, Ilova	218	218	6 993	6 993	…	…	…
Orljava	89	89	1 494	1 494	…	…	…
Bosut	186	151	3 097	2 572	…	…	…
Kupa	296	296	10 032	10 032	…	103	…
Sunja	69	69	462	462	…	…	…
Una	212	120	9 368	636	…	243	…
Adriatic Sea							
Cetina	101	101	1 463	1 463	8	36	146
Lika	…	78	…	…	…	…	…
Gacka	…	22	…	…	…	13	…
Krka	73	73	2 088	2 088	23	55	84
Mirna	53	53	458	458	4	8	14
Neretva	225	20	11 798	430	…	378	…
Zrmanja	69	69	907	907	17	38	52

Sources: Hrvatske Vode, 1997,
Statistical yearbook, 1998.

Notes:
a/ Average calculated over 30 years (1960-90).
b/ Mainly summer period.
c/ Mainly from December to March-April.

- the karst area, which comprises the major part of the mountainous zone and the coast including the islands (Dinaric region). A particular danger in the karst region (carbonates rocks) is the vulnerability of groundwater to pollution from the surface through fissures, conduits and caves enlarged by dissolution processes. The high quantity of rainfall sinks into the underground, where it constitutes large flows which surge out in littoral fresh springs, saline littoral springs or submarine springs. But, with the exception of a few large ones, the islands have no external inflow of groundwater.

Specific to Croatia is the abundance of thermal and mineral water springs; some of them are renowned.

Groundwater and springwater quality

The quality of groundwater is considered good throughout the country. The monitoring data from the Institute of Geology and county public health institutes show that there have so far been only few limited cases of pollution. In terms of point sources of pollution, the Zagreb landfill has been identified so far as a potential source of groundwater pollution by chemical substances, although the values still meet the standards. In terms of diffuse pollution by fertilizers or pesticides, the karst area is not under threat as there is no agriculture there. However, in Istria, nitrates have recently appeared sporadically in groundwater during the period of fertilizer spreading, although the standards were

met (10 to 12 mg NO_3/l). In the upper-Drava aquifer, the situation is more serious, with nitrate concentrations regularly higher than the Croatian standards for drinking water allow (44 mg NO3/l), but still below the EU standards (50 mg/l). The high iron content of the Sava aquifer is due to the geological layer's components. There, the water must be treated to reduce the iron content and chlorinated before human consumption.

Table 6.2 : Surface and underground water resources in Croatia

	Runoff (Billion m^3/year)
Surface water	
Black Sea basin	31
Adriatic Sea area	8
Ground water	
Karst area	4
Continental part	2

Source: Integrated Water Management System, Hrvatske Vode, 3 (1995).

Surface waters

The country is predominantly part of the Black Sea watershed. Most surface waters drain to the Danube or one of its tributaries; the rest (only 20 per cent of Croatia's river basins) go to the Adriatic Sea. The largest rivers are shared watercourses. The Danube flows through Croatia over a length of 188 km and the country's two other major rivers, the Sava and the Drava, flow through Croatia over 562 km and 505 km, respectively (both are tributaries to the Danube). The Kupa (296 km), Korana (134 km), Bednja (133 km), and the Cetina and Glina (100 km each) are entirely Croatian.

Most large rivers in terms of water flow drain to the Black Sea (Table 6.1). For instance, after its confluence with the Mura, the Drava's average flow is 587 m^3/s and at the point where it joins the Danube it is 620 m^3/s. The Sava's average flow rate is 340 m^3/s at the Slovenian border, the Kupa's is 283 m^3/s at Sisak. In the Adriatic catchment area, the Mirna's average flow rate is 16 m^3/s , the Rasa's is 12 m^3/s, the Rjecina's is 24 m^3/s, the Zrmanja's 23 m^3/s, the Krka's 50 m^3/s, the Cetina's 127 m^3/s and the Neretva's 378 m^3/s. Most of Croatia's watercourses reach a peak in spring and autumn, while the summer minimum is more pronounced in the Adriatic region than in the Black Sea catchment area. In Zagreb, the Sava flow rate peaks at 400 m^3/s in November, but drops to 180 m^3/s in August; in Slavonski Brod, it peaks at 1 400 m^3/s in March and falls back to 400 m^3/s in August and September. Because the rivers swell so much, floods have always been a serious threat, requiring the building of strong protection along watercourses.

There are not many lakes in Croatia: 26 natural and artificial lakes, totalling 105 km^2. The largest natural lake is Lake Vrana (30.2 km^2), followed by Lake Prokljansko (11.5 km^2), Lake Vransko (5.8 km^2), Kopacevsko (3.5 km^2) and the sixteen famous Plitvice Lakes (1.9 km^2) classified as World Natural Heritage Sites by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Croatia also has artificial lakes and reservoirs which have been created to produce hydroelectric energy: Kruscica (20 km^2) on the Lika river and Peruca (13 km^2) on the Cetina river are the biggest. These lakes have brought great changes to the naturally arid karst relief.

River quality

A regulation defines four river quality categories (from I, fairly good, to IV, bad - see Table 6.3). Quality objectives have been defined for all the country's water streams. The severe crisis in industry (operating at only 40 per cent of capacity) and the drastic reduction of inputs in agriculture (pesticides and fertilizers) have considerably eased the pollution pressure on waters (see Chapters 10 and 11).

Table 6.3: River quality classification

Parameters	Units	Classes	
		I and II	III and IV
NH_4^+	*mgN/l*	0.08	0.4
NO_2^-	*mgN/l*	0.01	0.5
NO_3^-	*mgN/l*	10	15
PO_4^{-3}	*mgPO_4/l*	0.1	0.1
Phenols	*mg/l*	1	50

Source: Report on the Quality of Surface Water, 1998, State Water Directorate.

In the Pannonian watershed, the rivers are frequently one quality level below the objective, in general due to bacterial pollution (from domestic wastewater direct discharges and agriculture breeding units). The worst conditions are found in the Sava river basin, which downstream is categorized as III or IV (downstream from Zagreb, in Obrovo region) because of bacterial pollution.

The left tributaries to the Sava have high BOD[5], nitrogen, phosphorus and bacterial contamination levels. Occasional river blossoming occurs. The water quality is so bad in some locations that mass fish kills occur sometimes in summer when oxygen deficiency is severe. The Drava and Mura rivers are quality III when they enter Croatia, where they tend to improve. Downstream from Terezino Polje they comply with category II conditions. Danube waters are category II throughout Croatia.

In the Istrian and Dalmatian Littoral basin, the watercourses are very clean upstream, but their quality deteriorates downstream in part due to untreated waste-water discharges from households, industry and agriculture. The quality of the Rjecina, the lower Gacka and Lika rivers, and the Cetina meets the objectives. In the Primorje-Istria catchment basin, the lower streams of watercourses are significantly polluted. In the Dalmatian catchment area, watercourses comply in general with category I or II, clean upstream, more polluted downstream. Along the coast, the water is mostly category II, with higher pollution levels in the vicinity of seaports and industrial towns, where the quality can drop to category III or IV.

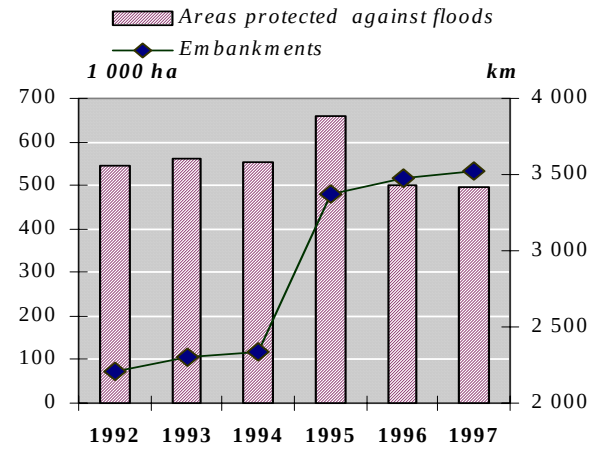
6.2 Water protection and use

Water protection and floods

Due to its geomorphology and its climate, Croatia is very prone to water damage. In the Danube basin, the Drava, the Sava and the Kupa have large flood plains. Protective measures include deliberate flooding, drainage of excess water and protection against erosion and torrents. A total of 1 500 km of protective dykes has been built since the early 90s (Figure 6.2).

In the Sava river basin, 285 000 hectares of fertile flatland are regularly exposed to floods, which cause damage to agriculture, industry and settlements. The protection plan of the Sava is 60 per cent complete. In 1997, in the central Sava basin system, 535 of the planned flood storage reservoirs were completed. Large flood storage and dykes along the river make it possible to store 30 per cent of the flood water and drain the remaining safely. The city of Zagreb is now well protected against floods. Protective measures are still needed 100 km downstream from Zagreb, near and downstream from Sisak.

Figure 6.2 : Protection from floods of external water, 1992-1997



Source: Statistical yearbook, 1998.

In the Drava basin, in addition to dykes, the flow is regulated by hydropower plants situated upstream in Austria and Slovenia, and another three in Croatia. There is a joint Croatian-Hungarian Water Management Commission, which is working to solve common problems regarding the regulation and use of the Drava. The situation of the basin is now satisfactory.

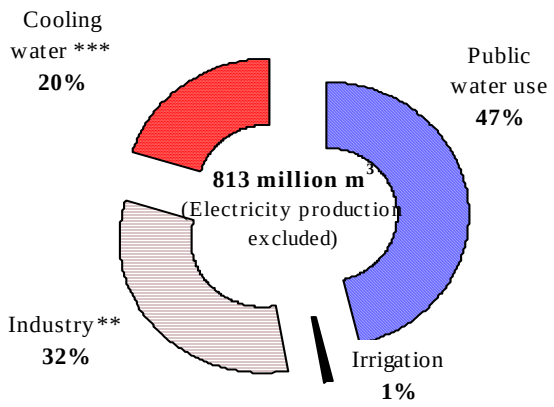
The karstic Dalmatian basin is also subject to severe floods in the rainy period. The entire flood area covers 34 000 ha, of which about 20 000 ha of agricultural land are still under threat. Erosion by torrents (339 torrents are recorded in this zone) also affects about 190 000 ha. The protective measures are based on building dykes along the banks, as well as tunnels and canals.

In the Istrian and Croatian littoral basin, 225 000 ha are threatened by floods and 456 200 ha affected by erosion. Measures are similar to those in the Dalmatian region: building dykes and canals, and flood storage reservoirs.

As they are vital, all protection installations are State property and are financed directly from the State budget. Their maintenance is the responsibility of the State Water Directorate (SWD), which can subcontract these tasks. Each year DM 70 million is spent on maintaining flood protection installations.

However, only an estimated 60 per cent of the necessary flood defence works have been built so

Figure 6.3 : Water abstracted* by activity, 1996



Source: Statistical yearbook, 1998.

* Excluding water losses.
** Industry (ISIC 10-37,402-403).
*** Cooling water for thermal power plants.

far. Funds raised to maintain and develop this system are just enough to maintain what is already built and to maintain the hydrometeorological water management system for warning and forecasting basin water regimes, and to coordinate national strategies. Too little money is left for new infrastructure.

Protection works are generally built with a view to combining the multipurpose uses of river streams with flood protection objectives. The Sava, the Drava and the Kupa rivers are of particular importance because they are to a large extent navigable. In Dalmatia, the Krka and Cetina rivers stand out because of their hydroelectric potential.

In 1997 the Government adopted a project to build a 61-km long, multipurpose Danube-Sava canal connecting the Danube basin to the Adriatic. The Sava would be channelled to Zagreb and used for navigation and hydropower production. The Sava floods would be controlled, some territories drained, and Sava's water used for industrial and agricultural purposes. The project's environmental impact is currently being assessed, with a public hearing planned before summer 1999.

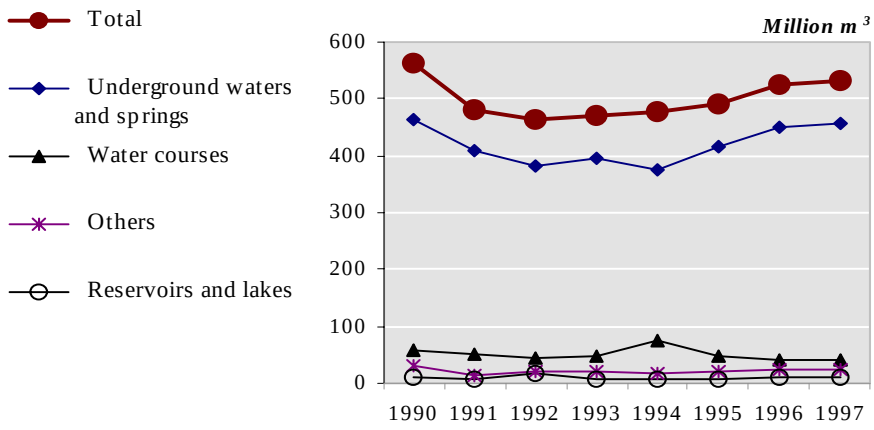
Water abstraction, supply and use

The direct abstraction of water for *hydroelectricity production* is huge (more than 35 billion cubic metres in 1997- Figure 6.3). Hydroenergy has been used for electricity production since the end of the 19th century. There are 20 hydropower plants; they have a total capacity of 2 076 MW and an average output of 11 700 GWh. In 1997, hydroelectricity production represented about 47 per cent of total electricity output and 26.1 per cent of total power output. Only 55 per cent of the potential of rivers is used today. There are projects to further develop 62 small and medium-size plants, half of which would be multipurpose facilities, providing also water supply and flood control (see above).

The *uptake for public water supply*, which had slowed down slightly in 1991-1993, is now again reaching its 1990 level, i.e. 530 million cubic metres in 1997 (Figure 6.4). Most comes from groundwaters: 51 per cent from aquifers and 35 per cent from springs. Surface waters (from watercourses, reservoirs and lakes) represent only about 10 per cent (Figure 6.5). In 1997 and based on these figures, with 63 per cent of the population connected to the public water supply network, water abstraction would amount to 190 m^3/cap or 519 l/cap/day all supplies combined (household, municipal and industrial users).

Water is also abstracted for *industrial use* (264 million cubic metres/year), but far less than in the early 1990s. Today, industry runs at only 40 per cent of its capacity and has drastically reduced its water use (down three quarters in 1996 compared to 1991). 80 per cent of the water used by industry is directly abstracted from surface watercourses, the rest comes from the public supply network.

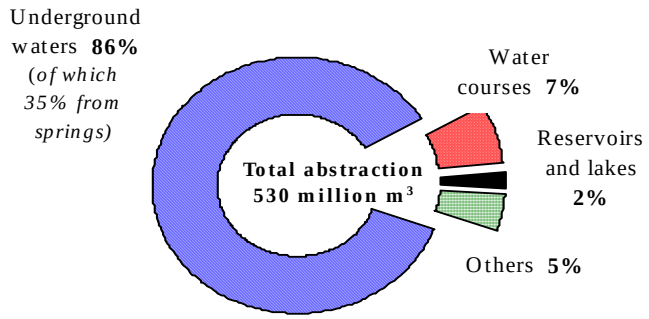
Figure 6. 4: Water abstraction* for public supply, 1990-1997



Source: Statistical yearbook, 1998.

* Data refer to public water supply system.

Figure 6.5 : Breakdown of water abstraction* by sources, 1997



Source: Statistical yearbook, 1998.

* Data refer to public water supply system.

Cooling water (over 700 million cubic metres/year) goes mostly to electricity production, the chemical industry and the refining industry.

Irrigation is negligible (less than 15 000 hectares of land is irrigated) and uses 9.5 million cubic metres/year. Only 0.8 per cent of the surface which would need to be irrigated is equipped with modern irrigation systems. About 80 per cent of this land is located in Dalmatia. There is no full-fledged irrigation system. Yet the need exists. A research project has therefore been undertaken and plans are being prepared; charges will be worked out accordingly.

Fish-farming and fish breeding in fish ponds of freshwater are well developed in Croatia. The related water use is estimated at about 280 million cubic metres a year. Water for all those uses is mostly taken from rivers and reservoirs in the Danube, Drava and Sava basins.

Public water supply

The public water supply is predominantly drawn from groundwater (above 85 per cent), although surface water is also used for drinking water in some places, such as the Pannonian plain. The use of groundwater for drinking is more common, as its

quality is generally good, necessitating only disinfection but no other treatment. Individual wells, however, do not seem free from bacterial contamination. From 1992 to 1996, an important proportion of the voluntarily checked samples proved to be contaminated and 12 epidemiological outbreaks occurred due to poor water quality (see Chapter 13).

Much of the water infrastructure was built in the 1980s, at a time of fast economic growth and tourism development. The most striking problem is the high water losses along the pipe network, which represent between 25 to 30 per cent of abstracted water.

In 1997, only 63 per cent of the population was publicly supplied with water. However, this figure conceals huge discrepancies. In the Sava basin, the situation is uneven, with a 51 per cent average supply rate, ranging from 10 per cent to 85 per cent (Zagreb). A large portion of the population still has individual supplies (tanks, shallow wells, etc). The supply rate is 53 per cent in the Drava and Danube basins, where surface water from watercourses may be used to supply the population. There, hydrogeological water research has been carried out to encourage the use of groundwater as drinking water and keep surface water for industrial use. In the Istrian and Dalmatian littoral basin, the development of tourism has rapidly increased the use of water (see Chapter 9). At the same time, even though the water infrastructure has been improved along the coast, the situation remains far from satisfactory. The drastic temporary increase in the population in summer coincides with the dry season and a low water resource level. In the Dalmatian basin, the supply rate is 73 per cent, but in general the situation is still difficult on the islands, as they do not have enough wells. Their water has to be brought in from the mainland by underwater pipelines or transported by special tank ships, which is common for the smaller islands. Cres and Losinj are the only islands able to meet as much as 90 per cent of their own water needs. Where underwater pipelines supply drinking water, the consumption tends to increase, resulting in more waste water. Moreover, small industry is increasing (fish processing, vineyards, small shipyards, etc.) as well as tourism. Expanding the transport of water by underwater pipelines would require a considerable financial effort.

In short, more than 2 000 small water supply systems meet local requirements. Some supply a few households, others supply groups of settlements. About 90 per cent of these facilities do not meet the required sanitary conditions. Domestic supply has been fairly stable over the years, while the water quantities supplied to businesses have decreased by about one quarter since 1990. In 1996, half the water publicly supplied was for domestic users (Table 6.4). The rapid growth in the urban population (e.g. the population of Zagreb has much increased since the war) often stretches facilities beyond capacity. Chlorination is not systematically performed in the countryside. The final development stage of the water supply strategy foresees a reduction in the number of water supply networks to 56, which will supply 90 per cent of the population.

Waste-water discharge and treatment

The total waste-water volume discharged in surface and coastal waters is equivalent to that of about 10.5 million inhabitants (including domestic and industry discharges). The typical sewage system is mixed. Only a few smaller cities and residential districts of bigger towns have separate systems.

Table 6.4: Public water supply by type of users, 1990-1997

	1990	1991	1992	1993	1994	1995	1996	1997
Total supplied* *(Million m^3)*	**429**	**357**	**339**	**357**	**359**	**362**	**374**	**372**
Water supplied to: *(as % of total)*								
- Households	*40*	*42*	*44*	*45*	*47*	*48*	*49*	*49*
- Sectoral activities	*52*	*47*	*51*	*48*	*47*	*44*	*43*	*43*
- Other water supplied	*8*	*11*	*4*	*6*	*6*	*8*	*7*	*8*
Water loss along pipe network *(as % of total abstraction)*	*24*	*26*	*27*	*24*	*25*	*26*	*29*	*30*

Source: Statistical yearbook, 1997 and 1998.

Table 6.5: Public waste-water sewage and treatment by technology, 1990-1997

	1990	1991	1992	1993	1994	1995	1996	1997
Public sewage *(Million m^3)*								
Total	**315**	**277**	**274**	**273**	**270**	**268**	**271**	**289**
Domestic sewage	112	109	117	115	116	122	127	134
Sectoral activities	204	168	156	158	154	146	144	155
Treated as % of total	*15*	*14*	*15*	*17*	*22*	*20*	*21*	*21*
Treatment by technology *(as % of treated discharge)*								
Mechanical	*83*	*76*	*77*	*85*	*81*	*84*	*76*	*81*
Biological	*10*	*11*	*10*	*11*	*9*	*9*	*10*	*6*
Combined	*7*	*12*	*13*	*4*	*11*	*7*	*14*	*13*

Source: Statistical yearbook, 1997 and 1998.

Industrial waste water is often discharged into the sewage system, in many cases without adequate pretreatment. In 1997, just over 20 per cent of all waste water was treated (Table 6.5), with big regional disparities. For instance, efforts to improve bathing water quality concern the beaches, where 60.5 per cent of the 1.74 million inhabitants are connected to sewage networks (1995 data). In general, it is difficult to get an accurate picture of the scale of the pollution discharged in Croatia's water bodies, as the only data available to the public (Statistical yearbook) are based on total volumes discharged, and not on pollution load or specific polluting components.

Within the framework of the Danube Convention, pollution hot spots on the Danube's tributary rivers have been identified in each country that participates in the Danube Strategic Action Plan. In Croatia this has happened along the Sava, Drava, Kupa and Danube rivers. In 1995, 22 hot spots were listed, 18 due to municipal waste-water discharges of large towns (Belisce, Belje, Cakovec, Karlovac, Koprivnica, Osijek, Sisak, Slavonski Brod, Varazdin, Vrbovec, Vukovar, Zagreb) and 4 due to discharges from industrial plants (iron works, chemical and food industries). The destruction of numerous water and waste-water networks by the war has caused additional environmental pollution. Waste-water treatment plants of several municipalities have been destroyed and not yet rebuilt, for instance in Gospic and Otocac. As the first priority was to rebuild the public supply system, there is currently a gap between the share of the population that is connected to the supply system (62 per cent) and the share that is connected to the sewage system (35 per cent). This means that 65 per cent discharge their waste water in individual treatment systems or directly into nature, which explains the bacterial contamination of surface waters in the watershed (see above). In general, the collective sewage system, where it exists, is obsolete.

On the Adriatic coast, waste-water treatment plants have been upgraded considerably in the resorts to improve the quality of bathing water. For instance, sea outfall pipes have been built in Pula, Porec, Umag and Dubrovnik. In 1994, a new municipal waste-water treatment plant was built in Rijeka. Other waste-water treatment projects are being constructed in Split and Kastela Bay. The Bay of Split is the most polluted area. Households, resorts and industries (cement works, chemical industries and shipyards) are concentrated there. The future waste-water treatment project will be based on mechanical treatment as a first step. The situation on the southern coast is worse, for instance around Makarksa and Dubrovnik, where the installations are ageing.

In general, along the coast, efforts focus on building sewage networks to further reduce individual discharges and develop collective sewage systems, primary waste-water treatment and deep injection into the sea (see Chapter 9). This is what has happened in Istria, which is now sufficiently equipped with mechanical treatment plants (flotation and settling). This is acceptable in times of hardship. The sharp increase (5 to 30-fold) of the population size in summer would make it difficult to start up and run biological units satisfactorily. Biological units pick up slowly and reach their full performance regime only after several weeks. In addition, they are badly affected by any variation in flow rate and load. Therefore, they are not well adapted to tourist areas. Nevertheless, many places have old sewage

systems that still do not have treatment facilities. Croatia is lucky in that coastal streams and deep sea water are close enough to wash pollution far away. But this solution might not be acceptable in the future (see Chapter 4, the Barcelona Convention).

On the islands the situation is not good. Few have sewage systems. This results in waste water still being disposed of in the same way as in the past, i.e. discharged into the sea through the sewage system after simple preliminary settling. Biological facilities are rare, and the quality of their operations questionable. Settlements along the coast have direct individual discharges. The increase in tourists and tourism activities and settlements adds to the problem. The case of the Krk Island is described in Chapter 12. Overall, there is a serious lack of water infrastructure.

In terms of treatment facilities, Croatia is under-equipped (Table 6.5). The bulk of its waste waters (81 per cent in 1997) is treated only mechanically, which means poor performance yields, except for suspended solids, and a poor effect on dissolved pollution. About 6 per cent of waste waters are biologically treated and 13 per cent are subjected to combined treatment. Because the only data available are expressed in volumes (no data are available for COD, BOD, SS, N, P or other specific elements in spite of existing monitoring and reporting), it is difficult to calculate the eliminated pollution load. The reduction in pollution load is estimated at around 25 per cent of what is treated. Sludge production by waste-water treatment plant is not recorded.

Since waste-water treatment was made a priority a few years ago, many municipal installations have been or are being built, but their operation is fraught with difficulty. In many cases, municipalities that have invested and borne 50 per cent of the cost of the plants do not have enough money to cover the loans, and operate and maintain the equipment. So, they bypass their empty facilities and discharge their polluted effluents untreated. At the same time, new projects are being designed and partly financed by the water agency (Hrvaske Vode) to equip other towns.

It is difficult to describe the situation in industry. There again, no data on pollution load from industry, or at least from the most polluting industrial sites, are published even though industry reports annually to the authorities (the SDW and recently the SDEP) on the pollution it generates. A peculiarity of Croatian practices is the fact that part of the waste water from industry (30 per cent in 1996) is discharged together with domestic sewage into municipal waste-treatment plants, as industry is obliged to use and contribute to the plants where they exist. Another part is discharged directly or after preliminary treatment (for instance in Pliva Company, the Zagreb production unit reduces COD and toxicity, the Petrochemia/Kutina Company recovers and recycles part of the nitrate and ammonium) into watercourses or the sea.

6.3 Water policy objectives and management practices

Priorities for water policy and management programmes

The Strategy for Water Protection was adopted in 1992. There are three basic objectives:

- To extend public water supply to 90 per cent of the population; the remaining 10 per cent would continue to rely on individual facilities;
- To repair, construct and reconstruct sewage and waste-water treatment facilities for a total capacity of 10.5 million population equivalent;
- To achieve protection against flood (including reservoirs, canals, etc.) and build multipurpose projects involving river water use.

The total investment for all these works has been estimated at DM 6 billion, equally shared between the three above-mentioned objectives. Additional objectives relate to river regulation, development of irrigation and a comprehensive information system on water resources and water quality.

According to the Water Law (1995), water management planning is to be based on the Water Management Master Plan drawn up at the State level (i.e. the Long-term Plan for the Development of Water Management 1986-2005), and water management plans and schemes drawn up at the catchment area level. The Long-term Plan specifically deals with watercourse regulation, protection from floods and other natural water catastrophes. It also covers the use of water resources and supply; and the management of water pollution. The Long-term Plan is a document that ought to be regularly revised and adjusted to changes and to other policy documents such as the National Development Plan of Croatia, the Strategy for Physical Development, the Strategy for Environmental Protection, forest management plans and the navigation plan of the inland navigation

system. The Water Management Master Plan is not yet finalized.

Geographical areas with complex water management problems should have a water management plan along the same lines as the Master Plan but restricted to a smaller area; other catchment areas only need water management schemes. These schemes and plans essentially deal with the distribution and supply of water and improvement of water quality. According to the law, they should be developed by the SWD (HV), in coordination with the SDEP, local authorities and planning authorities; public and scientific institutes should be involved. The plans are then submitted to the basin level. According to the law, water management plans must be drawn up in every river basin and in Zagreb. Today few of these local plans are ready. The plan for the complex use of the Drava has been adopted (1998). The plan for the Sava and Zagreb's plan have not yet been adopted. The Littoral and Istrian catchment area and the Dalmatian catchment area have no plan yet.

The Long-term Plan has a series of sub-components, each of them dealing with one of the strategic objectives mentioned above:

- The National Plan against Floods, 1997;
- The Water Use Plan;
- The Long-term Water Supply Programme;
- The Water Pollution Control Plan;
- The State Water Protection Plan, adopted in January 1999.

The State Water Protection Plan defines the basic guidelines, tasks, activities and measures to reduce the pollution burden on water. The Plan's objectives regarding freshwaters are:

- To preserve the water which is still clean; water monitoring and quality objectives of the rivers are prescribed. Watercourses should meet the prescribed water quality and other water properties.
- To stop water quality deteriorating further by implementing protective measures. Measures are classified into several categories according to their urgency. The Plan includes emergency measures and contingency plans. Objectives for completing the protection infrastructure are set, in particular for municipalities. Deadlines are set for the different steps, starting with equipping first the most populated municipalities. Settlements below 50 000 population equivalent will be dealt with at the local level, while the State Plan includes waste-water treatment plants for settlements with a population equivalent of more than 50 000. The investments that should be made in such facilities for settlements with a population equivalent of 50 000 and above (in total 5.5 million population equivalent) are estimated at 7 600 million kunas. The deadline for implementation is 2005.

Legal framework

The 1994 Environmental Protection Law sets goals and principles which are important for managing water (see Chapter 1). The Water Law was issued at the end of 1995. It is subdivided into 9 parts and contains 219 articles. This umbrella law regroups and integrates various acts and regulations that were inherited from the previous regime. It regulates the legal status of water and its ownership, the manner and conditions in which it is managed (water extraction and use, water protection, regulation of watercourses and other bodies of water, and protection against harmful impacts of water). It defines the responsible bodies, the sharing of responsibilities and water policing. It establishes a water agency: *Hrvatske Vode* (Croatian waters). It does not deal with the financing of water management.

A major feature of the Law is that it divides Croatia's territory into four water basins, plus Zagreb city:

- Water basin of the Sava river catchment area;
- Water basin of the Drava and Danube catchment areas;
- Water basin of the Littoral and Istrian catchment areas.
- Water basin of the Dalmatian catchment area.

A water basin contains one or more catchment areas of minor watercourses, and includes surface and groundwaters. The catchment area constitutes a territorial unit for water management purposes. Surface waters are divided into waters of State importance and of local importance. Basin and catchment areas have been defined by ordinances. The Law also provides for the regulation of watercourses and in particular the protection against the adverse effects of floods.

The Law states that the use of water for supplying tap water to the population has absolute priority over other uses. It regulates the protection of water

aquifers, wells and well-inflow areas. Under the responsibility of municipalities, sanitary protection zones should be set up around sources of water used for public supply. It seems that this measure is generally implemented, except in the Karst region, where the topography makes it difficult to put into practice.

There is a separate Law on Water Management Financing (1996). It regulates the sources of funding for activities and uses within the water management system, the manner of determining individual responsibility and collection of charges, and other issues concerning the allocation and use of funds. There is a series of public revenues from waters, i.e. water management contribution, charge on water use, charge for water protection, charge for sand and gravel extraction, basin water management charge, and a special charge for investing in land improvement and drainage systems (to local authorities). All water charges are collected by the water agency, Hrvatske Vode.

In 1997, the national regulatory framework for protecting water was completed. The local regulatory framework is not yet complete. There are no water protection plans. Environmental polluters need to be identified and systematic water monitoring needs to be established for all national and international watercourses. Activities which could potentially threaten water quality are occasionally surveyed (monitored); only four spot checks a year are required.

Institutional set-up

Water management and water protection are the responsibility of two government agencies: the State Water Directorate (SDW, created in 1994 under the Ministry of Agriculture and Forestry) and the water agency Hrvatske Vode. There is also a parliamentary committee, the National Water Council, which was formed as required by the Water Law to discuss policy, strategies and implementation of laws regarding water management, but is not active. The SDW is represented within the cabinet by the Ministry of Development, Reconstruction and Immigration. Other governmental bodies are also specifically involved in water management. The State Directorate for Environmental Protection, established in 1994, is responsible for water bodies inside protected areas, and deals with environmental protection information. It is responsible for the maintenance of the Environmental Pollution/Emission Cadastre created in 1997, which includes emissions into waters. The Ministry of Health looks at the health impact of water (drinking water) and water uses. There is no formal coordination mechanism between the SWD and the SDEP. The absence of a formal relationship between the two bodies is clearly a problem.

State and local water management takes place under the responsibility of Hrvatske Vode (HV). Its duties are to manage Croatia's waters according to the adopted water management plans and schemes, issue administrative and other orders and make decisions on issues of importance . Its tasks encompass:

- preparing strategies and plans, and investment programmes
- regulating watercourses and water bodies
- managing water use, water protection and water property
- managing the integrated information system and keeping water-related documentation
- disclosing information
- supervising the awarding and implementation of concessions and construction of waterworks, and
- planning and raising funds (collecting fees for water use and fines) for financing water management.

Operative sub-units (i.e. Water Management Departments) are established in each of the four basins. Branch offices responsible for catchment areas are set up in the Departments. Some important specific operations (design, construction, irrigation systems, water supply and waste-water disposal) are entrusted by Hrvatske Vode to other competent legal entities subject to the consent of the State Water Directorate. The Hrvatske Vode governing body is appointed and dismissed by the Government. Hrvatske Vode has a staff of about 700, 60 per cent of them hold university degrees in hydrobiology, hydrochemistry, microbiology, chemistry, economics, etc.

The SDW develops laws and regulations and ensures the administrative supervision of the implementation of the legislation on water. In particular, it exercises control over water quality standards and pollution levels, and is the Principal

International Alert Centre for early warning in the case of accidents on transboundary waters.

The SWD also checks compliance with the water permit. It controls Hrvatske Vode and arbitrates problems between it and county offices in charge of water management. Both the State Water Management Inspectorate (of the SWD) and the county water management inspectors (under the county offices) carry out inspections (1 800 inspections per year). There are 12 inspectors at the State level and 40 at the county level. In some counties, inspectors of the SDW and of the SDEP combine their inspections, on their own initiative.

The State Water Inspectorate supervises international commitments, prepares and implements the National Plan for Defence Against Floods, and other sub-plans under the National Water Management Master Plan. The State Inspectorate is in charge of monitoring water quality. The county water management inspectorate oversees the implementation of the law at local level and the application of measures that are not under the direct competence of the State level. The level of enforcement is still insufficient. The fining system is not adequate to change the behaviour of the polluting industries (see Chapters 1, 2 and 10), especially of the State-owned companies.

Monitoring and cadastres

There is no national integrated monitoring programme in Croatia. Since the 70s, the quality of *water* has been regularly monitored by the SWD. The monitoring programmes are implemented through 270 measuring stations and concern the quality of surface and underground freshwaters, estuaries and sea waters. The number of controls performed and the parameters involved vary according to the importance of the measuring station. They also differ according to watershed. There is no monitoring of non-point (diffuse) sources in Croatia. The quality of watercourses is assessed every five years. So far, samples are still taken haphazardly. They are analysed in 13 certified laboratories which follow international standards and methods. There is no on-line detection of pollution peaks or toxicity, and no ecotoxicological parameter measurements.

In the north, in the Black Sea watershed, the water quality of the international streams (Drava, Sava, Danube) is subject to monitoring programmes under ad hoc joint commissions with Austria and Hungary, as requested under the Danube and Helsinki conventions. The Sava and Drava rivers have been systematically monitored since 1973. The Sava is monitored in 60 stations with a sampling frequency of 5 to 52 samples a year. Since 1993, in line with the requirements of the Danube Convention, Croatia has been actively involved in international monitoring programmes on transboundary waters and participates in the laboratory intercalibration process under UNEP.

In the coastal Adriatic watershed, Croatia is implementing the Land-based Sources of Marine Pollution Programme (LBS) under the Barcelona Convention and carries out tests in about 60 measuring stations on municipal and industrial effluent discharges into the sea. Results are reported annually to the MED unit.

Hrvatske Vode compiles various water documents into a water book, a 'Water Cadastre' and data on concessionaires. The Water Cadastre includes a cadastre of waters, a water building infrastructure cadastre, a cadastre of water abstraction and a cadastre on water protection. The last is an additional tool for water management in Hrvatske Vode and is not transparent for other users.

There is also a register of emissions into waters. All entities which have a water permit must provide Hrvatske Vode via the county offices with recorded information/data on the pollution they discharge into water. However, it seems that the data are not computerized, nor are they made available for statistical use or as a decision-making instrument. They are not disclosed to the public either.

In 1997, the State Directorate for Environmental Protection (SDEP) started implementing an Environmental Pollution/Emission Cadastre (EPC/EEC, see Chapter 1). It includes emissions into waters from municipalities, industry and agriculture. The main parameters are covered, such as flow rates, COD, BOD_5 and suspended solids. Measuring and record keeping are the responsibility of the county offices (including Zagreb Municipal Office) and the municipal administrative environmental authorities. The SWD is involved in the elaboration of the EEC. Priority in the use of the EEC as a decision-making instrument is given to the protection of surface water.

Funding is still required to establish a monitoring system (DM 0.7 million for water monitoring by

the SDEP, cost estimated in early 1999). The quality and monitoring of drinking water is the responsibility of the Ministry of Health.

Regulatory instruments

A water management permit for water use (uptake and discharge) is needed for important water uptakes and discharges. It is a single-medium permit. It is delivered by the State Water Directorate (SWD) for 15 years. The permit is based on EQO (environmental quality objectives), i.e. the impact on the quality of the receiving waters, and not on the pollution flow generated per quantity of product produced, or the number of people connected. Therefore, the permit does not encourage the polluter to reduce the pollution burden or introduce cleaner technology. About 3 000 permits are given each year. A permit can be temporarily withdrawn if the polluter fails to comply with certain conditions. But this rarely happens. As industry is in dire financial straits and cities are often on the verge of bankruptcy, problems tend to be solved through negotiations (see Chapter 1 on enforcement). The Water Law sets the level of penalties at 400 to 40 000 kunas. Any work to prevent or clean up pollution damage is at the expense of the polluter.

Water is classified on the basis of limit values of certain substances (physical indices, dissolved oxygen, nutrients, metals, organic compounds, microbiological and biological indices, and radioactivity) and other water properties. Emission limit values are prescribed: (1) for industrial waste water before release, (2) for municipal waste water after treatment and before release and (3) for waste water discharged in sumps and collection tanks. A special ordinance of 1999 sets the maximum allowed concentration of hazardous/dangerous substances discharged into water.

The list and number of these water standards are in line with the EU requirements. There are two series of standards: one for direct discharges into waters (natural receiving body) and standards for waste water discharged into municipal sewage. However, emission limit standards based on technology performance do not yet exist, although their introduction was announced several years ago.

Economic instruments

The following instruments are in force:

Contribution to water management: The water contribution is levied only on businesses, and is also a source of financing for water management. Its rate is defined by the Parliament. In 1998, the water contribution amounted to 0.76 per cent of the total payroll. As of 1 June 1998, the water contribution has been suspended to relieve businesses.

Charge on water use: A charge is paid for extracting and using water and for using waterpower. It is intended for financing tasks and activities related to water use. The level of the charge is set by the Government and depends on the quantity (m^3) of extracted or supplied water. It varies according to the type of water, the means of extraction and supply, the purpose and the necessary investments. Since the beginning of 1998, 22 per cent VAT is levied on the water use charge.

Water protection charge: A water protection charge is paid for water pollution (1995 Decision on the Level of Water Protection Charges). The Government sets the level of the charge. The charge applies to industrial and household users. As mentioned above, a permit for discharging waste water is required. The protection charge is calculated on the basis of the permit. The charge is proportional to the water quantity discharged and the deterioration in the receiving water's quality and usability. For instance, the charge for a change in water temperature caused by a power plant is far smaller (0.00081 kuna/m^3 in 1997) than that for industrial pollution (0.81 kuna/m^3). For industrial users, the charge is proportional to the measured discharged pollution. Users connected to the public water supply pay according to the quantities of water supplied. Their charge is calculated and collected by municipal service enterprises according to the monthly water consumption.

Pursuant to the Law on Water Management Financing, the water protection charge cannot be below the cost of waste-water purification. However, at present, due to economic difficulties and the consequences of the war, the protection charge is about 25 per cent of the average purification cost, which removes much of its incentive effect.

All the collected protection charges are eventually remitted to Hrvatske Vode. This revenue is used for preparing and implementing water protection plans; monitoring water quality and taking protective measures; financing water protection facilities; and participating in various water management activities. In 1998, 235 million kunas

were collected with a collection efficiency rate of 85 per cent.

Water basin charge: paid by the owners and users of land and other real property in the basin. The rate of this tax is determined by the county assemblies of the river on a proposal by Hrvatske Vode. It is paid to Hrvatske Vode.

Waste-water and sewage non-compliance fees: According to the 1995 Water Law, fees are imposed for non-compliance with the conditions prescribed to protect water against pollution. They range from 40 000 to 500 000 kunas. They are paid into county budgets and earmarked for financing activities to regulate watercourses and water bodies pertaining to the basin within which the violation was committed.

All water charges are collected by Hrvatske Vode in a special account (see Chapter 2). The funds collected from the water use charges, the water protection charges and the water basin charges represent almost equal amounts. According to the 1998 budget plan, the overall revenue from these charges was to be around 825 million kunas, i.e. almost 70 per cent of Hrvatske Vode's total revenues (Figure 2.1 in Chapter 2). The rest of its revenues are funds from the State budget, which are mainly earmarked for the maintenance of flood protection, a task entrusted to Hrvatske Vode. 90 per cent of the income from charges is redistributed to finance water supply and waste-water treatment facilities.

Water pricing

Water delivered to users by municipal water services is metered. Prices for drinking water are not uniform throughout the country. They are composed of the price of the resource itself, including the cost of purification and supply specific for each location and determined at the municipal level, increased by a charge on water use, a water protection charge, and a water basin charge. Moreover, contributions to the construction of waterworks , sewage and purification facilities may be added. VAT is due on the total amount. As charges and taxes may be very different from one county to another, final prices can vary by as much as a factor of 1 to 3 for the same category of users. They are higher in the Adriatic zone than inland. Also, water prices for industrial use are significantly higher than for household consumption. Table 6.6 shows that in 1997 water prices varied from 2 to 6 kunas for household users and from 4 to 9 kunas for industry. These prices are like those in western Europe and very high compared to the average income in Croatia. While the collection rate is more than 80 per cent among households, it hardly reaches 50 per cent among industry. In particular in the coastal area, hotel resorts which are still State-owned rarely pay (15-18 per cent collected). No social measures are applied at the household level (for instance, progressive prices as a function of the quantity used, a common practice in many countries).

Hrvatske Vode (Croatian Waters), which collects the water charges, gives part of them (between 20 and 50 per cent) to municipalities, partly taking local circumstances into account. For instance, in 1998, the town of Vukovar got 50 per cent of the collected tax back, Sisak only 20 per cent. Most of the money that Hrvatske Vode receives is spent on investments (Figure 2.1, Chapter 2).

Financing and projects

Currently, most environmental investments are for water protection. They include the construction of sewage systems and waste-water treatment facilities. Investments in water supply have been important over the past four years but are now

Table 6.6: Mean water prices, 1997

kuna/m ^{3}

	Industry		Households	
	Charges and taxes **excluded**	Charges and taxes **included**	Charges and taxes **excluded**	Charges and taxes **included**
Mean water price	4.12	5.91	2.23	4.06
Range of water prices	2.37 <average< 6.79	3.68 <average< 9.47	1.00 <average< 3.27	2.17 <average< 6.02

Source: Account of water prices in the Republic of Croatia, 1997, Hrvatske Vode.

decreasing. Priorities and an implementation schedule have been set according the Long-term Plan for the Development of Water Management. Also, as pointed out in Chapter 3, the water infrastructure was ravaged by the war.

Flood protection works are covered directly by the State budget. They are investment-intensive. Environmental funding is tight in Croatia, and in general it is extremely difficult to obtain funds from the central budget. The estimated DM 200 million project on the Sava downstream from Sisak might be partially covered by a loan from the World Bank if negotiations go through. Recently, the World Bank has approved a credit line for reconstructing the flood control system in Eastern Slavonia worth DM 74 million.

The other major sources of domestic funding are funds collected from water charges by Hrvatske Vode, as mentioned above (Figure 2.1, Chapter 2). Hrvatske Vode carries out feasibility studies and manages the projects. Investments are decided at the higher level by the SWD and Hrvatske Vode, according to the Long-term Plan's objectives. Usually, Hrvatske Vode finances 50 per cent of the investment. The rest is to be found by the investing municipality, which often turns to loans from domestic credit banks (where loans are expensive -- no soft loans for environmental purposes) and to international funds. For instance, the protection works (sewage and primary waste-water treatment) and the development of the water supply in the Split, Kastela and Trogir area received 36.6 million USD from the World Bank in 1998. The European Bank for Reconstruction and Development (EBRD) is considering helping the Koprivnica agribusiness complex with its waste-water treatment and discharge plan.

In 1999, the SWD budget represented 92 per cent of the overall budget devoted to environmental expenses by SDEP and SWD. In particular, its budgeted capital expenditures amounted to 166 million kunas against 3 million in the SDEP budget.

Information, participation in decision-making and cooperation between stakeholders

The Water Law does not explicitly spell out the role of municipalities and users in the decision-making process regarding water strategies at the local level and water pricing. Similarly, the Act creates water basins, but does not emphasize the need to create multi-stakeholder steering committees (basin committee) to head its structures and guide Hrvatske Vode in the implementation of the basin management strategies.

It also seems that the users are not involved in the decision-making process regarding new investment projects and water pricing. For instance, in Sisak the municipality informs and consults its inhabitants about household waste collection and treatment cost and charges. But the price of water is not subject to any discussion. Similarly, it seems that when a new treatment facility is planned, the public is not informed in advance of the consequences it will have on the water price.

6.4 Conclusions and recommendations

Water management and protection are highly centralized in Croatia. They are in the hands of the State Water Directorate and its agency, Hrvatske Vode (Croatian Waters). Their policy and objectives are spelt out in a series of strategies, programmes and plans. The priorities are clear. Protection against floods, which is particularly important for the country, has been tackled first. Then comes water supply, with the objective of increasing public water supply and ensuring that the whole population has access to safe drinking water. The third priority is to construct or reconstruct sewage and waste-water treatment plants in order to protect water bodies from pollution.

All these tasks are set and driven from the national level by the State Water Directorate. Very few responsibilities are left at the local (county, municipal and city) level. The time has come to evolve toward more participatory and transparent decision-making, delegating more tasks to local institutions and involving more actors in water management be it at the national, basin/catchment or local (county-municipal) level. To this end, a series of measures has to be taken.

The Water Law provides that the principal management tool, namely the Water Management Master Plan, should be regularly adjusted to other strategies developed for other sectors. This requires good communication between the various ministries in charge of those sectors. A special body which should contribute to this harmonization has been created by the Water Law. It is the National Water Council, a parliamentary committee. Parliamentary committees are traditionally constituted of members representing

the different political parties. They discuss the laws, programmes and strategies that are proposed to the Parliament. They can usually call on experts, groups of specialists, people involved in the implementation of the laws, NGOs representing economic actors, and others to assist them. It would be helpful if the National Water Council adopted the same kind of functioning.

Recommendation 6.1:
The National Water Council should be revived. It should be representative of Parliament, and involve water management experts and scientists as well as NGOs. It should coordinate its decisions with the Committee of Environmental Protection and Physical Planning in matters regarding waters and environmental protection.

