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**UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL**

Distr. : LIMITED
E/ESCWA/TECH/1995/WG.1/5
30 August 1995
ORIGINAL : ENGLISH

**Economic and Social Commission
for Western Asia**

Expert Group Meeting on Revitalization of
Research and Development Activities in
the ESCWA Countries
12 to 14 September 1995
Hurghada, Egypt

**Assessment of the Activities of the
Kuwait Institute for Scientific
Research**

Prepared By

Yousuf Y. Al-Sultan
Assistant Director-General
Kuwait Institute for Scientific Research

KUWAIT

Co-sponsor : United Nations Industrial Development Organization (UNIDO)

**UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION
FOR WESTERN ASIA**

- 9 - NOV 1995
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Introduction

Research and development has been regarded as a pivot and prime support for any scientific and technological activities, therefore introducing and adopting well established and formulated R & D policy in a country would ensure that endogenous scientific and technological capabilities could proceed to secure and full fill the required dynamism for the economy. As stated in a UN document (1): Research and development endeavors are the arena where technological capabilities are strengthened, and simultaneously, conurbation to the production and service sectors are made. To achieve such objective, modern and traditional sectors should be distinguished and emphasized. A proper dynamic process of technical change and improvements would assist the transfer of traditional technologies that are in use into highly competitive alternatives. Never the less, R & D activities are prime source for such technological transformation.

The world is witnessing and shall be enjoying the fruits of its scientific and technological advancements and outputs. These include exploration of and introducing new issues such as penetration of ozone layer, introduction of GATT, the application of ISO 9000 in manufacturing, in addition to new trends that might be imposed by multinationals and/or regional grouping to put a premium on cost reduction, flexibility in production mix and equipment, and higher quality. Needless to see, and as supported by UN document (2), there is an increasing realization in the most Arab countries that, until suitable measure are adopted to develop local scientific and technological capabilities, there would be little or no significant and technological capabilities, there would be little or no significant development in the technology, a situation which would perpetuate the existing heavy reliance on foreign technology. Further more, the document has also concluded that weak link existed between R & D institutions in there countries and production and service sectors, and in particular the weakness of there intermediate technologies which is the capabilities to transform research results into products. However the issue of research and

development and its importance in socio-economic development plans have not received great interest and appreciation in many societies in the Arab world.

This document discusses the R & D activities in Kuwait, by narrating and analyzing the establishment of Kuwait Institute for scientific Research (KISR) as applied research center, its objectives, problems, achievements and future plans.

Kuwait Institute for Scientific Research was established in 1967 and has witnessed great success and gain well international respects and was considered one of the main R & D institutions in the developing countries and have granted several wards and patents, but unfortunately this civilized and scientifically advanced center has witnessed severe, inhuman and uncivilized assault, looting and complete distraction during the Iraqi aggression on Kuwait on 2 August 1990.

The Kuwait for Scientific Research (KISR): Establishments, Achievements and Future Plans

Historical Considerations

Since Kuwait, as a country, was only granted independence in 1961, it has had only 34 years to be in full control of its destiny. Consequently, by all odds, it can still be considered as a new developing nation. Thirty four years ago Kuwait was still a rural society, being almost totally dependent on human and natural resource input from outside sources. Today it has emerged as a regional leader in scientific achievement. In this regard Kuwait has the fundamental characteristics that make it a replicable "Case Study" for Arab World development.

From the outset, through wisdom, the country's leaders recognized that scientific and technological developments were abounding in the developed world, and that such developments could be put to work here. They realized (at this early time) that for a small developing country to prosper and lead into future, it must focus on creating its own scientific and technological infrastructure. For those reasons, Kuwaits leaders sought to have national development be given a scientific base. Therefore, within six years of independence, the country formed in 1967 the Kuwait Institute for Scientific Research (KISR) as a multi-disciplinary science and technology center. From a humble beginning in an old small building, in the city center, KISR rose to be a dominant leading force in this technological growth era. KISR has played a leading role over various stages of Kuwait's development, i.e., while the country was a new nation (1967-75, without prior user awareness of science and technology), while it was principally a

established reputations), and while it was a rehabilitating nation (1991-94, with obstacles and devastation in the aftermath of the Iraqi occupation). From the outset KISR started with few educated nationals, limited information access, lack of local university back-up, minimal national infrastructure, hardly any local industry or support bases, no system for managing and R&D, no rules, regulations or procedures, and no recognition or reputation.

KISR, therefore, provides a viable Case Study base, regarding needs, obstacles and achievements, yet with prevailing/continuing needs for full re-vitalization today.

Mandate

During the early years (1981) of KISR's development, an Amiri Decree (28) granted KISR its own charter. The objectives in this Decree, which helped chart the course of KISR's work over the past 14 years, have been to:

- Conduct research for the advancement of industry and protection of the environment.
- Study the utilization of natural resources, water sources and energy resources.
- Improve agricultural methods/develop local aquaculture, and provide research services and technical advice to public and private institutions.
- Study methods of diversifying national revenues.
- Orient research towards social and economic development.
- Conduct research and provide advisory services for relevant authorities.
- Encourage Kuwaiti youth towards careers in science and technology.
- Keep abreast of the latest scientific and technological developments, as well as adaptation potentials, and provide

- government bodies with scientific documentation/information.
- Establish cooperative relations with higher education institutes and centers for science and technology in Kuwait and abroad (joint research and exchange of information/expertise).

Evolverment of Science/Technology-Related "Development Techniques"

• The Planning Process

From the outset KISR placed considerable emphasis on the evolverment of a development oriented system, comprised of techniques that would bring the "application of science and technology" into the mainstream of sub-sectoral, sectoral, and/or national problems or opportunities. The techniques as evolved are applicable for replication in other countries of the Arab World.

One of the problems facing countries in the Arab World is the lack of emphasis on strategic and methodological planning. KISR's procedure and process in this regard have been unique, and have been successful, albeit these procedures and processes still remain in need of fine-tuning and continual re-direction. KISR's first planning effort focused on human resource development, establishment of facilities, and procurement of specialized instruments. Simultaneously, the "Work Plan", in those early years, was geared to demonstrate that science and technology, when properly applied, can help remove technical obstacles to development. This was followed by its first full-blown Strategic Program, which, while moving research efforts forward, introduced a research management system, the "Division" structure, and the matrix concept. The Second Strategic Program introduced the concept of Technical Research Programs, using Division back-up resources and facility support systems.

The Third Strategic Program was lost due to the invasion and occupation. Within a few months after liberation, KISR prepared a

one-year "Short-Term Reconstruction Plan", focusing on assessment of abuses and damage, development of new post-liberation databases, assessment of technological aspects of reconstruction, and initiation of technological developments that would be helpful in the future. In order to bring the program back in synch with the nation's over-all planning cycle, a Transitional Strategic Program (TSP) was prepared to guide re-development to this point where a new Strategic plan is about to be launched. The goals of the TSP were to:

- consider the existing ecological, economical, and social conditions and constraints and start the development of research on perceived top priority national needs,
- complete work that had been underway on top priority national needs,
- move each Division towards becoming the primary research and technology development support arm for its most appropriate sector,
- optimally develop the skills of and for its nationals, and
- provide expanded access to needed technologies, technological development potentials, and short-term or collaborating specialists.

At this time, KISR is about to launch its Fourth Strategic Program. The direct goals of this Program are to help place science and technology (R&D) at the forefront of the resolution of national and sectoral problems/obstacles inhibiting development, provide guidelines for resource allocations, support and develop the scientific capability of Kuwaiti nationals, maximize the technical, economic and social contributions of the outputs, stimulate team effort, and serve as a vehicle for enhanced communication with decision-makers. The Working Goals continue the focus of the TSP.

- Preparation of Sectoral, Sub-Sectoral, National, or Problem-Related Assessments or Plans

This technique applied vision to detail long-term targets and sets-out, with clarity, the sequence of projects that will most likely be needed to help the sector, or industry, solve the problem(s), create the opportunities, and/or reach the target(s). In other words this technique defines the incremental advances that will need to be realized from each individual project, and it also expands user participation, enhances application or use, ensures use of upgraded technology, and improves efficiency.

- Use of the Project System

This technique has been vital. It involves technical and management reviews, user staff involvement, matrix utilization of resources, mid-course review, and related concept/contribution spin-off. Project proposals are prepared, reviewed with potential users, and cleared with KISR managers and staff. Matrix systems are utilized to draw on KISR's broad areas of expertise for the efficient execution of the projects. "User" staffs carry out selected tasks or sub-tasks, in collaboration with KISR staff. This prepares the users for direct implementation of the findings. The results of the projects are periodically reviewed with the users informally, or formally through announced workshops.

- Establishment of Demonstration Projects, Pilot Facilities or Commercial Entities

Extension programs are common in the developed world, however, the involvement of researchers directly with the sectors is an unique development technique, and is directly applicable to the Arab World. Where user infrastructures are not in place, quasi private/public entities can be formed.

Advancement of Education and Development of Knowledge

One of the main problems in development is the lack of adequately trained human resources, or educated professionals, capable of applying the best in science and technology. Human resource development underscores all other problems or limitations. On the basis of this understanding, KISR implemented an intensive human resources development program with multi-dimensions.

KISR has, therefore, launched a scholarship program and a training program. Approximately 250 professionals have obtained Ph.D. or M.S. degrees here or abroad, and over 10,000 professionals have obtained training in specialized career development courses. Simultaneously, over 300 conferences/workshops have been held.

Considerations in Selecting Research Thrusts (3)

It was accepted that although KISR had been the country's primary applied development research/technical arm, decreed to help meet the needs of the sectors and the nation, it simply could not simultaneously make meaningful technical contributions towards fulfilling all needs. Monetary, physical, and human resource limitations precluded this. KISR, therefore, had to prioritize and intensify its thrusts or project areas, consistent with the national or sectoral needs, the Institutes capabilities, the monetary support that was available, and the directives given to it in the Amiri Decree 28. Plans are underway to carry out this type of prioritization exercise on a more formally structured basis over the long-term for each activity and/or Program Element existing in the Research Programs. Preliminary decisions, however, had to be made on a practical, timely basis at the outset of the planning process, so that the staff could proceed with the drafting of the Fourth Strategic Program plan. To fulfill this timely requirement, Program Committees (including highly qualified sectoral

representatives) were established to review past activities, and participate in the discussions which led to the preparation of these plans for the Fourth Strategic period. Some of the questions which the committees considered were as follows:

- Would the thrust or activity support the needs of the sector or national authority being served?
- Would the thrust or project activity address the key issues limiting the development of the sector, or enhance the knowledge base needed for its eventual development?
- Did the program have the human resource capability and/or needed facilities to carry out the proposed work?
- Would the thrust or project activity contribute to economic development, diversification, import substitution, efficiency, resource conservation or development, food and water security, waste reduction or recycling, environmental preservation or national security or safety?
- Would the thrust or activity open-up related development potentials - either monetarily or socially, or make Kuwait a better place to live and work?
- Would the proposed activity result in enhancement of Kuwaiti capability as well as needed careers or job opportunities for Kuwaiti's trained or skilled in related disciplines,
- Would new technology be introduced?
- Would the activities enhance KISR and Kuwaiti stature?
- Would the Program plans rationalize the differences between expressed societal need and existing allocation of resources and availabilities of facilities?

All of these questions and others were asked relative to the proposed contents for each program, as they were being formulated in compliance with KISR guidelines and the Amiri Decree. The inputs were considered in formulating the Fourth Strategic Program as presented herein. It is recognized, however, that the over-all prioritization process needs more structure and also needs to be carried out on a more or less continuous basis so that it can support changes, if needed during the mid-course review of this

Strategic Program Plan, as well as guide the annual allocation of resources.

Additional Factors Considered in Reviewing Program and Program Element Objectives and Proposed Projects

Following are some additional factors which were also considered:

- managements intuition and judgement regarding existing constraints and development potentials,
- emphasis on vertical expansion, not horizontal development of program thrusts,
- mechanisms for using the matrix system to optimize output from KISR's over-all staff and Program,
- need to integrate the plans for the Program's into national development plans, and/or business development potentials,
- opportunities for obtaining special additional funding from agencies or offset program activities,
- contributions which the activities will make toward enhancement of societal awareness of KISR and its Program,
- state of technological maturation or potential for significant contributions,
- needs that will exist in the sector for the absorption and use of the information/technology being developed or demonstrated,
- need for realism and recognition of the fact that for the objectives to be incorporated here they must fit KISR capability or potential capability, and sectoral need, i.e. they must be "home-grown",
- degree of complexities and subtleties in almost all of the Program Element Objectives, meaning that the immediate staff and sectoral representatives, i.e., those closet to the problems, have the best perspectives of appropriateness of the proposed plan,
- need for widespread participation (bottom-up) in selection of what is to be done, so that a sense of ownership will prevail,

and

- recognition of the need for reasonable stability in the over-all structure of the Program, so as to elicit the best output from the participants.

It was also recognized that long-term commitments have to be made to selected areas in order to train Kuwaiti nationals and achieve world-class levels of excellence. Hence, the foci are on development of program excellence. It was also recognized that enhancement of KISR's over-all image was and is of critical importance to the obtainment of funding and to the utilization of the results. Also important is communication enhancement at all levels, so that the total workforce feels that they are "team" members. Emphasis will, therefore, be given to Human Resource Development (at all levels). Resource planning will also be linked to operational planning during the execution of this Strategic Plan. Over-all, KISR's information system technology must also be upgraded to world-class levels, in order to obtain optimal efficiency and productivity of output.

Current Impediments to R & D

At this time KISR faces several general/generic impediments to R&D, some of which can be categorized as follows:

- o Absence of an explicit R&D guiding policy.
- o Scarcity of funding due to circumstances resulting from the Iraqi aggression, and control of and prioritization of budget allocations.
- o Lack of social appreciation for the importance of R&D activities for national and/or sectoral development.
- o Insufficient contact with sectors and sub-sectors and slow response to needs.
- o Discontinuity and constant changing of top management.
- o Difficulties in recruiting qualified technicians.

- o Absence of a well-defined information program for communicating with the public.
- o Confidentiality associated with contract research restricting the publications and disseminations of research methodologies and output.
- o In sufficient utilization of manpower, and over-lap functions of some units.

International Relations

A vigorous and effective scientific community cannot exist in a vacuum or without effective interaction with other scientific communities all over the world, through exchange of personnel and information along broad and clear channels.

KISR maintains such relations and encourages all forms of useful exchange and communications in areas related to our fields of competence, and supports them in a variety of ways.

Cooperative agreements with institutions in many countries, within the Arab Region and outside, exist already. They have been mutually beneficial and have contributed effectively KISR activities particularly training programs, as well as to the overall upgrading of our scientific and support personnel. Cooperation with KISR is now sought by an increasing number of other institutions. KISR aims to optimize such relations, which, if allowed to grow in number rather than in substance, relevance, and direct contribution to its mission, could become dysfunctional and wasteful of our finite credit of time and resources. KISR shall continue to pursue scientific relations permitting a two way flow of information and expertise, keeping in mind the present and future needs of our country and our duty in meeting these needs in an effective and timely manner.

The following is examples of such collaboration between KISR and other institutions, as officialized in form of agreements and protocols.

Germany

1-Umweltschutz Nord GmbH

Memorandum of Agreement

signed on August, 8th 1992

duration one year

Nature of Agreement

Assistance and scientific development of composting technology for remediation of oil contaminated soil in Kuwait by using the maulwurf machine which is property of the company, and special microbes for oil degradation.