Managing water resources, ensuring their sustainable use and providing the population with safe drinking water are important tasks that cannot be separated from protecting the quality of the resource itself. The present institutional structure, with the two separate State Directorates (Water and Environment), both represented at cabinet level by different ministries, is unlikely to make for a strong «protection policy», and does not facilitate synergies between the two State Directorates. Merging these two entities into one ministry, with Croatian Waters as its water agency, would allow Croatia to formulate and implement a more consistent environmental policy. See Recommendations 1.1 and 1.2 in Chapter 1.

Croatia should go ahead with the implementation of its water basin management strategy. The aim of this organizational structure is to better adapt local solutions to specific local problems. Therefore, water management plans for each of the basins have to be worked out as requested in the Water Law. Few water basin management plans are ready. It seems that the entities at the head of each basin are not independent, but rather branches of Hrvatske Vode. They have no financial autonomy. They do not decide the charge rate on their territory -- this is decided by the Government -- and, moreover, they do not receive a budget from Hrvatske Vode that they can spend according to the priorities set in the water management plan of the basin. Furthermore, no consultative or participatory bodies, i.e. basin committees, seem to have been set up yet. A basin committee should be the consultative body which voices its opinion on new projects, coordinates action amongst local administrative units and is consulted on the level of charges collected on the basin territory. Water management plans should be drawn up and implemented under its responsibility.

Recommendation 6.2
Basin water management plans should be urgently completed. Basin agencies should obtain greater autonomy, in particular regarding the spending of the financial resources collected in their basin. Basin committees should be created or their role strengthened in decision-making. These committees should be equally made up of representatives of local territorial authorities, users (or their associations) and the State.

Special emphasis should be put on protecting and managing waters in the karstic areas. In these territories, springs are numerous and underground waters abundant, although they fluctuate according to the season. However, they are also much more vulnerable to any pollution from the surface. Sanitary protection around underground extraction sites deserves particular attention.

Recommendation 6.3:
The efficient protection of complete river catchments in the karstic area deserves a special protection regime.

Not only at the State and basin level should the participatory process and transparency be improved, but also at local level, closer to the user. It is important that the municipalities and, ultimately, the users, who will have to bear the debt burden if investments are made, should be informed in advance of the decisions and their consequences. It seems that too often investments have been decided at a high level which the local level could not afford. Currently, many facilities are not operated and not maintained in order to save money; but at the same time new investments are being made. For the investments announced in the 1999 Water Protection Plan, it will be important to avoid that political position and commercial interests take precedence over expert analysis and stakeholders' opinion. The same principle should apply to smaller units and investments.

Priorities in allocating the funds should be re-oriented. They should:

- make existing waste-water treatment plants function (for instance by alleviating the debt of municipalities) optimize operation, maintenance, repair and modernization of the existing plants;

- build new installations for several settlements together (to be operated at the basin, county or municipality level).

Recommendation 6.4:
Funds collected from charges, or obtained from other sources, and earmarked for water protection at the basin level should be allocated case by case depending on the results of a cost-effectiveness analysis. See also Recommendation 9.8.

In these times of hardship, it seems that the water price is high for individual consumers. Paying the bill may be a problem for a substantial part of the population. There is no differential pricing to adjust the price to the consumer's circumstances. In its Declaration of 5 June 1992, the President of Parliament declared that drinking water was a strategic natural resource. However, this vital resource has been subject to 22 per cent VAT since early 1999. In most countries, vital goods are taxed below the normal rate. Applying true cost pricing to water is a sound policy, if certain arrangements can be found to ease the burden for the poorest. (See Recommendation 2.1).

At the same time, the higher water price for industrial users does not seem high enough to induce them to clean their waste water. The reason is twofold: (i) those who do not pay are not prosecuted, in particular State enterprises; (ii) it is far cheaper to pay the charges than to invest in treatment facilities, which are expensive to operate. In addition, fines are rarely enforced (see Chapter 1). At the same time, there is a lack of incentives to generate less pollution. In the past, a legal regulation provided for possible grants from the SDW or soft loans to help finance industrial water facilities. This measure has been abolished. Nowadays, waste-water pretreatment within industrial premises is not subsidized, nor is it eligible for preferential loans. Only pilot studies for defining the best type of treatment receive small subsidies. Therefore, it is important that other incentives should be created to make the introduction of clean technology attractive, and that command-and-control instruments should be reinforced. All instruments should have a synergetic effect (gradual shift toward an integrated permitting system). See Recommendation 1.3.

Recommendation 6.5:
Economic incentives and a command-and-control approach toward industry should be strengthened to encourage (i) the introduction of cleaner technology, and (ii) industrial investments in waste-water treatment units. See Recommendations 10.2 and 10.4.

Another typical feature is that industrial waste water, even after optimum treatment, cannot be discharged directly into natural water bodies unless it has gone through a municipal waste-water treatment plant. Consequently, industry also pays the municipality for the service and contributes to investing, maintaining and operating the municipal waste-water treatment plants. This obligation is a way to shift part of the financial burden to industry, but there is no technical justification for it. It has been proven that most of the time this kind of combined industrial/municipal treatment is difficult to operate and malfunctions are frequent. It works only in some specific cases where there is a true complementarity in the composition of the inputs. This situation should be assessed and decided case by case by specialists/experts after careful pilot studies.

Waste-water treatment facilities need to be operated by qualified people. Today, there are too few competent people to run the municipal treatment plants and sewage systems, as there is no professional accreditation for the job. This is also true for professionals at a higher level. There are too few competent people in the country who are able to carry out expert work, to work as consultants, to participate in debates on water management decisions. Such experts are needed to organize public participation at all levels, and to prevent Croatia having to turn to foreign experts and foreign equipment for each investment project.

Recommendation 6.6:
Professional training programmes should be set up for operators of waste-water treatment units. Engineers and experts employed in such units should be trained in water management, including all technical and policy-making issues, or adequate measures should be taken to retain chartered or other well qualified staff in these units.

Giving a clear picture of the water situation in terms of quality and availability in each basin, is a prerequisite for any reasonable and effective water management policy. Today, water bodies are monitored, as is waste water, but the monitoring data are not merged into one system that would make the impact of pollution on the quality of rivers clear. Data are not processed with a view to helping in decision-making. In addition, what exists is disconnected from other environmental considerations (waste generation, air pollution,

nature degradation). Therefore, it seems that the Environmental Emission Cadastre, which is being completed, can become a much needed instrument for decision-making. This set of data should also be seen as a first step towards the introduction of an integrated permitting system. Efforts should concentrate on making the most of it and avoiding other systems that would duplicate it. Consequently, the register of emissions into water compiled by the SWD and the EEC should be merged. The ultimate goal is that EEC should be an integrated database used by all institutions: SDEP, SWD and others.

Recommendation 6.7:
Once the Environmental Emission Cadastre will be reliable and complete, it should fully integrate the existing water emissions registers and should be used as a common decision-making tool, in particular in the introduction of an integrated permitting system.

A successful water monitoring programme should aim at providing a full insight into the quality of water resources. Processing the data, making use of them and disclosing information at all levels of decision-making should all be part of the programme. Croatia's monitoring programme falls short in this sense. Monitoring sites are not always located in the right places, the coverage and frequency of monitoring of surface, ground and sea water is uneven, the parameters checked are numerous but not always important, ecotoxicological measurements are not standard practice, and there is very little on-line, real-time analysis. Furthermore, data processing is underdeveloped.

Recommendation 6.8:
The existing monitoring system for waters should be harmonized and improved. The use of automatic monitoring should be increased. Integration and processing of data should be upgraded. The data should be processed and disclosed.

As most of the river basins of Croatia are to a large extent transboundary (e.g. the Danube, Drava, Mura and Sava), their sustainable use and protection depend critically on an effective cooperation with neighbouring States. In line with the provisions of the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, which Croatia has ratified (see Chapter 4), the riparian States should enter into agreements providing for the establishment of joint bodies. Such bodies exist and function already with Hungary (which has also ratified the ECE Convention) and Slovenia. The cooperation with Bosnia and Herzegovina and the Yugoslavia needs to be clarified and made effective, especially with regard to pollution prevention, control and reduction, as well as flood control.

Recommendation 6.9:
Cooperation between Croatia and all countries in the region concerned by transboundary water management and protection should be improved. The status of cooperation with Bosnia and Herzegovina and Yugoslavia should be clarified from the legal point of view, and a technical programme of cooperation should be defined in order to prepare the ground for the necessary international support and investments.

Chapter 7

WASTE MANAGEMENT

7.1 Current waste flows and management practices

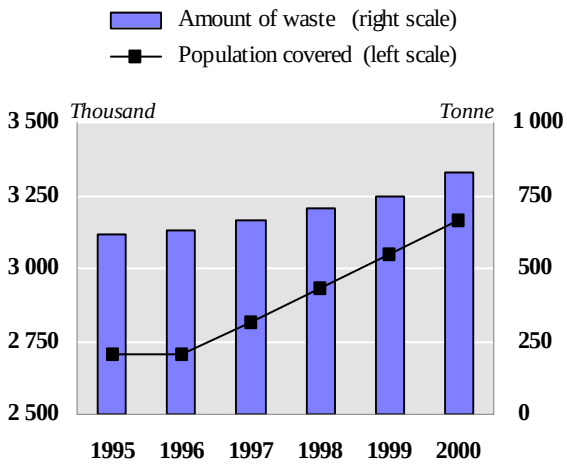
Municipal waste

Municipal waste includes household waste, waste from public areas and commercial waste if it is similar to household waste. According to the 1998 State of the Environment Report, 978 000 tonnes of municipal waste were generated in 1995, i.e. 226 kg per inhabitant. The per capita amount of waste generated in different counties normally ranges from 175 kg/year to 250 kg/year, with local peaks of up to 295 kg/year, if waste from tourism is included. The tourist industry contributes on average 1.68 per cent to the total amount of collected municipal waste.

Of the total quantity of municipal waste generated, 63 per cent (or 615 000 tonnes) are being collected and disposed of in an official way, which is 28.5 per cent more than in 1985. The remaining 37 per cent end up at (illegal) fly-tips, mostly near to the point of origin. Their number has been estimated to be between 800 and 1 000. In addition, the great majority of "official" dumpsites is not adequately equipped or managed.

A technical survey of 365 municipalities shows that 205 (i.e. 56 per cent) have no organized collection and transport of municipal waste to "official" disposal sites. The percentage of the population covered by waste collection and transport to "official" disposal sites is 57 per cent, ranging from 95 per cent in the county of Zagreb to 23 per cent in Krapinsko/Zagorska county. In 1995, 137 waste enterprises collected municipal waste. Their number increased slightly in 1996, but at the same time their financial situation became more precarious in view of the growing legal demands. Most of these enterprises are publicly owned. The smaller municipalities are not adequately prepared and equipped for waste management tasks (see Figure 7.1).

Figure 7.1: Estimation of the amount of municipal waste*, 1995-2000



Source: 1998 State of the Environment Report, SDEP.

* Data refer to municipal waste collected and disposed of in an organised way.

It is difficult to estimate future trends in the generation and management of municipal waste. The reasons for this are: outdated local authority plans; outdated spatial plans; significant demographic changes in certain areas; big economic changes and changes in enterprises. In the 1998 State of the Environment Report, it was assumed that the amount of waste generated per inhabitant would continue to rise at a rate of 2 per cent a year, whereas the population covered by collection and transport of waste to "official" disposal sites would increase by 4 per cent a year (Figure 7.1). The main reason for this assumption is the increasingly strict implementation of legal requirements. This trend would result in an increase in collected and disposed waste of 210 000 tonnes in 5 years, which corresponds to an increase of 34 per cent.

Separate collection and reuse of useful components from municipal wastes is developed to some extent. It is organized in Zagreb (by the ZGO company) and in some other counties (by companies like

Unijapapir and Unija-Nova). The quantities of reusable waste separated at the source in 1995 are shown in Table 7.1. The total amount of separately collected reusable materials corresponded to only 1.4 per cent of all municipal waste.

Table 7.1: Raw materials separated from municipal waste at source, 1995

	Amount (tonnes)	*As % of total*
Total reusable and separated materials	**13 411**	**100.00**
- Paper	6 310	47.05
- Plastics	2	0.01
- Metals	203	1.51
- Glass	2 664	19.86
- Biodegradable waste	128	0.95
- Batteries	5	0.04
- "Green" waste	4 000	29.83
- Waste oils	99	0.74

Source: 1998 State of the Environment Report, SDEP.

The management of municipal waste in Croatia is a cause of concern. First, there are no reliable data on past generation, collection and disposal of municipal waste. In fact, data vary considerably between sources. A minority of the 205 municipalities without organized collection of waste was, in 1995, introducing it. The 140 "official" landfills cover a surface of 434 ha and contain an estimated amount of 15.2 million tonnes of waste. Of that quantity, 5.3 million tonnes have been deposited during the past ten years.

A complete list of the major landfills does not exist. There are different kinds of "official" landfills:

- Simple dumpsite, without levelling, compacting, covering; without fence nor control
- Landfill with periodical levelling and compacting
- Landfill with continuous or sporadic waste burning and levelling (typical for the seaside and the islands), with fire prevention measures in the summer months
- Landfill with levelling, compacting, clay covering and certain controls (only about a dozen of this type)
- Sanitary landfills complying with the Law on Waste and other relevant regulations.

Only 5 landfills currently possess the necessary building and operating permits to be in this last category. Examples of satisfactory landfills are the new Jakusevec landfill, Bjelovar (under construction, but already partly in use), Hum na Sutli, Dubrovnik (being upgraded), Osijek (being upgraded) and possibly several landfills in Istria.

The many inadequately equipped and managed sites are a threat to the environment. Numerous landfills endanger groundwaters, such as the old Jakusevec landfill in Zagreb (Box 7.1). There are cases of documented impact on health by unprotected waste disposal, such as in Osijek, where nitrates in groundwater entered wells and caused oxygen deficiency.

Industrial waste

Industrial waste includes also wastes generated in agriculture and forestry. In the past, there was no obligation to report on the generation, types and treatment of these wastes. Most of the industrial wastes end up at landfills together with municipal waste. The data given in the 1998 State of the Environment Report have been obtained through interviews, questionnaires, extrapolations and other indirect methods. The total amount of industrial waste (excluding agriculture and forestry), generated in the period 1985 – 1993, is estimated at 19.58 million tonnes.

In general, industrial waste has been disposed of at municipal landfills that are not adequately equipped or managed for any type of waste. Of the approximately 600 landfills (including 150 major ones), for which some data exist, only 7 have operating permits. Only two landfills of INA Petrochemical Industries in Kutina and the landfill Lemic Brdo have operating permits for the disposal of industrial waste. No landfill for industrial waste is equipped with a system for collecting and treating leachate, and only few have basic provisions for visual entry controls and physical protection (fence, guards, fire-fighting preparedness).

There is a permanent threat of surface and groundwater contamination by rainwater percolating through landfills, especially in the karst regions. A particularly striking example is the so-called "Black Pit" (Crna Jama), a dump in the karst area near Rijeka containing about 250 000 tonnes

Box 7.1: Municipal waste management in Zagreb

The City of Zagreb, with its large and growing population, has not yet defined or implemented a comprehensive waste management policy. In the past, preferences changed between large-scale incineration and strictly regulated landfilling. The big problem is still the Jakusevec landfill, which is threatening the underlying groundwater reservoir, used for drinking-water supply. The amount of improperly landfilled waste at this site reached 3 million tonnes in 1990 and 7 million tonnes in 1998.

After investigating numerous options, it was decided to successively re-layer the waste, respecting all recent legal requirements. The main problems in this remediation are both technical (how to handle mixed municipal and hazardous waste components) and financial.

Remediation started in 1995, with municipal resources. However, the planned pace of remediation could not be maintained and in 1997 an EBRD credit was requested. The DM 168 million loan, for which the tendering is under way, will lead to a complete remediation of Jakusevec within 4 – 5 years. The loan was obtained on condition that waste collection would be completely reorganized and an additional waste collection fee of HRK 0.06/m^2 (of floor space in the apartment, the basis for calculating the fee) introduced. The reorganization of waste collection is complex as at least 10 companies are involved, which presumably operate as competitive enterprises. Their obligations are not always clear, which results sometimes in inefficiencies.

The preparation of a master plan on waste management would imply the partitioning of waste collection in the City of Zagreb on the basis of concession contracts. The master plan should also define a more systematic approach to separate collection and recycling of different materials. The ZGO company has done much, through publicity campaigns, to raise public awareness about waste management. ZGO has also started to introduce containers for different wastes. At present 2 000 disposal containers for glass are in use; 2 000 for paper; 1 000 for PET; 450 for aluminium cans; 120 for waste motor oil; and 300 for batteries. In addition, there are 6 recycling yards open to citizens and small businesses, 2 composting installations for green waste (with a capacity of 35 000 m^3 each), and 2 pilot projects for collecting the bio-waste of 20 000 inhabitants.

The City of Zagreb needs to take decisions and make choices for a long-term waste management strategy that would significantly increase recycling, extend landfill capacity and waste incineration.

of mixed -- including dangerous -- wastes. Remediation of that dump is an open question. Another geographic area threatened by inadequately equipped and managed landfills is in the counties of Medjimurje and Podravina. Drinking water analyses show a steady increase in components that may percolate from agricultural surfaces and landfills.

In addition to landfilling, various methods of treating or reprocessing industrial waste have been or are still being applied in Croatia. The treatment and reprocessing methods practised in 1994 are summarized in Table 7.2. Because of reductions in industrial production, the amounts of waste generated in 1994 were probably 25 per cent to 45 per cent smaller than in previous years (1985 to 1993). In 1998, they amounted to 6.8 million tonnes. There are no reliable data on the quantities of separated secondary materials from industrial waste. A technical survey estimated that 1 million tonnes of waste was generated in 1998 -- a questionable figure.

In Croatia more than 130 companies trade and process secondary raw materials. Their activities concern mainly iron and steel, light metals, collection and regeneration of polymers (HDPE, LDPE, PVC), collection and packaging of waste paper and textiles. The growing number of such companies will presumably contribute to the reduction in waste to be landfilled. However, the legal status of the companies is often not clear, since few have received the appropriate authorizations from the county authorities for these activities. As a consequence, the county authorities do not have data on the processing installations.

Hazardous industrial waste

The total generation of hazardous waste from industry has been estimated at approximately 200 000 tonnes in both 1994 and 1998. Table 7.3 gives an overview of the amounts generated in the different waste categories.

Some hazardous wastes are being legally exported for treatment abroad, such as PCBs and galvanic sludges. APO (Hazardous Waste Management Agency) estimated that the total amount of exported hazardous wastes in 1997 and 1998 amounted to about 400 t. This is much less than the quantity allowed on the basis of permits given by SDEP in 1997 and 1998, i.e. 23 447.5 t. No data on actually exported quantities are available. Waste oils are collected by specialized companies, as the users of oils must prove, on the basis of registers, that at least 45 per cent of the oils (or a corresponding percentage function of the type and usage of oils) have been delivered to collectors. The collector companies receive attestations from

Table 7.2: Treatment and reprocessing methods for various categories of technological wastes, 1994

Category activity*	Type of waste	Method of handling or treatment	Amounts generated *(Tonne)*
	Total		**4 685 305**
01 00 00	Mining	Disposal on the spot of mining activities or landfilling	100 000
02 00 00	Agriculture, fisheries	Biodegradation in the fields; reuse as cattle fodder	1 470 000
03 00 00	Timber, paper industry; furniture manufacture	Partly thermal reuse, mainly disposal in the woods or landfills	618 000
04 00 00	Leather and textile industries	Mainly landfilling, a minor part is regenerated	12 700
05 00 00	Crude oil, gas and coal processing	Partly recycling; sludges mainly landfilled, sometimes after being solidified	588 000
06 00 00	Inorganic chemical process industry	Disposal mainly at industry owned landfills	16 450
07 00 00	Organic chemical process industry	In a few cases incineration; mainly disposal in municipal landfills or sewers	30 000
08 00 00	Production, processing, trade and use of paints, glues, dyes	Very rarely incineration; mainly disposal at municipal landfills	1 200
09 00 00	Photographic industry	Partly recuperation of valuable components; mainly releases into sewerage	55 000
10 00 00	Thermal power production	Disposal at municipal landfills; reuse as building materials for construction platforms and dykes	31 000
11 00 00	Processing and protection of metals; light metals hydrometallurgy	Partly physico-chemical neutralisation, and recycling; mainly storage at industrial sites	60 000
12 00 00	Surface treatment of metals and plastics	Waste metals are collected for recycling; abrasion sludges are landfilled	10 000
13 00 00	Waste oils	Partly collected and recycled or incinerated in big thermal installations; mainly incinerated in small combustion installations, or goes into sewers	60 000
14 00 00	Organic solvents	Recycling is negligible; mainly released to sewers or stored at production sites	700 000
15 00 00	Packaging; absorbing, protective or filtering materials	Wood packaging is incinerated; plastics and papers mainly landfilled; metals recycled	350 000
16 00 00	Other unspecified wastes	Tyres are landfilled or incinerated (mainly in an uncontrolled or inefficient way); batteries are to some extent returned to the producer	3 200
17 00 00	Construction and demolition wastes	Landfilling; reuse for road construction and as building materials; partly incineration or recycling	1 300 000
18 00 00	Health sector	Small part of hospital waste incinerated, in hospital incinerators or thermal power plants; mainly landfilled	13 000
19 00 00	Waste water treatment and drinking water preparation	Sludges are landfilled or disposed in fields	21 000

Source: State of the Environment Report

Note:
* Croatian waste catalogue.

Table 7.3: Estimated generation of hazardous waste for various source activities, 1994

Category activity*	Type of waste	Amounts generated *(Tonne)*
	Total	**204 780**
03 00 00	Timber processing, paper, furniture production	10 000
04 00 00	Leather and textile industry	10 000
05 00 00	Crude oil, gas and coal processing	40 000
06 00 00	Anorganic chemical process industry	1 800
07 00 00	Organic chemical process industry	8 500
08 00 00	Production, processing, trade and use of paints, glues, dyes	750
09 00 00	Photographic industry	50
10 00 00	Thermal power production	18 500
11 00 00	Processing and protection of metals	40 000
12 00 00	Surface treatment of metals and plastics	7 500
13 00 00	Waste oil, emulsions, oily sludges	60 000
14 00 00	Organic solvents	700
16 02 01	Transformers and condenser containing PCBs and PCTs	20
16 06 00	Batteries	2 200
18 00 00	Health sector wastes	3 250
19 00 00	Sludges containing metals and metal hydroxides	1 500
20 00 00	Fluorescent tubes; other wastes containing Hg	10

Source: State of the Environment Report

* Croatian waste catalogue.

the SDEP, and the registers are submitted through county offices to SDEP and controlled by the environment inspectors.

In Croatia there is only one specialized public installation exclusively treating hazardous waste: it is a mobile waste incinerator (see information in Box 7.2). Some other installations constructed for other purposes may be used for the treatment of specific types of hazardous waste. In general, there is much public resistance to waste incinerators, especially in the case of hazardous waste.

All thermal power installations with a capacity above 3 MW (there are more than 20 in Croatia) can potentially be used to incinerate waste oils, in accordance with the Regulation on Waste Types. This occurs in the INA refinery plants of Sisak and Rijeka. Because of their high operating temperatures, cement kilns could also be used to incinerate waste oils, various sludges, obsolete pharmaceuticals, etc. These possibilities are not being used at all in Croatia. Cement factories did not take up numerous proposals to this end (See Chapter 10 for details).

A few companies possess waste incinerators of limited capacity for their own use, e.g. Regeneracija in Zabok, Herbos in Sisak, Chromos in Zagreb, INA-Refineries in Rijeka and in Sisak. The Dubrava Hospital in Zagreb also has a pyrolytic incinerator, which complies with EU standards. Incineration services are only exceptionally provided to other customers.

Obsolete pharmaceuticals are a major hazardous waste problem. They are a legacy of the war, when uncoordinated humanitarian aid resulted in considerable amounts (ranging between 1 700 t and 2 500 t) of obsolete pharmaceuticals. These are scattered among approximately 250 temporary storage sites. There is no ready-made solution to this issue. Whereas incineration in dedicated incinerators is certainly one option, others have been considered as well. In the past, several options were proposed, e.g. incineration in cement factories, but they failed allegedly because of fierce resistance by the public. The Croatian Electricity Company HEP does not accept pharmaceuticals to be incinerated in combustion installations of thermal power plants. The Pliva industry entered

Box 7.2: PUTO: "mobile" installation for hazardous waste incineration

PUTO (Croatian acronym for "mobile installation for thermal waste treatment") was installed in Zagreb in 1997. It started operating commercially after obtaining a permit in 1998. The main investor is the City of Zagreb, together with the companies Hafner (Bolzano) and IRS (Mannheim). The modular installation makes it possible to reuse the material and energetic content of input waste, at the same time respecting German, EU and Croatian environmental regulations. Flue gas retention is 99.99 per cent, and no liquid waste is produced. The "mobility" of the installation is limited because it requires a special concrete platform. Moreover, moving the installation is a major operation.

With a capacity of 1 200 – 1 500 kg per hour or up to 10 000 t per year, PUTO has done some useful work already. For example, the war resulted in the destruction of the sewerage of the Gavrilovic meat processing industry. PUTO incinerated 20 tonnes of grease. Overall, PUTO has been under-used. It is estimated that the total annual quantity of waste treated either on a test basis or commercially amounts to only 2 500 t. This is the result of the relatively high commercial tariff of HRK 5/kg charged for incineration. However, PUTO's capacity is physically far too small to handle all hazardous waste in Croatia, but PUTO could easily handle all obsolete pharmaceutical waste (see also Chapter 3).

into partnership with PUTO (see Box 7.2) to tackle, at least partly, the problem of obsolete pharmaceuticals. No overall solution has been worked out so far. (For details see Chapter 3).

Inorganic sludges containing heavy metals may be incorporated in brick products without loss of quality. Several companies (Zagorka in Bedekovcina, Prigorka in Sesvete, Ilovac in Karlovac) used to do so, but have delayed or terminated these activities after a change of ownership. As most thermal power plants use gas or fuel, slags and ashes from the only coal-fired plant is not a huge problem. There are plans to use ashes and desulphurization gypsum as input materials for other products (see also Chapter 10).

Several small installations for the regeneration of halogenated *solvents* exist, but their capacities are not fully used. The main reason for this low rate of regeneration is the mixed composition of solvent wastes, which undermines the quality of the regenerated product.

The management of *clinical/infectious/healthcare waste* is inadequate. Some is stored in inadequate conditions at PUTO, awaiting incineration. Their containers do not meet European standards (yellow bins). Wastes are stored without refrigeration and security. Since 1985/86, a crematorium in Zagreb has been used to destroy at least part of these wastes as well as drugs. It is subjected to detailed controls, including on air emissions, by the Institute for Medical Investigations (IMI).

Within Zagreb a number of hospitals have small, old on-site incinerators. Some of these were unable to accept glass, which meant that blood collection vials had to be washed out with a hypochlorite solution, which was then discharged into the drains and to a sewerage system discharging directly into the Sava River. Without inadequate water disinfection, this may in the longer term cause public health problems (see also Chapter 3).

Radioactive waste

According to IAEA criteria, Croatia is a B type country: broad use of radiation sources in industry, medicine and research, but no commercial nuclear reactors. The types and quantities of radionuclides used correspond to the level of industrial development. Industrial use comprises several hundred different gauges and measurement systems for gammaradiography with sealed radiation sources. In medicine sealed and open sources are used for diagnostic purposes (10 nuclear centres) as well as in radiotherapy (6 centres engaged in teletherapy and 3 engaged in brachytherapy). Several institutes use radionuclides for research purposes (tracer techniques, calibration, research, irradiation of medical equipment and food, etc.). Tens of thousands of radioactive smoke detectors and hundreds of radioactive lightning rods have been installed in the facilities throughout the country.

Most of the activities using radionuclides generate radioactive waste. Spent sealed sources are considered a problem requiring special attention. There is no radioactive waste disposal site in Croatia. At present, radioactive waste is collected and stored at two national sites run by research institutes (Institute for Medical Investigations (IMI) and Rudjer Boskovic Institute, both in Zagreb).

Radioactive waste management may have to change, if and when an agreement with Slovenia enters into force regarding the Krsko nuclear plant (see also below).

7.2 Policy objectives and management

Legislation and management structure

The legal framework concerning waste management has been completed in the past few years. The regulations follow as much as possible the recommendations of United Nations bodies and directives of the EU. The legal instruments relevant to waste management are:

- Law on Waste, 1995
- Law on the Transport of Dangerous Goods, 1993
- Law on Physical Planning, 1994
- Law on Nature Protection, 1994
- Law on the Municipal Economy, 1995
- Law on Administrative Fees, 1996
- Regulation on Waste Categories, 1996
- Register of professional institutions authorized to publish reports on physical and chemical waste components, 1996
- Regulation on treating packaging waste, 1996
- Regulation on the conditions for waste treatment, 1997
- Regulation on the conditions for handling hazardous waste, 1998
- Law on the Protection against Ionizing Radiation, 1999

Croatia is also a Party to the Basel Convention on the Control of Transboundary Movements of Hazardous Waste, and the International Agreement on the Carriage of Dangerous Goods by Road (ADR).

The *Law on Waste* is the basic legal instrument concerning the management of non-radioactive solid waste. It classifies waste according to its origin as municipal waste or industrial waste, and according to its characteristics as hazardous waste or inert waste (i.e. not producing any hazardous substances, not even through physical, chemical or biological degradation). The basic goals of waste management are to avoid and minimize the generation of waste, particularly hazardous waste. Wastes should be managed in a controlled way. If possible, they should be reused for material and energy recovery prior to disposal. Waste should be disposed of in controlled landfills and areas contaminated by waste should be remedied.

The Law allocates responsibility for waste management and its financing to different levels of authority, e.g. municipal waste at the level of municipalities; industrial waste at the county level; and hazardous waste at the State level.

Reusable waste components must be collected and stored separately. The producers of waste must inform the Waste Exchange of the Chamber of Commerce every month on the quantities and properties of reusable waste. The Law also defines what should figure on the registers of industrial and hazardous waste. All imports, exports and transits are under the control of the SDEP. The import of waste for disposal or for energy recovery is prohibited. The import of hazardous waste is also prohibited. Only the import of waste that can be treated in an environmentally sound manner is permitted. The Law on the Transport of Hazardous Waste contains safety provisions.

The *Law on Physical Planning* also spells out important provisions for waste management. According to the Law on Waste, installations for the storage, treatment and disposal of waste must be identified and indicated in physical planning documents. The most important physical planning documents as regards waste management are:

- State Strategy and Programme of physical planning
- Physical plans at the county level
- Physical plans at the municipal level

The most recent physical planning strategy at the State level was adopted in 1997. On the basis of this non-binding document, Croatia's Programme of physical planning was discussed and adopted in May 1999. This Programme is relevant to waste management as it determines the approximate distribution over the counties of storage sites for hazardous waste (4 locations in the country), centres for waste treatment and storage, and collection points for industrial wastes. The Programme also indicated two locations (Petrova Gora and Moslavacka Gora) for the possible disposal of low- and medium-level radioactive waste, but the Parliament rejected the Moslavacka Gora site.

On the basis of the State Strategy and Programme of physical planning, each county is obliged to develop a county physical plan by the end of 1999, and each municipality has to develop a municipal physical plan by the end of the year 2000.

At local level, the *Law on the Municipal Economy* defines and gives the responsibilities to municipalities to clean public areas and collect, The Law does not exclude the possibility of setting-up private-public partnerships (e.g. through giving concessions) for delivering the services required. In fact, the Law lays down that the provider of the service will determine the price and way of paying for a specific service. This explains

Box 7.3: Waste management in Sisak

According to a 1995 study, the city of Sisak produces 55 600 tonnes of waste a year, 25 per cent of this is municipal waste and 75 per cent industrial waste, including 8 per cent hazardous waste. To cope with this waste in the future, several projects have been initiated.

Sisak has a municipal landfill "Goricica", which was opened in 1987. Since then, about 450 000 m^3 have been disposed of there. This landfill is not up to modern standards and requires remediation at a total cost DM 10 million. The first stage, accounting for 25 per cent of the total cost, will be funded by the City. The remedial operations will include: removal of old waste deposits, the construction of a quarter of the circumference dam, placing a quarter of the ground sealing layer, building a dewatering and percolating water treatment system, a system for horizontal degassing, and a quarter of vertical degassing together with a gas-collection station, provisions for environmental monitoring (groundwater).

To that end, a tender was issued which, on top of remediation, also includes separate collection of waste, building of a composting installation, establishment of 2 recycling yards, and the day-to-day maintenance of the landfill. These measures will result in a reduction of about 45 per cent in landfilled waste. The company Saubermacher from Graz (Austria) on the tender and has already begun the separate collection of four categories of municipal waste: glass, paper, biodegradable waste and the rest. The concessionaire pays a fee of DM 50 for each tonne of waste, and collects HRK 30 per month from each household regardless of the living floor area, but with reductions in certain cases (singles, rural households that use their bio-waste). There are still some illegal dumps (mainly because bulky waste is collected only twice a year), but in general the system functions well, with a 90 per cent collection rate, which meets expectations.

Future developments (complete remediation, weighing of the amount of waste thereby stimulating waste minimization, energy recovery of landfill gases) are planned for the more distant future, and will depend on the economic recovery and access to credits.

As regards industrial waste, Sisak already has three installations for thermal treatment:

- INA Oil Refinery has a fluid furnace for the combustion of sludges resulting from liquid waste
- INA rotary kiln for oil-based waste is in the final phase of construction
- Chemical industry "Herbos" has a pyrolytic furnace for the combustion of containers polluted with pesticides and chemicals from pesticide production.

All these installations need retrofitting to comply with the most recent legislation. In addition, the county should anticipate other sites for the treatment and disposal of industrial waste which is not yet treated properly. It is expected that this will happen in the framework of the harmonization and adoption of the county environmental protection plan and the physical plan by the end of 1999.

that the basis and actual level of payments differs from municipality to municipality. Some successful initiatives for waste management exist at local levels (see Box 7.3 on Sisak). However, most transport, treat and dispose of municipal waste. municipalities are not able or not interested in changing the situation, whereas the SDEP considers itself not responsible for municipal waste.

The *Regulation on waste categories* contains a waste classification based on EU legislation. In addition, it incorporates the possible ways of handling waste according to Austrian and German standards (ONORM S 2100 and LAGA Catalogue). The definition of hazardous waste follows the Basel Convention. The Regulation gives also detailed instructions on the maintenance of registers on the generation and handling of wastes. The registers must be accessible for inspection. Collected data must be submitted to municipal, county and State bodies so that they can be incorporated into the Emission Cadastre.

The Regulation contains special provisions for the management of waste oils and the packaging of hazardous substances. Waste oils must be collected separately; they may be incinerated only in installations which produce 3 MW or more, or in cement kilns, to ensure the required combustion temperatures. Waste packaging of hazardous substances such as pesticides and waste oils must be collected in an organized way, by licensed enterprises. The Regulation does not cover infectious (hospital) wastes. The Regulation does contain obligations and detailed prescriptions concerning the sampling and the examination of the physico-chemical properties of hazardous wastes.
The *Regulation on the conditions for waste treatment* determines the technical conditions as well as professional qualifications needed for collecting, storing, treating and landfilling non-hazardous wastes. For thermal waste treatment utilities, the temperature of burning gases in the most unfavourable conditions must reach at least 850°C. However, energy recovery is not obligatory.

The waste collector may collect and sort waste only with a valid permit. The provisions concerning waste landfills generally follow EU legislation. The landfills are classified in categories I or II, depending on the type of waste they take. Municipal waste goes to category I landfills; industrial waste to I or II, depending on its leachability. The protective layers of category II landfills must have a minimum impermeability

which is 100 times higher than in category I landfills. The landfills must have adequate systems for dewatering and drainage. The leachate must be drained and controlled every three months. A borehole must be established at the place of groundwater inflow or discharge. On category I landfills, waste gases must be collected and treated, allowing for their chemical composition and quantity to be measured. The landfills must be fenced and guarded. Closure of a landfill must comprise measures such as: providing stability, technical and biological recultivation. The provisions of the Regulation apply to all new waste treatment facilities and landfills. For the existing utilities, the deadline for application is extended to early 2002.

The *Regulation on the conditions for handling hazardous waste* determines the technical specifications of installations for the storage, treatment and disposal of hazardous wastes. It also specifies the professional qualifications of those employed in hazardous waste management.

For thermal waste treatment utilities, the temperature of burning gases in the most unfavourable conditions must reach at least 850°C. If the waste contains more than 1 per cent halogenated organic compounds, the combustion temperature must be at least 1 100°C. There are no special air emission limits, apart from the regular ones.

The provisions concerning waste landfills generally follow EU legislation. There are strict requirements concerning the control and registration of data concerning the categories, quantities and origin of wastes. The requirements regarding the protective layers and the handling and control of the leachate are very stringent. The landfilling of some types of wastes is restricted: liquid, dust, pressurized gas, explosive, oxidizing or inflammable wastes, and wastes excluded by special regulations. Solid hazardous wastes may be landfilled only if their leachability for a series of noxious substances does not exceed specified limits.

There is also a *Regulation on the collection of packaging waste*, its labelling, treatment and disposal. The main provision is that the producers who put into circulation packaged materials must separately collect, according to packaging categories, and take back the packaging waste. The subsequent treatment must enable reuse or recycling of the packaging materials. Disposal is permitted only if such treatment is economically not feasible.

Finally, according to the *Law on the Protection against Ionizing Radiation*, the conditions for treating and disposing of radioactive waste are to be prescribed by the Minister of Health. The Law prohibits the import, storage and disposal of radioactive waste that has not been generated in Croatia.

Policy priorities

There is no formal strategy on waste management as such. A draft document was prepared in 1992 by the Hazardous Waste Management Agency (APO). However, that document had no government backing, and it was neither discussed nor approved by the public or Parliament. While now obsolete, the document addressed many problems that are still unsolved. It also formulated strategic aims and short-term goals.

The document abstracted in these tables has possibly played a role in the subsequent drafting and adoption of legislation on waste management. Some other successes are: (a) the initiation of a waste cadastre; (b) the accession to the Basel Convention; (c) the formulation of some educational programmes; and (d) the partial introduction of public information on waste management. However, most of the short-term goals have not yet been attained. There are no economic incentives to reduce the generation of wastes, either municipal or industrial. In particular, there are no incentives to recycle waste; everything is left to the market.

Waste management instruments and their application

The Law on Administrative Fees determines the fees for obtaining permits for the export, import or transit of wastes (see table below).

Category of permit	Fee (Kunas)
Import of waste	2 000
Export of waste	2 000
Transit of waste	2 000
Transit of hazardous waste	5 000
Compliance with technical requirements and equipment specifications for waste storage, treatment, disposal	1 000

The generators of municipal or hazardous waste have to pay a charge (see Chapter 2). The fee collection efficiency is similar to that for electricity and gas, i.e. about 70 – 75 per cent. No fees have so far been determined for the generation of industrial waste. At present, the fees for the collection and disposal of municipal waste cover the operating costs, but not the necessary investment costs for waste management infrastructure. The average fee for collecting and disposing of municipal waste is now 17 Kunas per household per month, which is 5 to 10 times less than in western Europe. While this fee is low compared to west European levels, it is high compared with Croatian salary levels (see also Chapter 2).

The Law foresees compensation to owners for the loss of value of their real estate located in the neighbourhood of installations for the storage, treatment or disposal of waste. This is applicable both in the context of inter-municipality agreements and with respect to private owners. A difficult case is that of waste of unknown origin, dumped by an unknown person. In that case the environmental inspector decides on the removal of the waste within a certain period at the expense of the real estate's owner if that is a legal person, or at the expense of a local self-government unit if the real estate owner is a physical person.

SDEP verifies compliance with the provisions of the Law. The Law contains very detailed penalties for various offences. The penalties for enterprises range between HRK 30 000 and 400 000 depending on the offence, and between HRK 5 000 and 50 000 for company managers.

The new system of multiple *permits* for managing waste has been in place only for a few years, and there is little experience with the permitting system, as there are few new installations. Before the construction permit can be given, the EIA rules must be followed. This may also require a change in the physical plan of the county. As a rule, construction permits for municipal waste landfills are given by the county office, but the county can forward the issue to the SDEP. Construction permits for installations treating hazardous waste are given by the Ministry of Construction in agreement with SDEP. Concessions for collecting waste must be approved by the county office, but in the case of hazardous waste including waste oils, the approval must be given by SDEP. An example of how spatial planning and waste management interact at county level is given in Box 7.4.

Much of the work of the environmental inspectorate concerns waste. Of the 400 cases where sanctions were imposed, more than half relate to waste. The inspectorate is under-staffed and works in an unfavourable economic situation which makes enforcement difficult. The staff has generally good technical training. However, the legal procedures are so time-consuming and the backlog is so large, that the inspectors prefer to impose sanctions through negotiated agreements, instead of going to court - a situation that does not render enforcement transparent.

The functions of issuing permits and verifying compliance are not always separated. In other cases, the responsibilities for verification and enforcement are fragmented. For instance:

- The control of the import, export and transit of wastes is the responsibility of the waste section within SDEP, which also issues permits.
- The control and permitting of waste incineration is the responsibility of the air protection department within the SDEP.
- The control of hospital (medical) and radioactive waste is under the supervision of the Ministry of Health.

Overview of existing problems in waste management

1. Non-compliance with legislation
2. Municipal fees collected not sufficient to finance waste collection and disposal
3. Instruments for financing waste management by enterprises not established
4. Uncontrolled landfills pollute surrounding soil and groundwater
5. No incentives for clean technologies
6. Lack of environmental awareness among citizens and enterprises
7. Spatial plans do not sufficiently consider siting for waste storage and disposal

Strategic aims

1. Establish a systematic and comprehensive approach to waste management, including preventive measures and remedial action
2. Reduce waste generation to the minimum
3. Reuse waste to the maximum
4. Minimize waste disposal
5. Introduce and apply EU criteria in waste management
6. Apply both territorial and branch approaches for separate collection, storage and disposal
7. Adopt a methodology and criteria for the choice of disposal sites
8. Increase cooperation with other States regarding waste management. This implies regulation of transboundary waste movements; accession to conventions on transport and control of waste substances; unified control of imports and exports of waste materials; incentives for market mechanisms in transboundary management of waste; incentives for reprocessing of secondary materials.
9. Organize a system of waste management which clearly defines the stakeholders, their obligations and rights, a system of institutional support and an information system
10. Create governing bodies to take up both control and advisory function in the process of waste disposal
11. Formulate educational programmes, ensuring communication and information to enable equality of all stakeholders
12. Put the burden of the full costs of waste management on generators or owners of waste
13. Remediate areas devastated by waste according to the priorities defined in the framework of remediation programmes.

Short-term goals and implementation

1. Adopt a waste management strategy
2. Formulate and adopt a short-term implementation programme
3. Amend a law on waste with accompanying regulations and decrees
4. Evaluate Croatia's entire territory with regard to the siting options for the disposal of various waste categories
5. Support the establishment of a waste cadastre
6. Identify waste devastated areas, define priorities for remedial actions
7. Prepare the basis for the financing of specific actions
8. Establish the organization of the waste management and initiate the establishment of an information system
9. Launch incentive mechanisms for an efficient waste management
10. Prepare the basis and initial financing for public waste disposal companies
11. Specify contents of educational programmes
12. Introduce a concept of continuous public information on waste management

Box 7.4: Physical plan and waste management in Varazdin County

A draft physical plan for Varazdin County was published by the County Institute for Physical Planning in January 1999. Waste management is identified as one of the county's major problems. There are 5 controlled and more than 100 uncontrolled landfills. As a first step towards a comprehensive solution to the problem, a study was carried out on the selection of future waste disposal sites. As none of the potential sites has been accepted so far, discussions are focusing on choosing technologies and approaches that would minimize, and if possible obviate, the need for waste landfilling as a permanent solution.

However, as the waste management situation is critical in a number of municipalities, and in particular in the City of Varazdin, landfilling will remain an option for some time to come. The collection of municipal waste in Varazdin was organized until recently by the municipal enterprise "Varkom", but recently this activity has become the subject of a concession to the private company Saubermacher. As there is no suitable location for a landfill in the municipality of Varazdin, all municipal waste is being transported (since 1983) to a landfill site in the municipality of Gornji Kneginec. The City of Varazdin pays DM 47/tonne of waste to the municipality of Gornji Kneginec, an amount that is not sufficient for additional investments, such as the necessary remediation of the landfill for its orderly closure in 2005. It is not yet clear how the necessary funding for investments and remedial action will be provided. It is expected that, with economic recovery, the concessionaire will be able to raise the contributions or service fees from the citizens. The municipality may take out a loan, but also this solution will depend on future economic recovery.

- The illegal dumping of waste into (surface) waters does not seem to be part of the responsibility of the environmental inspectorate (responsible for waste management only), nor of the water inspectorate (responsible for water protection - see the case of toxic releases in a lake near Imotski).
- The frequent illegal (but profitable) quarrying of gravel should be subject to a permit from the State Water Directorate and inspected by the mining service. Furthermore, the illegal dumping of waste into the pits contravenes SDEP nature protection rules. The three responsible authorities are not effective in halting this practice.

It seems that, in many cases, the various administrations responsible for inspections and controls of waste management do not operate jointly, nor under joint operational planning.

An important stakeholder is the Hazardous Waste Management Agency (APO). It was founded by HEP (Croatian Electricity Board) in 1991 and registered as a public enterprise under the Yugoslav laws in force at the time, particularly to manage hazardous and radioactive waste. The major task then was to build a repository for low- and intermediate-level radioactive waste, generated by routine operation and from the future decommissioning of the nuclear power plant Krsko in Slovenia, which started operation in 1984. Since 1991, the Agency's mandate and character have evolved. It is now a private company with limited liability, and with a wide scope of activities and know-how in hazardous waste management and the promotion of cleaner production. Its position is unchallenged. Various companies and State authorities use its professional services.

The implementation of the Law on the Municipal Economy depends very much on the traditions, vested interests and economic potential of each municipality. The present system of fees is based on the living or useful surface of private or industrial premises, which does not encourage a reduction in waste generation. It would be worth considering a system whereby the fees for municipal waste would be linked to the quantity produced, and the fees for industrial waste would be linked to its quantity and hazardousness.

The Regulation on Waste Categories specifically calls for the maintenance of registers on the generation and handling of wastes. However, the fact that many enterprises keep much hazardous waste on their premises without reporting it, means that this regulation is not fully complied with. The fact that enterprises cannot afford to pay for treatment and that there are not enough resources for inspection leads to frequent misrepresentation of waste-related data. It is unlikely, therefore, that the Cadastre on Waste will be complete and reliable by the end of 1999 as it is based on the information transmitted by enterprises to county offices.