Comments

The contract has been implemented and the work is very useful. KISR will gain practical experience including know-how, when the composting technology is applied on a large-scale.

The United States of America

1- Oregon State University

Signed December, 11th 1992

Duration 3 years

Nature of Agreement :

Consultancy services and exchange of scientists for various projects related to remediation of oil contaminated soil, fisheries and agriculture sector.

Comments : Various scientists have visited the Division and were quite useful in developing proposals and giving assistance for ways and means for remediation of oil contaminated soil and various aspects of technology such as solid waste management, agriculture and fisheries management.

2- Boston University

Signed March,30th 1992

Duration 20 month

Nature of Agreement:

To conduct a joint research project entitled, Damage Assessment of the Desert and Coastal Environment of Kuwait by Remote Sensing.

3- Oregon State University

Signed January,31st 1994

Duration Three years

Nature of Agreement:

- To investigate areas of environmental and related sciences, emphasizing the atmosphere, the marine waters, land, as well as the environmental aspects related to human, animal, plant and fish life.
- To provide assistance for specialized education and training, and to carry out laboratory analyses.

4- Colorado State University

Signed April, 22nd 1993

Duration Five years

Nature of agreement:

-To Investigate areas of water resources and related sciences, environmental sciences and arid land agriculture including ornamental and high value crops, as well as the research and training aspects of plant biotechnology and bioprocessing.

5- The University of Arizona

signed May, 7th 1993

Duration three years

Nature of Agreement:

To carry out research relevant to Kuwait local needs, and expanding educational and graduate training opportunities in the field of environment, agriculture, and water.

6- The Texas Agricultural Experiment Station (TAES)

Signed April, 11th 1993

Duration Five years

Nature of Agreement:

- To investigate broad areas of agriculture and related sciences.
- To carry out laboratory analyses.

- To obtain assistance for specialized education and training.

7- The U.S. National Research Council,

Through its Board on Science and Technology (BOSTID)

Signed April, 11th 1993

Duration: Three years

Nature of Agreement :

- To develop collaborative symposia, conferences, and workshops.
- To identify U.S. individuals with special expertise to work with Kuwaiti scientists.

- To assist in the transfer of existing and emerging technologies relevant to KISR's research divisions, in areas such as arid land, protected environment agriculture, biotechnology and food technology .

Romania

Memorandum of Understanding with

PETROM (RA)

The agreement covers the following centers:

- The Institute for Research and Technology- Cimpina(ICPT)
- Institute The Petroleum
- The Research Institute for Refineries
- Boldesti and Berca Production areas

Signed :June, 21st 1993

Nature of Agreement:

To conduct joint research in the field of petroleum.

JAPAN

1- Petroleum Energy Center

Signed July 2nd, 1994

Nature of Agreement:

- To support field demonstration of bioremediation of Kuwait's oil-contaminated region, and transfer relevant physical/chemical remediation technologies to KISR.
- Transfer greenery development/planning technologies for rehabilitating Kuwait's environment.

United Kingdom

Cranfield University

Collaboration Agreement

Signed January 11th, 1995

Duration

Nature of Agreement:

To promote collaboration in one or more of the following:

- Execution of joint or coordinated research and development projects.
- Training in connection with joint research and development programs.
- Exchange of scientific and technological information.
- Holding of joint seminar.

United Arab Emirates

Memorandum of Understanding

Agriculture Science College in U.A.E. University

Signed April, 23rd 1995

Nature of Agreement:

- To investigate the areas of Plants Production particularly palm tree tissue culture.
- To conduct a joint research projects in the areas of Animal Production.
- To develop collaborative symposia, conferences, training courses and workshops.

CULTURAL AGREEMENTS

Cultural agreements are agreements signed between the government of Kuwait and other governments. These agreements are general and technical cooperation between concerned institutes.

So far, KISR has not been able to successfully invest these agreements.

Performance and Achievements of KISR

Since 1981, when an Amiri-decree enacting law was promulgated, KISR has a new definition of mission and objectives, and has achieved the autonomy that demands greater responsibility and stringent criteria of performance. The aim of KISR was thus to embark a new phase of consolidation and greater effectiveness that reflects the interest and desire of Kuwait to make it a vehicle of progress in the country.

To achieve its objectives KISR management has in addition to recruiting qualified nationals and expatriates (see table 1 and figures 1 & 2), has established six research program (division) in addition to several units, namely:

- o Food Resources
- o Water Resources
- o Petroleum, Petrochemical and Materials
- o Environment and Earth Science
- o Engineering
- o Techno-economics

A survey of research projects executed in contractual basis was carried out, KISR in whereby their funding, in part or in totality, was secured by clients. The survey encompasses distribution, divisionwise and sectorwise, of the contractual research projects carried out during the fiscal years 1987/1988-1988/1989 and 1991/1992-1993/1994.

It is to be pointed out that the survey covers two periods of time, before and after the Iraqi occupation to Kuwait, in an attempt to evaluate the impact of the crisis on KISR's human resources, research activities and sectorial needs priorities.