The implementation of the Regulation on Treating Packaging Waste is in its initial phase. A number of municipalities including Zagreb, Osijek and Rijeka have started placing special containers and giving concessions for emptying them.

Whereas the control of radiation protection is mainly the responsibility of the Ministry of Health,

the nuclear fuel cycle including the management of spent fuel elements is within the realm of the Ministry of the Economy. However, the exact delimitation of responsibilities is not clear. There is no clear and coherent policy on nuclear waste management. On the one hand, the ban on the import of radioactive waste, as stipulated in the Law on the Protection against Ionizing Radiation, may contradict the contractual obligation between Croatia and Slovenia, stemming from 1970, concerning the responsibilities of the Parties resulting from co-ownership of the Krsko nuclear plant. Both sides seem to disagree on the interpretation of their contractual responsibilities. On the other hand, the plans to build a low- and medium-level radioactive waste disposal installation at Moslavacka Gora have been stopped with the designation of Moslavacka Gora as a nature park, and by the subsequent rejection of this location by the Parliament. Discussion of these issues between Slovenia and Croatia appear to advance slowly.

7.3 Conclusions and recommendations

The legislative instruments for waste management form a fairly complete formal basis for action. There are still a few gaps, e.g. there are no specific technical provisions concerning the remediation of waste dumps containing mixed wastes of unknown origin and composition. Also, the Law on Waste is mainly geared towards industrial waste management, whereas the Law on the Municipal Economy contains very little on the substantive issues of waste management, and the two laws are not consistent.

The biggest problem is the application of the existing instruments. However, the legislative instruments have not been in force for very long. It is therefore likely that the situation will improve somewhat with time. However, implementation remains a problem, partly because of some structural weaknesses, and partly because of a lack of human and financial resources. The remaining structural weaknesses can be corrected during implementation (like the separation of issuing permits from inspection activities).

The lack of human resources for waste management within the State authorities, especially the inspectorates, constitutes a considerable problem. Although the staff are highly qualified, their numbers are too small, and there is a lack of transparency and training in modern management, including in joint operations between services. Consequently, the authorities involved, including those responsible for economic and market development and reconstruction, do not play a role – as they should - in preparing instruments to promote cleaner production and waste minimization (see also Chapter 10).

This is equally true for the skill development at the county and municipal levels. With the given division of roles and responsibilities in waste management, the municipalities and counties should invest into capacity building to empower staff to develop master plans, financing and concession models, and to cooperate with other municipalities as well as with enterprises within the county. SDEP should take a leading role in bringing together counties and municipalities to develop coherent plans and learn from each other.

There is much need to develop professional capacities in the private sector as well. This is true both for the generators of waste and for the companies providing competitive consulting services. The sector organizations should be stimulated to develop strategies and action plans on waste minimization and waste management. This should lead to the growth of a consulting and service industry.

Recommendation 7.1:
The enforcement of the existing waste legislation should be considered the first priority for waste management. It should be facilitated by clearly committing sufficient resources to the task, including money to train inspectors and other public and private staff involved in waste management.

There is no integrated strategy on waste management. The most important challenges are financing of waste treatment and waste management in general, public acceptance of treatment and disposal installations, communication between waste generators and authorities, and coordination/harmonization with other public management sectors (physical planning, reconstruction, water protection, tourism, industry, agriculture and health). Most importantly, there are no efficient economic stimuli to help reduce waste generation and increase recycling and reuse of waste. All competent authorities should cooperate to prepare adequate economic instruments and harmonize them with policies favouring the introduction of cleaner technologies (see also Recommendations 10.2 and 10.4).

The scarcity of efficient economic instruments has several undesirable consequences. For example, compliance with the legal provisions regarding the collection of waste oils is unsatisfactory. On the one hand there is a lack of inspectors, on the other some enforcement measures cannot be strictly applied because the fines are so high that they would bankrupt enterprises in the present economic situation. Therefore, enterprises tend to adopt illegal practices – a sign that the instrument applied is not working.

There are no fees for the generation of industrial waste. It seems that the new waste cadastre, which is being established, will provide the necessary database for the determination of such fees. Also, there are no provisions in the State budget concerning the construction of landfills or incinerators. As compliance with the regulations on handling hazardous and non-hazardous waste requires additional investments, and since the industries are in a rather difficult financial situation, many prefer to hide the industrial waste and do nothing for the time being.

Recommendation 7.2:
A national waste management policy plan – currently under preparation as part of the National Environmental Action Plan - should be implemented, including legal and economic priorities and instruments that actually achieve the intended goals. A subsequent national programme of action for the various sectors should be adopted, making budgetary and other financial commitments. Special attention should be given to financing hazardous waste management. See also Recommendation 7.3.

Efficient waste management presupposes well coordinated activities at the local level of public management. The State authorities should assume a more proactive role in establishing a dialogue with and among the municipalities in order to establish a more sustainable framework for managing municipal waste. The fees for the collection and disposal of waste should take into account both operating and investment costs, and encourage the minimization of waste generation. Recycling and reuse are also to be encouraged (see Recommendation 2.3).

The practice of issuing permits for the import, export and transit of waste, and in particular hazardous waste, is ambiguous. Often the same body that issues the permits also seems to verify compliance. Different sources give different estimates of the quantities of waste involved. The tasks of issuing permits and verifying compliance should be separated, and more attention should be given to the quantities of waste import, export and transit in the waste register. Data on the import, export and transport of waste should be accessible to the public.

Recommendation 7.3:
The SDEP should consider establishing a small administrative unit to (a) propose streamlining administrative practices in waste management, and (b) facilitate dialogue with and between local waste management authorities. This dialogue should include exchanges on such issues as socially acceptable fees for the collection and disposal of waste. See also Recommendation 7.2.

Recommendation 7.4:
Both the Inspectorate and the Waste Register should give particular attention to the import, export and transit of wastes. It is recommended that detailed data on the permits and the actual import, export and transit of wastes, and in particular hazardous wastes, should be made accessible to the public. The permitting and control functions for the import, export and transit of waste should be separated and made transparent.

The legal instruments (including in some cases official comments) form the policy guidance on waste management in Croatia for the time being. There are no authoritative waste management programmes at the political level. This situation is deplorable since it does not provide for orientation, thereby delaying the solution of urgent issues in both municipal and industrial waste management. Whereas the implementation of physical planning legislation moves ahead, thus pre-empting decisions on the location of various sites for waste storage, treatment and disposal, these decisions cannot replace an integral policy on waste management.

Orientation is first of all needed at the municipal and county levels. All municipalities should be

required to develop master plans for waste management, including financing. They should address municipal, infective and industrial waste. Smaller municipalities should strive to cooperate in finding adequate organizational solutions for the management of municipal waste. A pilot programme for the promotion of municipal waste management could give insight into the possibilities of capacity building for municipal waste management and inspections.

Recommendation 7.5:
The SDEP should consider assisting municipalities to develop their waste management master plans, by launching a pilot programme in one county for capacity building in municipal waste management and inspection.

Efficient waste management requires reliable waste information. The fact that the existing data on waste generation and flows are incomplete hampers the development of consistent and credible policies, and their enforcement. The waste cadastre should be developed and used as a supportive instrument for policy development and implementation. The top priority should be determining the quantities, composition and destination of separated secondary materials, hazardous waste and transboundary movements of waste.

Recommendation 7.6:
A sufficiently complete and reliable waste information system should be developed between all institutions concerned, starting from the completion of the waste cadastre. The public should be informed of possibilities for waste reduction, recycling and similar issues through suitable campaigns.

The safe treatment of obsolete pharmaceuticals, as well as infective waste, is a particularly challenging hazardous waste management problem. If treatment methods need to be further investigated, the use of EIA methodology may be useful. Winning the confidence and support of the public is certainly a precondition for success. Once this problem is solved, the experiences gained could be applied in similar approaches to the treatment of other forms of hazardous waste (see also Chapter 3).

Recommendation 7.7:
The adequate elimination of obsolete pharmaceuticals, hazardous industrial chemicals, as well as medical wastes should be seen as the most urgent problem in hazardous waste management, which should be considered the most important part of waste management in general.

Chapter 8

NATURE CONSERVATION, FOREST AND BIODIVERSITY MANAGEMENT

8.1 Current state of nature

Habitats

Croatia lies on the boundary between two climatic regions with completely different natural conditions, the Mediterranean region and the central-European continental region. Because of Croatia's crescent shape, its north-western and western parts are under alpine influence, its western and south-western parts under Mediterranean influence, and its northern (Pannonian Plain) and eastern region under continental climate influence. Croatia's outstanding natural heritage is the result of its morphology and its geographical position.

It can be divided into three main regions:

- Continental flatlands and hilly countryside in the north. The watershed of the Danube, with most of the territory lying between the Drava and the Sava rivers. It has a temperate central European climate with hot summers and cold winters and 200-600 mm precipitation;
- The Dinaric Alps mountain region belongs to the Danube/Black Sea watershed. It has a mountainous climate with very cold winters;
- The karstic coastal stripe including the Adriatic islands. The climate is Mediterranean with high precipitation (600-1 000 mm) but dry between June and late August. The karst is not capable of holding underground water, therefore only organisms that can withstand the dry months are found there.

The varied geological properties of the bedrock layer and specific climatic conditions in Croatia have resulted in diverse types of soil. The Drava-Sava region has alluvial marshes and fens, and deep and fertile black earth; the slopes of the highlands, where the climate is wetter, are covered with pseudogley. The vast limestone and dolomite region has poorer brown soil, with a predominance of rock land and bare karst with "blotches" of red soil. The valleys are mostly filled with newer alluvium. The best farmland lies in the easternmost part of north Croatia, where the deep soil is suitable for ploughland, for orchards and for rich meadows. In Istria, part of Ravni Kotari, on small areas in the Dalmatian Zagora hinterland, along karst rivers, and on some islands, there is deeper red soil (terra rosa) and brown soil. The delta of the Neretva has an abundance of cultivable anthropogenic peat soil. It is the result of man's efforts to obtain cultivable soil for plantations, vineyards and vegetable gardens. It covers small areas (in the karst region and reclaimed areas).

This diversity of soil, combined with climatic factors, the distribution of watercourses and the bedrock structure, has resulted in a high abundance of vegetation and its peculiar distribution. There is also a very great variety and abundance of animals - on the surface, in the soil, and in the deep karst underground.

The Karst region

The Croatian karst area is about 1.3 million ha. Karst is a set of surface and underground occurrences developed mainly by the action of water, in the carbonated part of the earth's crust. It is found most commonly in the form of limestone and dolomite sediment rocks. The carbonate karst rocks cover 52 per cent of the dry land surface, which represents the most significant natural environment of Croatia. Although natural resources are fairly modest, karst ecosystems have a rich biodiversity. That is the result of local characteristics and isolated ecotypes. Their categories range from mountainous to marine and freshwater ecotypes, and also cave ecosystems. Interest is growing in the habitats of karst undergrounds, where a significant array of Croatian endemic phenomena was discovered.

Forest

Forests cover 36.7 per cent of the country's area. Wood and wood products are a major export

product. The deciduous forests give excellent wood and they are also of indirect value through their ecological and social importance. Because of the great variations in climate, relief, geological and soil foundation, the 20 630 km^2 forest include a great number of forest communities which vary according to their habitat. There are 17 forest communities in the Mediterranean area and 51 in continental Croatia. The north-east and the Adriatic coastal areas are less forested.

The Croatian forests contain a variety of tree types. The beech tree is the most widespread, followed by the common oak, fir and sessile oak, horn beam, ash, soft timbered broadleaves (willows, poplars), and pines (Aleppo pine, black pine). Other trees grow in small numbers. These are mostly deciduous trees, and only 18 per cent conifers, mostly common firs. Most of today's forests in Croatia are the results of natural renewal after the virgin forests were felled in the nineteenth century. In their composition, Croatian forests are very similar to the virgin forests they developed from, and perhaps the most natural in Europe.

Along the Adriatic coast, oak forests are degraded by anthropogenic pressure, as this area has been appreciated for millennia for human settlement (mild climate, sea routes, river mouths, agriculture, and fishing). The forests have been devastated by agriculture, stockbreeding, and felling for fuel and timber. Nevertheless, in comparison with the rest of the Mediterranean region, Croatia has several localities with preserved holm oak forests. There are also white oak forests and Mediterranean flood forests of the common oak. Efforts are made to renew Mediterranean forests, both through afforestation and reconstruction of existing devastated forests into high forests consisting of trees that have grown from seed.

All Croatian forests are highly valued. In the coastal area forests are precious for tourism, recreation, climate and water protection. In mountain areas the hydrological and anti-erosion function is more important. In natural origin forests, the great biological diversity and their capacity to preserve the genetic stock of plant and animal life have more influence. Many animal species that have been driven out of most European forests can still be found in Croatia, for example the brown bear, the lynx and the wolf.

Alluvial forests are especially important for preserving the genetic stock of rare plant and animal species. These are the best-preserved lowland forests in Europe, with many protected nature parks. There are more than 200 000 ha of lowland forests, of which 150 000 are covered by common oak, ash, sticky alder and other hygrophilous species, and about 50 000 by willows and poplars.

Hydrographic system peculiarities

The most abundant inland hydrographic system lies in the north of the country and drains to the Danube and ultimately to the Black Sea. Some of the most important Danube flood plains are located in Croatia, especially Kopacki Rit, which since 1993 has been listed as a Ramsar site. In total, there are 4 Ramsar sites with a surface area of 80 455 ha. Another important wetland nature park is Lonjsko Polje/Middle Sava, which houses threatened waterfowl and the common otter.

All inland waters of the Adriatic watershed reflect the hydrographic features of karst, with a poor surface and a rich underground hydrography, which results in a capricious natural distribution of fresh waters. Almost all rivers flowing into the Adriatic Sea, as well as lakes and groundwaters, are of such high quality that they can be used for water supply. Surface waters are also used for energy purposes. Apart from the Neretva, all rivers are fast and short, with a great variation in flow. Great quantities of rainfall rapidly reach the deep underground water layers. Some of these waters appear on the surface as springs and disappears underground through karstic sinkholes.

Permanent lakes are not particularly numerous. There are 26 natural and artificial lakes, which cover a total surface of 73.51 km^2. The natural lakes are of tectonic, karstic, glacier or riverine origin. To use the watercourses for the production of electricity, 5 reservoirs were built, as well as a number of smaller retention basins for water supply or irrigation purposes. The largest artificial lake, Vraniko (surface 30.7 km^2 and maximal depth of 4 m), is also a significant ornithological reserve.

Coastal area and sea

Croatia has a total coastline of 5 835 km, of which 4 058 around islands. Its coasts are generally rocky and indented. There are over 1 000 islands. A series of islands separates most of the Croatian coast from the open waters. The Adriatic is a relatively shallow sea, with an average depth of 239 m; it is warm and has a high salinity. Even in deeper places near the shore there is a submarine

barrier that does not affect the passage of large ships, but influences water circulation. Depending on the season, sea currents, winds and vicinity of the shore, the sea temperature varies throughout the year in both horizontal and vertical directions.

The highest degree of water transparency is found in the South-Adriatic Pit (56m), while along the coast the average value is 20 m, decreasing towards the north. The sea currents arrive from the Ionian Sea and run along the eastern coast towards the north-west. The coastline is irregular, with numerous bays, islands, sea passages and canals. The exchange of waters of the Adriatic Sea is slow. Near the shore, the salinity is lower due to the freshwater inflow from the land. There are great differences in primary production of organic matter between the practically unproductive southern part and the northern Adriatic (the Bay of Istria-Triest-Venice), which is one of the most intensive primary producer of the whole Mediterranean. This results in great differences in the occurrence of pelagic fish. The Croatian part of the Adriatic is poor in fish as compared to other seas, and even to some other parts of the Mediterranean.

A second lake called Vransko (74 m deep) on the island of Cres is the largest cryptodepression of Croatia. It is a natural phenomenon with a highly sensitive balance of watercourses, which prevent seawater intrusion into the lake. The Blue and the Red Lakes near Imotski are unique hydrographic phenomena in karst, and have been declared natural monuments.

Biodiversity

Croatia lies at the crossroads of several biogeographical regions: the Mediterranean region, which covers the coastal part (islands and restricted or wider coastal belt); the Euro-Siberian-North-American region, which covers the other lowland and mountain parts of Croatia; the alpine area, which is part of the alpine high Nordic region; and the north-east lowland of the Aral Caspian (Iranian-Turan) region. Croatia's biogeographical position gives it a great wealth, variety and special features of flora and fauna. This reflects the varied current ecological factors (climatic, edaphic, relief, biotic), and the changes that took place in Europe in the past, after the Tertiary, and particularly since the beginning of the Pleistocene or Ice Age.

During the glacial periods, great expanses of north and central Europe and the high mountains of the south were crushed under a thick layer of ice. Plants and animals became extinct, and the only species that survived were those that could "escape" to warmer southern areas and "hide" in suitable refuges. Some of these have been found on the territory of Croatia. In the interglacial periods and in the post-glacial period after the last ice age (which ended about ten thousand years ago), the climate grew more favourable and surviving species spread northwards again. Many, however, have not yet moved north but continue to live on as relict plants in more limited or wider areas of their former refuges. Besides current ecological conditions, these are the reasons for the wealth and variety of Croatian flora and vegetation.

Croatia is home to a great number of threatened species, such as the peregrine falcon, the otter and the agile frog (*Rana latastei*), of which only 90 relict populations still exist, four of them in Croatia. As concerns the Adriatic ecosystems, Kornati Bay is an important marine ecosystem, as well as the island. The Cres archipelago is the object of a biodiversity conservation programme, as is Kvarner Bay, where the griffon vulture can be found. Among the marine species, particular attention is given to marine turtles and the monk seal, a threatened species prevalent in the Adriatic.

Table 8.1: Number of different types of known organisms and their status, 1999

Number

	Total number	Endangered vulnerable or rare
Mammals	86	15
Birds	226	152
Reptiles	36	9
Amphibians	20	5
Freshwater fish	113	52
Invertebrates	22 993	..
Vascular plants	4 266	476
Mosses, hepatics	638	38
Fungi	1 686	130
Lichens	925	..
Algae	2 597	

Source: National Biodiversity and Landscape Strategy Action Plan, 1999

Protected areas

Nature protection acts define and protect landscapes of great natural beauty and importance. The latest law of 1994 distinguishes nine basic

categories of protection that depend on the character and purpose of the area. These are: national park, nature park, strict reserve, special reserve, nature monument, park forest, protected landscape, monument of park architecture, a specific plant or animal species. Among other categories, strict and special reserves are subject to very strict biodiversity protection measures.

About 7.5 per cent of Croatia is under some form of spatial protection, and in future that percentage might double. That includes the Adriatic islands, hydrographic and morphological peculiarities, and typical mountainous areas with interesting vegetation and relief, lowland marshy areas and lakes. Some areas are on the UNESCO World Natural Heritage list, Biosphere Reserves of UNESCO MAB Programme, and on the Ramsar Convention list.

Table 8.2 : Protected areas in Croatia, 1999

	Number	Total area *(ha)*
National park	8	99 400
Nature park	10	404 600
Strict reserve	2	2 400
Special reserve	74	32 500
Natural monument	80	600
Protected landscape	32	40 500
Park-forest	36	7 900
Monument of park arch.	114	900

Source: SDEP.

Table 8.2 shows that most of the protected areas are nature parks (about 9/12) and national parks (about 2/12). Since these are large and important areas with usually a diversity of interests, they are designated by the Croatian Parliament. County authorities designate other categories after reaching the necessary agreements.

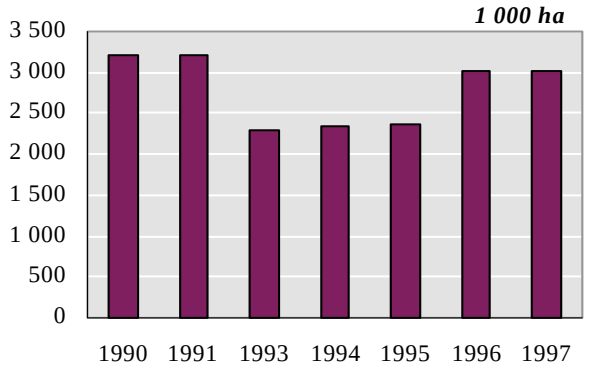
The structure of national parks and nature parks is a good illustration of the richness and diversity of Croatian nature. Three national parks are on islands (Kornati, Brijuni and Mljet) and include the surrounding sea. Two represent the karst hydrography (Plitvice Lakes and Krka); two are typical mountain regions in terms of vegetation and relief (Risnjak and Poklenica). One more national park is planned, North Velebit, today part of Velebit Nature Park.

The category of nature parks is a new form of protection in the world and in Croatia. It is used in areas whose overall natural values are great enough to merit protection and conservation, but which do not fulfil, or where it is impossible to meet, the much stricter criteria of national parks. Hunting and agriculture, which can be done in nature parks, are part of their management. Three of the nature parks are typical mountainous areas (Velebit, Biokovo and Medvednica), one is insular (Telascica), and two represent the biological richness of lowland marshy areas (Kopacki Rit and Lonjsko polje). The Plitvice Lakes are on the UNESCO World Natural Heritage list. The Velebit Mountain is included in the Biosphere Reservations list, while four of the areas are on the Ramsar Convention list (Kopacki Rit, Lonja Plains, Neretva River Delta and Crna Mlaka). Protected areas have suffered damage during the war but exact assessments of the damage are not available (see Chapter 3).

8.2 Impact of human activities on nature

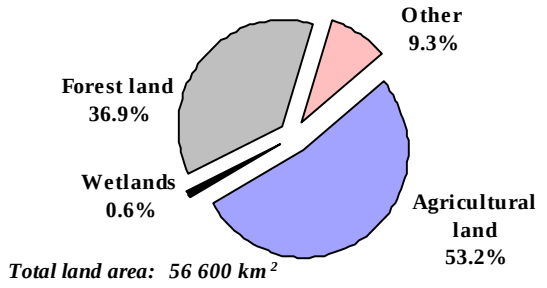
Agriculture and land use

Figure 8.1: Area used for agriculture, 1990-1997



Source: Statistical Yearbook, 1998.

Figure 8.2: Structure of land, 1996



Source: Statistical Yearbook, 1998.

The rural population is steadily decreasing. The cultivation of traditional Mediterranean species (grapes, olives) is diminishing and giving way to other species that are less labour-intensive or more profitable. The decreasing trend in the agricultural population and in the area of cultivated land in the coastal region is reinforced by the re-orientation of the landowners to tourism. The use of the agricultural land near urban centres has to a large extent been changed to meet the needs of secondary or tertiary activities, or turned into settlements. The use of fertilizers has decreased in recent years and agriculture is not considered a major source of soil contamination. Livestock production is more pronounced in the hinterlands of the coastal counties, which are hilly (sheep, goats). Individual farms dominate livestock production.

Soil erosion

Over 90 per cent of the soil surface is exposed to erosion of various intensities. The situation is particularly severe in the karst area, where erosion has reached the geological base. Forest fires, which are a major problem in areas with Mediterranean vegetation, are also a cause of soil degradation. Central and coastal Istria are the worst affected due to the increased erodibility of local soils and amalgamated layers where annual amounts of eroded material per hectare reach 100 to 200 tonnes. The situation is similar in the delta and coastline of Neretva River, which receives large amounts of earth from neighbouring Bosnia and Herzegovina.

Soil protection has so far been implemented through environmental protection measures resulting from environmental impact assessments for facilities and projects that required an environmental impact assessment study. This is regulated by the Physical Planning Act and the By-law on Environmental Impact Assessment. The establishment of a system of detailed information on the state of the soil is recognized as a priority, and the SDEP has begun a habitat database to create a soil inventory. It also foresees the establishment of a permanent system of soil monitoring.

Forest exploitation and forest resource management

Approximately 85 per cent of forestland in Croatia has a high production potential. In 1996 Croatian Forests sold 2.9 million m^3 of timber, which represented about 80 per cent of wood production in Croatia, of which 10 per cent were exported. The remaining 20 per cent are mostly corkwood and firewood, produced by small private forest owners.(See Chapter 11 for a more detailed presentation of commercial forest use.)

The condition of the forests worsened in 1995. Crown transparency above 25 per cent was found in 30 per cent of the broad-leaved trees, whereas 45 per cent of the conifers were severely damaged. Oak and fir are the most affected tree species. In terms of forest degradation, Croatia is 17^{th} in Europe (see also Chapter 11). Forest fires are a major problem. This problem is particularly acute in the coastal area and the islands, which account for 32 per cent of the total area burnt and almost half the fires. Research and experience show that a fire diminishes soil fertility, decreases the content of organic substances, interrupts the biological cycle of elements, and increases its tendency for erosion. Different soil types are not equally vulnerable to such degradation. Croatia does not systematically monitor changes in the soil quality resulting from fires.

Hunting and fishing

Organized hunting has a very long tradition in Croatia. Game animals are treated as part of the national wealth. The Faculty of Forestry has a chair on hunting, and is involved in game management. The Hunting Law of 1994 withdrew the management of hunting grounds from local hunting clubs, and switched to commercial leasing. The Law divides the country into hunting areas; each leased to a private person/organization that is responsible for implementing a management programme for that area. The Ministry of Agriculture and Forestry approves the programme, and also employs hunting inspectors. The Law specifies a list of game animals, which is regulated by the Ministry of Agriculture and Forestry. Around 50 000 hunters are registered in about 500 societies.

Fishing is a traditional branch of agriculture. There is a pronounced downward trend in the catch of seafish, molluscs and crustaceans (from 48 822 tonnes in 1987 to 17 347 tonnes in 1996). The largest part of the catch consists of pelagic fish, the largest share being pilchard. Alongside fishing, there is some rearing of marine fish and shellfish. In 1995, 25 fish farms were registered, of which 17 on the islands and 8 on the mainland. These

Error! Not a valid link.

produced 1 600 tonnes of marine fish, 600 tonnes of mussels, and 50 000 tonnes of oysters (see Figure 9.1 in Chapter 9).

Urban and industrial development

The large and medium-size towns absorbed the greatest migration pressure triggered by the outbreak of hostilities in Croatia. It is estimated that the population of Split has grown by almost 30 000 since 1991, that of Rijeka by more than 18 000, that of Zadar by more than 24 000, that of Pula by almost 15 000, and that of Dubrovnik by almost 10 000. One negative aspect of war migrations is the increased depopulation of the hinterlands, putting more pressure on the coastal urban infrastructure and leading to changes in the cultural identity of towns.

The growth of the active population will be slower. The most important factors are population size and its spatial distribution. According to the population census of 1991, Croatia had 4 784 265 inhabitants and an average population density of 86.6 inhabitants per square kilometre. Population density is higher in continental (Pannonian) Croatia, adding to the environmental pressures there, than in the mountainous part, where it falls below the average. Accordingly, the environment of mountainous Croatia is relatively closer to its original state. According to the Mediterranean Blue Plan scenarios for the period 2000-2005, a further urbanization in the whole country, and especially in the coastal region, can be expected. Two further trends are also visible: an increase in the number of households, leading to an increase in environmental pressure, and at the same time, a reduction in household size, which in turn weakens household pressure on the environment.

Industry exerts many different environmental pressures. Corresponding indicators show a general downward trend for the period 1990-94 (see Chapter 10), due to both the war and the transition. Certain sectors have recorded growth in production (although still below 1990 levels) and, accordingly, stronger environmental pressures, while others face further production cuts. Primary energy production and consumption, together with growing difficulties in the energy sector, create poor conditions for the solution of the existing management and structural problems. At present, responses to the environmental pressures from industry are uneven and insufficient.

Transport infrastructure

The total length of roads is expected to grow in the future as the density of the road network, especially of motorways, is still insufficient. This is particularly true for the coastal counties. Croatia is planning to build 1 600 km of four-lane motorways, mostly during the next decade, which should overcome the poor connections between the northern and southern parts of the country.

Other communications infrastructures also exert strong pressure on nature. Of the 9 airports, 7 are in the coastal region (Split, Dubrovnik, Zadar, Pula, Rijeka, Brac and Mali Losinj). Seaports, both for passengers and cargo, are located along the entire Adriatic coast. The most important cargo ports are those of Rijeka and Ploce. The traffic in Croatian ports dropped from 29 042 000 tonnes in 1987 to

13 875 000 tonnes in 1996. 10 million passengers were recorded in 1996, and their number is on the increase. The telecommunication network of Croatia is one of the best among the countries in transition (29 telephone lines per 100 inhabitants).

Tourism

Approximately 92 per cent of Croatia's tourist income is realized within the karst area, chiefly owing to summer tourism on the Adriatic coast and on the islands (for details see Chapter 12). Landscape features of karst offer many other tourist possibilities, e.g. speleological tourism, which is so far insufficiently developed. The Central Istria Regional Park has begun to develop eco-tourism projects, within the framework of conservation policies aiming at reducing the pressure of tourism on congested coastal strips. The generous, ecologically valuable environment is the one strategic resource that should contribute to the long-term growth of tourism.

A major problem is the relation between the further development of tourism and environmental issues. The pre-war tourist infrastructure had largely been developed in disregard of sustainable development. Several management plan studies have been undertaken, for example a study for the conservation of the Cres-Losinj archipelago, which seeks to identify a balanced approach to the development of the area. In December 1996, the World Bank approved a Coastal Forest Reconstruction project of US$ 42 million. In February 1997, the Croatian Parliament adopted the National Programme on Sustainable Island Development.

8.3 Nature protection policies and management

Legislation and policy objectives

Integrated environmental quality conservation and natural communities conservation are guaranteed by the Law on Environmental Protection. Nature protection is governed by the Law on Nature Protection (1994), which covers the protection and use of natural resources and the management of national parks, nature parks and other protected areas. This Law is the basic Croatian act regulating biological and landscape diversity preservation. The Law establishes 8 spatial protection categories (national park IUCN II, nature parks IUCN V, strict nature reserve IUCN I, special reserve IUCN I, monument of nature IUCN III, protected landscape IUCN V, park forest IUCN V and park architecture monument). Among the other categories for the protection of specific plant or animal species, managed by the respective counties, strict and special reserves are subject to very strict biodiversity protection measures. This Law also protects certain plant and animal species. These are predominantly species endangered or rare on the national scale, but also some internationally endangered species, protected in accordance with international conventions. The Law on Nature Protection prohibits killing, catching, hurting, capturing, buying, selling, importing or exporting protected species as well as destroying their habitats.

All wild animals in national parks, strict and special reserves, as well as the entire wildlife of the caverns, are protected by the Law on Nature Protection. All Croatian nesting birds are under protection, together with all other European bird species, except for the species intended for shooting, cormorants at the fish ponds and starlings on agricultural land. Reptiles are increasingly endangered because of the pet trade. Almost all native reptile species except for the horned viper and the common adder are protected, and so are almost all amphibian species, except three green frog species. The protection regime of other animal species is being revised, although the lack of scientific data and knowledge of the Croatian fauna is a serious problem. There are only 44 protected plant species and 130 fungus species. A rulebook is now being prepared that will regulate the protection of all the species of Croatia's Red Data List. The majority of native mammal species are also protected with the exception of the so-called problematic species and species intended for hunting.

Different laws regulate the protection of other, economically significant, animal species, such as the Law on Hunting (1994), the Law on Freshwater Fisheries (1993) and the Law on Marine Fisheries (1997). The economic use of all other unprotected species is regulated by special permits, issued by the State administrative authority in charge of nature protection pursuant to the Law on Nature Protection. This concerns mainly gathering edible snail and green frog species, but also certain other animals.

Croatia has a long and rich legislative tradition in forest management and natural forest regeneration. Clear-cutting is banned by the Law on Forests (1993), and natural regeneration is a fundamental

postulate. Only 5 per cent of forests are cultures and plantations. In the past several years, numerous acts have been passed containing regulations and resolutions relating to the sustainability and biological diversity of Croatian forests. The most fundamental are: Law on Forests (1993), Forest Seeds and Forest Plants Law (1992, revised in 1993), Law on Environmental Protection (1994), Nature Conservancy Law (1994). Forestry and other forest activities are also directly influenced by the following laws: the Water Law (1995), the Law on Hunting (1994), the Law on Fire Protection (1993), the Physical Planning Law (1994), the Science and Research Law, the Law on Newly Created Forests and Ornamental Taxa, and the Forest Management Code.

The Forest Management Regulation states the basic goals of forest management: (a) to ensure the stability of the forest ecosystem; (b) to conserve and improve the non-market functions of forests (ecological and social); and (c) to promote advanced and sustainable management and use of forests and forest areas in such a manner and to such an extent as to conserve their biological diversity, productivity, regenerative capacity and vitality, without harming other ecosystems.

The legal basis and a 225-year tradition in organized forestry have resulted in approximately 95 per cent of forests retaining a natural structure. They were formed by natural regeneration - the principal method of forest regeneration in Croatia. The Law on Forests set general objectives, organized public intervention in the forestry sector and introduced new financial mechanisms. There is an obligation for all forest owners to invest 15 per cent to 20 per cent of the income from wood sales in reforestation and an additional 3 per cent in the afforestation of new forest land. Also, all commercial and industrial companies are obliged to pay a tax of 0.07 per cent of their turnover to finance forest projects, the restoration of degraded forests in karst areas and forest research. In 1996, the total investment amounted to US$ 20 million.

Strategies

After the Republic of Croatia gained independence, its Parliament adopted several strategic documents. The most important for nature management are:

- The National Landscape and Biodiversity Strategy and Action Plan (1999) presents the state of landscape and biological diversity in Croatia, analyses existing threats and protection problems, and gives strategic guidelines as well as action plans for its protection.
- The Strategy for the long-term development of Croatian tourism (1998) emphasizes a better exploitation of the available potential with improved quality of services and a richer tourist offer in the coastal and hinterland areas. It advocates a thorough transformation of the sector.
- The National Programme for the Development of Islands (1997) aims at maintaining life on the islands, stimulating demographic recovery and economic development, and preserving the harmony of natural assets through small-scale, but well organized and long-term investments.
- Land-Use Strategy of the Republic of Croatia (1997) is the fundamental document for land-use planning. It unifies sectoral strategies and programmes, synthesizes them, and thus represents the only document that tackles all aspects of land use. The document gives important directives for the coastal region: the obligation to use the land rationally, to stop the urban sprawl on the most valuable coastal stretches, to locate marinas carefully, to assess the carrying capacity of the environment. It stresses the need to reconcile the economy with the specific features of the coastal environment, to preserve the value of the agricultural land and to rehabilitate traditional activities. The document orders further research and envisages the preparation of an integrated plan for the management of the coastal region as a whole (respecting the already adopted programme for the islands).

Other documents also relate to nature protection: Development Strategy of Croatian Agriculture; Traffic Strategy; National Programme for the Protection of the Cultural Heritage; Programme of Development and Organization of the Croatian Energy Sector (under development); Strategy for the Future Development of the Republic of Croatia (in progress); and Strategy for Environmental Protection (under preparation). The latest Report on the State of the Environment in the Republic of Croatia (1998) gives an accurate and well-organized review of the state and processes with relevant directives.

Croatia also follows international convention requirements and participates in international projects (see Chapter 4). Croatia is a member of the Danube Commission. It participates in other

regional conservation initiatives, such as the maintenance of 'Ecological Bricks' transfrontier parks - the Sava floodplain with Bosnia and Herzegovina and Kopacki Rit with Hungary. This project is financed by IUCN and considered to be a priority.

As a Party to the Convention on Biodiversity since 1996, Croatia was entitled to GEF funds for nature and biodiversity protection projects. In February 1997, funding from the World Bank/GEF was approved for the development of a national strategy and action plan for biological and landscape diversity conservation, which were adopted by the Croatian Parliament in June 1999.

Management of biological diversity

One of the environmental protection objectives in view of sustainable development is the permanent conservation of the authenticity of the diversity of natural communities and species, and the conservation of ecological stability. In situ biodiversity conservation means conservation of species and ecosystems in their natural surroundings. For domesticated or cultivated species, it refers to the surroundings in which they have developed their specific features. The principal in situ biological conservation method is the establishment of protected areas.

The management of national parks and nature parks is based on physical plans. For national parks, physical plans have already been prepared, some even revised. The physical plans for nature parks are still to be drawn up. Public institutions for managing nature parks have so far been founded for Telascica, Lonja Plains and Kopacki Rit, while they exist for all national parks. Physical plans are not foreseen for areas of lesser protection. They merely require protection measures by county administrations, with the consent of the national regulatory body in charge of nature protection. These territories are managed by public institutions founded by county assemblies (currently organized in Istria County, Split-Dalmatia County and Koprivnica-Krizevci County and Varazdin County). Apart from the legal protection provided to certain species and areas, it is of the utmost importance to incorporate biodiversity protection measures into all spheres of human activities. Habitat protection in economically exploited areas is reinforced by implementing specific guidelines in agriculture, forestry, water management, physical planning and other practices.

The Rule Book on Forest Regulation makes general forest uses part of the instrumental records of the forest management base. The process of selecting the corresponding evaluation method is under way. The preservation, restoration or creation of new small diverse biotopes of local value are promoted at the municipal level.

The ex-situ conservation measures are of extreme importance for very rare and endangered species. Their genes need to be preserved or even multiplied to repopulate their natural habitats. It is possible to conserve plant genes in the form of seed or tissue culture, while animal genes can be stored in gene libraries, where deep-frozen genomes are deposited. The alternative is keeping and breeding or growing certain plant or animal species. In Croatia, such material is mostly kept in botanical gardens, although the Faculty of Agriculture is currently working on a project for a Croatian bank of plant genetic resources. Zoological gardens are very important in ex-situ preservation of rare animal species. The Zagreb Zoological Garden has recently entered the European Endangered Species Programme (FEP), which coordinates breeding of certain endangered species in the zoos with the help of the International Species Information System (ISIS). Although this currently concerns only two non-native species (the snow leopard and the manned wolf), participation in this project is a significant contribution to the global biodiversity protection efforts.

Integration of nature protection and physical planning

Spatial planning is founded on a series of laws: the Physical Planning Act (1994, amended in 1998), the By-law on the Contents, Scales of Maps, Obligatory Spatial Indicators and Review Standard, the Obligatory Physical Indicators and the Standards for Physical Plan Studies, and the Law on Construction and other by-laws. The Physical Planning Act governs the spatial planning system, the preparation, adoption and implementation of spatial planning documents, the responsibility of self-government and government authorities in the implementation of spatial planning measures and activities. Physical planning is based on the following principles: uniform economic, social and cultural development of the State's space along with preservation of regional characteristics; coordination of space users' interests and priority actions; coordination of spatial planning of single parts of the State's territory; linking of the State's

territory with European spatial organization; publicity and free access to data and documents that are relevant to spatial planning under these and other regulations; establishing a spatial information system for the purpose of spatial planning, space use and protection.

Every intervention is done in accordance with physical planning documents, special regulations and location permits. Spatial planning documents relate to the State's Physical Planning Strategy and physical plans of counties, areas with particular features, municipalities, cities and towns, master plans and urban development plans. The national Physical Planning Strategy sets out the basis for physical planning and development of the State's territory. It provides the framework for coordination of space users' interests. The Strategy's fundamental principle is sustainable development. Development plans, including comprehensive protection plans, have to be interwoven. The Strategy suggests that alternative scenarios and models should be drawn up and examined before taking definite decisions.

Parliament has councils for planning and environmental protection. The State Councils for Land-use Planning and for the Environment evaluate the documents that are related to land-use planning and to environmental protection at the State level. The land-use planning system comprises County Institutes for Land-use Planning which are in charge of the preparation of land-use plans at the county level, and Offices for Land-use Planning which implement the plans. Within local self-governments there are departments in charge of land-use planning.

The Institute for Physical Planning, within the Ministry of Planning, Building and Housing, prepares and follows up the implementation of the State's Physical Planning Strategy and Programme and other documents passed by the Parliament. The Institute also prepares expert opinions for the issuance of location permits for structures relevant to the State. The State's Physical Planning Strategy and Programme pushes towards an integrated system of spatial plans. At the county level, County Offices for Physical Planning prepare and follow up the implementation of the county's physical plan. They also follow up activities at the municipal level. Data on the county's land use are being systematized with regard to the population and settlements, State and regional (county) infrastructure systems, and particularly valuable assets or areas.

The planning permission procedure is a key to the implementation of plans. The administrative location permit is issued on the basis of land-use or physical planning documents and special regulations and submitted for approval to SDEP. The latter bases its decision on an environmental impact assessment, which is prepared after the site has been selected. Interventions and concessions on public marine property (at least 6-m wide coastal strip) are regulated by the Maritime Code. When taking decisions, it is necessary to ensure that physical plans and regulations on environmental protection are met. The possibility of acquisition of property in areas of special interest is regulated by the Law on Eminent Domain, and applies only to the building of objects of State interest. Lack of similar instruments at the local level is a hindrance to defending public interest on the coast.

Institutions

With regard to nature management, the State Directorate for the Protection of Nature and Environment (SDEP) acts to protect various segments of the environment, including inspection and coordination of monitoring. The Directorate has three detached departments (situated in Rijeka, Osijek and Drnis). The Ministry of Planning, Building and Housing is responsible for physical planning and implementation of plans, as well as urban planning and building inspections.

The Ministry of Development, Immigration and Reconstruction prepares and manages the State development programmes and restoration processes. It is constituted of various directorates, among which the Directorate for Regional Development and the Centre for the Islands. The Ministry of Maritime Affairs, Transport and Communications performs, among other things, tasks related to the management of marine property. The Ministry of Culture with its Directorate for the Protection of Cultural Heritage acts in the domains of research, categorization and protection measures. It has departments in Rijeka, Zadar and Sibenik, and is also in charge of town conservation institutions in Dubrovnik and Split.

Within their mandates, other ministries also act in the coastal region: Ministry of Agriculture and Forestry, Ministry of the Economy (energy production and shipbuilding), Ministry of Tourism, State Hydro-meteorological Institute, State Hydrographic Institute in Split, and various other public enterprises operating within the sectors of

waters, forests, roads, etc. Parliament has committees for land-use planning and environmental protection, tourism, economy, navigation, traffic and communication.

NGOs are numerous in Croatia (see Chapter 1) and have long been active in nature protection. One of their most tangible results regarding nature was the designation of the first national parks in Croatia: the Plitvice Lakes in 1914 and Paklenica and some other areas in 1928. The Croatian Ecological Association has been particularly active both in the scientific field and in raising environmental awareness.

Monitoring and research

There is no comprehensive and satisfactory monitoring system that could help nature management. There are currently no plans to remedy this situation. Any management programme for protected areas should include a monitoring section to evaluate its success. Environmental impact assessments should prescribe monitoring of the impacts of development on nature and, hence, on special (i.e. hunted) and vulnerable species and habitats.

The following scientific and education institutes act in Croatia: the Zagreb Faculty of Science, the Veterinary Faculty, the Ruder Boskovic Institute, the Croatian Museum of Natural History, the Institute of Ornithology of the Croatian Academy of Science and Arts, the Faculty of Forestry at the University of Zagreb, the Forest Research Institute in Jastrebarsko, the Institute for Adriatic Culture in Split, the Department for Land Reclamation on Karst and the Centre for Scientific Work of the Croatian Academy of Science and Arts in Vinkovci. Research results, scientific studies, projects, as well as legislative acts in forestry and timber processing, are available to the public primarily through scientific and specialized journals. Television and radio channels also broadcast relevant programmes. Marine research is conducted by three major institutions - the Centre for Marine Research in Rovinj, the Institute for Oceanography and Fisheries in Split, and the State Hydrographic Institute in Split. These three institutes operate 3 major research vessels, pursuing on-board research in hydrography, physical oceanography, marine chemistry, fishery and biological research, and are also engaged in pollution monitoring.

8.4 Conclusions and recommendations

Nature is relatively well conserved in Croatia and is very rich in various kinds of habitats. The legal framework for protecting nature and conserving biodiversity seems to be sufficient for ensuring efficient management. However, despite an impressive record, nature protection now appears to be considered of lesser importance and as an impediment to industrial and urban development. This perception could jeopardize the future of Croatia's outstanding natural beauty. It may be typical of this period of recovery from the war and the economic transition, although policy declarations call for a sustainable development of all sectors of activities. Road construction, land privatization, water management, agriculture deterioration, tourism, all affect nature protection policy. It is important not to lose contact with relevant developments in these areas, in the interest of long-term preservation of the existing natural assets.

Recommendation 8.1:
The State Directorate for the Protection of Nature and the Environment should put a higher priority on nature protection, starting with increasing the expert staff in its relevant departments.

The management of nature is mainly under the State Directorate for the Protection of Nature and the Environment, which manages protected areas and populations of endangered organisms. Its main deficiency is the lack of expertise and the absence of regular monitoring activities. The scientific community could provide the needed knowledge. But in the present organizational set-up, the transfer of knowledge from the scientists to the decision makers is ineffective, because the relevant scientific institutes depend on the Ministry of Science, or are in the process of privatization. Efficient access to information on the environment would require the establishment of a clear system of regulations, providing procedural and institutional guarantees and appropriate application programmes. Moreover, economic interests often override nature conservation efforts.

Recommendation 8.2:
An academic advisory committee under the responsibility of the Director of the SDEP should be set up to assist in the decision-making and evaluation processes regarding biodiversity conservation.

Today, 7.5 per cent of the territory is protected. The National Physical Planning Strategy recommends doubling that figure, a proposal which has not been backed by Parliament. The bulk of protected territories are under national park or natural park protection regimes. The SDEP is responsible for the workplan of the national parks and provides their budget. It nominates the director who is the head of the directing committee, which is supervised by a steering committee where the SDEP and the relevant counties are represented.

For each of the national parks there is also a physical plan approved by Parliament. Physical plans for nature parks are still to come. These plans define the land use of the areas according to their protection regime (tourism and other human activities), but do not include management and monitoring of the protected areas. These plans are coordinated with the Planning Institute within the Ministry of Planning, so that ecological considerations may be under-emphasized in comparison with landscape and social planning concerns.

The protection of nature and the environment, and land-use planning are separated institutionally. The regulation authorities, development planning and environmental protection authority are spread over several places and a large number of institutions. This creates coordination problems and overlapping activities, and calls for a simplification of the procedures. (See also Recommendation 1.1)

Recommendation 8.3:
The responsibility of the Department for Protected Areas should be increased, In particular, it should oversee the implementation of the management plan more closely.

Besides the legal protection provided specifically to certain designated species and areas, other protection measures should aim at protecting nature and biodiversity in general. In view of the large variety of ecosystems, effective protection has to include specific measures adapted to each of them. The adverse consequences of human activities in different sectors of activity will have to be kept within acceptable limits.