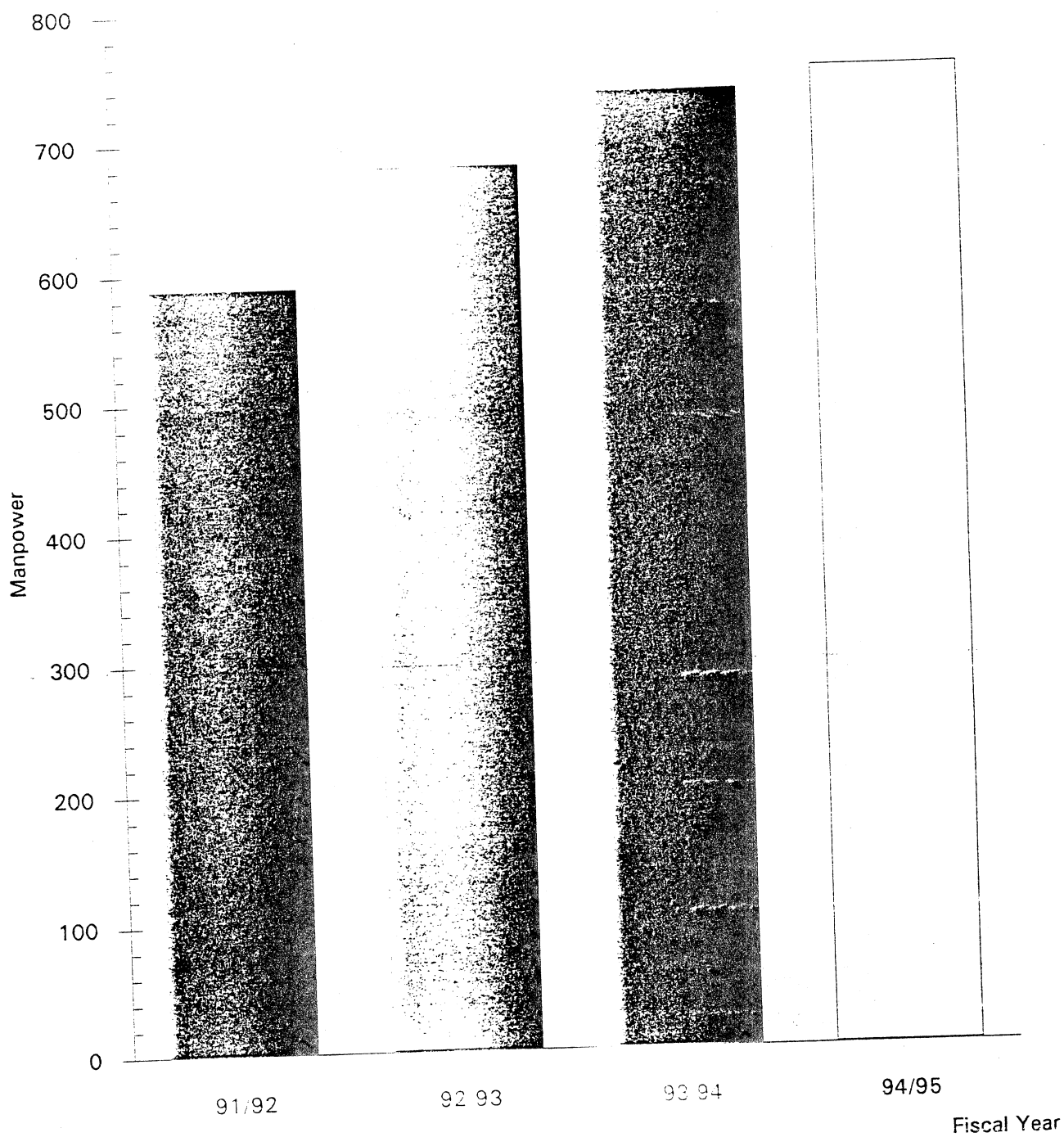
The surveyed research projects have been categorized for each fiscal year according to the follow terms:

- (a) Expenditure
- (b) Divisions (entrepreneur at KISR)
- (c) Sectors
- (d) Major clients