The revision of the Law on Agricultural Land foresees measures for sustainable agricultural land use and anti-erosion measures. It identifies harmful substances, determines permitted quantities of pollutants and contains measures for pollution prevention and control. It includes protection of agricultural land from alternative use and determination of situation-specific agricultural measures. The Law gives compensation for managing State-owned land, for performing governmental agricultural inspection, for non-agricultural land use, for fire-fighting measures, for growing erosion-proof cultures, and provides advice to farmers for the purpose of obtaining bank loans. A rulebook on the protection of agricultural land specifies substances considered as harmful for agricultural land. It determines permitted quantities of harmful substances in the soil, pollution prevention and control measures, aimed at protecting agricultural land against chemical and biological degradation. These plans and provisions should be translated into concrete action and implemented.

Recommendation 8.4:
Biodiversity protection measures should be incorporated into all spheres of human activities, and not only limited to the protection regime provided to certain species and areas. Protection of natural habitats in economically exploited areas should be improved by implementing specific guidelines for nature protection in agriculture, forestry, water management, physical planning and other activities.

An environmental impact study should assess the state of biological diversity in the location of the development project, and lists the biodiversity protection measures that have to be taken during the building, operation and termination. The study should also contain a biodiversity monitoring programme. The National Biodiversity Strategy and Action Plan that have recently been adopted by the Parliament anticipate guidelines for protecting individual ecosystems against economic and other activities.

Vulnerable and valuable nature assets deserve special protection. For instance, the karst phytocoenosis (surface and underground) must be protected by preserving, caring for, and expanding the native vegetation with a view to maintaining the basic process of karst creation and the prevention of soil erosion. Water protection in karst regions must be implemented over the whole surface, with emphasis on the hydrological structure of surface and underground flows. The coast also merits particular attention. When necessary, physical protection measures should be implemented.

Recommendation 8.5:
Each ecosystem should be used according to its specificity in an ecologically sound manner. The use of the coast for fish farming and marinas should be regulated. Urban sprawl along the coastline should be prevented, new constructions close to existing urban zones streamlined, a coastal strip protected from building and public access to the sea secured.

Nature protection is not only a national stake, managed by high-level authorities. Local administrations have their role to play, which is much more specific and concrete. For example, the Law on Forests regulates the management of forests and forest soils. The preservation, restoration and creation of new small diverse biotopes of local value are promoted at the municipal level. The denser and the more strongly connected the biotope networks created in that way are, the more they help to strengthen the stability and ecological balance of the overall biological diversity. The changes in government have brought about many changes in the field of spatial planning regarding the development of settlements, municipal infrastructure and protection of space and environment. It is now important to strengthen the vertical coordination between the different administrative levels. Also, more instruments are required at the local level to make county/municipal actions more efficient, for example the acquisition of real estate in the public interest.

Physical planning is well based on comprehensive consideration of space and environment, in order to create a basis for the most favourable management of natural and man-made assets. Particular emphasis is laid on predicting future development needs. Physical planning makes it possible to reconcile opposed interests and creates preconditions for a simultaneously efficient development and efficient protection of space and environment. Physical planning is a multidisciplinary and continuous procedure.

Most procedures for environmental protection planning are incorporated into physical planning, making it thus possible to note particularly valuable or sensitive areas, conflicts and hazards, as well as areas needing priority protection measures. Physical planning enables preventive action by timely environmental protection planning.

Recommendation 8.6:
Physical planning and its implementation should be based more strongly on joint actions and coordination between the national, county and local administrative levels.

Efficient policy implementation in biodiversity conservation and nature protection implies measures that affect or involve policies for other sectors of activity. There is a strong need for the different administrations to improve their coordination in issues affecting them. For example, the SDEP issues permits for the import and export of endangered and commercial organisms, but hunting and aspects of biodiversity management in forest areas are under the Ministry of Agriculture and Fishing, whereas water management (including its protection) is under the Water State Directorate. At present, the coordination between the various ministries and authorities is not smooth.

For example, the protection of cultivated plant species is not coordinated, nor is it systematic or adequately regulated. For domesticated animals, certain breeders and growers receive financial stimuli from the State, for example for breeding Istrian ox or Turopolje hog. Breeders' and growers' associations should received better support for the purpose of implementing protection programmes, thereby improving coordination of national breeding programmes.

Recommendation 8.7:
Coordination of actions regarding nature protection and biodiversity conservation between the SDEP and other ministries and directorates should be improved. A special unit in the SDEP should be entrusted with the responsibility for coordination. *See also Recommendation 1.1*.

No progress in protecting nature can be made if there is no reliable picture of the situation and its evolution. Monitoring appears to be insufficient in certain specific fields as well as across the board, and a particular remedial effort has to be made. Existing monitoring should be better integrated and optimized.

Recommendation 8.8:
The monitoring of nature should be improved in particular with regard to biodiversity, soil and surface water. An inventory of the state of soil degradation and of the state of natural habitats should be envisaged. *See also Recommendation 6.7*.

For obvious and good reasons, more and more strategies and programmes on biodiversity conservation and nature protection have an international scope. Cooperation with neighbours or participation in international conventions and programmes are also a way to improve national policy. International cooperation may also provide funds to solve the most pressing problems. As mentioned in Chapter 4, Croatia has not yet ratified some important conventions, like the Bonn Convention and the Bern Convention. Also, Croatia does not receive much international financial or technical assistance, at a time when it is recognized that the national budget is not sufficient. Croatia should therefore explore possibilities for increasing international activities.

Recommendation 8.9:
Cooperation with neighbouring States on physical planning, biodiversity and water management should be intensified, including data exchange. Croatia should implement the international conventions and agreements relating to nature protection and biodiversity conservation that it has ratified, and it should join the main international ecological and development programmes.

Chapter 9

MANAGEMENT OF MARINE RESOURCES AND POLLUTION

9.1 Major current issues

Features of the coastal area

Croatia's coastal zones are some of its most valuable economic and environmental assets. Croatia has a 1 777 km-long coastline along the Adriatic Sea. If the island coastline is added, Croatia's coast is 5 835 km long; its territorial waters cover 31 067 km^2. The Adriatic is very important for Croatia because of the highly developed economy, cultural and social life on its coasts. The coastal regions have a large variety of flora and fauna, including many endemic species. The Adriatic Sea, which cuts deeply into the European continent, has always represented an important link between the Middle East and western Europe. Its eastern coast, protected by numerous islands, provides suitable maritime routes from the Mediterranean to the Po Valley and Alpine passes. There are 718 small and big islands, 389 cliffs, and 78 reefs.

The United Nations Convention on the Law of the Sea categorizes the Adriatic as follows:

- complex navigation in a narrow space of semi-closed sea,
- ports are approached through long island areas and dangerous passages,
- complex weather conditions caused by rapid, sudden change and extreme parameters,
- danger from all kinds of pollution due to its small size and its weak and slow exchange, and
- living resources, cleanliness, amenities, and landscape that should be given special attention in terms of their use and conservation.

Approximately 20 per cent of Croatia's river basins drain to the Adriatic Sea. The country is predominantly part of the Black Sea watershed, with most rivers draining to the Danube or one of its affluents. The largest rivers of the Adriatic basin are listed with their characteristics in Table 6.1 of Chapter 6.

The total number of inhabitants in Croatia, according to the 1991 census, is 4 784 265. The coastal counties have 1 580 213 inhabitants (little more than 33 per cent of the total) and a population density of 64 inhabitants per km^2, which is below the Croatian average of 85 inhabitants per km^2. The most densely populated coastal counties are those of Split-Dalmatia (105 inhabitants per km^2) and of Primorje-Gorski Kotar (90 inhabitants per km^2).

The intensity and range of economic activities impact heavily on the fragile coastal environment and its natural resources. The economic activities concentrated in these areas include: agriculture; a range of industries; tourism; fishing; aquaculture; transport; and human settlements.

Urbanization in the coastal zone

Table 9.1: Ten largest towns in Croatia

	Number of inhabitants (according to 1991 Census)
Zagreb	867 717
Split*	200 459
Rijeka*	167 964
Osijek	129 792
Zadar*	80 355
Karlovac	70 950
Pula*	62 690
Sisak	60 884
Slavonski Brod	58 531
Sibenik*	55 842

Source: "Coastal Area Management in Croatia", The State Directorate for the Protection of Nature and the Environment, Zagreb, May 1998.

* Coastal towns.

In the past decade, there has been a visible migration flow from the inland areas towards the coasts. The major reason for this is the location of

various economic and the resulting economic growth in the area, which offers a better future to the newcomers. In fact, the favourable climate, abundant natural and historic assets, high accessibility, irrigated and fertile soil attract activities, which are in turn leading to important changes in the land-use patterns. Forests, pastures and even land that was used for intensive agriculture are gradually being converted to industrial, tourist and residential uses.

Residential developments on the coast are growing in parallel with the population. The spread of residential areas onto prime land is common. Densification in the form of high-rises, which offers an easy solution, puts a severe strain on the modest infrastructure, especially water and sewage networks, of the coastal cities (see Chapter 6 for more details). There is, also, another type of residential development which deserves special attention: secondary residences and summer homes. Secondary housing, which was very limited, until the 1970s, has since increased enormously and continues to grow.

Economic activities

From the economic point of view, *tourism* plays an increasingly critical role. Dubrovnik, Makarska, Islands of Krk, and especially the Istrian coastal towns have grown into important tourist centres. The coast's natural resource base has been subjected to intensive demands over the past decade, particularly from tourism and construction of holiday residences, and its long-term economic potential must be carefully reviewed if the rate of environmental degradation continues to accelerate. So, to prevent future imbalances, a framework for the environmentally and economically sustainable management of coastal tourism could be developed.

Industrial establishments preferring to locate on the coast may not take up much space. However, they are important sources of soil, air, marine as well as visual pollution. The northern part of the Adriatic Sea is fairly industrialized, with ports, oil refineries, oil terminals, petrochemical plant, paper mills, shipyards, cement plant and other smaller industrial plant. The largest industrial capacities are located around the largest urban centres, Rijeka and Split. Also shipbuilding is a traditional branch of

Table 9.2: Sewage system and discharge types in Adriatic catchment area, 1995

Catchment area	Inhabitants Total	Inhabitants connected to sewage network		Inhabitants served by treatment plants					Inhabitants connected to individual sewage collectors
				Primary treatment*		Secondary treatment		Tertiary treatment	
	Number	*Number*	*as % of total inh.*	*Number*	*as % of inh. connected*	*Number*	*as % of inh. connected*	*Number*	*Number*
All Adriatic	**1 747 802**	**1 056 183**	**60.4**	**488 731**	**46.3**	**25 967**	**2.5**	**0**	**464 000**
Northern Adriatic	573 802	323 683	56.4	229 731	71.0	13 467	4.2	0	81 000
of which:									
Istra	230 810	110 943	48.1	61 151	55.1	12 171	11.0	0	39 000
Hrvatsko primorje	257 667	190 982	74.1	167 030	87.5	1 196	0.6	0	22 000
Lika and podvelebit	85 325	21 758	25.5	1 550	7.1	0	0.0	0	20 000
Southern Adriatic	1 174 000	732 500	62.4	259 000	35.4	12 500	1.7	0	383 000
of which:									
Zadar region	255 000	122 000	47.8	10 000	8.2	7 500	6.1	0	118 500
Sibenik region	169 000	89 000	52.7	6 500	7.3	0	0.0	0	73 000
Split region	555 000	379 500	68.4	192 000	50.6	0	0.0	0	145 500
Dubrovnik region	195 000	142 000	72.8	50 500	35.6	5 000	3.5	0	46 000

Source: State enterprise "Hrvatska vodoprivreda"- Offices in Rijeka and Split.

* With long line under the seabed.

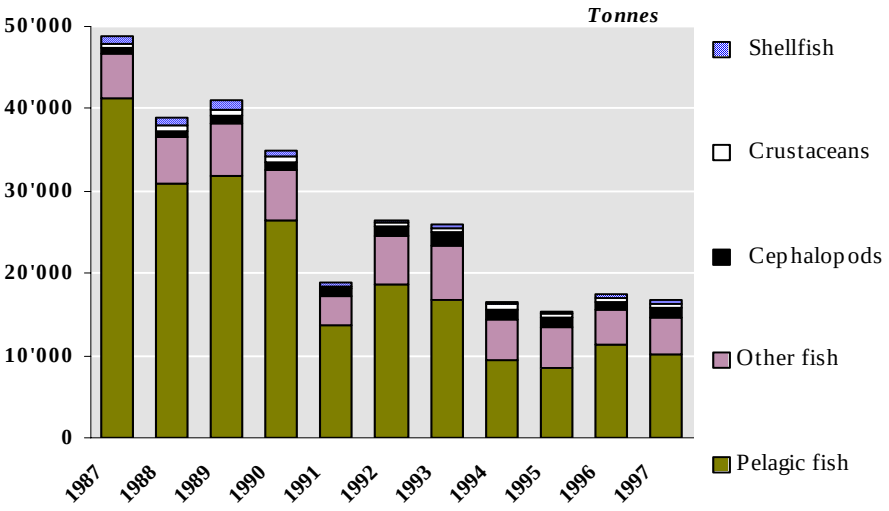
Table 9.3: Waste-water discharge and discharge of purified waste water from industry, * 1991-1996

	1991	1992	1993	1994	1995	1996
Waste-water discharge						
- **Total** *(1000 m^3)*	452 462	523 892	399 752	252 875	332 947	409 667
- *Discharged into the sea as % of total*	*43.2*	*43.3*	*23.8*	*61.3*	*55.4*	*53.7*
Purified waste-water discharge						
- **Total** *(1000 m^3)*	94 488	46 785	87 343	34 419	33 758	93 836
- *Discharged into the sea as % of total*	*19.9*	*21.2*	*12.0*	*23.8*	*23.9*	*7.3*

Source: Statistical Yearbook 1996-98.

* Wastewater does not include the amounts of water used for electricity generation.

Figure 9.1: Fishing, 1987-1997



Sources: SLJH-97, Statistical Information 1997.
SLJH-98, Statistical Yearbook 1998.

industry in which Croatia plays an important part at the global level.

The country's very long coastline with good natural conditions provides a suitable environment for *fisheries*, but the Croatian part of the Adriatic is poor in fish compared to some other parts of the Mediterranean. Every year 240 000 tonnes of fish and other sea products are caught in the Adriatic Sea. Annual fish consumption in Croatia is estimated at 7 kg/capita. From 1990 to 1994 there was a considerable increase in fishing. For instance, the number of the trawls increased by 34 per cent, drift nets by 33 per cent, but at the same time the catch drastically decreased. This is typical of overfished areas. There is a decrease in the average size and weight of the fish, some species are depleted, etc. Because of fishing practices, overfishing and pollution, fishing and fish processing declined by almost 60 per cent in 1989-1995.

The damage to fish hatcheries may be due to shoreline erosion. Also aquaculture has increased in recent years and has negatively affected marine ecosystems. In 1995, 25 fish farms were registered on the Croatian coast, of which 17 were on the islands and 8 on shore. Together with water-soluble waste, solid particles composed of uneaten feed stock and fish excrement cause pollution in both inland aquatic and marine ecosystems.

Maritime transport is an additional source of marine pollution from accidents in areas with heavy

traffic, especially petroleum transport, and improper disposal of ballast and bilge waters and solid waste. Two major port cities are Rijeka and Split, followed by Pula, Zadar, Sibenik and Ploce. Coastal trade and navigation have been very much developed, in particular among the Italian, Slovenian and Croatian parts. This is why the consideration of navigable waterways in the Adriatic and their control is becoming very important. Croatia has, therefore, adopted a Contingency Plan for Accidental Marine Pollution (Official Gazette No. 8/97). The officers responsible for its implementation are designated by the Croatian Government.

The Harbourmaster's Offices in Pula, Rijeka, Zadar, Sibenik, Split, Ploce and Dubrovnik are responsible for pollution control from ships, whereas the Water Authorities of the State Directorate for Waters are responsible for controlling the marine pollution from land-based activities.

Agriculture at land in the coastal region and the rural population are decreasing: in 1991, 8.56 per cent of Croatia's total population was in rural areas, and in the seven coastal counties it was 3.42 per cent. In 1996, agricultural land covered approximately 55 per cent of the total surface area of the 7 coastal counties, with several areas with high potential agricultural productivity (Ravni Kotari, Neretva river delta). The mild Mediterranean climate is particularly suitable for growing grapes, olives, fruit and vegetables, flower and typical Mediterranean plants.

The trend reflected in the decrease in the agricultural population and in the surface of cultivated land in the coastal region is further exacerbated by the re-orientation of the landowners to tourism. The use of agricultural land in the vicinity of the urban centres has, to a large extent, been changed to meet the needs of secondary or tertiary activities, or turned into secondary home settlements.

9.2. Policy objectives and implementation instruments

Institutional structure

The Central Government is responsible for the overall policy framework. In Croatia, there are no special organizational or legal forms of integrated management of coastal areas. Specific tasks for coastal resources protection and development are performed within the State organizations and sectoral and other institutions. Protection of nature and the environment and land-use planning are separated institutionally (physical planning as an integrated approach to development and environmental protection has been legally regulated in Croatia since 1973, soon after the Stockholm Conference. Since 1994, environmental protection has been separated into a special domain with its own laws.)

With regard to economic activity in the coastal region, the following ministries and State organizations are important:

- Ministry of Physical Planning, Building and Housing monitors the processes going on in physical planning and implementation of plans, as well as urban planning and building inspections.
- State Directorate for the Protection of Nature and the Environment protects various segments of the environment and oversees and coordinates monitoring. The Directorate has established an information system for the environment programme designed to support decision-making in environmental regulation and protection. Priority was given to the protection of sea and surface water, consistent with the fact that the most extensive parts of environmental legislation are dedicated to water protection. The Directorate has a detached department situated in Rijeka, the Office for the Adriatic, which has the main task of protecting the sea, and the coastal and insular areas of Croatia. The Directorate supports environmental NGOs in the coastal area that work on valuable environmental projects. One of them is the European Blue Flag Campaign for beaches and marinas. The Blue Flag project is intended to contribute to the modernization of tourist services and marine environment management, and especially to environmental education and public information.
- State Water Directorate develops law and regulations, controls quality standards and pollution levels. It has been set up with its four divisions in accordance with the Water Law. Its prime responsibility is directing the long-term development of water resources, managing water resources, and supervising the implementation of the provisions of the Water Law and related regulations. The State Water

Directorate is responsible for controlling marine pollution from land-based activities.
- Water Agency, Hrvatske Vode monitors water quality and collects water payments (see Chapter 6).
- Ministry of Development, Immigration and Reconstruction prepares and manages the State development programmes and restoration processes. It is constituted of various directorates, among which the Directorate for Regional Development, and a centre for the islands.
- Ministry of Maritime Affairs, Transport and Communications performs, among other things, tasks related to the management of Croatian marine territorial waters.
- Ministry of Culture's Directorate for the Protection of Cultural Heritage is active in research, categorization and protection measures. It has departments in Rijeka, Zadar and Sibenik, and is also in charge of the town conservation institutions in Dubrovnik and Spilt.

Within their mandates, other ministries are also active in the coastal region:

- Ministry of Agriculture and Forestry (Directorate for Fishery),
- Ministry of the Economy (comprises two important sectors : energy production and ship building),
- Ministry of Tourism,
- State Hydrometeorological Institute,
- State Hydrographic Institute in Split,
- Institute for Oceanography and Fisheries in Split,
- Centre for Marine Research in Rovinj, and various public enterprises operating within the sectors of waters, forests, roads, etc.

Land use planning is specially important for the protection of the coastal area. The documents related to land-use planning and environmental protection at the State level are evaluated by the State Council for Land-use Planning and the Council for the Environment. At local level, the land-use planning system comprises County Institutes for Land-use Planning, which are in charge of the preparation of land-use plans at the county level, and Officers for Land-use Planning, who implement the plans. Within the units of local self-government there are also departments in charge of land-use planning.

Municipalities have authority mainly over local environmental protection issues and physical planning. Monitoring and enforcement of laws and regulations is carried out by the local government and State inspectorates. Counties and municipalities make their own decisions on the development and management of their environment, which have to be in accordance with the master plan for water conservation where it already exists.

There are also specialized agencies that are set up as public companies, such as the Croatian Hazardous Waste Management Agency (APO), the Waste Management and Environmental Protection Agency, the Energy Research and Environmental Protection Institute (ECONERG).

Legal instruments and policy priorities

In relation to coastal zone management, there are many decrees and codes in Croatia's legislation. The recognition of the global and specific importance of the coastal region is obvious in Croatian policies at all levels: State, sectoral and local. Nevertheless, there are no specific legal norms regarding the management of the coastal region as a whole.

- The Environmental Protection Law (1994) is intended to create a comprehensive regulatory system, which had not existed in Croatia previously.
- Parts of the coast and the sea are protected by the Law on Nature Protection. The protected natural monuments in the coastal region cover a total area of 2 863 km^2, or 65 per cent of the area covered by all the protected monuments in Croatia, which illustrates the great value, as well as the sensitivity, of coastal and island areas.
- The Law on Land-use Management (1997) regulates physical planning and defines the obligation to issue regulations on the protection and management of the coastal region as an area of special interest for the State (these regulations, however, have not yet been drawn up).

The coastal region of the Croatian Adriatic is covered by physical plans based on a rich experience in regional planning and a strong

professional and scientific foundation. Those plans contain development objectives with the principles of and guidelines for the protection of coastal resources, including the borders of the protected coastline belt. Interventions and concessions on public property (at least 6-metre-wide coastal strip) are regulated by the Maritime Code.

Also, the use of environmental impact assessment has been regulated since 1984 by the Law on Land-use Planning and a new regulation issued in 1997 according to the Law on Environmental Protection. However, there is no difference between the projects in the coastal region and the others, although the former would require special consideration. The application of strategic environment assessment in coastal area management has not yet been taken into consideration.

The Water Law, passed by Parliament in 1995, applies in a similar manner as in the rest of the country (see Chapter 6). However, two recent important subsidiary laws have particular importance in the coastal areas:

- Regulation of Water Classification (follows the European Union's demands for monitoring of water quality parameters according to accepted conventions).
- Regulation of Dangerous Substances (defines toxicity, degradability and bioaccumulation).

The By-Law on Beach Water Quality Standards gives rise to quality control along Croatia's coast, and has been continuously performed since 1989. Tests are performed by an accredited laboratory. The microbiological parameters are considered to be the most important indicators of sea water pollution by sewage. The criteria for sea water quality used for swimming are in compliance with those prescribed by the EU and have more stringent than those of WHO/UNEP.

After the Republic of Croatia gained independence, its Parliament adopted several strategic documents relevant to the coastal areas. Those are:

- Declaration on the Protection of the Environment (1992). After the declaration, Croatia prepared a national report on environment and development, which advocates the preparation of special programmes and immediate measures to protect the Adriatic coastal and marine areas and preserve the values and attractiveness of Adriatic landscapes.
- Strategy for the Long-Term Development of Croatian Tourism (1993, amended 1998).
- National Programme of the Development of Islands (1997). The purposes are to maintain life on the islands, to stimulate demographic recovery and economic development and to preserve the harmony of natural values.
- Land Use Strategy (1997). It defines Croatia's Adriatic region as a large physical unit whose biosphere and special values need to be preserved.

Also, Croatia has adopted a Contingency Plan for Accidental Marine Pollution. The Plan applies to serious accidental marine pollution such as the spillage of oil or oil mixtures, the discharge of harmful and hazardous substances and unusual natural phenomena. The officers responsible for implementing it are designated by the Croatian Government.

Economic instruments

In Croatia, some form of economic instruments are used in coastal areas while not officially recognized as such. For instance, some taxes that are levied to support public infrastructure could be considered economic instruments. But the funds, fines, fees and penalties used to control pollution, the tourism incentives, the financial situation of the municipalities and the municipal tax system must be re-evaluated in the context of coastal zone management.

There are no environmental funds established on the State or the regional level. The Water Account of the Water Agency for water management activities and related projects collects water pollution fees and consumption charges (see Chapter 2 and 6). Funding is still required to clean up the main polluted rivers and the Adriatic Sea, and to reconstruct the monitoring system for water.

International relations

Croatia recognizes that international cooperation is crucial for protecting and conserving the global as well as its own marine environment and coasts. It has ratified international conventions and agreements such as the Barcelona Convention, the MARPOL Convention and the Basel Convention

Table 9.4. : Load calculations* from 8 river estuaries in the Adriatic

Tonne/year

Rivers	Dragonja	Mirna	Rasa	Rjecina	Zrmanja	Krka	Cetina	Neretva
Average annual flowrate (m^3/s)	*1.22*	*7.64*	*4.60*	*10.50*	*30.70*	*44.20*	*217.00*	*350.00*
Annual load								
SS	211.6	6 698.0	4 888.7	..	0.0	0.0	0.0	0.0
BOD	75.8	566.2	391.7	794.7	2 129.9	3 875.0	12 318.0	22 737.5
COD	281.2	2 390.1	2 003.4	2 913.9	...	22 859.8	60 905.5	90 397.9
Ammonia (NH_4)	1.8	7.7	4.8	25.2	58.1	43.2	0.0	220.8
Nitrite	0.1	1.2	0.3	0.3	0.0	1.4	0.0	0.0
Nitrate	460.2	390.7	241.7	435.7	435.7	625.9	3 059.0	5 397.4
Total P	2.2	14.7	8.9	9.6	9.7	40.4	266.9	253.9
Phenol	0.0038	0	0.000029	0.993	0.581	0	0	24.3
Detergent	0.269	0.482	1.02	0	6.78	0	3.42	53
Klor pesticide	0.006	0.006	0.0025	0	24.3	3.48	81.4	102.6
Cd	0.0008	0	0.015	0	2.23	4.88	7.53	27.6
Pb	0.012	0.048	0.116	0	3.87	4.6	34.2	2.21
Cu	1.28	1.28	0.609	0	6.58	2.79	22.6	33.1
Cr	0.0077	0.096	0.16	0	7.75	3.76	39.7	22.1
Zn	0.423	1.2	1.32	0	2.9	0.418	20.5	77.3
Hg	0	0	0	0	0	0	0	0

Source: Monitoring Programme, SWD.

***** Annual load has been calculated on the basis of the average annual flowrate and average concentration in the specified elements.

and collaborated in international projects within the framework of the studies in UNEP, UNDP, and among international financial organizations, particularly the World Bank.

Also, there are ongoing bilateral projects such as the Adriatic Scientific Cooperation Programme with Italy for the protection of the Adriatic Sea and coastal regions from pollution. Other regional initiatives include the PALOMAR project on the management of the Adriatic Sea area together with Italy and Slovenia. Moreover, Croatia hosts a centre of excellence dealing with coastal planning and management, the Regional Activity Centre of Priority Action Programme (PAP/RAC), which operates within the UNEP/MAP.

Monitoring

The quality of surface water and groundwater, river estuaries and coastal sea is monitored at a total of 270 measuring stations, within the established Programme. The number of tests depends on the importance of the station.

Waste-water quality testing is carried out at 62 measuring stations for public sewer systems and industrial effluent sea discharges. Eight stations are situated in river estuaries (Rivers Mirna, Rasa, Rjecina, Dragonja, Zrmanja, Krka, Cetina and Neretva). The load calculations for the eight estuaries in the Adriatic basin are given in Table 9.4.

9.3 Conclusions and recommendations

Many of the problems in the coastal zone are the same as those in other areas and the institutional arrangements established there should, in principle, be the starting point for those in the coastal zone. What is different in the coastal zone, however, is the intense pressure of competing demands, all appearing to converge on relatively small areas.

The eastern Adriatic region is still one of the best preserved coastal areas of the European part of the Mediterranean. But, generally, the mainland coastal waters are more polluted with sewage than the island coastal waters. This is the consequence

of intensive urbanization, and the inadequate collection and discharge of sewage into the sea.

Centralized sewer systems are constructed only in larger urban and industrial centres. Smaller and rural areas rarely have such systems. Less than 35 per cent of waste water goes to sewer systems and less than 10 per cent is treated in waste-water treatment plants.

The speed of development and the uncoordinated nature of policies have resulted in the partial degradation of Croatia's coastal resources. As regards the integration of environmental objectives with plans for the economic development of the coastal counties, there is little evidence of progress. In spite of major planning efforts, the underlying economic and environmental policies to attain these objectives remain uncoordinated.

Some bottlenecks are apparent in the administrative structure and the existing legislation. However, efforts to improve the management of the coasts in Croatia have been made:

- Realization of the importance of coastal zone management at the level of policy-making.
- Realization of the necessity of planning and new administrative arrangements to develop intersectoral integration between environment and development.
  Encouraging new experiments, case studies on coastal management on an international scale and continuation of in-depth studies on this subject (such as Kastela Bay Eco-Project, construction of multi-purpose Canal Danube-Sava, etc.).
- Croatia is following environmental management concepts and establishing an "Ecological Legal System". It has adopted some basic principles: precautionary principle, polluter-pays principle, cooperation principle, integrated approach in water management.

The bottlenecks are:

- The large numbers of laws and various bodies hamper coordination and imply inappropriate and outdated legislation. In particular, there is a lack of systematic environmental monitoring, and of clear definitions of rights, liabilities, responsibilities, control, financing and charges.
- In general, problem areas are identified as urban/industrial development, agricultural runoff and impacts of tourism and demolition of archaeological and historical sites. The greatest problem is the absence of integrated construction planning. A result is that some of the most valuable areas along the coast are now severely threatened, and their future uses considerably reduced.
- Lack of multi-sectoral approach at the implementation level.
- Coastal zone management has been delegated to the regional level, and municipalities have the task of implementing it. Regional planning systems need to be rearranged to improve intersectoral integration between environmental and development authorities.
- Insufficient resources for coastal area management. The use of economic instruments in the development of coastal areas has been limited.
- Institutional capacity is weak or non-existent in most environmental disciplines.
- Enforcement is still inconsistent, and pollution fines are too low to change the behaviour of the polluting industries, especially State-owned companies.
- Databases are not integrated.
- Lack of environmental education.

Based on these findings, the following needs of coastal zone management should be satisfied through an integrated coastal zone management plan:

- Institutional development at national, provincial and municipal levels.
- Potential cost recovery/financing instruments for the Government and local municipalities to recover the costs of infrastructure and services needed to satisfy requirements.
- Appropriate regulatory, enforcement and economic instruments to implement policy objectives, coastal development plans and regulations.
- Analysis of how incentives could be better targeted to achieve the Government's development objectives for given areas.

Recommendation 9.1:
An integrated coastal zone management plan should be prepared and implemented.

Integrated coastal zone management is generally recognized to be the only way to achieve sustainable development. Short- and long-term actions must be integrated. For instance, the long-term demand for environmental and natural

resources (water, forest, soil, marine resources) should be examined in a comprehensive way given their present and projected rates of use and consumption. Integrated management requires an appropriate legal and administrative framework, national planning and special standards to protect highly fragile environments. For such an approach, physical planning, environment, nature and water protection issues should better be brought together under the umbrella of one ministry. See Recommendation 1.1.

There are too many institutions. They are difficult to coordinate and their activities overlap. This situation calls for a simplification of the procedures. The main responsibility of the SDEP is to coordinate environmental activities. However, it is difficult for the State Directorate to carry out its work efficiently, given its low operational budget and the general lack of support from ministries. The difficulties of coordination among the various bodies are further complicated by the fact that the State Directorate operates at a lower level than the ministries.

Also land-use planning is a crucial element in regulating both population density and industrial activity along the coast and, hence, the likely pressure on the environment. Consequently, land-use planning should be developed with environmental considerations in mind. Within this framework, industrial estates that promote the orderly development of industries by supplying serviced land at a reasonable price to industrial establishments that would otherwise have dispersed are an important instrument. Municipalities should start to implement programmes to relocate polluting industries settled in the coastal zone.

Recommendation 9.2:
Technopoles should be established where medium and small-sized industries can share basic supply and treatment facilities so as to benefit from economies of scale in investment and operating cost.

Croatia was one of the first Mediterranean countries to enforce a national Contingency Plan for Accidental Marine Pollution. But only two operational centres have been established and equipped (in Rijeka and Split). The other places do not have any vessels or equipment to clean up deposits of oil and solid waste from the sea surface, etc.

Recommendation 9.3:
Operation centres should be set up to deal with emergencies and protection of the coastal sea and shoreline, where this is not yet the case.

Waste disposal to karstic areas affects groundwater and the sea. In the entire coastal region there is not a single acceptable dumping site for the controlled disposal or modern treatment of solid waste.

Recommendation 9.4:
A waste management plan should be developed for the islands and the coastal area.

The purpose of the routed navigation system is to divert the traffic from environmentally sensitive areas, thus minimizing the danger of ships colliding or stranding, and streamlining traffic in the Adriatic.

Recommendation 9.5:
It should be explored, whether navigation should be routed further away from the islands and the coast and to safer port approaches. Especially cargoes with hazardous substances, oil, etc., should follow special routes. Monitoring should take place in coordination with Italy, Croatia and Slovenia.

Croatia has drafted a national monitoring programme named *"Systematic Research of the Adriatic Sea as a Basis for the Sustainable Development of Croatia"*. The scope of the project will depend primarily on the specific requirements for solving constraints that hamper the sustainable development of the Croatian Adriatic region. Nevertheless, it should also deal with issues of regional and global significance whenever they form part of Croatia's international obligations (e.g. issues relevant to the Barcelona, Biodiversity or Climate Change Conventions).

There are many problems connected with elementary data for planning. Some water quality data collected with existing monitoring programme are useless without simultaneous flow measurements. There is virtually no continuous quality monitoring of water. Data comparison is impossible because of different statistical approaches. There is no control of pollution discharges from rivers to sea. The national monitoring programme could redress these grievances.

Recommendation 9.6:
Croatia's national monitoring programme "Systematic Research of the Adriatic Sea as a Basis

for the Sustainable Development of Croatia" should be approved and implemented.

Inland and coastal waters are not managed in a mutually beneficial manner, despite the full recognition of the need for greater coordination. At present, inland waters are the major source of coastal pollution. Because industrial pollution is inadequately controlled, industrial wastewaters are insufficiently treated, and discharges from small enterprises are poorly managed because of limited treatment facilities and improper operation. Also, large quantities of wastewater in the Adriatic basin originate from the disposal of household waste water into inappropriate septic tanks, or into porous karstic underground. Installations of all kinds that are not environmentally sound, and controllably so, should not be permitted to function.

Recommendation 9.7:
Any new installation should be allowed to operate only if it is monitored and found to comply with the appropriate pollution control. Old and highly polluting installations should be closed within a relatively short time unless they can be economically retrofitted to environmentally sound conditions.

Due to the intensive and rapid rate of development in coastal areas, the financing problem is particularly acute. Moreover, cutting the subsidies currently provided for tourism and industrial development in the coastal areas could both reduce the pressure on the environment and generate additional funds for infrastructure and environmental protection instead. Any funds freed in this way should help to accelerate the badly needed improvement of wastewater treatment in the coastal areas.

Recommendation 9.8:
All municipalities and major tourist resorts should have proper sewage treatment and effluent systems. An acceleration of investment in waste-water treatment is needed to counteract the deterioration of inland and coastal water quality. Effective conservation of the coastal water quality depends on success in the protection of complete river catchments in the karstic areas. *See also Recommendation 6.3.*

Coastal development should correspond to the natural advantages and carrying capacities of both the individual region and its adjoining coastal areas. The concept of sustainable development implies that economic development should be subject to the possibilities of the natural resources, as well as to integrated environment planning and management.

Recommendation 9.9:
Croatia should assess the tourist carrying capacity of its Adriatic region in coordination with the Ministry of Tourism, the Ministry of Physical Planning, Building and Housing, the State Directorate for the Protection of Nature and the Environment, the State Water Directorate and assistance from the Regional Activity Centre of the Priority Action Programme.

PART II: MANAGEMENT OF POLLUTION AND OF NATURAL RESOURCES

Chapter 10

MANAGEMENT OF SELECTED ENVIRONMENTAL ISSUES IN INDUSTRY

10.1 Recent development of industry

Economic development and structure

Industry as the main sector of the national economy (see the economic structure in Table 10.1) contributed 28.7 per cent to GDP in 1990 and 25.9 per cent in 1997. In 1998, GDP growth was forecast to slow down to around 3.55 per cent. GDP growth for 1999 was expected to reach about 4 per cent.

Croatia's industry includes the following major sectors: mining of energy resources (coal, lignite, peat, crude petroleum and gas); other mining and quarrying; manufacturing of food products, beverages and tobacco; textiles and textile products; leather and leather products; wood and wood products; pulp, paper and paper products; coke; petroleum products; nuclear fuel; chemicals, chemical products and fibres; rubber and plastic products; non-metallic mineral products; basic metals and manufactured metal products; machinery and equipment; electrical and optical equipment; transport equipment; furniture; recycling; electricity; gas and water supply. Figure 10.1 shows the volume of production trend, overall and for the recycling industry.

Between 1989 and 1995 the volume of production decreased by 46.3 per cent, ranging from 30 to 70 per cent for different industrial sectors. The sharpest decrease between 1987 and 1997 was registered in the manufacture of rubber and plastic products (60 per cent), basic metals and manufactured metal products (66 per cent), machinery and equipment (70.0 per cent), transport equipment (54 per cent) and recycling materials (51.2 per cent). There was a slight increase in industrial production of about 10 per cent during 1995-97.

The decrease in industrial production was caused by the following economic and technical factors:

- Worn-out industrial equipment.
- High cost of production because of raw material and energy prices.
- High import duties for equipment, including for environmental protection.

Table 10.1 : Share of major sectors in GDP

	1990	1991	1992	1993	1994	1995	1996	1997
	As % of total sector's value added (current prices)							
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Agriculture*	10.6	10.3	13.6	13.3	11.2	10.4	10.0	9.3
Industry**	28.7	28.2	26.9	29.7	27.4	23.1	25.6	25.9
Construction	5.9	4.5	3.3	4.8	5.1	5.9	6.6	7.1
Wholesale and retail trade	17.7	15.0	14.9	13.5	14.7	17.1	15.2	15.6
Transport and communication	8.3	9.1	6.1	5.8	8.2	8.2	8.8	8.7
Financial services, real estate	5.8	8.5	12.2	7.8	7.8	8.1	14.7	14.0
Other services	23.1	24.5	23.0	25.1	25.7	27.2	19.1	19.5

Source: UNECE economic database.

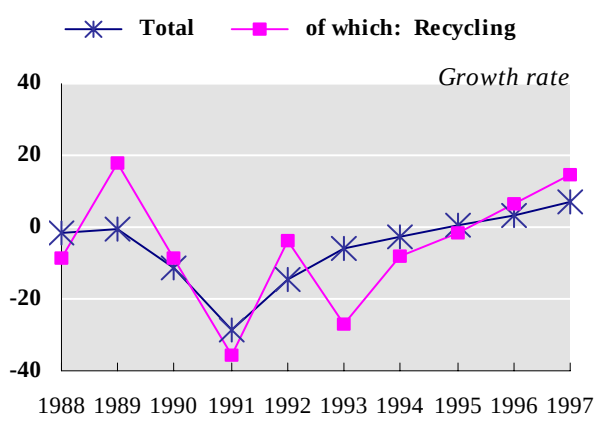
Data are presented in terms of NACE/ISIC classifications.

* Agriculture includes hunting and fishing.

** Industry includes mining, manufacturing, production of electricity, gas and water. (For 1993-1995 Croatia not reported in NACE/ISIC and for this period industry includes mining, manufacturing and water management).

- Lack of financial resources for industrial investment, including in cleaner technologies.
- Decrease in agricultural production leading to declining consumption of agrochemicals.
- Decrease in exports of industrial products.
- Consequences of the war.

Figure 10.1 : Volume of production, 1988-1997



Source: Statistical Yearbook, 1998.

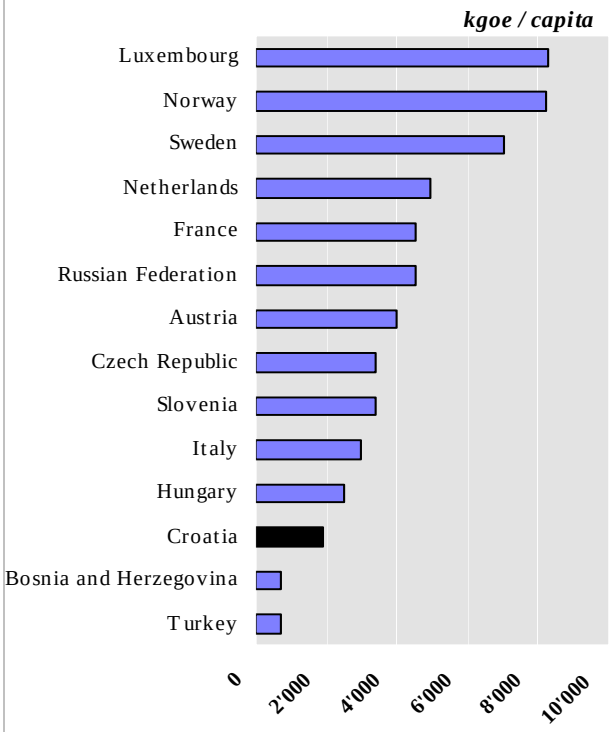
This chapter is confined to general issues related to the introduction of cleaner technologies, as well as to the development and the environmental problems caused by major industrial polluters, i.e. the energy sector, the manufacture of chemicals and chemical products, and the manufacture of cement.

Technological options for industrial use of energy

General information on energy resources, production and use is included in Chapter 5. Total energy supply per capita in Croatia and selected countries is given in Figure 10.2 and energy intensity in Croatia and selected countries is presented in Figure 10.3. Compared to other European countries Croatia's total energy supply per capita is relatively low. The final energy demand by industry during 1993-1997 accounted for 23-29 per cent of total energy demand. The total consumption of energy in industry was 7.8 per cent higher in 1997 than in 1996. Significant increases were registered in the use of liquid fuels (16.9 per cent) and natural gas (12.8 per cent). At the same time, coal consumption increased by only 2.1 per cent in 1997 compared with 1996.

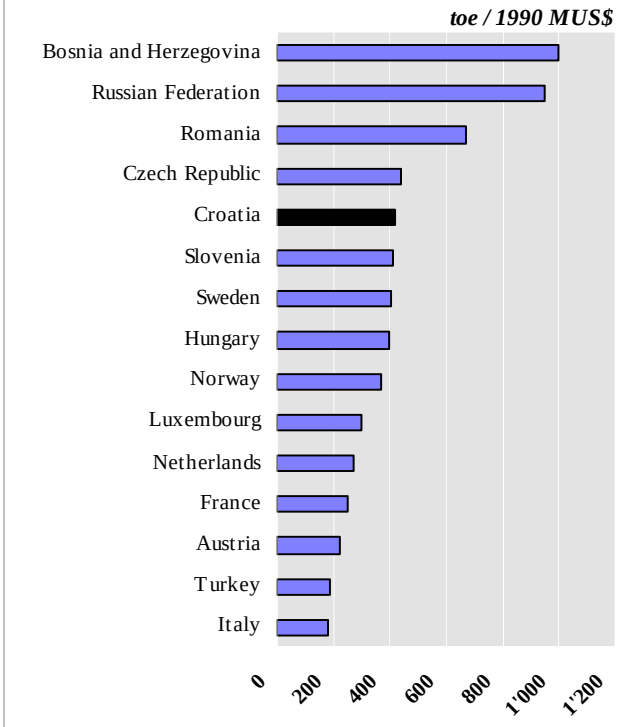
Increased use of gas tends to reduce air emissions from the burning of fuels. The main obstacle to

Figure 10.2: Total energy supply per capita in Croatia and selected countries, 1997



Source: Annual Energy report 1993-1997, Ministry of Economy, Republic of Croatia.

Figure 10.3: Energy intensity in Croatia and selected countries



Source: Annual Energy report 1993-1997, Ministry of Economy, Republic of Croatia.

the use of natural gas is uncertainty about future gas prices and gas distribution. Modern technologies using gaseous fuels include:

- combined cycle power plant
- combined heat and power generation
- steam injection gas turbine
- intercooling and steam injection gas turbine
- humid air turbine
- chemical recovery gas turbine

Coal is the most readily available and cheapest energy source, but its main disadvantage is its negative impact on the environment compared with gaseous and petroleum fuels. However, new technologies may result in a reduction of SO_x and NO_x emissions. Table 10.2 summarizes new coal technologies. For example, combustion technology using fluidized-bed cuts SO_x emissions by 90-95 per cent. A series of new processes is under development or consideration for advanced flue gas desulphurization. They include chemical and physical coal and gas cleaning, coal gasification and coal liquefaction. Many of these processes are already at the commercial or demonstration stages and could be implemented in industry.

Table 10.2 : Status and technical properties of the most significant coal-using technologies

Technology	Status	Efficiency	SO_x emission reduction	NO_x emission reduction
			(%)	
Pulverized coal fired combustion (below and over-critical parameters, PCFC)	Commercial	38-47	-	-
Fluidized-bed combustion (FBC)	Commercial/Demonstration	34-37	90-95	60
Circulated fluidized-bed combustion (below and over-critical parameters, CFBC)	Commercial/Demonstration	37-39	90-95	60
Pressurized fluidized-bed combustion (below and over-critical parameters, PFBC)	Demonstration	42-45	90-95	70
Integrated coal gasification combined cycle (IGCC)	Demonstration	45-48	98-99	98-99
Integrated gasification fuel cells (IGFC)	Developing	40-60	92-99	92
Direct coal-fired cycle turbines (DCC)	Developing	35-45	85-85	70-80
Diesel with direct coal-fired cycle (DCC)	Developing	35-45	80	50
Advanced flue gas desulphurization (FGD)	Commercial/Demonstration	37-39	90-97	-
Sorbent injection	Commercial/Demonstration	37-39	55-75	-
Wiping by sprinkling	Commercial/Demonstration	37-39	70-90	-
Combined SO_x / NO_x	Demonstration/Developing	37-39	70-95	70-90
Additional combustion	Demonstration	38-40	0-20	60
Combustion with low NO_x	Commercial/Demonstration	38-40	-	45-60
Further combustion	Commercial/Demonstration	37-38	-	40-90
Physical coal cleaning	Commercial/Demonstration	90	30	-
Chemical / Biological coal cleaning	Developing	85-90	90-95	-
Lower rank coal reproduction	Developing	80	30-95	-
Mixture coal / water	Demonstration	-	50-75	-
Coal gasification	Commercial/Demonstration	75-80	90-99	-
Indirect coal liquefying	Developing	60	95	70
Direct coal liquefying	Developing	55-60	99	97

Source: Energy sector development strategy of the Republic of Croatia (draft January 1999), Ministry of Economic Affairs.

Table 10.3 : Status and charasteristics of some renewable energy resources

Technology	Status	Technical feasibility	Per unit power	Efficiency *(%)*	Environmental impact
Active solar systems					
- heating	Commercial	Good	1-50 MWt	25-50	Small
- cooling	Developing	Medium/Good			
Passive solar systems					
- heating	Commercial				
- cooling	Developing	Medium/Good	0.005-500 MWt	25-50	Small
- daily illumination	Commercial/Developing				
Solar thermal energy	Demonstration	Medium/Good	7-100 MWe	15-30	Medium
Photo voltaic systems					
- connected to the grid	Demonstration	Medium/Good	1-7 000 kWe	10-25	Medium
- not connected	Commercial	Good	0.01-1 000 kWe	10-25	
Biomass					
- fuels	Commercial	Good	-	-	High
- energy	Commercial	Good	5-50 MWe	25-35	Medium
Wind energy	Commercial	Good	0.02-1.5 MWe	25-45	Medium
Geothermal energy					
- hydro-thermal	Commercial	Good	10-500 MWe	10-16	Medium
- heat dry rocks	Developing	Bad			High
- lava	Developing	Bad			-
Small hydro-power plants	Commercial	Medium/Good	0.5-25 MWe	80-90	Small/High
Wave and tidal energy	Commercial/Developing	Bad/Good	3-10 MWe	-	Medium
Sea heat energy	Developing	Bad	100-1 000 Mwe	-	Small

Source: Energy sector development strategy of the Republic of Croatia (draft January 1999), Ministry of Economic Affairs.

Nuclear energy is considered a long-term option. Taking into account the difficulties with gas and oil derivatives, renewable energy sources are attractive and available in Croatia. They include the use of solar systems; photovoltaic energy; biomass; wind energy; geothermal energy; small hydro power plant; wave and tidal energy and sea heat energy. Their potential use in Croatia is the subject of Table10.3.

The production and use of hydrogen, in particular by water electrolysis, as an alternative source of energy is also attractive for future energy systems after the year 2010. The most promising technologies are fuel cells for direct energy production from hydrogen without mobile parts and with high efficiency.

Structure and development of the chemical industry

The chemical industry is one of Croatia's main industrial sectors. It accounted for 11.34 per cent of GDP in 1997. It comes second after the food industry and represents 8.2 per cent of total employment in the manufacturing industry. The main chemicals produced are: ammonia, nitric and other inorganic acids, detergents, vinyl chloride, carbon black, plant pesticides and herbicides, urea and compound fertilizers, polyethylene, synthetic materials and resins, pharmaceutical raw materials, commercial medicines, soap, cosmetics, coating materials, glues and films.

During the 1987-97 period, the chemical industry performed better than total manufacturing industry, as its production volume index declined only from 170.5 in 1987 to 97.1 in 1997. During the 1993-1997 period, the production of inorganic chemicals and fertilizers slightly increased, for example compound fertilizers from 482 800 to 536 700 tonnes. There was also an increase in the production of pesticides and herbicides (from 7 568 000 tonnes in 1993 to 8 813 000 tonnes in 1997). See Chapter 11 on information regarding the trend in fertilizer (N; P_20_5 and K_2O) consumption.

Development of the cement industry

The cement industry is particularly solicited in the post-war reconstruction of Croatia. Production grew in 1994, 1996 and 1997 in comparison with the preceding years. In 1998 and 1999 cement production was estimated at 2 125 000 and 2 910 000 tonnes, respectively. There are four cement producers, the biggest being Dalmacijement (RMC) with a capacity of 2.3 million tonnes a year (3 plants), and Tvornica Cementa Koromasno with a capacity of 0.6 million tonnes a year. Full capacity of the four companies is 3.08 million tonnes a year, which means that, in 1998, the cement industry was working at about 70 per cent of its capacity.

A study was prepared by a group of professionals and scientists to assess the potential role of the cement industry in the treatment of waste. The following kinds of hazardous waste could be incinerated in cement kilns:

- waste oils and oil-containing wastes
- organic solutions
- used car tyres
- flammable part of municipal wastes, in particular packaging
- wood wastes
- waste-water treatment sludges

The advantages of waste incineration in cement kilns are:

- use of waste materials as alternative energy sources
- saving natural resources
- protection of the environment as waste discharged into the environment is eliminated and there is no need to build extra waste-disposal facilities
- high degree of waste decomposition because of the high temperature in the furnace (flame temperature is more than 2000°C, and the temperature of materials is 1450-1500°C; the organic parts of waste are destroyed and inorganic parts in the form of ash mixed with raw material)
- ash quantity and composition has a negligible influence on the quality of the cement
- sulphur-containing fuel could be used because SO_2 in exhaust gases is reduced due to its reaction with clinker
- heavy metals are totally incorporated into clinker without changing its properties
- exhaust gases, after heat recovery and purification, meet international standards
- the content of high toxic organic substances (dioxins) is lower than required by standards (0.01 mg/m3).

Measures needed to insure the full-scale incineration of wastes in cement production are:

- development and implementation of appropriate legislation and regulations laying down standards for the quality of clinker and cement, lists and characteristics of wastes to be used on the basis of existing European practices
- development of a national system for the collection of wastes which would guarantee a sufficient supply of it for use as energy sources
- creation of a national market for waste suitable for burning in cement kilns, possibly including the import of such wastes from neighbouring countries
- adaptation of cement production technology so that conventional energy materials can be partially replaced by wastes while maintaining the same cement quality and emission standards.

10.2 Environmental management at selected industrial enterprises

INA Industrija Nafte d.d.

INA is Croatia's largest company for oil and gas exploration and the production, refining, transport and distribution of gas and oil products. In 1997, 1 786 147 tonnes of oil and gas condensates were produced, 1 496 223 tonnes from domestic oil and 289 924 tonnes (16 per cent) from imports. Production of domestic natural gas amounted to 1.7 billion cubic metres; 879 million cubic metres of natural gas were imported. Oil production is mainly from INA, which processes crude oil in the refineries in Rijeka and Sisak.

As part of environmental management, the company invested in waste-water treatment, thermal treatment of wastes and abatement of air emission. Total investment in environmental protection in 1997 stood at 5 368 745 kunas. The company provides information on its activities to the public and allows it to participate in the decision-making process. The representatives of company management together with specialists organize special meetings with the public in the vicinities of the industrial facilities. They inform the public of new developments in the production

processes, the environmental measures being taken, as well as the interest of developing local industrial facilities and its benefit to the public.

The company's environmental policy was developed according to the Law on Environmental Protection and INA's Charter of Safety. Its basic policy objectives in environmental protection are:

- EIA of new facilities
- Risk assessment in the case of accidents
- R&D into cleaner technologies
- Introduction of an environmental management system in accordance with ISO 14000
- Improvement of the quality of products, by developing environmentally friendly chemicals (INA BIOLANCOL-biodegradable lubricants, INA-BIOHIDRAOL-36,46 - new generation of hydraulic oils, INA-BIOTRANSHIDROL JD-biodegradable oil)
- Training of staff in environmental protection measures.

Each sector and technological unit of the company has a department responsible for environmental protection. The INA Corporate Environmental Protection Department coordinates overall environmental protection activities and cooperates with governmental and non-governmental institutions in the implementation of national and international legislation, regulations and standards on wastes and emissions. Since 1995, the company has drawn up an inventory of air, water and soil emissions, as well as of generation of solid wastes.

Most hazardous wastes (floating and heavy sludges, unpumpable residues from waste-water pretreatment) are incinerated in-house. Oil wastes are recycled as fuel and highly toxic wastes are incinerated in a special furnace or treated at specialized, authorized companies.

The company has introduced the following environmentally relevant processes:

- INA started to produce unleaded petrol in 1986.
- Rijeka Refinery started a new unit for hydrodesulphurization and mild hydrocracking gas oil to produce diesel fuels and fuel oils according to European standards.
- Reconstruction and starting of production of sulphur from refinery gases using the Claus process, in particular at the Rijeka Refinery.
- An appropriate waste-water collection system was installed.
- A first unit for the treatment of oily rainwater and waste water was installed and new facilities are being completed.
- The first incinerator for biological sludges was put into operation.
- A rotary kiln waste incinerator is being completed.
- A system to monitor the quality of treated waste water was introduced.
- Emissions of SO_2, CO, NOx and particulates are monitored discontinuously.
- A waste inventory and an emission inventory are kept.
- An air quality monitoring system has been set up in the vicinity of the Rijeka Refinery.

Petrokemija Fertilizer Company

Petrokemija is one of Croatia's biggest chemical companies producing fertilizers (about 1 million tonnes per year), carbon black and bentonite clays. Fertilizer production is based on the use of raw phosphates, sulphur and natural gas. The plant also produces ammonia, nitric, sulphuric and phosphoric acids, urea and nitrogen. The consumption of fertilizers in agriculture decreased by more than 40 per cent in 1998 compared with 1988. This trend negatively affected the company, which is working at less than full capacity. The main environmental problems for the Petrokemija plant are:

- disposal of phosphogypsum from phosphoric acid production
- purification of exhaust gases from fluorides, ammonia, hydrogen sulphide, nitrogen oxides, sulphur dioxide and dust
- treatment of waste water and sludges.

The production of phosphoric acid gives rise to about 5 tonnes of phosphogypsum per tonne of P_2O_5 generated. At present, most phosphogypsum is disposed of in landfills or ponds, or is discharged to sea. Phosphogypsum may be hydraulically transported from the phosphoric acid plant to the land disposal site. Geological and hydrogeological research was carried out prior to the creation of the disposal site, which covers about 1.6 km^2 and has a capacity of about 7 000 000 m^3. The disposal pond is a source of environmental pollution, resulting in the contamination of air and underground water by fluorides, phosphates and small amounts of radionuclides.

The monitoring system for the disposal pond is operated according to the national legislation based

on IAEA recommendations. The maximum permissible level for Ra226 is 1000Bq/m^3. The disposal pond is checked regularly, and the existing contingency plan contains measures to be taken in an emergency. An air quality management system has been developed and is implemented at the plant.

Recent improvements in the company's overall environmental performance can be summarized as follows:

- improvement in production processes by introducing cleaner technologies. This is an overall goal of the company
- double contact and double absorption in sulphuric acid production
- using natural gas instead of oil feedstock in ammonia and energy production
- scrubbing tail gases in fertilizer production with a considerable reduction in the emission of NH_3, NO_x, F and dust
- introduction of a bag filter system in the rock phosphate grinding unit
- treatment of waste water containing ammonia and nitrates by an ion-exchanging method
- separate waste-water treatment from sulphuric acid production, phosphoric acid (both through neutralization by lime), and urea (hydroliser stripper, recycling released ammonia back into the process)
- recycling of spent catalyst from ammonia and sulphuric acid production to catalyst manufacture
- incineration of PCBs by a specialized company.

Environmental protection measures were also undertaken for particular units:

- In 1993, at the nitric acid plant, the absorption column was made more efficient, resulting in a reduction in nitrogen oxide emissions.
- In 1993, one urea and one ammonia unit were closed, contributing to a reduction in ammonia emissions.
- At the calcium ammonium nitrate (CAN) unit for fertilizer production, granulation was introduced instead of prilling, and a pipe reactor has replaced the final evaporator.
- Disposal of phosphogypsum by high storage was started to save land near the Lonjsko polje natural park.

The introduction of the following new, cleaner processes is planned:

- waste gas scrubbing to reduce ammonia and dust emission at the NPK 1 plant
- increasing absorption column efficiency by supplying oxygen to reduce NO_x emission at the nitric acid 1 plant
- upgrading the automatic control process and increasing the capacity at the ion resin waste-water treatment plant
- reducing waste water by modifying ammonia nitrate (AN) production at the AN/CAN unit
- reducing NO_x emission at the ammonia 2 plant
- introducing granulation instead of prilling, and a scrubbing gas system to reduce ammonia and dust emission at the urea 2 plant
- reconstruction and flaring tail gases to reduce H_2S and CO emissions at the carbon black plant.

Petrokemija facilities have developed and put in place all necessary measures to prevent, prepare for and respond to industrial accidents, including those capable of causing transboundary effects. Among these measures the following should be mentioned:

- The Operational and Information Centre of Petrokemija manages and coordinates all emergency activities; contingency plans are developed and staff are informed of how to act in the event of emergencies; an automatic meteorological station is used for the prediction of the dispersion of toxic clouds.
- A list of hazardous substances was drawn up. It includes ammonia, ammonia nitrate and calcium ammonium nitrate, nitric, sulphur and phosphoric acid urea and elementary sulphur.

Pliva d.d. Company

Pliva is one of the biggest chemical companies producing bulk pharmaceuticals, animal health products and agrochemicals, foodstuff, cosmetics and hygiene products. It has daughter companies in Bosnia and Herzegovina, Poland, Slovenia, Switzerland, and the United States. Health-care products account for 82 per cent of total turnover, or 2 716.2 million kunas. The environmental protection division is active in environmental monitoring and audit, environmental technologies, waste management and recycling, waste-water treatment, and the analytical control of emissions. Compliance with the emission standards of the European Union is the company's main challenge.
The main environmental problem is waste-water treatment, in particular in the production of yeast. Within the framework of Capacity Building in

Cleaner Production, the company started a project on good water housekeeping and reducing emissions to the environment (see also Table 10.4 below). A treatment and heat recovery unit will be built for cooling water from yeast production, which uses huge quantities of water to cool the bioreactors. The reaction takes place at 30°C and the temperature of the cooling water at its inlet is 14-15°C and at its outlet 23-27°C. At present, the water is discharged into the river Sava. The recovery of heat and the reduction of water use (by up to 90 per cent) would result in savings of US$ 450 000 per year.

Pliva is a good example of a company introducing industrial safety measures. It has contingency plans in the event of accidents at all facilities. At Savski Marof, the plan contains information on facilities and sewage systems, possible accident points, the potential causes of accidents and their possible severity, the area covered by an accident, communication before, during and after an accident, measures for preventing accidents, personnel responsible for managing an accident, human resources and technical equipment to mitigate the effects of industrial accidents. A list of hazardous substances produced and used at the industrial facilities, including their threshold quantities, has been drawn up.

10.3 General introduction of cleaner technologies in industry

Legal aspects and priorities

There is no law on the introduction of cleaner technologies in Croatia. In 1996, a round table on cleaner production took place. The participants adopted the Declaration on Cleaner Production, aiming at the promotion of cleaner production as the priority production strategy to enable industries and the economy to adapt to the requirements of sustainable development. The Declaration underlines the need to:

- define the promotion of cleaner production in industry and the economy as a whole as a priority through education, training and information
- develop urgently a strategy for the implementation of cleaner production and create an organization responsible for such implementation through a network of interested companies and institutions
- designate an appropriate ministry to initiate the involvement of Croatia in the UNIDO/UNEP international network on cleaner production and to meet the requirements of existing international conventions and recommendations.

Institutional arrangements

Following the round table, the first Committee for Cleaner Production (ICCP) was established. It consists of representatives of the Government (State Directorate for the Protection of Nature and the Environment; Ministries of Science and Technology and of the Economy), the Chamber of Commerce, industries (food, pharmaceuticals, electric), the Universities of Zagreb and Rijeka, the Croatian Council for Sustainable Development, NGOs and the Hazardous Waste Management Agency (APO), which is the secretary of the Committee.

In July 1997, an agreement for a project on Capacity Building in Cleaner Production was signed by the Governments of Croatia and the Czech Republic, and UNIDO. The project covers the following main activities:

- training trainers
- implementing cleaner production demonstration projects
- establishing a national cleaner production centre (NCPC) in Croatia within the UNIDO/UNEP network.

The centre will be financed from the Multilateral Development Assistance Programme of the Czech Republic in the framework of the UNIDO/UNEP NCPC network. Its activities will cover:

- conducting audits to help companies to identify wasteful processes and implement measures to prevent pollution and reduce waste generation
- training managers, technical and national consultants in the use of tools and methods to improve production processes and organize cleaner production workshops for experts from government, universities, and business
- disseminate information on cleaner production and raise awareness through seminars, newsletters, brochures, and cooperation with the national media, industrial associations and training institutes
- advise the Government on policies and strategies to include cleaner production provisions in national legislation and encourage enterprises to reduce or prevent pollution at source and to use energy and raw materials rationally.

Table 10.4 : Cleaner production demonstration projects in Croatia

Company Industry, activity	Project description	Capital investment	Savings	Payback period
		(HRK)	*(HRK/year)*	
CIMOS BUZET d.o.o. Metal-processing	Reduction in the environmental impact of chromate ions in the zinc-plating process	1 900	32 230	immediately
ERICSSON NIKOLA TESLA d.d. Electronics and telecom.	Waste reduction and reduction in material consumption in the process of wave soldering of printed board assemblies	0	146 900	immediately
HERBOS d.d. Sisak Chemical industry (herbicides)	More efficient use (+1%) of raw materials	0	780 000	immediately
	Reduction in waste-water contamination through tenzide addition and turbidimeter installation in herbicide production	75 000	717 000	< 1 month
KIO - Orahovica d.d. Ceramics industry (ceramic indoor tiles)	Reduction in ceramic waste tiles (raw, glazed and fired scrap)	758 000	973 300	9.5 months
KRAŠ d.d. Confectionery industry (sweets)	Reduction in raw materials losses and in total waste in waffle production	21 600 000	4 425 000	4.9 years
LABUD d.d. Zagreb (detergents, cosmetics and other cleaning materials)	Waste-water reduction (washing and cooling water) in liquid product unit	45 000	10 700	4.2 years
PLIVA d.d. Zagreb (pharmaceuticals, cosmetics and food products)	Improvement of water management and reduction in waste water and freshwater consumption at yeast production plant	1 817 000	2 839 000	8 months
SAPONIA d.d. Osijek Chemical industry (detergents and cleaning materials)	Product dosage improvement, better raw materials use and less packaging waste in abrasive cleaning materials production	1 000 000	225 000	4.4 years
SIPRO d.d. Umag (production of self-adhesive tapes)	Raw materials saving and emission reduction	0	92 600	immediately
	Hexane recovery with cooling water processing	147 000	121 700	1.2 years

Source: Broj 2174 Kutina, 11-3-1999.

As part of the project, a seminar on the promotion of cleaner technology was organized. About 200 experts and representatives from the Government, industry, universities and NGOs participated in it. The first long-term interactive training course on cleaner production was organized in November 1997, based on "train the trainer" methods developed by the Czech Cleaner Production Centre from Norwegian experience. 32 experts were trained and 11 cleaner technology projects at 9 companies were developed (see Table 10.4).

The projects cover cleaner technologies to save energy and raw materials, reduce discharges of waste water and solid wastes, and improve waste-water management. The implementation of almost all projects has started, sometimes with immediate payback effects. These projects are expected to result in:

- 1 025 300-m^3 reduction in waste-water discharge
- 54.6-tonne reduction in COD in terms of O_2 of waste-water discharge
- 23.2-tonne reduction in VOC air emissions a year
- 1 620-tonne reduction in solid industrial wastes a year
- estimated economic benefits of US$ 1 685 000 a year

10.4 Environmental management in energy and chemical industries

Energy industries

Croatia's draft energy sector development strategy, which sets policy objectives for the energy sector, has passed its first reading in Parliament. It now awaits the second reading before its final adoption. It is part of Croatia's General Economic Development Strategy. The energy strategy covers economic, legal, organizational, institutional and educational aspects. Its concept takes account of national interests, energy market trends in the European Union and Croatia's needs to develop its own energy market, which must conform with the standards of developed countries. The research results on the content of the strategy were published in 25 documents. The main objective of the research was to delineate various aspects and preconditions of both economic and energy sector development, as part of the effort to transform Croatia into a modern European State with a parliamentary democracy, private ownership and a market economy.

The draft strategy addresses:

- the laws and regulations of the energy sector;
- the transmission/transport and distribution network for gas and electricity;
- the development of a non-discriminatory market and competition, as well as the future demonopolization of the market;
- restructuring of HEP and INA, partial privatization of these companies;
- improvement of energy efficiency;
- stimulation of the use of renewable resources and cleaner technologies;
- improvement of the consumer's position, high-quality service and lower prices;
- education, information and consultation services and development of public relations.

The new coal-fired power plant Plomin II is expected to be put into operation by the end of 1999. No further power production capacity increase is expected until 2010. A 5 per cent rise in gross domestic product would bring about a 3.3 per cent growth in energy consumption per year. After 2010 energy demand is expected to rise in all sectors but mainly in households and services, which may require some additional sources.

The dominant sources of energy by 2010 will be liquid fuels (42 per cent), natural gas (32 per cent), hydropower and coal (24 per cent). The share of renewable energy sources is expected to increase by 2 per cent in 2010. A systematic policy of renewable energy production in Croatia is based on the national energy programmes launched in 1997 by the Government. They comprise among others the following sub-programmes:

- BIOEN Biomass and Waste Utilization Programme. Its potential by 2030 is assessed to be 50-80 PJ (16 PJ in 1996)
- SUNEN Solar Energy Utilization Programme. By the year 2020 about 50 per cent of non-industrial energy demand in the coastal area is expected to be covered by solar energy
- ENWIND Wind Energy Utilization Programme. The potential of 29 selected macro-locations is assessed to be 750 kW a year
- GEOEN Geothermal Energy Utilization Programme. Croatia's geothermal potential is considerably higher than the European average. Geothermal energy is already used in several places and its use is expected to increase approximately tenfold
- MAHE Small Hydro Power Plant Construction Programme. There is an estimated potential of 100 MW of total installed power.

Increasing energy efficiency is one of the fundamental requirements for sustainable development. Croatia's international position in terms of its energy intensity is shown in Figure 10.3 . The energy institute Hrvoje Požar, together with other institutions, developed an energy conservation strategy in 1998. The Strategy was adopted by the Government and included into the energy sector development strategy. The Energy Conservation Strategy comprises the following national energy programmes:

- KUENzgrada: Building Energy Efficiency Programme
- MIEE: Industrial Energy Efficiency Network
- KOGEN: Cogeneration Programme
- KUENcts: Energy Efficiency in Centralized Thermal Systems Programme
- TRANCRO: Transport Energy Efficiency Programme

Considerable technical improvements in the energy

sectors are required to reach the energy-efficiency goals. They are spelled out in the Energy Conservation Strategy. Among them are: the replacement of worn-out equipment and installations, the use of waste heat of exhaust gases, the introduction of new automatic control and management systems and standardized regulations as well as precise control equipment, the stimulation of cogeneration, and the establishment of efficient price and tariff systems.

The implementation of the Strategy will be supported by a set of policy instruments. The investments required for its implementation are estimated at 4 billion kunas a year (approximately DM-1.1 million), or about 850 kunas per capita annually. The Government is expected to set up a national energy programme fund to finance the energy-saving and renewable energy projects and provide its seed money. The fund will be formed as a special-purpose financial institution, depending on the State and its own management bodies, and their institutions. The following sources of financing could also be considered:

- State budget and local management unit budget
- "Debt-for-environment" swaps as a mechanism for converting part of the State's foreign debt into financial sources for the fund
- Commercial bank loans
- Interests on loans approved by the fund
- Penalties collected from polluters
- Part of the energy price
- International financial sources.

Energy price liberalization and the step-by-step privatization of the energy sector are expected to facilitate the strategy's implementation. Further support is expected to come from independent producers (IPP).

Safe management and production of chemicals

Legislation. The Law on Poisons was adopted in 1999. Also, the Law on Environmental Protection contains environmental safety provisions related to hazardous products and environmental impact assessment. It prescribes the drawing-up of local environmental protection programmes with elements for industrial contingency plans. Apart from contingency plans, users and manufacturers of hazardous substances are obliged to perform risk evaluations and train their staff to work with poison in accordance with domestic legislation. However, there is still a need for an umbrella law on the safe management of chemicals.

The framework programme of activities related to prevention, preparedness and response in the event of industrial accidents is anticipated by the Environmental Emergency Plans, National Water Protection Plan and Contingency Plan for Accidental Marine Pollution in the Republic of Croatia. These programmes are implemented in close cooperation with the Ministry of the Interior, the Ministry of Defence and the INA Operative Information Emergency Centre, the headquarters of the expert unit for Environmental Protection Emergency Plan implementation.

Policy objectives and management instruments. The objectives of governmental policy in the safe management of chemicals are:

- Drawing up a programme for chemical risk reduction and risk assessment procedures
- Improving the classification of chemicals, their packaging and labelling
- Harmonizing legislation, rules, standards and norms with those of the EU
- Preventing the illegal trade in hazardous chemicals
- Improving the sharing of information on the safe management of chemicals among all partners involved in handling them (production, consumption, storage, trade, etc.)
- Introducing cleaner technology and processes in the chemical industry

Reporting system

In 1993 and 1998 a special survey of industrial accidents and other emergencies was conducted.

The survey was based on data on the availability of contingency plans at plants, the parties involved in those plans, the analysis of past industrial accidents, competencies, the availability of technical means to mitigate the effects of an industrial accident, the role of the media in the event of an industrial accident. This survey of industrial accident management at 61 chemical companies gave the following results:

- Alarmingly, almost half the respondents were unaware of the existence of contingency plans or chemical management systems;

Table 10.5: Evaluation of accidents in the period 1996-1999

	1996	1997	1998	1999*
Railway accidents (Croatian Railways records)	52	80	68	20
Road transport accidents of hazardous substances (Ministry of the Interior)	-	17	23	17
Cases of water pollution (Hrvatske vode)	15	32	39	35

* Data for 1999 are from January to August.
Source: SDEP, 1999.

- It is necessary to standardize contingency planning methodologies in more detail and oblige the major stakeholders (on-site and off-site) to develop appropriate plans and establish appropriate systems, and test their effectiveness;
- The majority of respondents consider that good preventive measures are just as important as remedying chemical accidents, and that the companies where an accident could occur are primarily responsible for prevention and remediation;
- Technical and technological equipment for chemical accident management is not satisfactory. To solve this problem, wider international support and cooperation are crucial;
- The provision of information to the public about the probability of chemical accidents and protective measures has been mostly unsatisfactory.

This determines the priorities for follow-up activities, especially the need to make a greater effort to inform and involve politicians. The survey's results reflect the interest and readiness of the respondents to help solve this issue. Moreover, they have identified key elements and steps that should be part of any chemical accident management system.

A reporting system for ecological accidents has been established and is operated by the Operative Watch Department of the Ministry of the Interior and the Observation and Notification System Department of the Ministry of Defence. It supplies all information related to accidents to the Section for Environmental Intervention Plans within SDEP, which in turns is in charge of taking further action.

The analysis of existing legislation and structures as well as the recorded cases of uncontrolled and accidental discharge of hazardous substances into the environment in the past three years is a strategic starting point for planning prevention and response measures. Since 1996, SDEP has systematically monitored the situation and kept records of the number and types of accidents (Table 10.5). It should be pointed out that the number of accidents involving hazardous substance discharges into the environment from the chemical industry is particularly high.

10.5 Conclusions and recommendations

Industry contributes more than 25 per cent to Croatia's GDP. Despite an improvement in the economic situation during 1994-97, the majority of industrial sectors continue to work at only 50-60 per cent of their capacities. As a result of this economic depression, industrial pollution has eased. This period of reduced activity should be used to develop both legal frameworks and policy strategies for the future introduction of cleaner and more sustainable industrial practices. Initiatives are required to develop a general framework for cleaner production in all industries.

Framework for cleaner production

There is no strategy for sustainable industrial development. A strategy for industrial development and industrial policy is being prepared and should be ready by the end of 1999. It will be based on the principles of sustainable development, so the gradual application of cleaner technologies is unavoidable. It is expected that the strategy will serve as a guiding document for the development of industry, also with regard to the introduction of cleaner technologies.

The Declaration on Cleaner Production, defining policy objectives of cleaner production, was drawn up and adopted. A national cleaner production centre will be established with assistance from the Czech Republic and within the framework of UNIDO/UNEP cooperation. A project on capacity building in cleaner production was started in July

1997. The project covers training activities and the implementation of 11 cleaner processes at 9 chemical enterprises. The project's estimated annual economic benefit amounts to US$ 1 685 000. However, there is no specific law on the introduction of cleaner technologies. This deficiency will certainly hamper any industrial pollution abatement policy in the future.

Already, the Environmental State Report mentions the possibility of using cleaner production practices in industry. The environmental strategy, which is now being prepared, considers the various forms of integrated environmental management, of which cleaner production is a part.

Recommendation 10.1:
A legal framework promoting the development and implementation of cleaner technologies should be developed in cooperation with the State Directorate for the Protection of Nature and the Environment, the future national cleaner production centre, and other appropriate public and industrial institutions.

The need for a legal framework for the introduction of cleaner technologies does not obviate the need for practical technological improvements in Croatia's industry. A Multilateral Development Assistance Programme is at present operated with assistance from the Czech Republic and national funds. The Programme also provides financial assistance for the implementation of industrial cleaner production projects. Another available option for the promotion of cleaner production consists of the UNIDO/UNEP network. An information campaign should be launched to inform individual industrial companies of the activities of these two, as well as of other options for assistance in matters of cleaner production. However, the most important aspect in the introduction of cleaner technology is the cooperation of industry. At this stage, industry should be encouraged, by the information campaign, to adopt relevant ISO standards. To this end, information on relevant demonstration projects should be regularly disseminated.

Recommendation 10.2:
The State Directorate for the Protection of Nature and the Environment should undertake a large-scale information campaign on available assistance for industrial enterprises in their introduction of cleaner technologies. The promotion of the ISO 9000 and ISO 14000 series in Croatian industry should be a second major objective for the campaign. The campaign should also provide information on relevant demonstration projects for the actual introduction of cleaner technologies and products.

Industrial accidents

Special attention is already being paid in Croatia to the prevention of, preparedness for and response to industrial accidents. A specific study on industrial safety was conducted, and the Environmental Inspectorate has a section for environmental intervention plans. The next step is to improve, further develop and apply industrial safety measures in cooperation with industry. The ECE Convention on the Transboundary Effects of Industrial Accidents, which Croatia has recently ratified (June 1999), could be instrumental to the achievement of this end (See Recommendation 4.4).

Measures for the chemical and petrochemical industries

The chemical industry is Croatia's biggest industrial sector. While it has not fully escaped the current economic depression, the chemical industry is faring better than the average Croatian industry. There is a national structure for the safe management of chemicals. It includes legal, administrative and institutional arrangements. Relevant legal provisions are dispersed over many laws and regulations, which hampers the safe management of chemicals. The objectives of governmental policy were defined and institutional arrangements were made, in particular by the creation of the Commission on the Safe Management of Chemicals. It includes representatives from government, industry, private and non-governmental organizations. As a result, there are many experiences and projects. However, they do not appear to be very well coordinated. Coordination also appears to be a prerequisite for a more systematic implementation of norms and standards concerning the production, storage, trade and use of chemicals.

Recommendation 10.3:
The State Directorate for the Protection of Nature and the Environment, in cooperation with other governmental authorities represented in the Commission on the Safe Management of Chemicals, should develop a law for the safe management of chemicals, based on the relevant EU directives and practices. It should also strengthen its coordinating role in the safe management of chemicals.

Examples from large chemical companies show that their development policy normally contains measures for the protection of the environment. Companies like Petrokemija, INA and Pliva d.d. have introduced cleaner production processes, contributing to the protection of the environment and to product quality, according to ISO 9000 and ISO 14000 standards. However, the unfavourable economic and financial situation in industry does not generally permit companies to apply cleaner production technologies and meet the requirements of the existing national norms and standards on the permissible concentration of pollutants without special measures. The overall economic situation as well as the examples referred to above suggest that the development of adequate economic instruments should be the main strategy for encouraging the chemical and petrochemical industries to step up their efforts to protect the environment.

Recommendation 10.4:
The Government, in cooperation with chemical companies, should define and apply economic measures that promote a wider introduction of environmental protection measures in the chemical and petrochemical industries, including both in-process and modern end-of-pipe technologies.

Sooner or later, economic development will make a pollution-specific abatement policy necessary. The chemical and petrochemical industries in Croatia will be at the forefront of such a policy. At that time, it will be necessary to base industrial pollution management on information about actual pollution patterns. The necessary monitoring and other measurement should be prepared early, as the development of information systems is costly and time-consuming. An important step in this direction is the establishment of the Environmental Emission Cadastre (see also Chapters 1 and 6).

Recommendation 10.5:
The development of an information system on industrial pollution should be started in the near future, beginning in the chemical industry. It should primarily focus on monitoring soil and groundwater pollution in the vicinity of refineries and chemical industrial sites.

Measures for the energy industries

A draft energy sector development strategy has been drawn up according to the existing energy legislation. The strategy includes economic, organizational, administrative, institutional, technical and educational aspects. It lays down policy objectives and management instruments, including for the improvement of energy efficiency. The main objective of the strategy is to ensure that Croatia's energy system develops in harmony with EU practices, including with regard to energy legislation. Several national programmes have been developed to implement the strategy. Owing to these very positive efforts, Croatia appears today on the road towards sustainable development in the energy economy. The first priority now appears to be the implementation of the strategy, focusing on restructuring the energy sector, together with privatization efforts.

Recommendation 10.6:
Restructuring and privatization in the energy sector to improve energy efficiency, taking into account national conditions and interests, should be seen as an urgent requirement for energy conservation.

Croatia's reserves of oil and natural gas do not match the country's needs. As a result, much research and development have gone into the use of coal and renewable energy. Numerous environmentally friendly processes for the use of coal in energy production are at the commercial or demonstration stages. New environmentally sound processes for the use of renewable energy resources, such as solar energy, photovoltaic systems, biomass, wind, geothermal and hydro energy, are also at the commercial stage (see also Chapter 5). Nuclear technology is considered as a long-term energy option. It is important that research and development in the future structure of the energy economy should continue, and that environmental protection be included into such research and development at an early stage so that it influences the specification of future energy supply options.

Recommendation 10.7:
Government and energy enterprises should undertake further research and development of cleaner coal processes, as well as environmentally sound processes using renewable energy resources.

Measures for the cement industry

The cement industry is making a large contribution to post-war reconstruction. There are four cement companies. The sector presently works at about 70 per cent of its capacity. In Croatia cement companies could make a considerable contribution to environmental protection, in particular through the incineration of industrial and municipal wastes like waste oils, oil-containing wastes, organic

solvents, used tires, the flammable part of municipal wastes, wood wastes and waste-water treatment sludges (see also Chapter 7). The use of cement kilns for such purposes would require relatively small technological adaptations in the cement industry in the use of fuels, air emissions and product quality. The necessary regulations for such practices could be derived from existing European practices and standards.

Chapter 11

ENVIRONMENTAL CONCERNS IN AGRICULTURE AND FORESTRY

11.1 Conditions and activities of agriculture and forestry

Basic characteristics of agriculture and recent developments

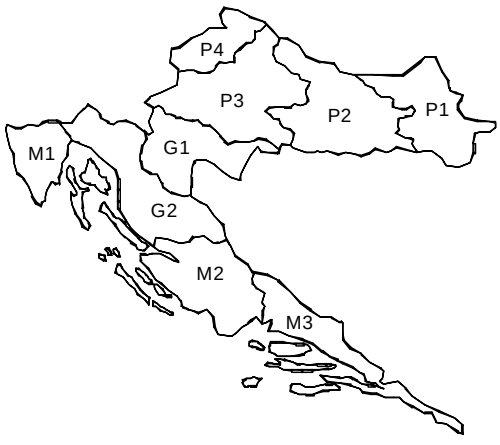
Croatia's climate varies. The Mediterranean climate is mild, with rainy winters, and dry, cloudless summers. The air temperature does not fall below 5°C. The mountain climate dominates in the mountain region, with snow on the ground for 50-60 days, and generally large amounts of precipitation. North and east Croatia have a moderate continental climate with warm (but humid) summers and cold winters.

There are three agricultural regions in Croatia: the Pannonian region, the mountainous area and the Mediterranean zone. Each consists of sub-regions. The Pannonian region is the southern part of the wide Pannonian plains. It covers 48 per cent of Croatia. Its flat lands, with the most fertile soils, represent Croatia's breadbasket, with high yields of all the most important crops. This is where most cereal production, in particular wheat (total production 833 508 tonnes on 208 377 ha in 1997), takes place. Cereals grow throughout Croatia (total production 2 387 000 tonnes on 407 207 ha in 1997). In the hilly part, family farms, orchards and vineyards are mixed.

The Mountain region is relatively heterogeneous. Its period of vegetation is very short. Its agriculture is characterized by small holdings, with stockbreeding the main activity. Arable farming is subordinated to the needs of providing fodder. The selection of crops is very small: mainly corn, but also potatoes (there are no outbreaks of diseases), rye and vegetables. The central mountain region is characterized by fruit production. Production is traditionally extensive, with a minimum use of pesticides and mineral fertilizers, and the soil is among the cleanest in Europe. The region's agricultural potential is little exploited.

The Mediterranean region enjoys favourable agro-ecological and agricultural features. Conditions are good for subtropical vegetation: olives, figs, citrus fruits, etc. There are several special agro-ecological and economic areas: Cepic field and Mirna valley in Istria, and the Neretva valley in central Dalmatia. Here private holdings with small production plots prevail, but production is very intensive, especially in market gardening.

Figure 11.1: Agricultural regions in Croatia



Subregions:
P_1-Eastern Pannonian
P_2-Central Pannonian
P_3-Western Pannonian
P_4-Northwestern Pannonian
M_3-Southern Mediterranean
G_1-Premountain
G_2-Mountain
M_1-Northern Mediterranean
M_2-Central Mediterranean

Table 11.1: Agricultural exports and imports, 1990-1997

Million US$

	1990-91	1992-93*	1994	1995	1996	1997
Export						
Total	3 102.4	4 250.7	4 260.4	4 632.7	4 511.8	4 340.9
Agriculture *(as % of total)*	*9.6*	*12.8*	*11.5*	*11.3*	*12.1*	*12.7*
Import						
Total	4 127.2	4 563.5	5 229.3	7 509.9	7 787.9	9 122.5
Agriculture *(as % of total)*	*15.4*	*11.2*	*11.7*	*12.4*	*11.9*	*11.0*

Source: Central Bureau of Statistics.

Note:
* Not including countries of ex-SFRY.

Croatia's production of industrial crops includes: oil crops (sunflower – 23 060 ha producing 41 506 t, rape – 5 356 ha producing 11 181 t), sugar beet – 25 577 ha/ 1 056 669 t, soya bean – 21 151 ha/ 45 867 t, tobacco – 7 310 ha/ 11 888 t. Olive oil production totalled 579 tonnes in 1997. Grape production stands at 350 000 t on 58 000 ha of vineyards, wine production at about 200 million hectolitres (477 types of wine, 0.7 per cent of world production). Production of all vegetables, except potatoes, totals 40 000 – 50 000 tonnes on 53 000 ha, primarily family farms. Potatoes are planted on 63 000 ha. Vegetables are also grown in greenhouses: about 40 ha are under glass and 150 – 200 ha under polythene tunnels.

Livestock production in Croatia (about 45 per cent of the value of total agricultural production) includes cattle, pig, poultry, horse, sheep, goat. In meat (except poultry and pork) and milk production, private family farms dominate. Cattle production accounts for approximately 40 per cent of the total value of livestock production. The total number of cattle has dropped from 800 000 head in 1990 to 451 000 head in 1997. There were 1 176 000 pigs in 1997. Pork production in 1996 totalled 163 000 tonnes. Sheep and goat production is the least developed livestock sub-sector today. The reason is that this production was based on family farms and neglected by the Government. In 1997 there were 453 000 sheep and 100 000 goats.

Agriculture, forestry and fishing represent around 10 per cent of GDP and employ 3.8 per cent of the labour force. In 1990 they produced 11.67 per cent of GDP and in 1995, 11.44 per cent. Private farmers own approximately 70 per cent of all agricultural land. More investment into agriculture would promote the principles of self-sufficient, high-quality production, especially of meat, milk and crops. Data from 1994 show that 117 495 000 kunas were invested in agriculture.

Broad characteristics of forest resources and use

Table 11.2: Forest resource base

	Forest area	Growing stock
	km²	*Million m³*
Low-land plain	9 135	150
Hilly and mountain zone	7 766	100
Coastal zone	8 012	80

Source : Forestry in Croatia, published by State enterprise "Hrvatske Sume".

Forest lands cover 43.5 per cent of the State territory (total 2.49 million ha). 84 per cent of it is covered with forest vegetation (i.e. 37.6 per cent of the country). Forests in Croatia are primarily owned by the State (80.2 per cent) and managed by the State agency Croatian Forests (Hrvatske Sume). 1.3 per cent is managed by non-forest organizations (such as directorates of protected areas and scientific institutions). The remaining 18.5 per cent is privately owned. Forests are categorized by their functions into exploitable (94.2 per cent), protective (3.6 per cent) and other (2.2 per cent) forests. Table 11.2 shows the forest area and growing stock in each of the three regions.

The share of forestry in Croatia's GDP is 1.2 per cent. The contribution to GDP made by the timber industry is 2.5 per cent. Timber production includes the production of sawn wood, pulpwood, fuel wood, pit props and other industrial wood and amounts to 5 354 018 m^3 a year. In 1995 Hrvatske Sume's share consisted of 2 604 000 m^3 and in

1996 of 2 871 000 m^3. Timber production is one of Croatia's major export earners. Croatia is a net exporter of semi-finished and lesser finished wood products.

Forests and forest land are managed on the basis of a forest management plan that divides areas into management units. Each unit has long- and mid-term development plans. These are approved by the Ministry of Agriculture and Forestry (MAF), which takes into account the opinion of its expert commission. The aim is to preserve the forest and use its resources in a sustainable manner.

According to the Integrated Monitoring Methodology, an inventory of forest damage was compiled. It showed that 25 per cent of forests were damaged in 1997, with a peak of 38 per cent in Gorski Kotar. In terms of forest degradation, this figure puts Croatia in 17th place in Europe. The most serious types of forest damage are:

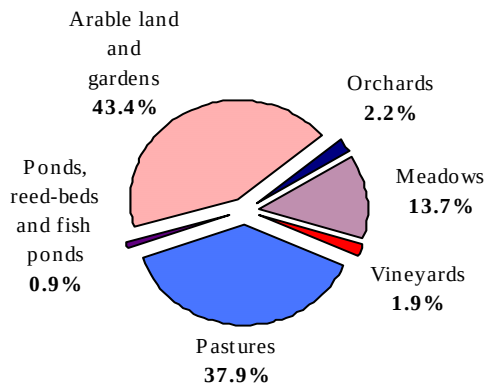
- negative influence of acid rain on the mountainous area (Gorski Kotar), where the most serious damage occurs (common fir)
- damage to lowland forests (lowland common oak and broadleaved ash forests)
- forest fires in the coastal zone (in 1996, 3 129 fires destroyed 29 000 ha of woodland).

Programmes to protect forests against pollutants, fire and disease along with integrated pest management programmes (protection against biotic and abiotic factors and deforestation) have been initiated. (See also Chapter 8 for forest management.)

Agricultural land use and monitoring

strongly influenced by the ownership conditions prevailing until 1991: dominant private ownership of land was paralleled by "socially owned" holdings - agrocombines. A second stage of privatization in agriculture started in 1991, according to the Law on Agricultural Land, and it led to the transfer of agrocombines into State ownership, with the aim of further privatization. Agrocombines focused on producing the main arable crops, pig and poultry breeding. Data from 1997 show that, of a total of 3.18 million ha of agricultural land, 2.04 million is privately owned and 1.14 million ha State-owned.

Figure 11.2: Agricultural land by type of cultivation, 1996



Source: Central Bureau of Statistics.

Agricultural land use in Croatia continues to be Structure of agricultural land by type of cultivation represents 1.84 million ha of arable land and 1.14 million ha of pastures. The arable land consists of 1.3 million ha of cultivated land, and 58 000 ha of vineyards, 67 000 ha of orchards and 413 000 ha of meadows. The area of cultivable land (0.42 ha per capita) exceeds the west European average.

Family farms represent 80 per cent of the arable land and livestock, 90 per cent of the total number of tractors, and 90 per cent of the total workforce in agriculture. Croatia has one tractor for every 7.11 ha of cultivable land, which is a specific load of 2.94 kW/ha. The best equipped countries have one tractor for every 5.5 ha, or 3.77 kW/ha. For every 1.89 peasant farm there is one single-axle or two-axle tractor of an average of 20 years, which means that peasant agriculture is inadequately equipped.

In the hilly and mountainous parts of Croatia, the appropriate power for a universal tractor is between 35 and 65 kW. In the coastal parts, most work is done with motorized cultivators. Harvesters have too great a capacity to be owned by one farm only, and are either owned collectively or leased. It is essential to purchase machinery for collective use, to do certain jobs cheaply, and technically efficiently, such as tilling and sowing with a combined machine, spraying, fertilization, harvesting, machines for making silage etc.

Croatia has around 534 266 agricultural holdings, divided into 18 million plots with an average size of 2.9 ha. This fragmentation is one of the fundamental obstacles to a more rational use of the

Table 11.3: Consumption of plant protection agents, 1995

	Preparations		Active substance		Value	
	tonnes	*kg/ha**	*tonnes*	*kg/ha**	*Total in US$*	*US$/ha**
Total	**7 661.30**	**3.250**	**3 418.05**	**1.450**	**55 880 639**	**23.70**
Insecticides	1 445.60	0.610	204.14	0.087	9 703 469	4.11
Herbicides	3 853.50	1.630	2 037.42	0.864	30 985 395	13.15
Fungicides	1 937.70	0.820	1 141.84	0.484	12 736 462	5.40
Other	424.50	0.180	34.65	0.015	2 463 314	1.04

Source: Croatian Agriculture at the Crossroads, Zagreb, 1996.

* Of arable land, orchards, vineyards and pastures.

production potential. The major goals of land reform and privatization in the agricultural sector are to increase private ownership, boost the average size of individual family farms and ensure a more efficient use of agricultural land.

Agricultural land in Croatia is divided into 6 groups (the best quality = Group 1). According to the Rule Book on Soil Survey, soils are divided according to their quality, the climate, the relief and some other factors.

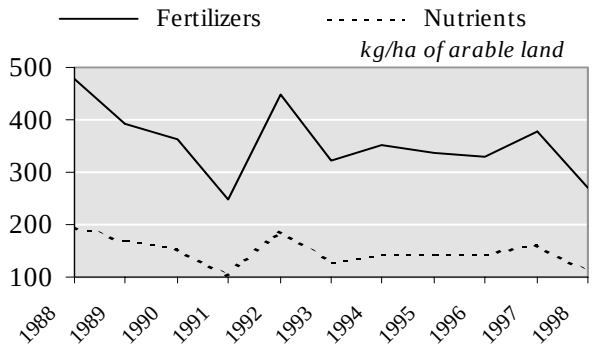
Production and use of fertilizers and pesticides

In Croatia, four firms produce, import and distribute plant protection agents: CHROMOS Agro.d.d. Zagreb, HERBOS d.d. Sisak, PLIVA d.d. Zagreb and SAPONIA d.d. Osijek. These factories produce and export another 2 000 tonnes of agents valued at about US$ 9 million. The value of consumption is estimated at approximately US$ 17/ha.

Crop pests decrease yields by 29.2 per cent (the level of damage for Europe is 28 per cent). In the past decade, the use of plant protection agents has decreased, not for ecological but exclusively for economic reasons. Peasant farmers simply cannot afford them.