Table 1: Manpower Composition
in KISR

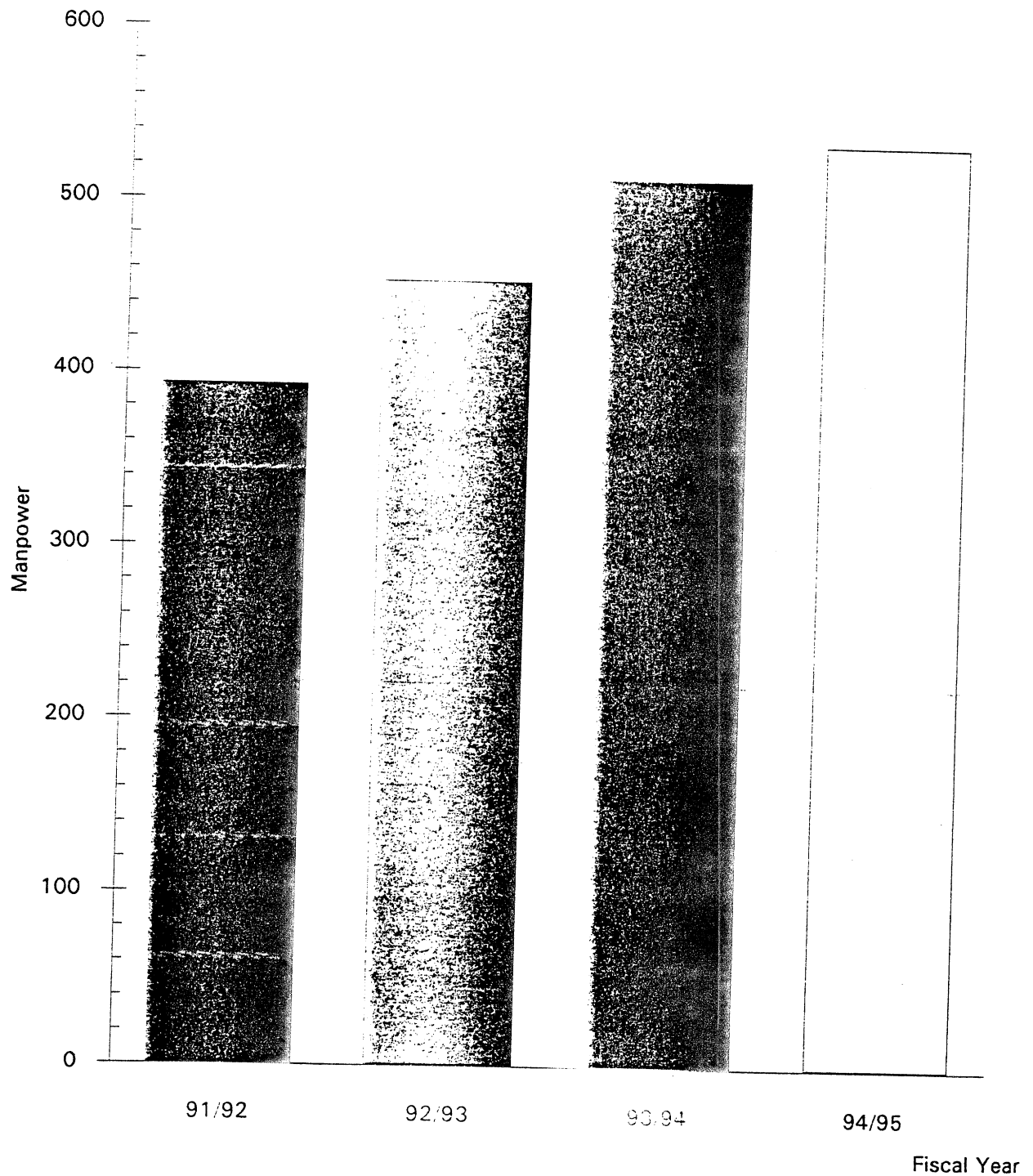
Year	Scientific Research Manpower		Total Manpower		
	Non Kuwaiti	Kuwaiti	Non Kuwaiti	Kuwaiti	Total
88/89	302	346	621	384	1005
92/91	78	315	161	427	588
93/92	104	350	201	478	679
94/93	135	379	233	502	735
95/94	139	396	234	517	751

TOTAL MANPOWER IN KISR DURING THE FISCAL YEARS
1991/92-1994/95



(Figure 1)

TOTAL MANPOWER ENGAGED IN RESEARCH ACTIVITIES IN
KISR DURING FISCAL YEARS 1991/92-1994/95



(Figure 2)

1.0 FISCAL YEAR 1987/1988:

1.1. EXPENDITURE:

Total number of contractual research projects signed during the fiscal year 1987/1988 was (53) projects with a total budget K.D. 3,592,325 distributed as follows:

KISR contribution = K.D. 1,866,023 = 52%
Clients contribution = K.D. 1,726,302 = 48%

1.2 DIVISIONS:

1.2.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER DIVISIONS:

	<u>Number</u>	<u>%</u>
PP&MD	17	32
ENG	11	21
FRD	11	21
TED	10	19
EES	4	7
WRD	0	-

**1.2.2. DIVISIONS RANKED IN A DESCENDING ORDER
ACCORDING TO THE BUDGET OF THE CONTRACTUAL
RESEARCH PROJECTS:**

	KISR Contribution (K.D.)	Clients Contribution (K.D.)	Total Budget (K.D.)
FRD	853,256	598,861	1,452,117
PP & MD	441,749	367,945	809,694
TED	231,690	527,626	759,316
ENG	306,823	189,990	496,813
EES	32,505	41,880	74,385
WRD	-	-	-

(Figure 1)