Consumption of mineral fertilizers in Croatia began in earnest in 1960 with higher imports, but a real leap occurred only with the building of the first phase of the INA Petrochemicals Factory in 1968. Consumption peaked in 1988. After 1988, consumption eased off for economic reasons. Mineral fertilizer consumption was optimal in only 18 per cent of the State sector, in the Pannonian region, where high cereal yields were achieved. In the State sector, about 320 kg/ ha of active substances were used. The consumption of mineral fertilizers will always be uneven. It will be highest in the eastern part of Croatia, and in the Mediterranean region, where it is expected that more vegetables, fruit and flowers will be grown with further irrigation.

Figure 11.3 : Consumption of fertilizers and nutrients, 1988-1998

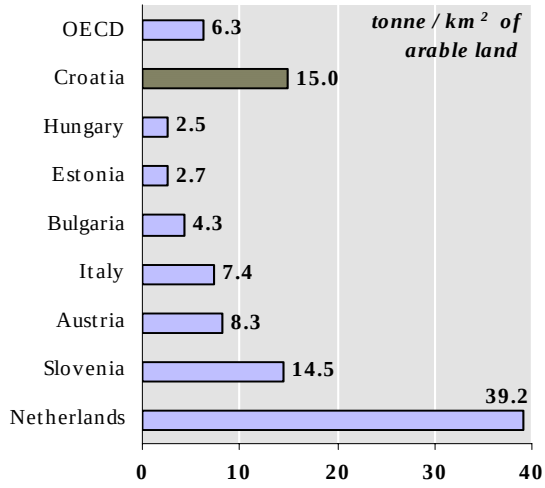


Source: Broj 2174 Kutina, 11-3-1999.

Given Croatia's climatic and soil conditions and its focus on tourism, by the year 2000 it might again reach the maximum pre-war consumption of mineral fertilizers (774 000 tonnes) and by 2010 it could reach the current European average of 225 kg/ha of active substances.

INA Petrochemical in Kutina (Petrokemija- see Chapter 10) is the only factory producing mineral fertilizers in Croatia, and one of the biggest in this part of Europe. It produces approximately 1.5 million tonnes a year. Its production is based on the import of raw phosphates, potassium salts, sulphur and 50 per cent of its natural gas requirement. Annual consumption of mineral fertilizers is 70 000 to 80 000 tonnes/year.

Figure 11.4: Use of nitrogenous fertilizer in selected European countries, 1995



Source: OECD Environmental data (Compendium 1995).

11.2 Environmental concerns in agriculture

Soil quality and degradation

Intensive crop production, particularly too intensive crop rotation, use of agro-chemicals and heavy machines damage land in some parts of the country with intensive agricultural production. The other causes of damage are industry, which pollutes the air and causes acid rain, waste dumps and the use of fossil fuels in urban areas. Between 1965 and 1987, Croatia lost 166 441 ha of agricultural land, or as much as 7 235 ha a year or 20 ha a day, through the change of land use.

The most serious form of damage is the irretrievable withdrawal of land from its primary use – the production of organic substances in agriculture or forestry. About 0.60 ha of land is needed per inhabitant to meet the normal food requirements; Croatia avails of 0.42 ha (less in some areas, coast and islands). In such conditions, each loss of production may be dangerous for sustainable development.

Land erosion is certainly one of the most dangerous processes in Croatian agriculture. Over 90 per cent of the soil surface is exposed to wind and water erosion of various intensity. Central and coastal Istria are faced with the worst consequences: 100 to 200 tonnes are lost per hectare each year. The area round the delta and banks of the Neretva River receives large amounts of earth from the neighbouring countries. There is a pronounced surplus of water in winter and a great deficit in summer. In winter, measures have to be taken to protect the soil from erosion. In summer it is essential to carry out irrigation or watering.

Agricultural activities have not caused serious soil or environmental pollution as the consumption of pesticides and fertilizers in the private sector is fairly low (25 per cent of the west European mean). In the former public agrocombines, consumption was similar to that in the developed countries. However, the absence of a soil inventory and of regular soil monitoring is a severe obstacle to taking soil protection and sustainable management measures, as the true condition of the soil is practically unknown (see also Chapter 8).

Water use and water pollution

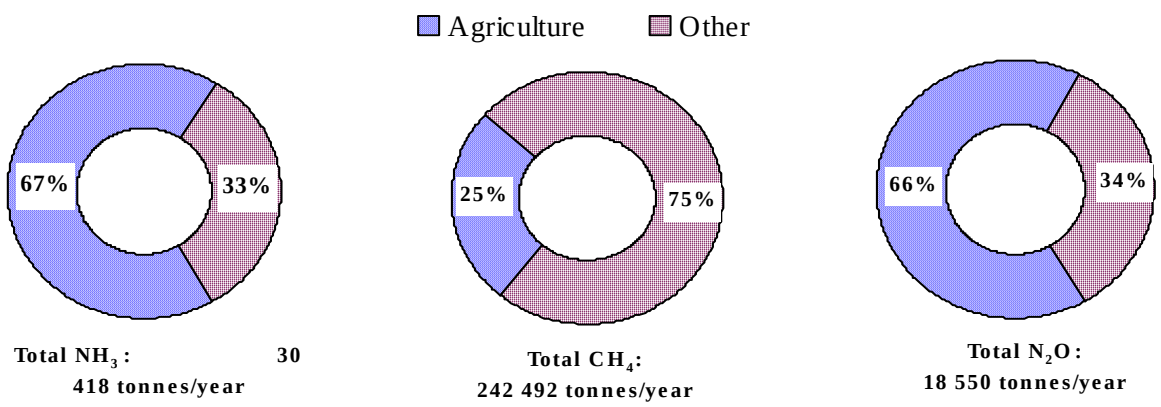
Croatia uses very little water for irrigation (about 5 790 ha of irrigated land). About 680 000 ha requires irrigation. Irrigation systems have been built on the Neretva river, in Imotsko Polje, Dalmatinski rastok, at Zadar and Vukovar. Of a total of 1 789 070 ha of land with excess water, surface drainage systems have been built on only 600 054 ha (33.5 per cent). The water quantity in fish ponds (13 050 ha) is estimated at 286 million m^3 a year.

Compared with other countries, Croatia's agriculture is not a serious source of pollution. But surface and groundwaters frequently receive wastes from some large livestock farms and fish ponds. There is no systematized data collection about waste water from livestock farms and fishponds. The major agricultural and fishery polluters are in the Sava basin, the Drava (Osijek) basin, in Istria and in Dalmatia (Zadar).

The majority of surface waters, the quality of groundwaters and of groundwaters in the well fields, as well as in lowland forests and hydromelioration systems (Karasica, Vucica catchments, Lonjsko polje area) are monitored (see Chapter 6 for comments). The water agency Hrvatske Vode is responsible for carrying out water management according to the Law on Water.

Monitoring of nitrates and phosphates in surface waters shows that the average values for nitrates are, in general, well below the maximum allowable concentration (MAC), which is 10 mg N/l. Excess concentrations were recorded only on the Pazincica river, the Drava near D. Dubrava (11.8 mg N/l) and the Mura near Gorica (39.10 mg N/l). In the Sava

Figure 11.5: Air pollutant emissions from agriculture, 1995



Source: Statistical Yearbook 1998.

watershed, the concentration of phosphates exceeds the MAC of 0.1 mg P/l in all sampling stations. The excess is smaller downstream from Zagreb and on the Una river.

The percentage of wells with a nitrate level above 8 mg N/l (particularly in Eastern Slavonia) was much higher in 1992 than in 1993 and 1994. This was related to the treatment of agricultural land. Nitrate levels peaked in the Medimurje region in 1986 (13 mg N/l). Generally, there are no data on the phosphate level in the groundwater in intensive agricultural areas or in private country wells. Some data from sampling stations show that concentrations are below the MAC.

The pesticide content in water has not been monitored on a regular basis. The level of atrazine in water sometimes exceeds 100 ng/l, which is the Croatian and the European Union's MAC for a single pesticide in water intended for human consumption.

Wastes

The main sources of wastes in agriculture are fluid manure and waste water from intensive livestock breeding and fattening, as well as waste from land cultivation. In Croatia, as in other countries of the former Yugoslavia, livestock farms use too much water (liquid manure contains 96 to 98.5 per cent of water and is classified as sludge).

Scientists are trying to find new and effective solutions for the use of livestock water to prevent hazardous emissions into the environment. The "Biokont" concept is oriented towards sustainable agriculture. Its aim is to process unused organic matter from land cultivation, fluid manure and waste water from livestock in an ecologically acceptable way.

Large farms are estimated to produce one third of the total quantity of manure. Livestock breeding farms produce farmyard manure (60 per cent) and slurry (40 per cent). Manure from husbandry is used locally on farms and is not discharged directly into surface water. There are no accurate data on the quantity of manure from large livestock farms that is discharged directly or indirectly into surface water. Manure produces a total of 65 000 tonnes of N a year and 33 000 tonnes of P_2O_5 a year.

Regional problems

A synopsis of environmental issues in agriculture by region is presented in Table 11.4.

11.3 Policy, priorities and management

Strategy and legal instruments

After Croatia gained independence, its Parliament adopted several strategic documents and laws of overall and specific importance for environmental concerns in agriculture and forestry.

The Declaration (1992) focuses on economically sustainable development based on existent agriculture. The actions for promoting sustainable agricultural and rural development are prepared by the MAF with the assistance of the FAO in the "Sustainable Agricultural Development Strategy in the Republic of Croatia". The Strategy's main goal

Table 11.4: Specific environmental problems in some agricultural areas

Subregions	Agricultural production, type of ownership	Specific environmental situation	Expectations, suggestions
		Pannonian region	
P1 – Eastern Pannonian	- wheat, maize -sugar beet, soybean, sunflower -grape on hilly areas -livestock (on decrease) *Ex-social owned, intensive*	Soil degradation due to: -soil compaction -herbicide (atrazin) deposition -soil erosion (wind and water) -humus decrease in soil -water pollution by nitrates, eutrophication	-increasing private ownership with increasing average size of farms -investment into irrigation system Favourable situation on traditional private farms
P2 – Central Pannonian	-intensive crop production -vineyards -livestock *Private farms,* *Ex-social (less)*	-anthropogen soil degradation in ex-social sector -increasing of soil erosion by water	-usage of complex activities of soil protection measures
P3 – Western Pannonian	-livestock (private farms) -fruits, grape -narrowed crop rotation with maize *Predominant private, fragmented farms*	-acid soils -soil erosion -high persistence of herbicides in soil (atrazin) -hazardous substances emissions from industry of Zagreb, Sisak, etc.	- regular soils liming - complex soil conservation measures
P4 – Northwestern Pannonian	-feed stuff production -high share of maize production in crop rotation *Private farms (predominant)*	-acid soils	- regular soil liming - soil conservation measures
		Mountain region	
G1 – Premountain	-extensive agriculture -wood area (predominant)	-acid soils -soils preserved from damage and degradation -clean water in river -degraded forests -chronicle difficulties regarding water supply -degraded forests	-soils liming (improvement) -drainage in water flow valleys -irrigation from rivers (where required) -development of ecological agriculture
G2 – Mountain	-rye,potato -livestock (sheep,goat) *Private fragmented households*	-frequent frosts -great amount of precipitation -soil erosion	-complex soil conservation measures -irrigation agro-technical soil melioration (calcification) -development of tourism, agrotourism etc. -production of high quality potato-seeds
		Mediterranean region	
M1 – Northern Mediterranean	- olives, vine, almonds, peach, nectarine, mandfarin - vegetables *Private fragmented farms*	-high productive,valuable soils -precipitation excess in winter and lack in summer season	-irrigation in summer season
M2 – Central Mediterranean	- grape, fruits - vegetables - flowers *Ex-social sector (predominant)*	- drained productive soil in Karst field - precipitation excess in winter and lack in summer season	-investment into irrigation -rational use of agro-chemicals -no use of persistent pesticides
M3 – Southern Mediterranean	- olive, mandarin, fig, etc. - vegetables - flowers *Fragmented private farms, negligible ex-social sector*	- sensitive ecosystems in Neretva-river valley - high amount of agrochemicals -high quality water -bare calcareous and dolomite rocks, scarce grassland on shallow soil -degraded forests	-investment into irrigation -island revitalization -soil improvement

Source: Author compilation

is to harmonize Croatia's agricultural policy with the Guidelines of the GATT Uruguay round, i.e. promotion of efficient production and marketing of agricultural products in order to contribute to the growth of the Croatian economy, to protect the natural resources and to ensure the competitiveness of Croatian agricultural products in the world market. It puts special emphasis on private family farms, which are the basis of Croatian agriculture.

The Strategy focuses on: the structure of agriculture, rural financing, trading and pricing policies, support services to farms, etc., and sets out short-, medium-, long-term goals.

All the counties have set up extension services, veterinary services and livestock breeding services to advise and help farmers. To facilitate the transition of the agricultural sector, the MAF has started the Family Farms Support Services Project (World Bank). It should:

- teach ecologically sustainable agriculture to farmers in the counties' extension centres
- prevent harmful inputs in agriculture by educating farmers
- stimulate food production based on ecologically sustainable agriculture, etc.

The strategic documents, drawn up in Croatia, integrate environmental and economic components. The National Programme for the Development of Islands (1997) aims at the sustainable development of the Croatian islands in all economic sectors, particularly agriculture. This Programme is coordinated by the Ministry of Development and Reconstruction.

The Law on Environmental Protection and other laws include provisions that are also relevant to agriculture and forestry (like the EIA provisions, see Chapter 1). Among the specific laws on agriculture, the Law on Agricultural Land prescribes the protection and use of agricultural land, etc. Following this Law, the Regulations on the protection of agricultural land were drawn up. The Regulations have been adjusted in line with the experiences in the countries of the Alpe-Adria Commission. They provide basic parameters for the protection of land from pollution, primarily with 13 heavy metals and polyaromatic hydrocarbons (PAHs). The other Regulations concern the use of sewage, compost, liquid manure, fertilizers, etc.

The Law on Plant Protection regulates the protection of plants and plant products against pests and diseases, the transport of pesticides, and the control of plant protection. According to this Law, MAF issues permits for the sale and use of plant protection agents. The trade in protection agents is regulated by the Law on Poisons.

Several laws lay down charges, e.g. charges for the use of nature resources -- soils, forests, etc. -- or for the impact during use -- fertilizers, pesticides, etc. (see Chapter 2). Among them are the Law on Financial Incentives and Charges in Agriculture and Fisheries and the Law on Forests. The Law on Forests mentions ecological protection as one of the forests' functions.

Declaration on Environmental Protection in the Republic of Croatia	1992
The Sustainable Agricultural Development Startegy in Republic of Croatia	1995
The Strategy for the Long-Term Development of Croatian Tourism	1993
Strategy on Physical Planning of the Republic of Croatia	1997
National Programme of the Development of Islands	1997
Report on the State of the Environment in the Republic of Croatia	1998
Law on Agricultural Land	1994
Law on Plant Protection	1994
Law on Mineral Fertilizers	1992
Law on Nature Protection	1994
Law on Forests	1990
Law on Wine	1995
Law on Financial Incentives and Charges in Agriculture and Fisheries	1997
Law on Veterinary	1997
Law on Livestock Production	1997
Law on Animal Welfare	1999

Agricultural and environmental inspections are prescribed by special laws. They are carried out by different inspectorates: environmental protection, agriculture, water, veterinary services, plant protection.

Croatia is a member of several international organizations and participates in conventions and processes that deal with agricultural and environmental concerns. As a full member of FAO (since1993), Croatia signed the FAO International Convention on Plant Protection. The MAF and the World Bank cooperate on several projects. One is the "Coastal Forests Reconstruction and Protection Project", for which Croatia obtained a US$ 42 million loan. MAF and EBRD cooperate on the creation of the Whole Sale Agricultural Market in Croatia. At the regional level, Croatia participates in the Alpe-Adria Commission and the International Commission for the Protection of the Danube River. See also Chapter 4.

Institutional responsibilities

Various governmental organizations are responsible for agricultural development and food security. The *Ministry of Agriculture and Forestry* (MAF) implements laws and regulations concerning agriculture, fisheries, food, timber and tobacco industries, veterinary science, forestry, and hunting. MAF inspects different agricultural activities.

The *Croatian Agriculture Extension Services* were established in 1997 to advise private farmers. The SDEP is concerned about the environmental impact of some agricultural practices. The *State Water Directorate* is in charge of water management, preparing development plans, water quality control, ensuring water resources, protecting water from harmful effects. Erosion of land by water and wind and protection from erosion also fall under water management. Croatia is one of the few European countries that do not have an organized special service for the protection of land from erosion.

The *Ministry of Finance* and the *Ministry of the Economy* are responsible for national and international trade in agricultural products, customs duties, use of the State budget in agriculture, supply of the Croatian market with sufficient agricultural products of an adequate quality. Other governmental and non-governmental organizations have a stake in agriculture. For example, at the initiative of the Ministry of Development, Immigration and Reconstruction, the Conference on Reconstruction and Development of Croatia gave MAF the opportunity to present Project Proposals for the Rehabilitation of Agriculture in war-affected areas. In total 38 194 farms (465 000 ha of arable land, 25 per cent of the total stock, 18 000 tractors) were affected by the war. Rehabilitation is based on the Strategy of Sustainable Agricultural Development. Finally, agricultural education is well established in Croatia – there are agricultural and forestry institutes and faculties in Zagreb, Osijek, Krizevci, Split, etc.

Promotion of alternative farming

There are many examples of established agro-ecological processing in different parts of the country and of environmentally friendly technologies in private agriculture (Liburnia, etc.). The application of 'Integral Plant Nutrition' and 'Integral Plant Protection', as defined by FAO, could help to boost yields.

The Ministry of Agriculture and Forestry is preparing a law on organic farming.

Agriculture and tourism as economic sectors relying on natural resources have a long tradition in Croatia, and tie in with the concept of sustainable development. Better protection of the natural resources that are extremely important for agriculture, in particular land and water, would help to increase yields.

Croatia's natural conditions, its need to produce and distribute sufficient high-quality domestic agricultural foods that meet international standards, and the introduction of eco-labelling are at the basis of its desire to develop agro-ecological tourism. To this end, Croatia has drawn up a proposal for the special classification of food, based on the definition of the properties of land and on farming practices. According to this proposal, food could be classified according to the following criteria:

- 'Standard Food' (CRO-STAND-FOOD) is produced on land that meets international criteria for the concentration of heavy metals and toxic substances (P2 subregion - see map Figure 11.1)
- 'Nostalgic Food' (CRO-NOST-FOOD) is produced on small farms, on very clean soil. Minimum quantities of fertilizers (manure, green or leguminous fertilizers) are used in its production(P3, P4, mountain region).
- 'Bio-Dynamic Food' (CRO-BIOS-FOOD) is produced following IFOAM provisions on land containing only 50 per cent of the maximum

permitted heavy metals and other pollutants (Soil Protection Rule Book). These concentrations would be controlled by the International Soil Information System linked to the Internet. Under the Rule Book, manure containing more than 30 per cent of the maximum permitted pollutants may not be used to fertilize or improve the land.

- 'Baby Food' (CRO-BABY-FOOD) is a special category produced without synthetic substances and on soils with only 10 per cent of the maximum permitted concentration of pollutants (mountain region).

It is expected that each farm will be allowed to produce only one category of food. The agents that are not allowed to be used may not be kept on the farm.

11.4 Conclusions and recommendations

Croatia's agricultural activities, which are locally very different according to the climatic zones, have not caused serious environmental damage. But this is more the result of external factors, such as the traditional extensive exploitation in the mountain region, the drop in fertilizer and pesticide use due to the economic hardship, rather than a deliberate and rational approach to more environmentally friendly agricultural practices and land use.

Soil protection is a problem that has been underestimated. It is difficult to have a clear picture of the situation as no inventory and no soil monitoring data are available. In general, the soil is reputed to be unpolluted. However, soil erosion, inadequate land use and agricultural practices (resulting in soil compaction, acidification, decrease in humus content, etc.), and soil pollution by industry are often quoted as factors impairing the quality of the soil. The change in land ownership is another important reason.

Today, soil management and soil protection are under different authorities. Croatia's agricultural land and forest land are within the competence of the Ministry of Agriculture and Forestry. The competence of the SDEP in respect of land is not strong enough. Damage caused to land by water and wind erosion is within the competence of the water agency Hrvatske Vode, which operates separately from agriculture and forestry (the main users of the land). The institutional set-up might have to be reviewed to improve the integration of environmental parameters also into agricultural decision-making (see findings on institutional restructuring of Chapter 1). In any case, the possibilities for protecting the soil from damage should be developed together with the new ownership conditions. There is therefore a need for legislation on soils and for an explicit land protection policy. The creation of a separate administration for soil erosion problems should be considered.

Recommendation 11.1
The draft law on soils should be finalized, and a land protection policy should be formulated, adopted and implemented. The management of soil erosion risks should be entrusted to a special administrative entity under the supervision of the State Directorate for the Protection of Nature and the Environment, which is currently responsible for soil protection.

Agriculture does not appear to be an important source of pollution in Croatia, except in some regions. The contribution of agriculture to the degradation of surface and groundwaters is not easily calculated from the available data. There is no satisfactory monitoring programme. The data on total phosphorus, organic micropollutants, toxic metals and microbiological parameters are insufficient. Surface water is systematically monitored throughout Croatia. The groundwater is permanently analysed only in the well sites of water supply cisterns. The creation of a soil information system specifically for the assessment of the effects of agriculture on soil is another precondition for a land protection policy.

Recommendation 11.2:
Permanent monitoring of soil quality should be established – preferably on the basis of the law on soils proposed above - together with a land information system. See also Recommendations 8.8 and 11.1.

The average size of the agricultural holdings is very small, which raises production costs. Legislation is needed to limit any further subdivision of the holdings. Cooperatives or other forms of sharing between agricultural producers are needed to make agricultural production more efficient. Economic instruments like tax holidays during the first years after privatization and/or depending on the type of cultivation could help.

Land consolidation (enlarging the sizes of agricultural holdings) has long been used in Croatia to improve agricultural land. Most consolidation took place from 1956 to 1988. In this period more

than 650 000 ha of land were consolidated into 420 large holdings, accounting for about 20 per cent of all the cultivable land. At that time the land owned by the State increased considerably. At present, privatization should be done in such a way that the positive effects of larger agricultural production units are not lost. To this end it is necessary to review of the legislation and adapt it to the new conditions, as well as to create an adequate land administration.

Recommendation 11.3:
The existing legislation – Law on Heritage, Law on Cadastre, Law on Agricultural Land – should be harmonized in the framework of general environmental policy, and a new land register should be prepared, so as to improve the economic efficiency in agriculture and encourage privatization.

To encourage alternative agricultural production, the Croatian Chamber of Commerce has established a business association of producers and promoters of food from alternative agriculture under the name "eco-food". Croatia offers exceptionally favourable conditions for the expansion of alternative agricultural production because much of its agricultural land is relatively unpolluted, particularly in the mountainous and Mediterranean regions.

There is currently no legislation on organic farming, but the draft law on organic-biological farming has been prepared by the Ministry of Agriculture and Forestry and other ministries. It will establish eco-labelling for agricultural products. A number of documents (Rule Book on Environmental Label Award, other legislative provisions and norms, ISO 9000 norms, EEC Council directives, etc.) are used as a starting point for the development of comprehensive legislation in this area. Such a legal basis would promote the development of a Croatian strategy for the ecologically safe development of agriculture and food safety.

Recommendation 11.4:
The finalization of the law on organic farming and its adoption by Parliament should be seen as a priority.

Tourism and agriculture are especially important for the development of Croatia. There are many links between agriculture and tourism. The natural environment is the basis for the success of both. In addition, tourism uses large quantities of agricultural products and can thus help to boost the agricultural sector. The 'natural alliance' between agriculture, tourism and environment seems to offer opportunities for common initiatives between these sectors. The development of agriculture on the basis of rural family farms in the vicinity of tourist regions could become an economic option on a large scale and in the long run, if relevant governmental and non-governmental activities can be coordinated. The short-term objective should be to specify the infrastructure, training and information needs in the relevant policy documents for agriculture, tourism, nature protection and infrastructure development.

Recommendation 11.5:
Economic incentives and other means should be applied to encourage family farms to turn to various forms of sustainable agriculture and agro- and ecotourism.

Nitrate levels in surface waters are below the MAC of 10 mg N/l, except for the Pazincica, the Drava near D. Dubrava and the Mura near Gorica. The phosphate level is generally on the increase (with 0.24-9.8 mg P/l, the Sava river fails to meet the MAC of 0.1 mg P/l). To reduce nitrogen accumulation in the regions with intensive plant nutrition in soils and limit the leaching of plant nutrient elements into water resources, it is necessary to continue strengthening crop rotation, sometimes use a second crop in crop rotation, and widely use organic fertilizers, green fertilizers and leguminous fertilizers.

The use of organochlorine pesticides in Croatia has been restricted for some 20 years; DDT has been banned since 1972. In recent years much attention has been given to the leaching of triazinic herbicides (atrazine, simazine, etc.) into water, since they are highly soluble and are therefore a threat to the environment.

Recommendation 11.6:
Developing national guidelines for good agricultural practices should be considered. Farmers should pay particular attention to preventing ground and surface water pollution by nitrates, heavy metals and pesticides and permanent monitoring should be established. The role of extension services should be strengthened in regard to the use of fertilizers and plant protection agents. The use of biological and other environmentally friendly pesticides should be encouraged.

The livestock industry is well developed in Croatia. However, there is a need for developing sustainable management, particularly with regard to the use of the waste it generates (manure, liquid manure, gas emissions, pollution of surface and groundwater). The Croatian concept currently being developed under the name of "*Biokont"*, which focuses on sustainable agriculture and includes some scientific principles such as the reuse of agricultural waste into the agriculture production cycle, should be promoted. The measures that could be taken include increasing the use of organic fertilizers, biogas production or other forms of alternative energy use. Also, it should be possible to achieve a dry matter content of 8-10 per cent in liquid manure by reducing water use in animal husbandry. A historical review of what used to be done in the past with liquid manure and unused leftovers of crop production could assist in determining further methods.

Recommendation 11.7:
Methods should be implemented to reduce water pollution by farm effluents, and to reduce the excessive water use in livestock facilities and the high water content of liquid manure. Systems for the collection of liquid manure and other effluents from major farms need to be built.

Chapter 12

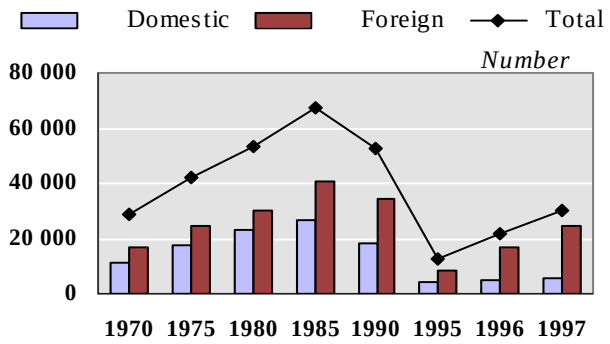
ENVIRONMENTAL CONCERNS IN TOURISM

12.1 Tourism development and problems

The importance of tourism in Croatia

Before the war, tourism played a major role in the Croatian economy. Tourism from the West flourished along the Adriatic coast, particularly in the northern region of Istria, bringing in hard currency (between US$ 3.5 and 5.3 billion a year). In 1985 Croatia received around 10 million tourists (4.5 million domestic and 5.5 million foreign visitors), accounting for 67.6 million overnight stays (26.6 million domestic overnights and 41 million foreign overnights; see Figure 12.1). Tourism provided approximately 180 000 jobs (120 000 directly in tourism) and accounted for about 12 per cent of GDP.

Figure 12.1: Tourist overnights, 1970-1997



Sources: Ministry of Tourism, 1998; Central Bureau of Statistics, Statistical Information 1998.

However, the advent of hostilities changed all that. Tourism revenues plummeted, even though Istria was largely unaffected by the fighting. The conflict directly affected the tourism industry in two ways. Firstly, coastal hotels provided shelter for displaced people. Secondly, partly as the result of the refugee influx, foreign tourists deserted Croatia for alternative destinations. As a result, overnight tourist stays in 1991 were at only 16 per cent of their 1989 level.

Since the end of the war, the Government has been looking increasingly to a major tourism revival to drive economic growth. Hopes are focusing on the tourism industry particularly because other parts of the economy are weak. The country's poor merchandise trade performance increases the significance of tourism as a source of support for the current account.

Nowadays the tourism sector accounts for about 4-5 per cent of GDP. Revenues generated directly or indirectly by tourism reached almost US$ 3 billion in 1998. The tourism sector employs around 90 000 workers, i.e. half the number it employed in the 80s. The number of foreign tourist overnight stays recorded in 1997 (24.7 million) corresponds to 79.7 per cent of the 1990 level (31 million) and to only 61.5 per cent of the 1985 level (41 million). Likewise, the 683 300 beds registered in 1997 represent 79.2 per cent of the 1990 capacity (862 700 beds). However, there was a rapid increase in the number of overnights between 1995 (12.9 million) and 1997 (30.3 million), although the progression was less spectacular in 1998 (estimated increase around 5-6 per cent). These figures show that tourism in Croatia has not yet recovered.

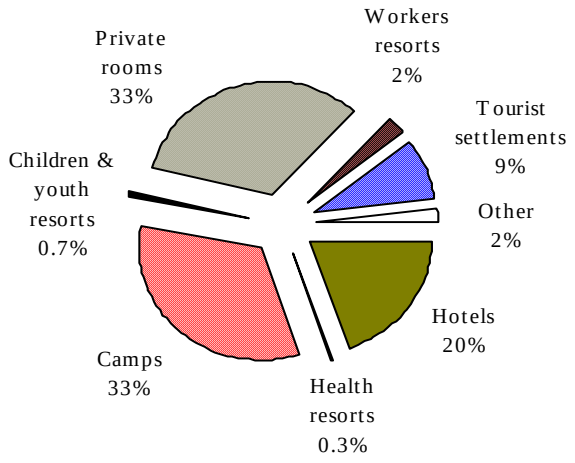
Table 12.1: Number of beds according to the type of tourist resort, 1997

	Number of beds	%
Total	**683 334**	**100.0**
Sea coast	646 381	94.6
Health resorts	3 161	0.5
Mountains	2 945	0.4
Other tourist resorts	3 860	0.6
Zagreb (Capital)	12 393	1.8
Non-tourist resorts	14 594	2.1

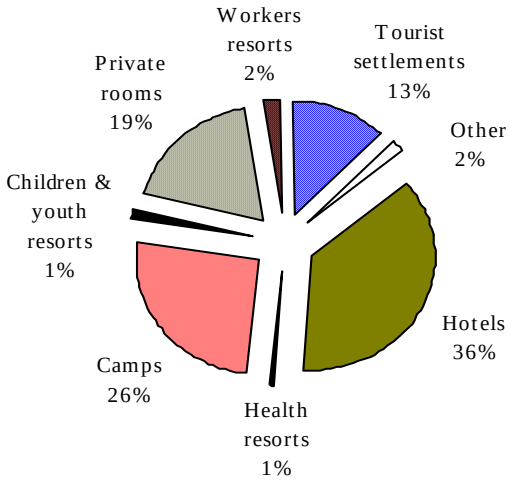
Source: Ministry of Tourism, 1998.

Figure 12.2: Accommodation capacities and related number of overnights, 1997

Number of beds: 135 114



Tourist overnights *(1 000)* : 30 314



Source: Ministry of Tourism, 1998.

One important characteristic of Croatian tourism is that about 95 per cent of the accommodation capacity is located in seaside resorts (see Table 12.1). The majority of this capacity is in private accommodation and camping sites (each accounting for 33 per cent), while hotel accommodation represents around 20 per cent (see Figure 12.2). As this figure also shows, the majority of tourist overnights are registered in hotels (37 per cent), followed by camping sites (26 per cent) and private rooms (19 per cent).

There are approximately 13 000 independent catering units (restaurants, inns, taverns, bars, snack bars, bistros, etc.) and 43 marinas with around 11 500 berths on the sea and 4 000 places on land.

Economic problems of tourism in Croatia

Even though there are some regional differences regarding the conditions under which the tourism industry operates, the following general problems should be mentioned:

- the transport network (road and rail) is technically and functionally deficient;
- most of the accommodation facilities are hotels and tourist complexes adjusted to the needs of the mass tourism of the 70s and not to the needs of today's tourists;
- the hotels are in general badly maintained and heavily indebted;
- the prices are relatively high compared to the quality of tourist infrastructure and services;
- many skilled workers left in the 90s owing to the low and irregular wages.

Apart from these problems, largely related to the disruptions caused by the war, the main difficulty for Croatia's tourism industry is the change in ownership. Like most economic assets, hotels were in "social ownership" until 1991. The war caused the value of tourist assets to plummet. As the Government prioritized revenue-raising in its privatization strategy, it preferred to wait before selling off its tourist facilities. Out of the 470 hotel, catering and tourism enterprises of 1991, 71 enterprises were privatized by January 1997 (representing about 8 per cent of the total equity of all tourist enterprises). Consequently, most tourist facilities found themselves in State ownership until recently, either directly (by the Croatian Privatization Fund) or indirectly (by State-owned banks and State pension funds).

The second phase of privatization has been implemented these past two years through a mass voucher privatization scheme. The shares that had not been sold in the first phase and were still held by the Croatian Privatization Fund were distributed to

individuals affected by the war, such as injured servicemen, widows of slain soldiers and their families, displaced persons and refugees. At the beginning of 1999, the State directly owned only 9 per cent of the tourist facilities, including 8 per cent put aside for previous owners (see Table 12.2).

Table 12.2: Ownership structure in the tourist sector, 1999

Owners	%
Banks	18.8
MIORH (Pension fund)	10.5
Croatian Privatization Fund	9.1
of which:	
- Privatization Fund	*1.1*
- Reservation for previous owners	*8.0*
Small shareholders	29.0
Voucher privatization for individuals affected by the war	17.1
Other owners	15.5

Source: Ministry of Tourism, 1999.

In theory, the current situation corresponds to an open market. A foreign investor can become the owner of tourist facilities or buy land by establishing a company in Croatia. In practice, the uncertainty about Croatia's political and economic future prevents foreign enterprises from investing massively in Croatian tourism.

Environmental issues in Croatian tourism

Tourism is more sensitive to environmental degradation than other economic activities, as the environment is its primary resource. It is important to keep this in mind because in Croatia the pre-war tourism infrastructure had largely been developed in disregard of sustainable development.

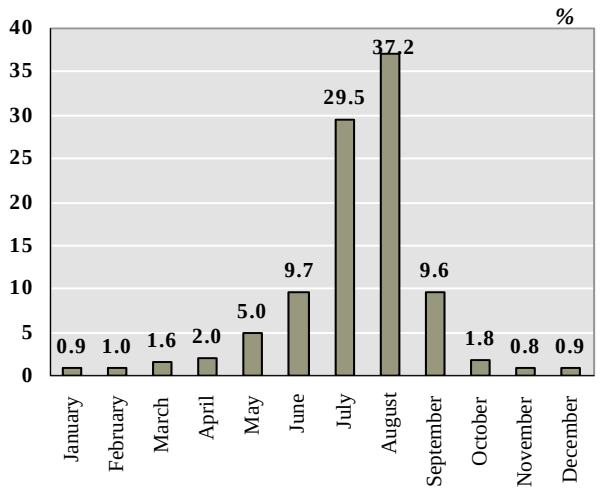
The negative impact of tourism on the environment takes various forms, such as air pollution caused by increased traffic, water pollution (sea and freshwater) by discharges of waste water and solid wastes from tourist establishments and tourist vessels, and soil pollution by the multiplication of open dumps (see Chapters 6, 7, 9 and 14). The problem is largely due to the concentration of tourist activities in space and time. As mentioned before, the narrow coastal area of Croatia accounts for approximately 95 per cent of total accommodation capacity and the two northern counties of Istria and Primorje-Gorski Kotar register 67.6 per cent of all tourist overnights (see Table 12.3). July and August alone account for 66.7 per cent of all tourist overnight stays (see Figure 12.3). As a result of this concentration of tourists in space and time, there is also often a shortage of freshwater, particularly on the islands and in the driest coastal regions.

Table 12. 3: Tourist overnigths by county, 1997

	Tourist overnights	
	(1000)	*%*
Total	**30 314**	**100.0**
Istria	12 301	40.6
Primorje – Gorski Kotar	8 188	27.0
Split - Dalmacija	3 514	11.6
Zadar	1 782	5.9
Dubrovnik - Neretva	1 651	5.4
Sibenik - Knin	1 008	3.3
City of Zagreb	658	2.2
Lika - Senj	480	1.6
Others counties	732	2.4

Source: Ministry of Tourism, 1998.

Figure 12.3: Tourist overnights by month, 1997



Source: Ministry of Tourism, 1998.

Another serious problem is the uncontrolled (and often illegal) building of secondary homes, which now occupy large areas envisaged as "tourist areas". This continuous land-grabbing for the construction of tourist facilities, often in the most valuable places (beaches and protected zones), burdens the natural resources more than their actual capacity allows. Moreover, the tourist buildings degrade the coastal landscape by altering the local vegetation, the settlement morphology and the architectural heritage. The use of national parks or other protected areas as attractions for tourism also puts pressure on the natural ecosystem (see Chapter 8). Although the natural conditions are not good

for skiing in Croatia, particularly in comparison with those in neighbouring Austria and Slovenia, some promoters wish to develop around 15 ski resorts in the Croatian mountains, which would further damage the environment.

Paradoxically, the years of war sometimes helped to improve the quality of the environment in certain tourist areas. For instance, in the Dubrovnik region the water quality is much better now than ten years ago, which can mostly be explained by the fact that the tourists, and the environmental damage resulting from their presence, disappeared from this region during the armed conflict.

The quality of Croatia's natural environment is generally better than that of other European Mediterranean countries. The negative environmental impact of tourism development does not yet prevent Croatia from being an attractive tourist destination from an environmental point of view.

12.2 Policy priorities and management

Objectives and strategy of Croatia's tourism policy

As already mentioned, the Croatian authorities are putting much emphasis on the restructuring of tourism as a key sector of the economy. Although the Government does not invest directly in facilities, it is committed to improving infrastructure and communications, providing special measures for the development of islands and attracting investors. In 1991 the "Study of Tourism Area Development" was drawn up to make recommendations regarding land use for tourism. In 1993 Croatia passed its Strategy for Long-term Development of Croatian tourism (revised in 1998) and in 1994 its Master Plan for the Development of Croatian tourism, which is a more detailed application of the principles contained in the Strategy. These documents outline the goals and strategy for tourism development and provide measures for their implementation. In particular, the Strategy sets the following basic objectives for tourism development:

- to mark and protect all the potential tourist resources in Croatia;
- to build up a new identity for Croatian tourism and to acquire a satisfactory position on the European and Mediterranean tourist market;
- to develop tourism in the framework of sustainable development;
- to provide an income to the local population, especially where tourism offers one of the rare possibilities for economic development and employment;
- to provide an economic base for the stable, long-term development of the rural areas and the islands;
- to provide an additional market for the numerous domestic products, thereby bolstering the national economy as a whole (especially small and medium-size firms) and boosting employment and tourist outlays.

With regard to physical and ecological aspects, the Strategy emphasizes the following points:

- polycentric development;
- development of tourist buildings according to the physical plans and the territorial capacities;
- adoption of legal procedures for the awarding of concessions;
- participation of local communities in the permanent monitoring of the quality of the water, sea and beaches in order to protect tourist destinations;
- education of the population regarding environmental protection and preservation of nature by the local communities;
- establishment of links between tourism and ecology such as protection and monitoring of the environment in the tourist areas;
- introduction of biological waste-water treatment.

For the Ministry of Tourism, it is clear, firstly, that space and environment should be preserved as the basis for tourism development and, secondly, that the quality of existing accommodation facilities should be improved and no new facilities built. In concrete terms, 70 per cent of existing accommodation facilities could be improved, 20 per cent should be used for other purposes and 10 per cent eliminated due to their poor quality. Even though the authorities consider that there is enough accommodation in Croatia, they plan to build more

recreational facilities such as golf courses, marinas and ski resorts. It must also be stressed that the entire territory of Croatia is considered to be a tourist resource, because the natural conditions for tourism are present everywhere and because the Government would like to avoid migration from inland to coastal areas by developing tourism in other parts of the country. Croatia's main declared priority is to develop tourism of high quality and ecotourism instead of mass tourism.

To implement the principles contained in the above-mentioned documents, specific legislation on tourism, prepared by the Ministry of Tourism, was adopted by the Croatian Parliament in the mid-90s:

- Law on Tourism Communities and Promotion of Croatian Tourism,
- Legislative Law on Ranking, Minimal Conditions and Categorization of Catering Facilities,
- Law on Membership Fees for Tourism Communities,
- Law on Catering Activities,
- Law on Tourist Activities,
- Law on Tourist Inspection.

Other official documents are also important for tourism in Croatia, such as the Strategy for Space Organization of the Republic of Croatia, the National Programme for the Development of Islands and the Plan for the Development of Motorways and Major Roads (all adopted in 1996). All these documents are coordinated with the Strategy for Long-term Development of Croatian Tourism.

Environmental instruments for tourism

In addition to the already mentioned documents (Strategy for Long-term Development of Croatian Tourism, Master Plan for the Development of Croatian Tourism, National Programme for the Development of Islands and Strategy for Physical Planning of the Republic of Croatia), which all emphasize the necessity of sustainable tourist development, the Law on Tourism Communities and Promotion of Croatian Tourism aims notably at raising public awareness about the preservation/rehabilitation of cultural and historic monuments and environmental protection through tourism organizations. The principal idea is to protect, preserve and use the environment according to its capacity, i.e. a rational environment-development relationship based not only on profit-making, but also on protecting the environment as the prerequisite for a long-term, sustainable development of tourism.

The negative impact of tourism on the environment is dealt with in environmental laws and regulations, which also apply to tourism, such as the Laws on Physical Planning, on Construction, on Environmental Protection, on Waste, on Air Protection, on Water, and on Nature Protection and the Regulations for Sea Water Quality Control for Bathing and Recreational Purposes.

Different projects related to tourism are submitted to an EIA according to the annex to the Law on Environmental Protection. These projects are:

- sports and recreational centres with various sports grounds of 10 ha or more;
- ski runs with ski lifts;
- golf courses;
- specific kinds of ports (marinas);
- hotels and restaurants over a surface area of 10 ha or more;
- infrastructure in national and nature parks;
- buildings in maritime areas.

Physical planning for tourist development is particularly important. In the former Yugoslavia, the planning of tourism began in 1968. At that time, the special plans aimed at developing mass tourism and foresaw building accommodation facilities for a total of 1.5 million beds. Nowadays, according to the new principles of more sustainable tourism, the purpose is to rebuild and renovate the existing facilities and not to build new tourist resorts (see above).

Implementation of environmental instruments for tourism

As the environmental instruments relevant to tourism are part of the environmental regulations, the State Department for the Protection of Nature and the Environment is the administrative body responsible for the implementation of most of them at the national level. However, the State Directorate of Water deals with environmental provisions concerning the quality of freshwater and waste-water treatment, and the Ministry of Physical Planning, Building and Housing with regulations regarding physical planning and construction.
The Ministry of Tourism (about 50 staff) is not directly involved in the implementation of environmental provisions, but is particularly

interested in environmental planning and management. In particular, its Section for Area Development and Protection of the Environment, which employs three people, analyses and evaluates the natural resource basis for the development of tourism and the state of environmental protection in tourism sites. It defines the basis for the development of environmentally friendly tourism in existing tourist destinations and directs the development of various ecologically acceptable forms of tourism. Furthermore, the Ministry of Tourism cooperates with the State Directorate in the programme "European Blue Flag for Beaches and Marinas" (through the Commission for Blue Flag, see also Chapter 1) and in monitoring sea water quality according to the Regulations for Sea Water Quality Control for Bathing and Recreational Purposes. It also participates in all committees for the review of EIA studies, in the yearly Environmental Protection Awards process. It has representatives on the team responsible for implementing the intervention plan in case of accidental pollution of the sea around Croatia.

More generally, the Ministry of Tourism takes part in the preparation of all laws, bylaws and reports related to the protection of the environment in Croatia. This participation aims at ensuring sufficient and permanent coordination between tourism administration and environment administration. Due to the limited financial and staff resources, it is a daily challenge to keep this coordination at a satisfactory level.
Until 1999, the Ministry of Tourism had inspectors responsible for controlling the application of the legal provisions in the tourist companies. Now, these inspectors work in the Section for Tourism of the newly established State Directorate for Inspection. Their task includes controlling technical standards for accommodation and catering, and controlling working conditions and environmental provisions (waste water, quality of water, waste). They can fine the enterprises which do not respect the legal provisions.

Though interested in environmental issues, the Ministry of Tourism was not involved in the publication *Country Profile Implementation of Agenda 21* (1997). Most ministries and other administrative bodies (Reconstruction and Development, Physical Planning, Agriculture and Forestry, etc.) did take part in it.

At the regional and local level, the Law on Communal Activities obliges counties and municipalities to form companies for water supply, waste-water treatment and solid waste treatment. The counties and municipalities draw up contracts with these companies pointing out exactly what their tasks are in the environmental domain. These companies are also allowed to sell their services to tourist communities or tourist enterprises (for example, for street cleaning or park maintenance).

Numerous environmental local and regional NGOs in the tourist areas aim at encouraging sustainable tourism. These NGOs concentrate their activities on education and information to the authorities and the general public, but also on concrete actions such as cleaning beaches during summer. In this respect, even though they are not legally responsible for implementing environmental instruments, they make a useful contribution to improving the quality of the environment in the tourist regions.

Tourism management at the local level: the Krk Island

Situated not far from the city of Rijeka and connected directly to the coast by a bridge over the sea, the island of Krk covers 410 km^2 and has a population of around 17 000 according to the 1991 census. During the summer the number reaches 100 000 people, including the local population, owners of summer houses and tourists. The island is divided into seven administrative units: the town of Krk and the municipalities of Omisalj, Malinska, Dobrinj, Punat, Vrbnik and Baska. As tourism is the island's main industry, the local inhabitants are mainly engaged in tourism, but also in agriculture (vineyards, olive groves, cattle breeding) and other branches of industry. Accommodation is provided in hotels, guest houses and campsites. There are also a high number of domestic visitors from other counties. The high season is from June to the end of September, reaching a peak in July and August. During the rest of the year there are few visitors, they come mainly on weekends. Consequently, the pressure on the environment is high during the peak tourist season, causing serious problems requiring investment in sewage systems, waste-water treatment and solid waste disposal.

However, the economic future of the island cannot be sought outside tourism, as the other economic sectors are weak. The local authorities of Krk have planned to develop nature- and culture-based tourism. Several measures have already been taken, such as participation in the Blue Flag project, creation of a group dealing with environmental issues in the island's county tourism office, implementation of Agenda 21 under the supervision of a local NGO called "Eureka" and regular monitoring of the sea quality around the island. Other concrete environmental measures are implemented by PONIKVE Krk, a public utility company founded by all the municipalities of the island. PONIKVE is in charge of the water supply and waste-water disposal for the whole island, as well as the central landfill and domestic waste collection from approximately 50 per cent of the island's area.

The existing sources of water supply are sufficient for most of the year. Problems arise in the summer months, when water consumption is 4-5 times higher than in winter. The resulting shortage is resolved by bringing in water from the mainland. As water is a limiting factor for the further development of the island, the local authorities want to preserve existing resources and would like to find new ones on the island before investing in additional water import from the mainland to cover peak consumption in the summer months.

There are now serious water-quality problems in the water supply system, especially where water is supplied from surface reservoirs. The existing treatment plants are not producing water of a satisfactory quality. To resolve this problem, more groundwater will be used because surface waters (rivers, lakes and reservoirs) cannot be distributed without prior treatment. In any case, surface and groundwater resources should be carefully protected within sanitary protection zones, to ensure untreated, raw water of a high quality. As the quality of water distributed to consumers must be analysed regularly and the water disinfection system must be upgraded, the authorities hope to find funds to build a fully equipped, modern laboratory.

Only 15 per cent of the island's residents are connected to waste-water disposal systems. The existing waste-water disposal systems consist of a coastal pipeline and a street sewerage network to which all the larger consumers, as well as a number of individual users (establishments), are linked. The island has six small systems, each covering the needs of one settlement, mainly seaside resorts (the amount of waste water increases fivefold during the tourist season). Each system has at least one pumping station. Waste water is pumped to the treatment plant if there is one (three of the six systems do not have one) and from there it is discharged by gravitation into the sea. Prior to the construction of these outfalls, no profound analysis of sea currents or modelling of effluent dispersion had been performed. Consequently, some sea outfall pipes will have to undergo reconstruction in the near future or new ones will have to be built.

In Malinska, for instance, a programme was drawn up in 1995 and, in 1998, the municipality of Malinska, the Ministry of Reconstruction and Development and Croatian Waters agreed on a financing plan for a sewage system. According to this agreement, all the waste water from the hotels and private houses of Malinska Bay and of neighbouring Njivice will be collected and treated by 2001.

Solid waste treatment is another serious problem. At present, domestic waste is dumped unsorted, then compacted and covered with inert material. All the amounts of waste trucked to the central landfill are registered and notified to the local communities and regular sanitary-epidemiological measures are carried out. Nevertheless, as the existing dump does not meet legal requirements and has an available capacity of only one year of waste production, new measures are now being designed. According to the county plans, a landfill will be built on the mainland. In the meantime, the authorities have to find temporary solutions.

The county's physical plan is being drawn up. It has to be finished by the end of 1999. Each community has to make its own plans for the end of the year 2000. These plans should indicate all the existing and planned major infrastructure, such as roads, water supply systems, sanitary protection zones for drinking water, residential zones and agricultural zones. In particular, great attention is paid to the planning of the coastal area in order to define exactly what can and what must not be built there. The planning is expected to stop the further spreading of secondary homes (at present, the island has some 20 000 weekend cottages). Each level of planning (municipality/county/State) has to fit in with the higher level. At the local level, the plans are submitted to the population and NGOs, who can make comments and suggestions. Before

the Law on Local Self-government (1993), the island of Krk formed only one community. Since then it has been divided into seven communities. This greatly complicates coordination among them.

Regarding the relations between the municipalities of the island of Krk and the State, two points should be mentioned. Firstly, the local authorities would like to see more of the taxes they pay return to the island so that they have funds to solve their basic problems. Secondly, even if they agree with the principles contained in the Strategy for Long-term Development of Croatian Tourism and in the Master Plan drawn up at the national level, they have to produce their own documents defining the future tourist development of the island, because the general notion of sustainable tourism is too vague.

12.3 Conclusions and recommendations

In the 70s and 80s Croatia's Adriatic coast was developed mostly to cater for mass tourism. Tourist complexes were built as independent units; they were not integrated in the local life of the inhabitants. With the breakdown of the former Yugoslavia and the ensuing war in the early 90s, tourism collapsed, causing, among other serious problems, unemployment and a lack of foreign currency. Since the mid-90s the Croatian authorities have been trying to revive tourism, as tourism was, and could again become, a crucial economic activity for the country.

The environmental problems related to tourism are the result of the concentration of tourists in space and time. This concentration in the summer months causes problems particularly for the water supply, waste-water treatment, and solid waste management, and it damages both nature and landscape.

Conscious of these problems, the Croatian Government would like to adjust tourism development to Croatia's natural properties. The need for sustainable tourism is emphasized in the Strategy for Long-term Development of Croatian Tourism. The Strategy recognizes that nature and the environment must be taken into account when planning tourism development. However, the Strategy gives only a general orientation; it says nothing about the manner in which practical measures must be taken at the local level. The national Strategy should now be made more concrete by the development of guidelines for the local level. It is crucial to involve the local communities and NGOs that have already started up such a process of Agenda 21 (as is the case on the island of Krk) in the creation of these guidelines.

Recommendation 12.1:
Guidelines for sustainable tourism addressed to local communities, containing notably a checklist of important elements to take into account in tourism development and practical advice on how to resolve environmental problems in tourism, should be drawn up at the national level according to the principles of local Agenda 21.

In terms of laws, plans and strategies related directly or indirectly to tourism, Croatia has developed a comprehensive approach, taking into account the impact tourism has had on the environment. In this respect, the general design of the tourism policy can be viewed as satisfactory: on paper, the instruments given by this policy can surely greatly improve the state of the environment in the tourist areas. Furthermore, there is no obvious contradiction between the objectives of the tourism policy and the objectives of the environmental policy. Nevertheless, the building of golf links and ski resorts must be carefully planned so as to limit their number and the environmental damage they cause. Moreover, more emphasis should be put in the future on those aspects that have not been sufficiently taken into account until now in the tourism policy. They are: general education in tourism matters (stressing the dependency of tourism on natural resources), the systematic use of carrying-capacity assessments to determine what environmental limits should not be exceeded and, finally, the need to better protect the cultural and natural tourist resources against other economic activities such as industry or transport, which can destroy them.

Recommendation 12.2:
The national authorities should adopt legal instruments on protected tourist resources, defining a list of tourist resources and protecting them against other economic activities. The legal instruments should mention environmental requirements that protected tourist resources have to preserve, including the quality of bathing water in accordance with international practice.
Concerning the institutional arrangement, there is a strong need to improve cooperation between the Ministry of Tourism and the administrative bodies responsible for the management of environmental problems -- State Directorate for the Protection of

Nature and the Environment, State Directorate for Water and Ministry of Physical Planning, Building and Housing (horizontal cooperation). For example, the Ministry of Tourism and the State Directorate for the Protection of Nature and the Environment have common interests. Both give particular importance to the preservation of the environment and both have to preserve the common interest in competition with other economic activities, such as industry, transport or agriculture, that may have a negative impact on the environment and tourism. (See Recommendation 1.1).

At the same time, there is also a great need to improve collaboration between the State level, the county level and the local level (vertical cooperation). In particular, an institutional mechanism should be found to collect and synthesize all the local experiences before spreading this information throughout the country. This could also make the Strategy more concrete and more helpful for the (less experienced) local communities. This mechanism could take the form of a permanent committee joining together members of the three different administrative levels (State/county/community). Its first task could be, for example, to draw up the guidelines for sustainable tourism mentioned above.

Recommendation 12.3:
A permanent committee on sustainable tourism composed of representatives of State, county and local levels, and NGOs should be established. The committee should have permanent scientific staff at its disposal and should take part in international networks on sustainable (tourist) development. *See also Recommendation 12.1*.

The case study of the island of Krk shows that the implementation of the environmental regulations relevant to tourism is only in its early stages and that a lot remains to be done. Whether the efforts to develop sustainable tourism bear fruit depends above all on the capacity of the Croatian Government and the local authorities to find domestic and foreign funds for this purpose. The authorities have to develop strategies and measures to stimulate investment in environmentally friendly tourist infrastructure.

Recommendation 12.4:
The National Strategy of Tourism should include provisions for foreign and domestic investors in the tourism sector dedicating part of their investment to the building or renovation of public environmental protection facilities.

In the longer term, i.e. when Croatian tourism will have returned to its pre-war level, the main risk is that Croatia will not be able to control its overall tourism development in spite of the different existing regulations. Since the Ministry of Tourism views every part of the country as a potential tourist area, it is of prime importance that the national authorities have the leadership in physical planning in order to keep a balance between more and less developed tourist areas, notably by defining what sort of tourism is appropriate for which region. The difficulty here is to determine exactly which areas can be developed for what kind of tourism and to find (financial) mechanisms to compensate the voluntarily less developed tourist areas. Another important point for the future will be to set quantitative limits on tourist development (maximum number of beds, marinas, ski resorts, etc.) in order to prevent tourism from "nibbling" more land.

All this implies that the general public should understand what is at stake and why it is important to develop sustainable tourism in their county in the years to come. People's attitudes will have an important role to play, as tourism could develop all over the territory, but still be specific to the local area. Therefore, public awareness about sustainable tourism should be raised.

Recommendation 12.5:
At primary and secondary levels of education, courses should be introduced concerning tourism in general and the importance of developing an environmental friendly tourism in Croatia in particular.

Chapter 13

HUMAN HEALTH AND THE ENVIRONMENT

13.1 Status of human health and its relation to environmental factors

General assessment

The main statistical indicators show that the health status of Croatia's population is above the European average. In fact, it does not differ much from the European Union's average. Some indicators deteriorated in 1996/97, but this has been attributed to changes in the headcount of the population. The trends should be watched carefully, since part of the change may indicate a deterioration in the health status in the most recent years. The available data do not suggest that any particular environmental factor has had a significant negative impact on the health status of the Croatian population. However, a more detailed geographical analysis might be necessary to verify if such a conclusion can be applied to the entire country.

Life expectancy and mortality

According to the data from 1997, out of the close to 4.6 million people living in Croatia, 20 per cent were younger than 15, and 12 per cent were 65 or older. Both numbers are close to the European average. Life expectancy at birth has fluctuated significantly in the 1990s. It increased from a minimum level of 71.0 years in 1991 to 73.3 years in 1995, and declined again to 72.6 years in 1997. That decrement is attributed to the changes in the statistics system and the reduction in the population estimates by some 250 000 in 1996 (previously, the 1991 census data were used for the population headcount; starting from 1996, the mid-year population estimates have been calculated by the National Bureau of Statistics). The 1997 life expectancy estimate is similar to the European average. It is 4.9 years shorter than the EU average, but 1.1 years longer than the central and east European average. The level and trend of life expectancy at age 65 are relatively less favourable. The former declined in 1995-97 to 1.6 years below the European average (3.5 years below the EU average and 0.4 years below that in central and eastern Europe).

The infant mortality rate (8.1 per 1 000 live births in 1996) was below the European average (by 36 per cent), but still exceeded the EU level (by 41 per cent). The overall declining trend stopped in the early 1990s (during the war) and, again, in 1997, when the rate reached 8.2 deaths per 1 000. Post-neonatal mortality was even closer to the EU rate than overall infant mortality, which indicates that the hygienic conditions surrounding the newborns are effective in supporting their health. There is a substantial variation in the county-specific infant mortality rates, with the highest rate 3 times the lowest (13.1 vs. 4.3 in 1997).

Diseases of the circulatory system are the predominant cause of death. They are responsible for 50.4 per cent of all deaths in Croatia. After a slow decline between 1985 and 1992, the mortality rates stabilized, but rose in 1996/97. The age-standardized rates of mortality due to these diseases are 10 per cent higher than the European average and almost double the EU average.

Malignant neoplasms claim 21 per cent of deaths. The cancer mortality rates have fluctuated widely in the 1990s. After a period of relatively low rates between 1991 and 1995, the rates increased by more than 10 per cent in 1996 and 1997. In 1996, cancer mortality in Croatia exceeded the European average by 16 per cent. The most common cancer was that of the respiratory system (trachea, bronchus or lung), and the mortality caused by it was more than 20 per cent above the European average. Since information on the prevalence of tobacco smoking is not available, it is difficult to attribute the high lung cancer mortality in Croatia to smoking. The mortality due to chronic obstructive lung disease (another disease group closely linked with tobacco smoking) was 20 per cent below the European average in 1997, though the rates were significantly higher than in the years before 1995.

External causes led to 6 per cent of all deaths in 1997. The mortality rates were 20 per cent below the European average but almost twice as high as the rates observed in the EU. In the period 1991-1993, the number of deaths due to external causes almost doubled in Croatia (to 13 per cent of all deaths). Road accidents (some 20 per cent of accidental deaths) declined to almost half their pre-1990 level in 1993-94, but the rates have increased again to the European average in more recent years.

Infectious and parasitic diseases cause less than 1 per cent of deaths, and the mortality level is similar to that in other central and east European countries (where it is some 50 per cent higher than in the EU).

A relatively large proportion of deaths (some 6 per cent) is coded as "ill-defined conditions". This is four times more than in the EU and is caused, to some extent, by the incompleteness of the data on causes of death in documents certifying the death of Croatian citizens abroad. When these deaths are excluded from the analysis, the ill-defined conditions are mentioned on less than 5 per cent of death certificates, which is still some three times more than in the EU. Such a high rate of non-specific cases may cause problems in the analysis of cause-specific mortality, especially if changes in the disease structure emerge in the registered cause of death.

Registered morbidity

All primary health care clinics and hospitals provide a wealth of information about patients' visits and health problems. Yet, the use of this information to assess the health status is limited: one patient may make several visits with different complaints, or have several consultations for the same disease. The primary health care system registered over 92 000 consultations related to intestinal infectious diseases, some of them possibly caused by contaminated water or food.

The system of communicable disease registration has reported not more than 20 000 cases of infectious diseases of the digestive system. This system provides an insight into the trends and patterns of communicable diseases. Table 13.1 summarizes the information related to acute intestinal infections, possibly linked with the consumption of contaminated water or food. Overall, the number of registered cases of food-borne infections and enterocolitis increased in 1997, compared to 1996, but was not higher than in 1995 or in earlier years. Only a small proportion of the reported cases occurred in identified outbreaks, with a common source of infective agent. The incidence of hepatitis (also HbA) is below the EU average and several times lower than the European average, which shows that the water supply systems are free from this type of infection.

Few outbreaks of water-related diseases are registered in Croatia. In 1997, two such outbreaks occurred, one with 335 cases, the other with 7 cases of enterocolitis of unknown causative agent. No outbreaks were registered in 1996 and one in 1995. In previous years, between 2 and 7 outbreaks were reported annually.

System of mortality and morbidity monitoring

The Central Statistical Office collects and processes death certificates and calculates mortality rates. For the deaths occurring in Croatia, the causes are coded centrally by the Croatian National Institute of Public Health. This ensures a high quality of classification. However, the information on deaths

Table 13.1: Registered cases and incidence of acute intestinal infections, 1996-1997

Number

	1996	1997		
	Cases	*Cases*	*Per 100 000*	*Outbreaks / Cases*
Enterocolitis	7 956	8 474	184	8 / 464
Bacterial dysentery	149	90	2	-
Food-borne infections: - due to Salmonella	2 899	4 204	91	35 / 382
" " **- other aetiology**	3 582	4 037	88	4 / 46
Viral hepatitis	824	682	15	-
of which: **- Hepatitis A (HbA)**	249	102	2	3 / 20

Source: Croatian health service yearbook 1997. Croatian National Institute of Public Health, Zagreb 1998.

of Croatian citizens abroad does not pass through the Institute, which may explain the high proportion of deaths with ill-defined causes. The place of residence of the deceased is coded on death certificates, and most (some 70 per cent) of the data are computerized. The county-specific mortality data are published in the Croatian Health Service Yearbook. These data indicate wide disparities (more than double) in (crude) total mortality rates. However, there is no comprehensive geographical analysis of mortality to assess and explain these differences within Croatia.

The Croatian National Institute of Public Health compiles, processes and publishes statistics on the use of health care services (primary health care clinics and hospitals). As mentioned before, there are problems with case identification, but the data do provide a potentially useful source of information on the less severe health problems. Again, no region-specific analysis is conducted and the potential to link the morbidity information with environmental conditions at the place of residence is not used.

13.2 Health risks associated with environmental factors

Drinking water

Public supply system of drinking water covers 63 per cent of the total population of Croatia. However there are significant regional differences in the coverage. In some rural parts of the country, less than 50 per cent population has the access to public water supply. Individual wells are 10-100 m deep, and for more than 50 per cent of them exists a significant risk of microbial contamination. Shortages of drinking water in dry periods occur in high karst areas, especially in the tourist season with a higher drinking water demand. Also some islands on the Adriatic Sea suffer the shortage of drinking water.

Drinking water quality is monitored by the public health authorities according to the Law on Food and Object of Common Use Safety (Off. Journal 60/92), where water is treated as a food item, and the Drinking Water Safety Regulation (46/94). The water quality standards are concordant with the EC and WHO recommended values. Certified laboratories perform the analyses and submit the results to the National Institute of Public Health. In 1997, chemical tests were performed on 22 511 samples and microbiological assays on 24 007 samples. The standards were not met in, respectively, 8.8 per cent and 9.0 per cent of samples. The results of the testing vary substantially between the regions. In some counties the proportion of samples failing the chemical test exceeded 50 per cent (with turbidity being the most common cause of test failure), and the proportion of microbiological assays not meeting the standards reached 24 per cent (heterotroph, total coliform and faecal streptococci counts exceeding standards). The results of the tests differ also between types of water supply systems, as shown in Table 13.2. Individual wells and small distribution systems are notably less safe than the public supply systems, with close to 1/3 of all samples failing microbiological tests. The health of some 10-15 per cent of the population is thought to be at risk because of poor water quality.

Though the programme of drinking water quality testing, including the location, frequency and number of samples to be collected, is clearly defined in the drinking water safety regulations, the limited resources do not allow for its full implementation. Therefore, the share of negative tests may depend on the local approach to testing (e.g. at a time when or a place where water contamination is more or less likely). To ensure a better comparability of the results between areas, the laboratories responsible for water quality testing should follow the recommendations of the programme more strictly.

Table 13.2: Drinking water quality test results by type of water supply system, 1996

	Chemical parameters		Microbiological parameters	
	Number of samples	*% not meeting standards*	*Number of samples*	*% not meeting standards*
Public	20 436	3.5	21 035	7.1
Individual	5 514	28.4	5 416	38.3
Other	4 227	31.8	5 710	31.5

Source: Croatian National Institute of Public Health, Zagreb 1998.

Recreational waters

Of the 158 freshwater and 831 coastal bathing sites that are monitored in Croatia, 96.8 per cent complied with the national standards for recreational water quality in 1997. For the freshwater sites that result was similar to those achieved in 1994-1996, while for the coastal sites it was an improvement from the previously recorded 92 per cent - 93 per cent. Still, the proportion of recreational water samples not meeting standards was 10 per cent, 11 per cent and 32 per cent for the samples taken from, respectively, coastal sites, inland waters and swimming pools. Taking into account the large quantities of untreated waste water discharged into the sea and rivers, the contamination of recreational water may pose a health risk, especially in the tourist areas.

Air quality

The national priority related to air quality is to achieve clean or slightly polluted air over the entire territory of the country within the next 10 years. A set of legal instruments has been developed in the past 5 years to this end (see Chapter 5 on air management).

According to the Law on Air Quality Protection, the main responsibility for monitoring air quality in urban areas, the most relevant for determining the population's exposure to air pollutants, is with the local public health offices. The Institute of Medical Research and Occupational Health in Zagreb, which is also involved in developing and overseeing monitoring methods, prepares an annual report summarizing the monitoring results. The monitoring is conducted at 135 stations located in 16 cities. This network covers 35 per cent of the population. However, in many stations only the dust sediment is measured. Black smoke and sulphur dioxide are measured in, respectively, 56 and 52 stations, NO_x in 17, and ozone in only 5. In several locations the concentration of total suspended particulates (TSP) is measured as well, including one location in Zagreb where the measurements have been conducted since 1972. The Institute started measuring PM10 and PM2.5 in November 1998, and the methods are being further developed.

The routine assessment of air quality is conducted with reference to the recommended and limit values, which are equal, or close, to the WHO Air Quality Guideline values (for comparison of national and WHO or EU standards, see Table 5.5). In most locations, the air pollution levels have been below the reference values since 1995. The exceptions are mostly the mass of sedimented dust, or the amount of cadmium or lead in the sedimented dust, which were higher than the national recommended levels in several cities. However, there are no data on the concentration of the metals in suspended particulate matter, and it is difficult to assess the health significance of these findings.

The limited information that is available on the mass concentration of suspended particulate matter indicates that air pollution with particles measured as TSP is falling. In Zagreb, the annual mean concentration decreased from 149 $\mu g/m^3$ in 1976 to 92 $\mu g/m^3$ in 1991. However, in the 1990s the TSP concentration has not decreased below 60 $\mu g/m^3$ and in 1996/97 it was higher than in the mid-1990s. The measurements of TSP in Rijeka and of black smoke in Zagreb and Split reveal similar trends. These data show that, after a successful reduction in particulate pollution to a "moderate" level, below or just above the national recommended value, no further reduction has been achieved.

The evidence from a number of epidemiological studies conducted in various countries of Europe and America suggests that the still high levels of TSP in some of Croatia's cities could be a cause for concern. These studies, which are behind the revised WHO Air Quality Guidelines, indicate that a wide range of adverse health effects may occur at the levels of exposure encountered in Croatia. These observations are supported by a study conducted in Zagreb, demonstrating an increased number of hospital visits caused by an exacerbation of chronic obstructive pulmonary disease on days with higher concentrations of particulate matter. The estimated effects resulted in an 18 per cent increase in the number of visits per 10 $\mu g/m^3$ of TSP concentration. Another analysis based on TSP data in Zagreb and the results of epidemiological studies estimated that several hundred premature deaths occur each year because of the particulate pollution in Zagreb.

The present levels of TSP and the findings of the epidemiological study on COPD indicate that the air pollution with particulates may remain a significant factor affecting health. The introduction of PM10 and PM2.5 monitoring and the design of an effective pollution reduction strategy are, therefore, paramount in the prevention of impacts of air pollution on health (see Chapter 5).

No information on the concentration of lead in ambient air is available, but measures of lead content in deposited matter were made in Zagreb (see Chapter 5). However, the relatively high percentage of leaded petrol used in transport and the high levels of lead in the sedimented dust indicate that the exposure of urban children to lead in air may pose a risk to their neurobehavioral development. This expectation was not confirmed by a survey of the blood lead level in children conducted in Zagreb in the early 1990s. In that study, the blood lead level was found to be between 2.4 and 14.2 µg/dl, and the mean exposure level correlated well with the traffic density near the school.

In some parts of Croatia, *indoor* exposure to radon may be of health concern. The measurements conducted in a limited number of houses in the Istrian peninsula point to a possibility that slag and ash, used in building materials of old houses, may be a source of high radon concentrations. However, the measurements in Zagreb have also detected a number of houses with a high radon level. On average, these data would put Zagreb in the "medium" exposure category, where some 5-9 per cent of lung cancers may be attributed to radon exposure. Managing this risk would require preventing the radon from penetrating into the dwellings through, for instance, improved ventilation below the ground floor.

Waste

The lack of an integrated waste management system (see Chapter 7) is certainly an environmental problem and also a potential source of health risks. The main route of exposure would be through drinking water contaminated by the wastes. The high proportion of drinking water samples collected from individual wells and small distribution systems that do not meet the quality standards may be one indicator of the problem. The fact that relatively few samples taken from public water distribution systems are contaminated is due to the efficient protection of the designated water catchment areas as well as to the water purification and disinfection in these systems.

Data on population exposure to hazardous chemicals are scarce. The studies conducted by the Institute of Medical Research and Occupational Health in Zagreb concerning the levels of persistent organochlorine pollutants in biological samples (also in mother's milk) do not indicate a high level of exposure. No recent data on the exposure to heavy metals are available. Such studies require high-quality laboratory procedures and good standardization of methods. International collaboration may be necessary to ensure the comparability and reliability of their results.

One of the problems following the war was the accumulation of expired drugs and other medical supplies donated to Croatia in the early 1990s (see Chapters 3 and 7). According to recent estimates, the treatment of some 2 000 tonnes of these wastes will cost approximately US$ 4.3 million. The first step is to sort and to store the drugs so as to prevent the distribution of the expired medicines to the population. Subsequently, they can be incinerated, either in the facilities available in Zagreb or abroad. The Croatian National Institute of Toxicology has prepared the project to effectively eliminate the risk. It must now be implemented.

The war in the early 1990s left behind a specific environmental health hazard – land mines (see Chapter 3). It is estimated that some 6 000 km^2 (over 10 per cent of Croatia's surface) may be mined. The mines constitute a real risk of injury and death. Fortunately, only few mine-related accidents are reported annually, but the reporting system is not well adjusted for registering this type of accident, so real numbers may be obscured in the health statistics. The number of accidents could increase when the remote mined areas are visited more often.

Food safety

Monitoring food safety is one of the important tasks of the network of Public Health Institutes. The nationwide "minimum annual sampling programme" requires 5 samples to be tested per 1 000 population per year. More tests can be performed if local conditions require it, but the available resources limit this additional programme. Several other services (veterinary, trade, health inspections) also carry out monitoring, but the coordination of these actions is insufficient.

Chemical safety tests rejected 5.5 per cent of the 26 006 food samples tested. The samples were rejected mostly because of their inappropriate taste or excessive level of food additives. There are only few cases of contamination by specific metals or pesticide residues, possibly linked with soil contamination (Table 13.3).

As mentioned earlier, over 8 000 cases of food-borne infection were registered in 1997. They are

mainly related to the improper food processing and storage or to microbial contamination. Over 9 per cent of food samples failed health safety tests due to microbial contamination (Table 13.4). The most common causes were the excessive number of micro-organisms, the presence of Salmonella or coagulase-positive Staphylococci.

Table 13.3: Tests of food contamination, 1996

	Samples tested	Samples contaminated
	Number	*%*
Microbiological hazards	43 455	9.60
Mercury	5 415	0.06
Arsenic	7 459	0.24
Lead	8 189	0.15
Cadmium	6 171	0.03
Pesticide residues	6 526	0.08

Source:Croatian National Institute of Public Health, Zagreb 1998.

13.3 Priorities and management

Policy objectives

One of the main objectives of environmental policy is to protect human health. This is spelled out in the Croatian Constitution, which, in its Article 69, proclaims that "*... citizens have the right to live in a healthy environment…*". This principle is also reflected in the Environmental Protection Law, the Law on Air Quality Protection of 1995 and in the Law on Health. An important policy document linking health with various aspects of environmental policies is Croatia's "Health for All by the year 2005". It recognizes the significance of the "*effective control, evaluation and prevention of all health risks created by specific factors in people's living and working environment*". It also aims "*to eliminate and reduce harmful substances in all environments that surround human beings and with which man comes into contact … by combined, mutually supportive inter-sectoral and multi-disciplinary activities*". The policy sets targets to be achieved by the year 2005. It also sets out strategic actions, both to develop the institutional or legal infrastructure and concerning individual aspects of the environment (water quality, waste management and soil pollution protection, food safety, air pollution control, occupational health, housing).

An extension of the Health for All policy, also related to environment and health, is the national environmental health action plan (NEHAP). The Minister of Health chairs the NEHAP Steering Committee, which also includes high-ranking representatives of all other relevant sectors. This will give the proposed programme a high political priority. The NEHAP is being presented to the National Health Committee, the body appointed by the Parliament (spring 1999), and will create a general framework for the multi-sectoral approach to the country's environmental health problems. It will set a wide range of objectives related to the development of managerial tools, the prevention or reduction of health risks related to each of the environmental media, as well as to the activities of individual economic sectors. Addressing such a wide range of objectives is not feasible in the short run, and the objectives and the resources will have to be balanced carefully to ensure effective implementation. Such a prioritization will be the subject of follow-up work, aiming at the creation of a national strategy.

Institutional responsibilities

The responsibilities for assessing, preventing or reducing the impacts of environmental factors on health are divided among a number of institutions belonging to various parts of Croatia's administration. Most of the services dealing with the prevention and control of environmental pollution aim, indirectly, to prevent health impacts. However, the role of the agencies of the Ministries of Health and of Science and Technology is also important.

The Law on Health assigns responsibility for monitoring and controlling environmental health hazards to the public health institutes (the Croatian National Institute of Public Health as well as to the Institutes in each county). In particular, the Institutes are responsible for:

- Monitoring, studying and assessing the safety of drinking water, surface waters and waste waters, as well as the condition of the water supply;
- Monitoring and assessing food and 'objects of common use';
- Controlling and evaluating the impact of the environment on health.
- The Institutes contribute to risk assessment through, for instance, the surveillance of communicable diseases.

The Croatian National Institute of Toxicology has been created to work on the prevention of chemical

accidents and population exposure to toxic substances. It assesses the risk of selected installations, is involved in controlling the transport and transit of hazardous chemicals and prepares educational materials for workers who risk exposure, for local decision makers and for the general population. It also serves as a reference centre providing round-the-clock advice in emergencies and in cases of acute poisoning.

The Institute of Medical Research and Occupational Health, established in 1947, has a long, internationally recognized record of work related to the assessment of impacts of environmental factors on health and to the development of methodology. It has a prominent role in the national system of urban air quality monitoring. It is also developing methods for PM10 and PM2.5 monitoring and participates in laboratory quality assurance networks. Despite its long tradition and professionalism, the interaction of the Institute with the environment and health decision makers could be improved. The Institute's programme has to fit the country's current and future needs better, and its work should be used to shape national and local decision-making.

The universities and the School of Public Health provide professional education and capacity building for environmental health. However, there is very little interaction between the agencies involved in education, research and public health, limiting the opportunity for closer collaboration. This situation will affect the flow of qualified personnel to environmental health services.

The noticeable insufficient inter-sectoral collaboration between environment and health affects the ability to comprehensively assess health risks and may hamper the ability to design and implement effective risk reduction action.

13.4 Conclusions and recommendations

The principles of protecting public health from environmental hazards are well reflected in the existing legislation and basic policy documents. However, there is no plan of action, assigning responsibilities and identifying resources.

Recommendation 13.1:
An operational plan to implement the National Environmental Health Action Plan should be prepared in close coordination with the National Environmental Action Plan and accepted by the Government. The plan should set priorities, define methods of implementation, and assign responsibilities and resources.

In spite of the formal acknowledgement of the need for inter-sectoral and inter-institutional collaboration, the existing contacts between the environmental and health administrations are insufficient.

Recommendation 13.2:
Collaboration should be clearly improved between the sectors and institutions involved in assessing and managing the health risks due to environmental exposure (administration, public health agencies, research and education).

The general health indicators present a rather satisfactory picture of the population's health. However, there are significant regional differences. The system of data collection allows for a more thorough assessment of inter-regional variability in health, but no analysis is conducted to identify problem areas and explain the reasons for the poorer health status or unsatisfactory trends.

Recommendation 13.3:
Existing data on health status should be analysed to gain insight into the geographical differentiation in health and its links with the environment. Geographical, region-specific analysis should be routinely used in health surveillance. The National Institute of Public Health may need additional capacity for this activity.

Recommendation 13.4:
Time trends of several health indicators deserve closer scrutiny (e.g. drop in life expectancy at age 65, high mortality due to lung cancer, injuries). It is also necessary to assess to what extent the patterns can be related to environmental factors.

Some aspects of the health status information are inconsistent and may have an impact on the interpretation of trends and spatial patterns of health, and on their links with environmental factors.

Recommendation 13.5:
Efforts should be made to reduce the share of deaths with causes classified as "ill-defined conditions". Especially in a region-specific analysis, the large proportion of such deaths may obscure the spatial and temporal patterns of mortality.

Recommendation 13.6:
The number of medical consultations caused by intestinal infectious diseases registered by the primary health care system is five times the number of digestive system infectious diseases registered by the communicable disease registry. It should be verified to what extent this difference is caused by the definition of diagnostic criterion applied by each system, or by systematic errors. If the quality of the data collected by the primary health care service is verified, this information can be considered for use in the surveillance of water-related health risks. As with the mortality data, the analysis must include a spatial component.

The presently measured levels of air pollution with suspended particulates indicate that this pollution may pose a significant health risk in Croatian cities. Other air pollutants related to increasing motor vehicle traffic are also a health concern.

Recommendation 13.7:
National air quality standards for thoracic particles (PM10) should be re-considered and the recommended values may have to be markedly reduced. PM10 and PM2.5 should be monitored to verify compliance with the standards and to assess the results of actions to reduce pollution and its health impacts.

Recommendation 13.8:
The level of population exposure to heavy metals, and in particular the blood lead level in children, should be assessed to verify if the high concentration of some metals in sedimented dust is also a health risk. The assessment should focus, in the first place, on people living in the vicinity of the larger waste sites and in areas with heavy traffic.

Existing data indicate that population exposure to radon may increase the incidence of lung cancer.

Recommendation 13.9:
A programme should be established to reduce population exposure to radon, if further measurements show that there is a genuine health risk.

Food safety is monitored by the network of Public Health Institutes as well as a number of other services. This disperses resources.

Recommendation 13.10:
The national system of food contamination control should be improved to ensure more efficient actions on the part of the responsible services and to reduce the risk of food-borne disease.

Chapter 14

ENVIRONMENTAL CONCERNS IN TRANSPORT

14.1 Geographical and socio-economic situation

Located in south-eastern Europe, where central Europe, the Balkans and the Mediterranean meet, Croatia is one of the major transit routes between western and eastern Europe. Two important waterways run through Croatia, namely the river Danube (137.5 km navigable) and the river Drava (198.6 km navigable). Croatia also has a long coastline on the Adriatic Sea with territorial waters of 31 067 km^2, and a 1 777 km-long coastline. Because of this geographical structure, all transport modes are present in Croatia: air, inland waterways, sea and coastal shipping, rail and road.

Due to Croatia's central location, its infrastructure is an essential part of the transport network for the regional economy, including Bosnia and Herzegovina and Serbia. The regional network includes the roads from Zagreb to Belgrade, the railway lines from Rijeka to Hungary, the road and rail bridges across the Sava and Una Rivers into Bosnia and the seaport at Ploce in southern Croatia. The road network, which is the most important transport mode in terms of traffic, is 27 400 km long, including 278 km of motorway.

Transport plays an important role in Croatia's developing economy, providing access to goods and people. In Croatia the transport sector's share of GDP (8.7 per cent in 1997, see Table 10.1) is comparable to other European countries (6 to 8 per cent). CO_2 emissions from the transport sector increased from about 16 per cent in 1992 to about 19 per cent in 1997 (see Figure 5.2 in Chapter 5).

14.2 Transport situation and trends

Transport volume

Traditionally, Croatia has provided one of the main transport links between western Europe and the Balkans. Since 1991, war has disrupted many of these links. Much of the main transport infrastructure was damaged or suffers from deferred maintenance. Trade embargoes have added to the disruption and overland transport has suffered considerably; transit traffic was interrupted for a number of years. Freight transport decreased after the economic recession in 1989 and dropped dramatically during the war (1991-1995). Passenger transport shows the same pattern – for example, public transport decreased by 55 per cent from 10 631 million p-km in 1990 to 5 719 million p-km in 1995. More recently there has been strong growth in transport with fundamental changes compared to the period before the war: road transport has increased, rail transport and public transport have decreased. Table 14.1 includes the most recent data on transport volume.

Table 14.1: Transport volume, 1998

	Freight transport				Passenger traffic			
	1 000 tonnes	*%*	*10^6 tonne-km*	*%*	*1'000*	*%*	*10^6 passenger-km*	*%*
Total	**55 250**	**100.0**	**168 919**	**100.0**	**481 296**	**100.0**	**5 168**	**100.0**
Road	5 689	10.3	1 151	0.7	77 595	16.1	3 964	76.7
Rail	12 643	22.9	2 001	1.2	17 102	3.6	921	17.8
Public transport	..	..	..	..	379 676	78.9	..	..
Marine navigation	35 758	64.7	165 714	97.4	6 923	1.4	283	5.5
Inland waterways	1 160	2.1	53	0.0	..	..	..	..
Pipelines	..	..	1 183	0.7	..	..	..	..

Source: State Bureau for Statistics Department of Transport and Communications.

Railway traffic volume decreased by about 70 per cent and 65 per cent respectively for freight and passenger traffic between 1990 and 1996 as a combined result of the hostilities and the shrinking proportion of the railways in the transport industry. In 1995, rail transport accounted for 21.9 per cent of total overland transport. While the number of passenger-km for all modes fell by one half from 1990 to 1995, the number of passenger-km by rail transport declined by more than two-thirds.

Maritime transport has always been very important because it provides a regular service to the Croatian islands. Freight traffic declined considerably between 1990 and 1995, the volume of freight shipped falling by 69 per cent to 5.127 million tonnes during this period. Passenger traffic suffered the least - with a 25 per cent decline between 1991 and 1996.River traffic amounts to 3 per cent of the total volume. Inland waterway transport involves a variety of freight vessels.

Road vehicle fleet

The vehicle fleet declined by about 35 per cent between 1990 and 1995. In 1994 there were 698 000 cars, and about 1 900 buses and 2 900 commercial vehicles registered in Croatia. The total number of registered motor vehicles (including trailers) was 826 000. In 1995 there were 841 000 vehicles in Croatia, which corresponds to 0.176 vehicle per capita; 85 per cent of those vehicles were passenger cars (Table 14.2). There were 68 000 heavy-duty trucks and buses, mostly with diesel engines. New car registrations in 1995 stood at 87 000, corresponding to about 10 per cent of the fleet. The average age of the vehicle fleet in 1995 was 10 years for passenger cars and 15 years for trucks. In 1995, at least 37 per cent of the vehicle fleet originated in central and east Europe.

Data on the development of mobility show the great competition from private cars in the passenger transport sector: the number of private cars per 1 000 inhabitants increased from 153 in 1991 to 208 in 1998 (Table 14.2). In Croatia it is still possible to purchase a vehicle without a catalytic converter and there is no accurate information on the number of vehicles equipped with them. It can be assumed that approximately one fifth of passenger cars registered in Croatia are equipped

Table 14.2: Registered motor and trailer vehicles, 1990-1998

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Number of vehicles *(1 000)*	1 238	1 171	1 102	743	826	841	1 009	1 142	1 264
of which:									
Passenger cars *(1 000)*	795	736	670	646	698	711	836	932	999
Vehicles per 1 000 inhabitants *(Number)*	258	244	230	155	172	176	211	239	264
Passenger cars per 1 000 inhabitants *(Number)*	165	153	139	134	145	148	174	194	208

Source: Croatian Centre for Vehicles.

Table 14.3: Fleet age, 1998

	Average age	Registered vehicles on 31/12/1998		Vehicles first registered in 1998	
	(Years)	*(Number)*	*%*	*(Number)*	*%*
Total	**11.0**	**1 265 628**	**100.0**	**117 672**	**100.0**
Mopeds	8.2	31 584	2.5	6 844	5.8
Motorcycles	10.7	18 958	1.5	2 125	1.8
Passenger cars	10.6	1 000 187	79.0	85 922	73.0
Combined vehicles	10.5	9 135	0.7	522	0.4
Buses	12.3	4 814	0.4	247	0.2
Freight vehicles	11.3	106 655	8.4	7 652	6.5
Other vehicles	16.6	1 977	0.2	114	0.1
Machinery	10.1	2 403	0.2	527	0.4
Trailers	14.6	23 930	1.9	2 845	2.4
Tractors	16.2	65 985	5.2	10 874	9.2

Source: Croatian Center for Vehicles.

with three-way lambda-controlled catalytic converters.

Transport infrastructure

With the signing of the Washington Accords in 1994, the Government of Croatia began to rebuild its transport infrastructure. Following the approval of the Dayton Accords in 1995 and the end of hostilities in the region, the Government began a full-scale reconstruction programme. The situation in the individual modes of transport in 1996 was as follows:

City transport infrastructures		
	Number	**Length of links** *(km)*
Trams (motor cars and trailers)	452	21
Buses	1 031	8 033

Maritime and coastal transport infrastructure	
	Number
Port authorities	7
Vessels (Passenger ships and ferries)	84

Inland waterway transport infrastructure	
	Length *(km)*
Danube	138
Drava	199

Air transport infrastructure	
	Number
International airports	10

Pipelines	
	Length *(km)*
Network	about 2 200

Sources: Ministry of Maritime Affairs, Transport and Communications; Statistical Yearbook.

The railway transport infrastructure is considered insufficient, and due to war damage, some areas and towns are no longer connected to the network. Staff productivity and freight wagon productivity of the Croatian Railway Company (HZ) are very low, and its financial performance worsened between 1994 and 1997, despite increasing Government operating subsidies. The HZ organization consists of strongly function-based, isolated departments, in which the hierarchical structure inhibits information flows and effective team decision-making. Responsibilities and authority are centralized with little delegation, and this, combined with a lack of clear and consistent company-wide top-down objectives, targets and priorities, has allowed individual organizational units to fix their own narrow objectives and priorities. In addition, HZ management information systems do not provide adequate support for business decision-making.

To remedy the situation, in 1994 the Government adopted a law governing the Croatian Railways so as to gradually restructure HZ into a joint-stock company. The first step, just initiated, foresees:

- Increase of the share capital of HZ
- Partial or complete privatization of HZ subsidiaries
- Staff adjustment
- Repair of war damage
- Construction of new railway infrastructure according to economic development needs

Table 14.4: Transport infrastructure, 1996-1997

km

	1996	**1997**
Road transport infrastructure		
Total length of roads	27 000	27 378
- Motorways	326	330
- E-roads	2 153	2 153
Railway transport infrastructure		
Total length of railway links	2 726	2 726
- of which, electrified (%)	*36.1*	*36.1*

Source: 1998 Statistical Yearbook.

Island transport

Sea links between the island and the mainland are not particularly efficient – Jadrolinija, Rijeka, the largest Croatian passenger shipper, accounts for almost 90 per cent of regular coastal lines with its 29 local, ferry and ship island-mainland lines. Jadrolinija has 47 vessels, but the fleet is old and slow.

Island roads cannot be considered satisfactory. They were mostly built along old routes and are inadequate for motor traffic. The National Road Authority's records show that there are about 27 000 km of categorized and almost as many non-categorized and unregistered roads.

There are international airports on the islands of Krk, Lošinj and Brac. Krk airport was built for the needs of the city of Rijeka and is rather oversized in comparison to the island itself. The Lošinj and Brac airports accommodate smaller piston-engined planes, and although they have not been completely finished yet, they can meet the needs of the islands. Moreover, an airfield has been built for small aircraft on the island of Unije.

No hydroplane transport is available and emergency helicopters use improvised heliports.

Fuel distribution and use

Total petrol consumption declined between 1990 and 1993. From 1993 to 1997 energy consumption increased for transport (total +33 per cent) due to the growth in road transport (+39 per cent) and air transport (+27 per cent), whilst the consumption of energy by rail, sea and river transport decreased. The share of public transport in cities has been in continuous decline during this period. Figure 14.1, showing the energy demand by means of transport (PJ) from 1993 to 1997, clearly illustrates the current trend towards increasing road transport volume.

The three RON grades of petrol are: unleaded 91 and 95 RON and leaded 98 RON. For unleaded grades, 95 RON has the biggest market share (78.7 per cent against 21.3 per cent for 91 RON). The market share of unleaded petrol increased from 2.5 per cent in 1990 to 30 per cent in 1996, while the consumption of leaded petrol has remained almost constant in recent years.

In 1997, there were 192 tank distribution lorries, 398 petrol stations and 8 LPG filling stations. Since 1992, all petrol stations have offered unleaded petrol with different pump nozzles for leaded and unleaded petrol. Only 4 stations have a vapour recovery installation for tank filling (VOC Stage I) and 1 station for car filling (VOC Stage II).

The basic energy forms in transport -- petrol, gas, diesel oils, and electricity -- increased, while the consumption of other forms of energy decreased. The highest increase was in the consumption of petrol (37 per cent), followed by gas/diesel oils (34 per cent) and jet fuel (29 per cent). Electricity grew only 7 per cent. LPG consumption in the transport sector is negligible (about 1 per cent). Figure 14.2 shows the trend of the energy demand in transport by fuel.

INA, the State-owned oil corporation, processes crude oil in two refineries (Rijeka and Sisak). Petrol production is based on catalytic reforming, isomerization and fluid catalytic (FCC) units. The equipment is on average 25 years old and the last improvements date back to 1976, see also Chapter 10.

Transport is a large contributor to acidification. In 1997 it accounted for over 64 per cent (47 500 tonnes) of nitrogen oxides (NO_x) emissions, 46 per cent (35 000 tonnes) of the total NMVOC emissions and about 10 per cent (8 100 tonnes) of sulphur dioxide (SO_2). In the same year the transport sector was responsible for 24 per cent

Table 14.5: Vehicles' lead emissions, 1990-1997

	1990	1995	1997
Total lead emissions *(tonnes)*	454	250	181
Share of total emissions *(%)*	97	95	95
Emissions / km^2 *(kg)*	8	4.5	3.4
Emissions per 1 000 inhabitants *(kg)*	94.7	53.9	39.6

Source: SDEP, 1999.

(4.78 million tonnes) of carbon dioxide (CO_2) total emissions and 47 per cent (172 thousand tonnes) of carbon monoxide (CO) emissions.

Emissions from road transport contribute to heavy metal pollution: in 1997, 181 000 tonnes of lead, corresponding to 95 per cent of total lead emissions, were emitted from transport.

The Croatian urban monitoring network does not systematically cover all pollutants deriving from transport activities, in particular benzene, particulate matter and polyaromatic hydrocarbons (PAH), which are the most harmful transport-related pollutants. However, considering the age and the high emissions of the transport fleet, it can be assumed that hydrocarbon emissions, in particular benzene, from petrol engines, and emissions of particulate matter from diesel engines are relatively high.

14.3 Management of environmental aspects of transport

Responsible institutions

The Ministry of Maritime Affairs, Transport and Communications is responsible for transport management. Physical planning is under the responsibility of the Ministry of Physical Planning, Building and Housing. For many years, environmental protection was handled by the Ministry of Civil Engineering and Environmental Protection. That Ministry represented very complex, often conflicting interests (including also physical planning and housing) and environmental protection priorities were not always respected.

When the State Directorate for Environmental Protection was established, all duties previously handled by the Ministry of Civil Engineering and Environmental Protection were transferred to the State Directorate. At present, the main responsibility of the SDEP is to coordinate environmental activities. However, the State Directorate's political weight and funding are lower than those of the Ministries (see Chapter 1).

In the transport and environment sector, environmental competencies are split up: environmental concerns were taken into account in drafting the Croatian National Plan for Transport, recently presented to Parliament, as well as in determining physical planning strategies. However, the SDEP had no direct part in the decision-making process.

Environmental impact assessment

Transport and land-use planning as well as economic policy programmes determine the framework for land-use patterns and economic development and thus have a decisive influence on the transport systems and their environmental impact. Transport development programmes provide a framework for transport policy and technical measures, traffic planning and the choice of transport modes as well as for transport infrastructures, with a considerable effect on human health and the environment. Strategic environmental assessment (SEA) procedures for transport planning should cover all transport modes and evaluate the environmental effects of the transport system as a whole, e.g. the shift to other transport routes, changes of means of transport, generated traffic, as well as air quality criteria for the protection of human health and vegetation and user quality. Such strategic evaluations are not currently carried out in Croatia.

Where the location or route have not been determined or specified in the physical planning documents, the environmental impact assessment is drawn up in two parts: as a preliminary study exploring possible locations/routes, and a final study defining environmental measures for the chosen location/route.

Main international agreements

Croatia has adopted and implemented (or plans to implement) the main UNECE agreements and conventions which are directly or indirectly related to transport and the environment, in particular:

- The Programme of Joint Action from the Vienna Conference on Transport and Environment (1997)
- The Central European Initiative (CEI) Declaration (1997)
- The Convention on Environmental Impact Assessment in a Transboundary Context
- The first five specific protocols to the 1979 Convention on Long-range Transboundary Air Pollution (1984 - 1994) and the recent Protocol on Heavy Metals (1998)
- The Aarhus Convention (1998)

Croatia participated in the preparative work for the Third Ministerial Conference on Environment and Health (London, June 1999), which devoted a session to transport.

Regulatory and technical measures

Regulatory and technological measures concerning transport consist of vehicle emission standards, vehicle inspection and maintenance programmes, fuel quality and fuel efficiency standards.

Vehicle emissions standards (exhaust gases and noise). Vehicles registered for the first time in Croatia are subject to a list of ECE rules and EEC guidelines that address noise pollution and exhaust gas emissions for different vehicle categories. Administrative inspection of homologation compliance precedes export clearance and first registration.

Provisions for periodic vehicle inspections (exhaust emissions, safety). Two kinds of technical inspections are carried out: regular and periodic. All motor vehicles and trailers are subject to regular annual technical inspections, except new vehicles, which undergo their mandatory first regular technical inspection in the second year only. Light trailers (trailer vehicles with a maximum permitted weight up to 750 kg) are subject to regular three-yearly technical inspections. All technical inspections primarily concern safety requirements. At present there is no testing of exhaust gases, of the kind undertaken at the European level.

Vehicles with a maximum permitted weight above 750 kg, buses, vehicles carrying hazardous substances, rented vehicles, taxis etc. are subject to periodical technical inspections. The deadlines depend on the age of the vehicles (see Table 14.6).

Table 14.6: Inspection obligations for vehicles

Vehicle age	Inspection periodicity
Up to 2 years	every 12 months
From 2 to 7 years	every 6 months
Older than 7 years	every 3 months
Vehicles carrying hazardous substances, regardless of age	every 2 months

Source: Ministry of Maritime Affairs, Traffic and Communications.

Table 14.7:- Fuel quality standard

	Pb *(g/l)*	Benzene *(% v/v)*	Sulphur *(% p/p)*
Standards for super leaded 98° RON petrol			
For imported petrol	0.15	5	0.05
For petrol produced in Croatia till July 2002	0.50	5	0.10
" " " after July 2002	0.15	5	0.05
Standards for super unleaded 95° RON petrol			
For imported petrol	0.01	5	0.05
For petrol produced in Croatia till 1/7/2002	0.01	5	0.10
" " " after 1/7/2002	0.01	5	0.05
Standards for diesel fuel			
For imported diesel fuel			0.20
For diesel fuel produced in Croatia till 31/12/1999			0.50
" " " from 1/1/2000 till 1/7/2002			0.30
" " " after 1/7/2002			0.20

Source: Ministry of Maritime Affairs, Traffic and Communications.

Fuel measures. The composition of motor vehicle fuel has important implications for vehicle emissions. Fuels with high sulphur levels inhibit advances in emission reduction technology and fuel-efficient engine operation. Lead content in petrol is a major source of lead pollution and is incompatible with catalytic converters. High benzene and aromatic levels in petrol cause high benzene concentration in the exhaust emissions. Croatia has fuel quality standards, in particular regarding sulphur, lead and benzene content. They are shown in Table 14.7.

Transport prices and economic instruments

Incentives are planned for transport operators purchasing vehicles complying with current EU emission standards (Euro I and Euro II). To increase the consumption of unleaded petrol, a tax differentiation scheme has been in force throughout the 1990s. The retail price difference was 10 per cent in 1991 in favour of unleaded petrol, 5 per cent at the end of 1994, and 7.5 per cent on 31 December 1997.

Projects and investment programmes

The Government has initiated a programme to repair and reconstruct its transport infrastructure. Besides the reconstruction of war-damaged road, bridges and railroads, a general upgrading of the transport infrastructure is foreseen to face demand by increasing trans-European traffic.

In Europe there are several plans and actions for the (re)construction of the infrastructure network in countries in transition. Plans have been drawn up by UNECE, ECMT, EC, CEI, CEC (Central European Conference). The widest approach to the network of central and eastern Europe can be seen by the "Crete Transport Corridors" adopted at the Crete meetings and revised in Helsinki in 1997 at the third Pan–European Traffic Conference. Pursuant to decisions taken in Helsinki, Croatia is linked to the European region by two traffic corridors.

- Corridor 5 : Budapest – Zagreb – Rijeka – Trieste and connection to Bosnia and Herzegovina
- Corridor 10: Italy/Austria – Slovenia - Yugoslavia - former Yugoslav Republic of Macedonia – Bulgaria - Greece – Turkey

In 1995 the World Bank provided Croatia with a loan for the Highway Sector Project to finance the building of the main road network. In 1996 the Bank approved a US$ 102 million loan to Croatia to help finance an "Emergency Transport and Mine Clearing Project". This project, which emphasized investments of mutual advantage to Croatia and Bosnia and Herzegovina, has an important transport component (US$ 76 million). The primary objective of the transport component is to finance the repair and the rebuilding of essential regional transport infrastructure. In particular the project will rebuild a major surface transport link between eastern Croatia and north-eastern Bosnia and Herzegovina, upgrade the primary seaport (Ploce Port) serving Bosnia and Herzegovina and repair and rebuild the road and rail networks needed to improve the efficiency of transport throughout Croatia.

In addition, the Bank is considering a loan of US$ 100 million to Croatia to modernize and restructure the Croatian Railway Company (HZ), to diminish the HZ deficit and thus also the HZ financial burden on the budget, while creating a company adapted to a competitive transport market.

However, none of this financing for transport development projects requires specific environmental performances. It could be argued that the concentration on financing road transport projects is the result of the emphasis on short-term economic returns, at the expense of longer-term environmental or social costs.

The Parliament is currently considering a programme that would overhaul Croatia's road infrastructure. In this programme motorway expansion is considered a priority, with plans for the construction of 1 300 km of new motorways. This will require investments of about US$ 15 billion over the next 15 years.

With a GDP of only 19.7 billion dollars in 1997, Croatia cannot afford to finance such ambitious plans alone. The Government had hoped to finance road construction by attracting foreign investors with concessions. However, this met with little interest, and the remaining financing method is through foreign loans. The repayment of foreign debt, which is already high (5 billion dollars in 1997), could become a long-term drain on the economy.

The Government has not used the opportunities afforded by the awarding of construction contracts to open the industry to market forces, but rather has retained control over it. The State-owned road

maintenance and construction agency, Hrvatske ceste, is building most roads, with much of the work being done by the army engineering corps.

The Government has identified the following priorities for air traffic infrastructure investments:

- investments in the reconstruction of Dubrovnik and Zadar airports
- construction of the new passenger terminal at Zagreb airport
- preparation and construction of small airports on several islands (Korcula, Hvar, Vis, Lastovo, Lošinj)

International financing of air traffic projects can be summarized as follows:

- commodity loan of the French Bank Société Générale for the equipment of Zadar airport
- Austrian Creditanstalt-Bankverein loan for the reconstruction of Dubrovnik airport

Concerning inland shipping, the Croatian Government programme includes the construction of the multi-purpose canal Danube-Sava from Vukovar to Samac. The construction of the 61-kilometre canal will reduce the navigational distance from central European Danube States to Croatia and will have other important functions such as the drainage and irrigation of large areas. The estimated cost of the project is about US$ 600 million.

Regarding fuel supply projects, INA is planning to develop and renew the Rijeka and Sisak refineries. In particular, it plans to build new Klaus and HDS plants to reduce the sulphur content in the fuels and alkylation and MTBE units to increase the octane ratings of the petrol. The investment required will be about US$ 50 million from 1999 to 2007 (see also Chapter 10).

According to the Protocol on Heavy Metals and the strategy on the phase-out of lead in fuel, adopted at the Aarhus Conference in June 1998, Croatia is planning to phase out leaded petrol by the year 2005. Lead is added to petrol to boost octane ratings (antiknock properties) and to lubricate the valves of the engine. Most old cars require high octane fuels and lubrication for operation, so in a country with many old vehicles, other 98 RON petrol must be put on the market, if leaded petrol is eliminated.

In the absence of lead additives, other approaches can be taken to obtain the desired octane: the most environmentally friendly solution is to increase the alkylated fraction of hydrocarbons in the petrol, but this is also the most expensive. Another solution is to increase the benzene and aromatic fraction. This solution can become a real hazard to human health because it increases the percentage of benzene, a genotoxic carcinogen substance, in the exhaust and evaporative emission. Finally, it is possible to increase the amount of oxygenated compounds or additives other than tetraethyl lead but all of them, like lead, can present risks for human health.

The major obstacle to the phasing out of leaded petrol is the lack of funds necessary for the reconstruction of the refineries. International investment support from international financial institutions is therefore deemed crucial.

Refuelling emissions from petrol distribution and from the loading and unloading of volatile cargoes from tanker ships are important sources of anthropogenic VOC emissions. Currently there are no provisions for encouraging vapour recovery installations at petrol stations for tank filling (Stage I) and for car filling (Stage II) or vapour recovery systems from ships both on board and at the terminal.

14.4 Conclusions and recommendations

The war and the economic crisis considerably affected overland transport. Most of the main transport infrastructure was damaged and from 1990 to 1995 Croatia experienced a decline in both freight and passenger transport. Public and railway transport fell dramatically. These negative effects on transport led to a corresponding decline in fuel consumption and falling emissions of pollutants.

Since 1995, the number of private vehicles (primarily cars) on the road has grown fast. The movement of goods and people has increased, especially by road, which is the most energy-intensive and polluting form of transport. The motor vehicle is becoming the most popular form of personal transport and a large proportion of freight is now distributed by road. Public transport has been declining continuously, while rail transport and sea and river transport have grown slowly.

Croatia has put in place important laws to protect the environment from the negative effects of

transport activities and further measures are planned. However, more should be done to improve existing and planned measures to limit the impact of transport on the state of the environment. Environmental competencies concerning the transport and environment sectors are split up: environmental concerns were taken into account in drafting the Croatian National Plan for Transport, recently presented to Parliament, as well as in determining physical planning strategies. However, the SDEP did not directly participate in the decision-making process.

Recommendation 14.1:
As a matter of priority, environmental factors should be considered in managerial decisions at State level on physical planning and related new transport policies. The State Directorate for the Protection of Nature and the Environment should have a role in the related decision-making process and the public should be involved earlier. See also Recommendation 1.1.

On the whole, the pressure of transport on the environment is still sustainable, but the current legislative framework is not able to protect the environment sufficiently against the consequences of the rapid increase in road transport. Furthermore, the present national plan on transport, which has allocated large resources to developing road transit, and the absence of a general transport strategy based on a strategic environmental assessment (SEA), mean that the current pattern of transport will not change.

Recommendation 14.2:
Strategic environmental assessment should be established to provide a sound basis for a long-term transport strategy. It should cover all transport modes and include effects like shifts in traffic, changes in the choice of the means of transport and possible traffic-inducing conditions.

At present, environmental assessment procedures begin when the crucial decisions have already been taken at regional planning level. So far, none of the loans from international financing institutions for projects on transport development has required any specific environmental performance assessment of the options included in the Croatian National Plan for Transport.

As a result of the SEA, alternative political and planning options should be compared, with an analysis of the effects, including their impact on human health and the environment, and the assessment of the possible achievements of standards and criteria for health and vegetation protection (air quality, noise, risk of cancer, land use and user quality).

Recommendation 14.3:
The environmental impact assessment of transport infrastructures should be improved.

Croatia's geographic position allows for the development of a transport system of international relevance. Furthermore, its natural configuration has all the necessary elements for structuring the system in a sustainable way, particularly addressing the transport development towards modal shifts from road to rail and inland or coastal navigation.

Railway transport infrastructure is insufficient. Due to war damage, some areas and towns are no longer connected to the railway network and the percentage of electrified railway is very low. Tourism, which is developing rapidly, is almost exclusively based on private car use.

A shift from road traffic, both passenger and freight, to more environmentally efficient modes of transport, such as rail, maritime, inland waterway and combined transport should be encouraged through tactical, structural, financial and restrictive elements. This will require a strong involvement of the environment authorities in the decision-making process related to transport and land-use planning and infrastructure, and require users to pay the full cost of transport including external costs.

Recommendation 14.4:
A long-term plan in the transport sector, based on the results of a strategic environmental assessment, should be drawn up. In particular, a strategic plan for the future development of the national transport system should favour electrification of railways and improvement of both public and waterway transport.

Two primary means should be pursued to contain environmental pressures resulting from increased demand. The first is to encourage a shift from road traffic to more environmentally efficient modes of transport as aforesaid. The second is to promote less polluting fuels and vehicles. Such regulatory measures for transport should be mandatory and should cover vehicle emission standards, vehicle inspection and maintenance programmes, fuel quality and fuel efficiency.
No adequate resources have been allocated to develop important activities such as public

transport, new refinery processes for producing cleaner fuels, or monitoring of the more harmful traffic-related pollutants in urban areas - measurements needed also for the integration with a mechanism allowing local authorities to limit traffic when pollution levels are high. In urban areas, the monitoring network does not cover all pollutants deriving from transport activities, in particular benzene, polycyclic aromatic hydrocarbons (PAH) and particulate matter, which are the most harmful to human heath. No measures to limit traffic and reduce traffic pollution are established should air quality standards be exceeded.

Recommendation 14.5:

Environmental pressure from the transport sector should be controlled in particular in urban areas. In this regard, resources should be made available, and available instruments be used, for the following priority tasks:

- *promoting the use of less polluting vehicles and fuels, in particular the use of gaseous fuels in the transport sector both through incentives and by setting up a distribution network over the whole territory*
- *setting up inspection and maintenance programmes to enforce emission control standards*
- *monitoring benzene and particulate matter in urban areas.*
- *phasing out leaded petrol.*

See also recommendation 5.3.

ANNEXES

Annex I: Selected economic and environmental data

Annex II: Selected bilateral and multilateral agreements

Annex I

SELECTED ECONOMIC AND ENVIRONMENTAL DATA

Selected economic data	
	Croatia
TOTAL AREA (1 000 km^2)	87.6
POPULATION	
Total population, 1997 *(100 000 inh.)*	45.7
- % change (1991-1997)	*- 6.1*
Population density, 1997 *(inh./km^2)*	51.3
GROSS DOMESTIC PRODUCT	
GDP, 1997 *(US$ billion)*	19.9
- % change (1992-1997)	108.2
per capita, 1997 *(US$ per capita)*	4 362.3
INDUSTRY	
Value added in industry, 1998 *(% of GDP)*	25.9
Industrial output	
- % change (1992-1998)	- 35.9
AGRICULTURE	
Value added in agriculture, 1997 *(% of GDP)*	9.3
Agricultural output	
- % change (1992-1997)	- 15.9
ENERGY SUPPLY	
Total supply, 1997 *(Mtoe)*	8.3
- % change (1992-1997)	...
Energy intensity 1997 *(toe/ 1990 US$ 1 000)*	...
- % improvement (1992-1997)	...
Structure of energy supply, 1997 *(%)*	
- Coal	2.8
- Oil and oil products	49.2
- Gas	29.1
- Others	19.0
ROAD TRANSPORT	
Road traffic volumes, 1998	...
- mil. veh.-km	13 200.0
- % change (1990-1998)	...
- per capita *(1 000 veh.-km/inh.)*	...
Road vehicle stock, 1998	
- 10 000 vehicles	124.1
- % change (1990-1998)	2.1
- private cars per capita *(veh./1 000 inh.)* 1998	218.7

Sources: Croatia and UNECE.

Selected environmental data	
	Croatia
LAND	
Total area *(1 000 km²)*	56.5
Protected areas *(% of total area)*	9.3
Nitrogenous fertilizer use, 1996 *(tonne/km² arable land)*	15.0
FOREST	
Forest area *(% of land area)*	36.7
Use of forest resources *(harvest/growth)*	84.0
Tropical wood imports *(US$/inh.)*	..
THREATENED SPECIES	
Mammals *(% of known species)*	14.9
Birds *(% of known species)*	41.0
Freshwater Fish *(% of known species)*	35.9
WATER	
Water withdrawal *(% of gross annual availability)*	..
Fish catches *(t)*	16 752.0
Public waste water treatment *(% of population served) 1996*	..
AIR	
Emissions of sulphur oxides, 1996 *(kg/inh.)*	14.7
Emissions of sulphur oxides, 1996 *(kg/US$ 1 000 GDP)*	3.4
Emissions of nitrogen oxides, 1996 *(kg/inh.)*	15.3
Emissions of nitrogen oxides, 1996 *(kg/US$ 1 000 GDP)*	3.5
Emissions of carbon dioxide, 1996 *(tonne/inh.)*	4.1
Emissions of carbon dioxide, 1996 *(tonne/US$ 1 000 GDP)*	0.9
WASTE GENERATED	
Industrial waste* *(mil.t/US$ 1 000 GDP)*	1.4
Municipal waste *(kg/inh./day)*	0,6-0,8
Nuclear waste *(tonne)*	1.0
NOISE	..
Population exposed to leq > 65 dB (A) *(million inh.)*	..

* Excluding mining activity.

Annex II

SELECTED MULTILATERAL AGREEMENTS

	Worldwide agreements		Croatia
	as of 1 July 1999		
1949	(GENEVA) Convention on Road Traffic	y	
1957	(BRUSSELS) International Convention on Limitation of Liability of Owners of Sea-going Ships	y	
1958	(GENEVA) Convention on Fishing and Conservation of Living Resources of the High Seas	y	R
1963	(VIENNA) Convention on Civil Liability for Nuclear Damage	y	R
1969	(BRUSSELS) Convention on Civil Liability for Oil Pollution Damage	y	R
	1976 (LONDON) Protocol	y	R
1969	(BRUSSELS) Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualities	y	R
1971	(RAMSAR) Convention on Wetlands of International Importance especially as Waterfowl Habitat	y	R
	1982 (PARIS) Amendment	y	
	1987 (REGINA) Amendments	y	
1971	(GENEVA) Convention on Protection against Hazards from Benzene (ILO 136)	y	R
1971	(BRUSSELS) Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	y	R
1972	(PARIS) Convention on the Protection of the World Cultural and Natural Heritage	y	R
1972	(LONDON) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	y	R
1973	(WASHINGTON) Convention on International Trade Endangered Species of Wild Fauna and Flora	y	R
	1983 (GABORONE) Amendment		
1973	(LONDON) Convention for the Prevention of Pollution from Ships (MARPOL)	y	R
	1978 (LONDON) Protocol (segregated balast)	y	R
	1978 (LONDON) Annex III on Hazardous Substances carried in packaged form	y	R
	1978 (LONDON) Annex IV on Sewage		R
	1978 (LONDON) Annex V on Garbage	y	R
1974	(GENEVA) Convention on Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents (ILO 139)	y	R
1977	(GENEVA) Convention on Protection of Workers against Occupational Hazards from Air Pollution, Noise and Vibration (ILO 148)	y	R
1979	(BONN) Convention on the Conservation Migratory Species of Wild Animals	y	
	1991(LONDON) Agreement Conservation of Bats in Europe	y	
	1992 (NEW YORK) Agreement ASCOBANS	y	
1982	(MONTEGO BAY) Convention on the Law of the Sea	y	R
1985	(VIENNA) Convention for the Protection of the Ozone Layer	y	R
	1987 (MONTREAL) Protocol on Substances that Deplete the Ozone Layer	y	R
	1990 (LONDON) Amendment to Protocol	y	R
	1992 (COPENHAGEN) Amendment to Protocol	y	R
	1997 (MONTREAL) Amendment to Protocol		S
1986	(VIENNA) Convention on Early Notification of a Nuclear Accidents	y	R
1986	(VIENNA) Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	y	R
1989	(BASEL) Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	y	R
1990	(LONDON) Convention on Oil Pollution Preparedness, Response and Cooperation	y	R
1992	(RIO) Convention on Biological Diversity	y	R
1992	(NEW YORK) Framework Convention on Climate Change	y	R
1997	(KYOTO) Protocol		S
1994	(VIENNA) Convention on Nuclear Safety		R
1994	(PARIS) Convention to Combat Desertification		S

Source: UNECE and Croatia.

y = in force; S = signed; R = ratified

	Regional and subregional agreements		Croatia
	as of 1 July 1999		
1950	(PARIS) International Convention for the Protection of Birds	**y**	**R**
1957	(GENEVA) European Agreement - International Carriage of Dangerous Goods by Road (ADR)	**y**	**R**
1958	(GENEVA) Agreement - Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle.Equipment and Parts.	**y**	**R**
1968	(PARIS) European Convention - Protection of Animals during International Transport	**y**	
	1979 (STRASBOURG) Additional Protocol	**y**	
1969	(LONDON) European Convention - Protection of the Archeological Heritage	**y**	**R**
1976	(BARCELONA) Convention - Protocol - Mediterranean Sea against Pollution	**y**	**R**
	1976 (BARCELONA) Protocol - Dumping	**y**	**R**
	1976 (BARCELONA) Protocol - Co-operation in Case of Emergency	**y**	**R**
	1980 (ATHENS) Protocol - Land-based Sources Pollution	**y**	**R**
	1982 (GENEVA) Protocol - Special Protected Areas	**y**	**R**
	1994 (MADRID) Protocol against pollution from exploration/exploitation		
1979	(BERN) Convention - Conservation European Wildlife & Natural Habitats	**y**	
1979	(GENEVA) Convention - Long-range Transboundary Air Pollution	**y**	**R**
	1984 (GENEVA) Protocol - Financing of Co-operative Programme (EMEP)	**y**	**R**
	1985 (HELSINKI) Protocol - Reduction of Sulphur Emissions by 30%	**y**	
	1988 (SOFIA) Protocol - Control of Emissions of Nitrogen Oxides	**y**	**S**
	1991 (GENEVA) Protocol - Volatile Organic Compounds	**y**	**S**
	1994 (OSLO) Protocol - Further Reduction of Sulphur Emissions	**y**	**R**
	1998(AARHUS) Protocol on Heavy Metals		**S**
	1998(AARHUS) Protocol on Persistent Organic Pollutants		**S**
1991	(ESPOO) Convention - Environmental Impact Assessment in a Transboundary Context	**y**	**R**
1991	(SALZBURG) Convention on the Protection of the Alps	**y**	
	1994 Protocol on physical planning and sustainable development`		
	1994 Protocol on Hillside Farming		
	1994 Protocol on Nature Protection and Landscape Management		
	1995 Protocol on Tourism		
	1995 Protocol on Mountain Forests		
	1998 Protocol on Energy		
	1998 Protocol on Soil Protection		
1992	(HELSINKI) Convention - Protection and Use of Transboundary Waters and International Lakes	**y**	**R**
1992	(HELSINKI) Convention - Transboundary Effects of Industrial Accidents		**R**
1992	(BUCHAREST) Convention - Protection Black Sea Against Pollution	**y**	
1993	(LUGANO) Convention - Civil Liability for Damage from Activities Dangerous For the Environment		
1994	(LISBON) Energy Charter Treaty		**R**
	1994 (LISBON) Protocol on Energy Efficiency and Related Aspects		**R**
1994	(SOFIA) Convention on Cooperation for the Protection and Sustainable Use of the Danuble River		**R**
1998	(AARHUS) Convention On Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters		**S**

Source: UNECE and Croatia.

y = in force; S = signed; R = ratified

Note:

The status of ratification of the above-mentioned environmental conventions by the 55 UNECE member States was updated for the Conference "Environment for Europe" in Sofia (October 1995) and published in document SOF.CONF/BD.3.

Sources

Personal authors

1. *Baskin, M*. "The reconstruction and reintegration of Eastern Slavonia, Baranja and Western Sirmium". *Est-Ouest.* No 6, 1996.
2. *Cvitan, I, Cicek, J., Makoter, M*. "MAR-KO-ING" Zagreb. "Transformer units destroyed by combat activities and the problem of waste management". Waste Management - Zagreb '96, IVth International Sumposium Zagreb, November 20-22 1996.
3. *Draganovic Eugen.* "Marine Life in the Adriatic Sea". 1998.
4. *Franicevic, V. and Kraft, E*. "Croatia's Economy after Stabilisation" *Europe-Asia Studies.* Vol. 49, No 4, 1997, pp. 669-691.
5. ***Gjigas, O., Juras, A., Kosterink, P***. "Report on a Visit to the Republic of Croatia: A Report on the Fact Finding Mission in October 1994". REC Publications. Country Reports. 1998.
6. *Grzancic, Z.* "Legal and Institutional Framework and Practices for Public Participation". *Doors to Democracy.* ISBN: 963 8454 56 3. The Regional Environmental Center for Central and Eastern Europe. 1998, pp. 131-154.
7. *Lenardie, M*. "Reconstruction and rehabilitation of the war-torn areas in Croatia". *Est-Ouest.* No 6, 1996
8. *Plavsic, F*., Croatian National Institute of Toxicology. "Environmental contamination caused by war". 1999
9. *Richardson, M*. "Report Visit to Croatia, 10-24 April 1996". 1996.

Regional and international organizations

10. Council of Europe/Centre Naturopa. *Naturopa newsletter 1995, special issue on Croatia.* (ISSN 0252-0419).
11. Energy Charter Secretariat. "Survey of Exceptions to National Treatment, Country Report: Croatia". CS (96) 198, SENT 34 Rev. Brussels, November 1996.
12. Environmental Programme for the Danube River Basin. "Strategic Action Plan for the Danube River 1995-2005".
13. European Bank for Reconstruction and Development. *Croatia: Key reform challenges*. "Transition report 1998: economic transition in central and eastern Europe, the Baltic states and the CIS". (ISBN: 1 898802 10 6). EBRD, 1998.
14. European Union. "MEMO 96/57 of June 6, 1996 – Spokeman's Service of the European Commision."
15. Foundation for Environmental Education in Europe (FEEE). "The Blue Flag Awards of 1998". The European Coordination, The Danish Outdoor Council. 1998.
16. Implementation of the Environmental Action Programme for CEE, Sofia Initiative Economic Instruments. "Country Survey: Croatia", Source-book on Economic Instruments in CEE Countries (1997-1998), Zagreb, October 1998.
17. Regional Environmental Centre for Central and Eastern Europe. *The Emerging Environmental Market. A Survey in Bulgaria, Croatia, Romania and Slovenia.* (ISBN: 963 8454 48 2), Szentendre, Hungary, September 1997.
18. ———. "Status of National environmental Action Programs – Country Reports: Croatia". 1998.
19. ———. "Summary Report to the Aarhus Ministerial Conference". Sofia Initiative on Environmental Impact Assessment. 1998.
20. ———. *Strategic Environmental Assessment in Transitional Countries.* (ISBN: 963 8454 60 1). Szentendre, 1998
21. ———. "Policy Recommendations on the Use of SEA in the CEE/NIS Region". Sofia Initiative on Environmental Impact Assessment. 1998.
22. UNEP/Mediterranean Action Plan. "Guidelines for carrying capacity assessment for tourism in mediterranean coastal areas". Priority Actions Programme, Regional Activity Centre, Split, February 1997.
23. ———. "Training course on carrying capacity assessment for development of tourism in mediterranean coastal areas, Tartous, February 7-11, 1998, Report. (PAP 9/CCA/TC.1). Priority Actions Programme, Regional Activity Centre, Split, February 1998.
24. UNIPEDE, Economic and Tariffs Study Committee (May 1996). "Prices of Electricity as at January 1996", 1996.
25. United Nations Economic Commission for Europe. "Fourth Ministerial Conference: Environment for Europe. Declaration by the Ministers of Environment of the region of the United Nations Economic Commission for Europe (UN/ECE)". (ECE/CEP/56), June 1998.
26. ———. **"**Oslo Ministerial Declaration: First Meeting of the Parties under the UN/ECE Convention on Environmental Assessment in a Transboundary Context". Oslo, 1998.
27. United Nations Economic Commission for Europe/United Nations Environment Programme. "The Legal and Regulatory Framework for Environmental Management in Croatia". Workshop on Legal and Regulatory Framework for Environmental Management. (WS.1/CRP.11), June 1993.
28. ———. "Environmental Policy Planning and Management Techniques in Republic of Croatia". Workshop on Environmental Policy Planning and Management Techniques. (WS.3/CRP.7). November 1993.
29. ———.. "Short Review of Financing Environmental Protection in the Republic of Croatia". Workshop on the Application of Economic Instruments for Environmental Management. (WS.4/CR.13). December 1993.
30. United Nations Industrial Development Organization (UNIDO). "Effective Environmental Management for the Pharmaceutical Chemical Industry". Technical Report Series. (CLT97/2010). March 1998.
31. ———. "Provision of a techno-economic study on different options of hospital waste management in the Szent Imre hospital, Budapest, Hungary". Final Report, Technical Report No 8. (Project No TF/HUN/94/F90, Contract No 98/039P). October 1998.
32. ———. "International Meeting on Effects of War on the Environment,". US/CRO/92/164, Croatia. Technical Report: first mission to Croatia". (IO/R.263). 1993.

33. WHO Liaison Office in the Republic of Croatia. "Work on the document: National Environment and Health Action Plan (NEHAP)". Zagreb, June 1998.
34. World Bank Group. "Country Profiles - Summary of Private and Financial Sector Development: Croatia. 1998.
35. ———. "Press Release: World Bank helps Croatia reconstruct transportation routes and clear mines". New Release No 97/1176 ECA. 1996.

Republic of Croatia national institutions

36. "Catalogue of questions for the second training course in the Regional Training Centre for Implementation of the Basel Convention in Bratislava, 2024 October 1997. Zagreb, September 1997.
37. "Croatian Economy". *Croatia Your Partner*. 1998.
38. "Energy Policy of Croatia." Conference on Energy Co-operation between Croatia, Slovenia and Austrian Federal States of Carinthia and Styria.
39. APO-Hazardous Waste Management Agency, Zagreb, Savska c. 41/IV. "Catalogue of questions and answers for the third training course in the Regional Training Centre on Inventory and the Information Management Systems on Wastes". Zagreb, November 1997
40. Central Bureau of Statistics. "1998 Statistical Yearbook". (ISSN: 1330-0369). Zagreb, 1998
41. Croatian Almanac. "Republic of Croatia". 1998.
42. Croatian Chamber of Economy. "How to do business in Croatia". Zagreb, 1998
43. Croatian Investment Promotion Agency (CIPA). "Tourism in Croatia – Investment Opportunities". 1998.
44. ———. "Agribusiness in Croatia - Investment Opportunities". April 1998.
45. ———. "CIPA". Zagreb, 1997.
46. ———. *Croatia – Economic Outlook 1998.* Zagreb, 1998
47. ———. *Customs in Croatia..* Zagreb, 1998.
48. ———. *Legal Framework for Doing Business in Croatia.* Zagreb, 1998.
49. ———. *Taxation in Croatia.* Zagreb, 1998.
50. ———. *Free Zones in Croatia..* Zagreb, 1998
51. Croatian National Institute of Public Health. "Environmental Performance Review, Chapter 13: Environment and Health".1999
52. ———. "EPR Environment and Health". 1997
53. Hazardous Waste Management Agency. "Cleaner Production in Croatia, past, present and planned activities". 1998.
54. Hrvatske Sume. "Business report 1996 - Summary".1997
55. Hrvatske Vode, Water Use and Management Sector. "Account of Water Prices in the Republic of Croatia". 1997.
56. Ministry of Agriculture and Forestry of the Republic of Croatia/Food and Agriculture Organization of the United Nations (FAO). *Agriculture in Croatia. A strategy for development.* (TCP/CRO/2351, ISBN 953-96620-01).
57. Ministry of Agriculture and Forestry of the Republic of Croatia/The World Food Summit. *Croatian Agriculture at the Crossroads.* (ISBN 953-96620-1-X). Zagreb, October 1996.
58. Ministry of Agriculture and Forestry. "Chapter 11: Environmental concerns in agriculture and forestry: Environmental objectives of agricultural policy". 1998.
59. ———. "Forestry policy aims, including soil protection". 1998.
60. ———. "Marine Resources Management and Pollution". 1998.
61. Ministry of Building and Environmental Protection, Department for Nature Protection. *Red list of plant taxons, animal taxons – mammals of the Republic of Croatia.* (ISBN 953-96068-2-9). Zagreb, 1994.
62. Ministry of Civil Engineering and Environmental Protection. "National Report on the Implementation of the Barcelona Convention for the period from the middle of 1991 to the middle of 1993". Zagreb, September 1993.
63. Ministry of Development and Reconstruction. "Project Proposals: Economic Development and Creation of Employment". Conference on Reconstruction and Development of Croatia. 1998
64. ———. "Project Proposals: Housing Reconstruction". Conference on Reconstruction and Development of Croatia. 1998.
65. ———. "Project Proposals: De-mining". Conference on Reconstruction and Development of Croatia. 1998.
66. ———. "Project Proposals: Rehabilitation of Agriculture". Conference on Reconstruction and Development of Croatia. 1998.
67. ———. National Island Development Programme". (ISBN 953-96810-2-). 1997.
68. Ministry of Economy of the Republic of Croatia. *Energy in Croatia 1992-1996, Annual Energy Report.* (ISBN 953-6474-12-3). 1997.
69. ———. "Renewable energy in Croatia". (ISBN: 953-96311-1-4). Zagreb, June 1995.
70. Ministry of Education and Sports of the Republic of Croatia. "The Development of Education: The National Report – The Republic of Croatia.1998
71. Ministry of Finance. "Monthly Statistical Review of the Ministry of Finance". Zagreb, March 1998.
72. Ministry of Physical Planning, Building and Housing, Institute for Physical Planning. "Environmental Performance Review Preparatory Mission. Spatial planning having the function of environmental protection". Zagreb, 1998.
73. Ministry of Tourism. "Croatia, small country for a great holiday". Croatian National Tourism Office.1997
74. Republic of Croatia, Nature Friends Movement 'Lijepa Nasa'. "Feasibility Study: European Blue Flag for Beaches and Marinas, Republic of Croatia". 1998
75. Republic of Croatia. "1997 Report on the Eco-Schools Project Implementation in the Republic of Croatia and the Implementation Plan for the First Half of 1998". 1998.
76. ———. "About the State Directorate for Environment of the Republic of Croatia". 1998.
77. ———. "By-Law on quality standards for liquid oil fuels". 1997.
78. ———. "By-Law on recommended and limit values of air quality". 1996.
79. ———. "Contingency Plan for Accidental Marine Pollution in the Republic of Croatia". 1997.
80. ———. "Croatian Forests, a heritage of diversity and sustainability:. Journal, issues 1997-1998-1999. (Nature conservation - Abundance of habitats; Ecological aspects – Numerous benefits; Silvicultural methods – Following nature; Richness and diversity of the Croatian forest environment; Forest protection - An integrated approach; Karst region of Croatia; Friendly use of forests;

Changing forest research; Forestry institutions; History and tradition; Hrvatske Sume, State forestry enterprise; Natural resources and the community; Croatian Forests, a heritage of diversity and sustainability).
81. ———. "Croatian School System". 1998.
82. ———. "Decree concerning the sea water quality at beaches". 1996.
83. ———. "Decree on Limit Values of Pollutant Emissions from Stationary Sources to the Air". Official Gazette No 48/95, December 1997.
84. ———. "Decree on Environmental Impact Assessment". Official Gazette, April 2, l997.
85. ———. "Description of Certification Methodology". 1999
86. ———. "Environment Label of the Republic of Croatia. 1999
87. ———. "Environmental Impact Assessment in the Republic of Croatia" - changes which have taken place last year. 1998.
88. ———. "Government of the Republic of Croatia, Cabinet Members". 1998
89. ———. "International Environmental Protection Support". 1998
90. ———. "Law on air quality protection". 1995
91. ———. "Law on Waste". 1995.
92. ———. "Life expectancy trends in the Republic of Croatia, 1985-1995". 1997
93. ———. "Parliament of the Republic of Croatia". Zagreb, 1992.
94. ———. "Position, Climate, Soil, Waters and Specific Land Forms. 1998.
95. ———. "Projects of the Ministry of Agriculture and Forestry of the Republic of Croatia with international financial organizations". Zagreb, 1998.
96. ———. "Specific criteria for product groups for environmental label of the Republic of Croatia". 1999
97. ———. "Structure of the State Directorate for the Protection of Nature and Environment".1998
98. ———. "The Law on Environmental Protection", 1993.
99. ———. "The Water Act", No 107/95, Zagreb, 1995.
100. ———. 1997 and 1998 Croatian State Budgets. "Environmental Preservation Expenses". 1998.
101. ———. Conference Proceedings from the International Conference "Environmental Protection Financing", Mljet, 3-4 June 1998.
102. ———. *Country Profile Implementation of Agenda 21*. (ISBN: 953-97087-2-9). The State Directorate for Environment, Zagreb, 1997.
103. ———. Environmental Impact Assessment Law, 1997
104. ———. UN-ECE/FAO. "Temperate and Boreal Resources Assessment 2000, Country: Republic of Croatia". 1997
105. ———. "Croatian policy of health for all by the year 2005". Zagreb, October 1997.
106. ———. "Hrvatska Elektroprivreda". Information Department. Zagreb, 1997.
107. ———. "The framework for environmental policy and management". The State Directorate for Environment, Zagreb
108. ———. Hrvatska Elektroprivreda. Information Department. "Basic Data 1997 Hrvatska Elektroprivreda" Zagreb, 1997
109. State Directorate for the Protection of Nature and Environment . "Summary of the Report on the State of Environment in the Republic of Croatia". 1998.
110. ———. Environmental Pollution Cadastre of the Republic of Croatia. 1998.
111. ———. List of Environmental Impact Assessment Studies, 1998
112. ———. Inspection Department. "Safe Management of Chemicals". 1998
113. ———. "Environmental Performance Review: Croatia. Chapter 9: Management of marine resources and pollution". 1997.
114. ———. "National Monitoring Programme of Croatia (for 1996)". Zagreb, 1996
115. ———. "Rule book on awards and prizes for environmental achievements". Official Gazette, l March 1996.
116. ———. "Rulebook on waste management". 1997.
117. ———. Environment Label. "Description of Certification Methodology. 1998.
118. ———. "Emissions from Mobile Sources".1998.
119. ———. "Review of Regulations in the Competency of the Sate Directorate for the Protection of Nature and Environment
120. ———. "The Framework for Environmental Policy and Management: legal instruments and institutional arrangements for environmental protection". 1998.
121. ———. Economic Incentives to Ecological Activities - Legal Base and Enforcement. 1998.
122. ———./Ekonerg. "Croatia Corinair90. Air Pollutants Emission Estimate for Croatia". Zagreb, 1996.
123. ———. "Catalogue of questions for the first training course in the Regional Training Centre for Implementation of the Basel Convention in Bratislava, 2-6 July 1997". Zagreb, 1997.
124. ———. "Comparative list of wastes". 1996.
125. ———.."Report on management of equipment and devices containing PCBs in the Republic of Croatia". 1998
126. ———. Inspection Department. "Staff Management of Chemicals, Basic Objectives and Tasks". 1998.
127. ———. "ISO standards in the field of environmental protection in the Republic of Croatia". 1998
128. ———. *Coastal Area Management in Croatia.* (ISBN 953-6429-14-4). Zagreb, 1998.
129. ———. "List of requirements/Projects of Nature and Environmental Protection in the Republic of Croatia", Zagreb, 20 January 1999.
130. ———. "Review of regulations in the competency of the State Directorate for the protection of nature and Environment". 1998
131. ———. "Tourism and Urbanization of Mediterranean Coastlines. Example of the Croatian Coast".
132. ———. "A brief review of the development of tourism and the protection of the environment in the Republic of Croatia". 1998.
133. ———. "Hazardous Waste in Croatia". Seminar on Institutional and Technical Aspects of the Implementation of the Basel Convention in CIS and Eastern European Countries, Moscow, 4-8 May 1998. Zagreb, 1998.
134. ———. "Rule Book on Environmental Label". 1996.
135. ———. "Review of international treaties a party of which is Republic of Croatia." 1998.
136. ———. "Current state in the Republic of Croatia in the field of air quality protection". Zagreb, 1998.
137. ———. "Review of international treaties a party of which is Republic of Croatia (in the competency of the State Directorate for the protection of nature and environment)" 1999

138. ——————. “Information and Documentation Section. Establishment of Nature and Environment Protection Information System”. 1998
139. ——————. “Environmental Performance Review: Air Quality Management in the Republic of Croatia”. Zagreb, 1998.
140. ——————.”Access to Information, Public Participation”. 1998.
141. State Water Directorate. “Water resources and use”. 1998.

Other

142. Croatia Weekly. “A unique marine lake system in Mljet national park”. Zagreb, 1998.
143. ——————. “Ancient Zadar in contemporary tourism”. Zagreb, 1998.
144. ——————.. “Bakar’s doors closed to polluters for all time”. Zagreb, 1998
145. ——————.. “Bjelolasica: showplace for skiers”. Zagreb, 1998.
146. ——————.. “Can environmental disaster be avoided ?”. Zagreb, 1998.
147. ——————.. “Construction of Multipurpose Canal Dunav-Sava to begin”. Zagreb, 1998
148. ——————.. “Contract signed with world’s largest construction firm”. Zagreb, 1998.
149. ——————.. “Croatia has a new Minister of European Integration”. Zagreb, 1998.
150. ——————.. “Croatia to construct 1,300 Km of roads in the next decade”. Zagreb, 1998.
151. ——————.. “Croatian Identity and Tradition in Lisbon”. Zagreb, 1998
152. ——————.. “Croatian Islands: sustainable growth through ecological agriculture”. Zagreb, 1998.
153. ——————.. “Ecology 9 Eco-project to rescue Kastela Bay”. Zagreb, 1998.
154. ——————.. “Eco-Settlement: the village of Istria”. Zagreb, 1998.
155. ——————.. “Forests sound alarm”. Zagreb, 1998.
156. ——————.. “Four Consortiums in race for second GSM Network”. Zagreb, 1998
157. ——————.. “Geological heritage under protection”. Zagreb, 1998.
158. ——————.. “How can the mediterranean monk seal be saved ?”. Zagreb, 1998.
159. ——————.. “In the Realm of Birds: Kopacki Rit”. Zagreb, 1998.
160. ——————.. “Kastela Bay awaits better days with new eco-project”. Zagreb, 1998.
161. ——————.. “Lonjsko Polje: new bird species discovered”. Zagreb, 1998.
162. ——————.. “Lovran: an unusual combination of maritime and mountain tourism”. Zagreb, 1998.
163. ——————.. “Mali Ston Bay: a strict natural reserve”. Zagreb, 1998.
164. ——————.. “Mediterranean monk seal returns to Mljet”. Zagreb, 1998.
165. ——————.. “Moslavacka Gora nuclear waste disposal ?”. Zagreb, 1998.
166. ——————.. “Nature Park heals the wounds of Medvednica”. Zagreb, 1998.
167. ——————.. “Neretva Delta becomes nature park”. Zagreb, 1998.
168. ——————.. “Omisalj: Air quality meets highest standards”. Zagreb, 1998
169. ——————.. “Outlying Adriatic Islands may become nature reserves”. Zagreb, 1998.
170. ——————.. “Plitvice Lakes: Revitalization Program for a National Park”. Zagreb, 1998.
171. ——————.. “Posavina Highway construction continues”. Zagreb, 1998.
172. ——————.. “Protected waters in croatian national parks”. Zagreb, 1998.
173. ——————.. “SOS for the Wolf in Croatia”. Zagreb, 1998.
174. ——————.. “The Adriatic: the largest reservoir of drinking water”. Zagreb, 1998.
175. ——————.. “The Brijuni: fourteen islands on a piece of heaven”. Zagreb, 1998.
176. ——————.. “The Croatian Adriatic – The sea of the future”. Zagreb, 1998.
177. ——————.. “The Croatian National Parks Race”. Zagreb, 1998.
178. ——————.. “Tourist boom on the adriatic”. Zagreb, 1998.
179. ——————.. “Velebit: can a thermoelectric plant be built near a biosphere reserve ?”. Zagreb, 1998.
180. ——————.. “Velebit: Croatia’s most vital mountain belt”. Zagreb, 1998.
181. ——————.. “Vransko Lake: a unique natural phenomenon”. Zagreb, 1998.
182. ——————. “Waters are Croatia’s strategic wealth”. Zagreb, 1998.
183. ——————.. “Will Paklenica’s Griffon Vultures Disappear ?”. Zagreb, 1998
184. ——————.. “Zagreb: A world-class tourist sensation”. Zagreb, 1998.
185. ——————.. “Mediators between Man and Nature”. Zagreb, 1998
186. HDKI / Kemija u industriji. *Effects of War on the Environment.* (ISSN 0022-9830). Zagreb, 1994.
187. INA. “Price structure for motor petrols, diesel fuels, fuel oils EL and LS No. 14.4/98”. 1998.
188. KoREMA. *Proceedings. Conference on Energy Management.* (ISBN: 953-6037-25-4). Dubrovnik, May 1998.
189. Lijepa nasa. “National Eco-Schools Report for Croatia”, 1998
190. Oxford Analytica Brief. “Croatia: Banking Politics”. 1998
191. ——————. “Croatia: Postponed Reforms (E)”. 1997.
192. ——————. “Croatia: Privatisation Renewal”. 1998.
193. ——————. “Croatia: Road Plans”. 1998.
194. ——————. “Croatia: Tourism Outlook”. 1997.
195. Plan Econ Report. “Croatian Economic Monitor”. Vol. XIV, No 7-8. 1998.
196. The Economist Intelligence Unit (EIU). “Croatia 3rd quarter 1997”. Business Report, 1997.
197. ——————. “Croatia 3rd quarter 1997”. Business Operations Report. 1998.
198. ——————. “Croatia Country Report, 4th quarter 1998”. 1998