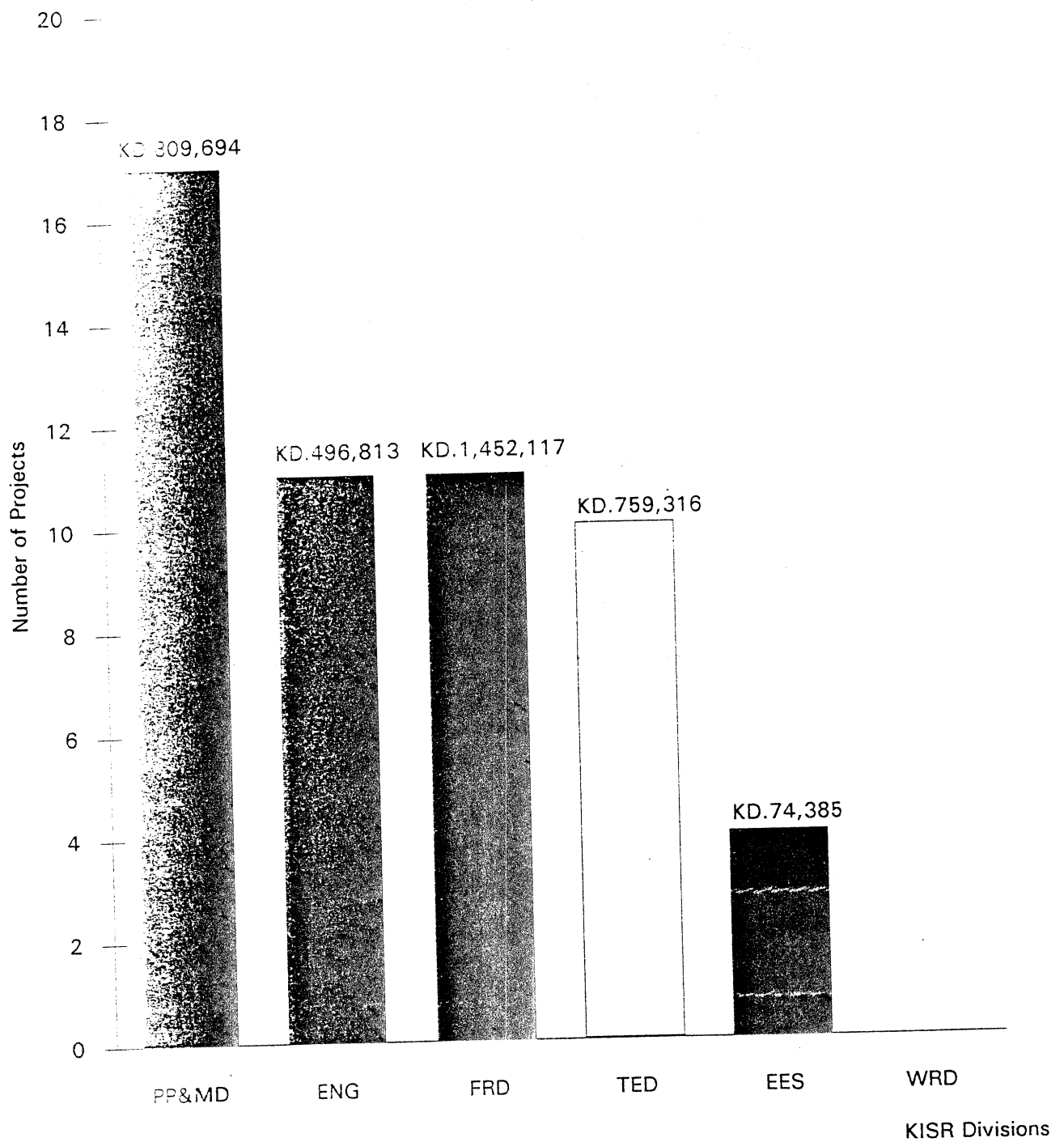
1.3. SECTORS:

**1.3.1. DISTRIBUTION OF CONTRACTUAL
RESEARCH PROJECTS OVER SECTORS:**

1.3.1.1 GOVERNMENTAL SECTOR:

Number of contractual research project = 28
Number of clients = 17
Total budget of contractual research projects = K.D. 1,650,433
Sector contribution = K.D. 999,266 = 61%

TOTAL NUMBER AND VOLUME OF CONTRACTUAL PROJECTS
SIGNED IN THE FISCAL YEAR 1987/1988 PER DIVISION



(Figure 3)

Governmental sector clients:

	<u>Number</u>
Kuwait National Petroleum Company (KNPC)	5
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	4
Kuwait Oil Tanker Company (KOTC)	3
Petrochemical Industries Company (PIC)	2
Ministry of Electricity & Water (MEW)	2
Ministry of Defense (MOD)	2
Justice & Legal Affairs Ministry (MJL)	2
Ministry of Public Health (MPH)	1
Ministry of Communications (MOC)	1
Ministry of Commerce & Industry (MCI)	1
Kuwait University (KU)	1
Kuwait Investment Authority (KIA)	1
Kuwait Municipality (KM)	1
Kuwait Fire Department (KFD)	1
Kuwait Lube Oil Company (KLOC)	1
Higher Planning Council (HPC)	1
Environmental Protection Council (EPC)	1

1.3.1.2. PUBLIC/JOINT SECTOR:

Number of contractual research projects	=	10
Number of clients	=	6
Total budget of contractual research projects	=	K.D 1,153,847
Sector contribution	=	K.D 565,446 = 49%

Public/Joint Sector Clients:

	<u>Number</u>
Kuwait Foundation for the Advancement of Sciences (KFAS)	4
Kuwait Consulting & Trading Company (KCTC)	3
Livestock Transport & Trading Company (LTTC)	1
Bubiyah Fisheries Company (BFC)	1
Industrial Bank of Kuwait (IBK)	1
Mobile Telephone Systems Company (MTSC)	1

1.3.1.3. PRIVATE SECTOR:

Number of contractual research projects	=	9
Number of clients	=	9
Total budget of contractual research projects	=	K.D 171,210
Sector contribution	=	K.D 100,200 = 68%

Private Sector Clients:

	<u>Number</u>
Arabian Light Metals (ALM)	1
Al-Msheer Company (AMC)	1
Al-Afrah Company (AFRAH)	1
The General Trading Company for Adhesive Materials Industry (GTCAMI)	1
Industrial Investment Company (IIC)	1
IBM World Trade Corporation (IBM)	1
Specialities Company (SC)	1
Al-Sanea Chemical Products (SCP)	1
Sultan Center (SULTAN)	1

1.3.1.4. OTHER REGIONAL AND INTERNATIONAL COMPANIES/ORGANIZATIONS:

Number of contractual research projects	=	6
Number of clients	=	6
Total budget of contractual research projects	=	K.D 526,655
Sector contribution	=	K.D 61,390 = 12%

Regional/International Clients:

	<u>Number</u>
University of Arizona (ARIZONA)	1
BASRA University (BU)	1
Gulf Cooperation Council (GCC)	1
Halophyte Enterprises (HENT)	1
University of Hohenheim (HU)	1
United Arab Shipping Company (UASC)	1

(Figure 2)

1.4. MAJOR CLIENTS:

	<u>Number</u>	Clients Contribution (K.D)	%
Kuwait Foundation for the Advancement of Sciences (KFAS)	5	386,245	22.4
Kuwait Investment Authority (KIA)	1	210,490	12.2
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	5	165,500	9.6
Kuwait National Petroleum Company (KNPC)	5	159,656	9.2
Bubiyan Fisheries Company (BFC)	1	114,361	6.6

(Figure 3)

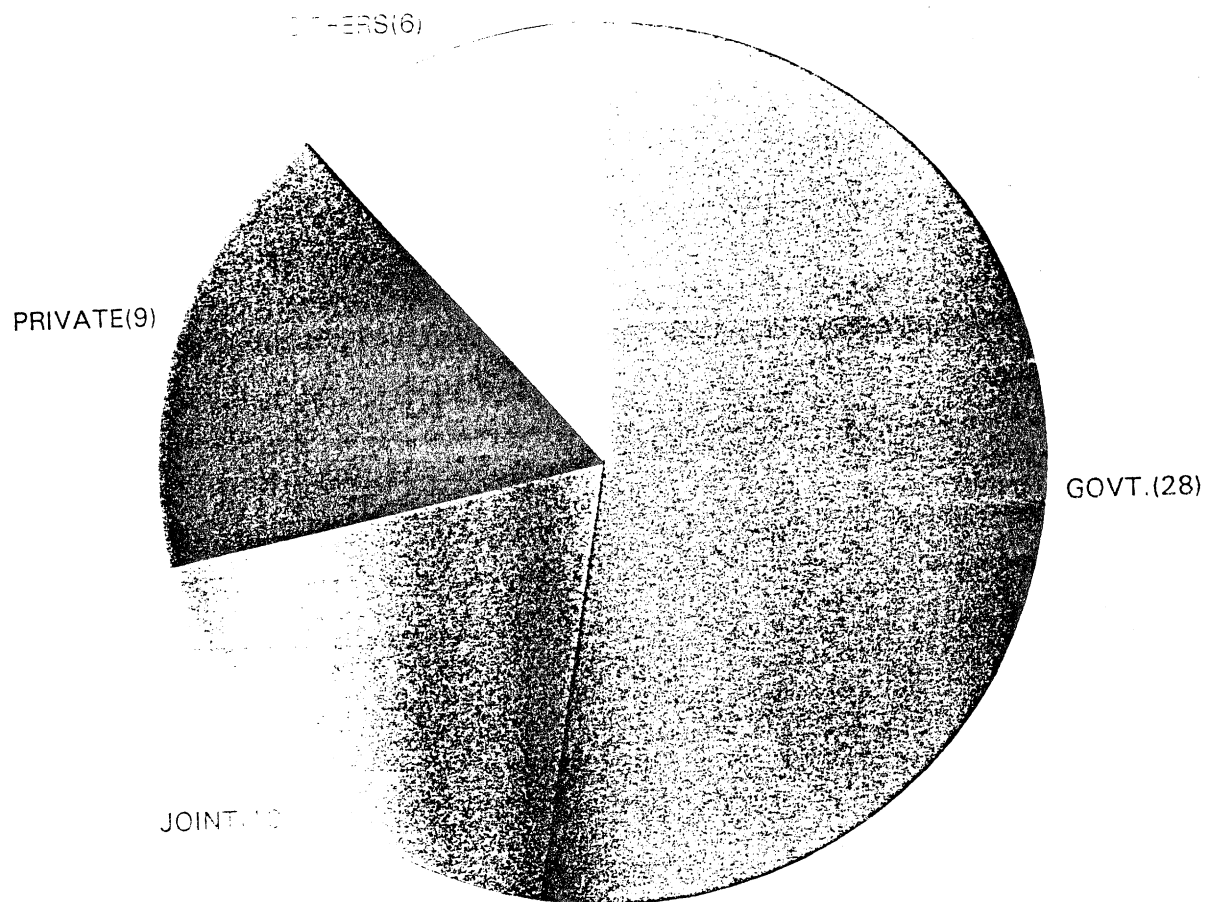
2.0 FISCAL YEAR 1988/1989:

2.1. EXPENDITURE:

Total number of contractual research projects signed during the fiscal year 1988/1989 was (55) projects with a total budget K.D 7,119,595 distributed as follows:

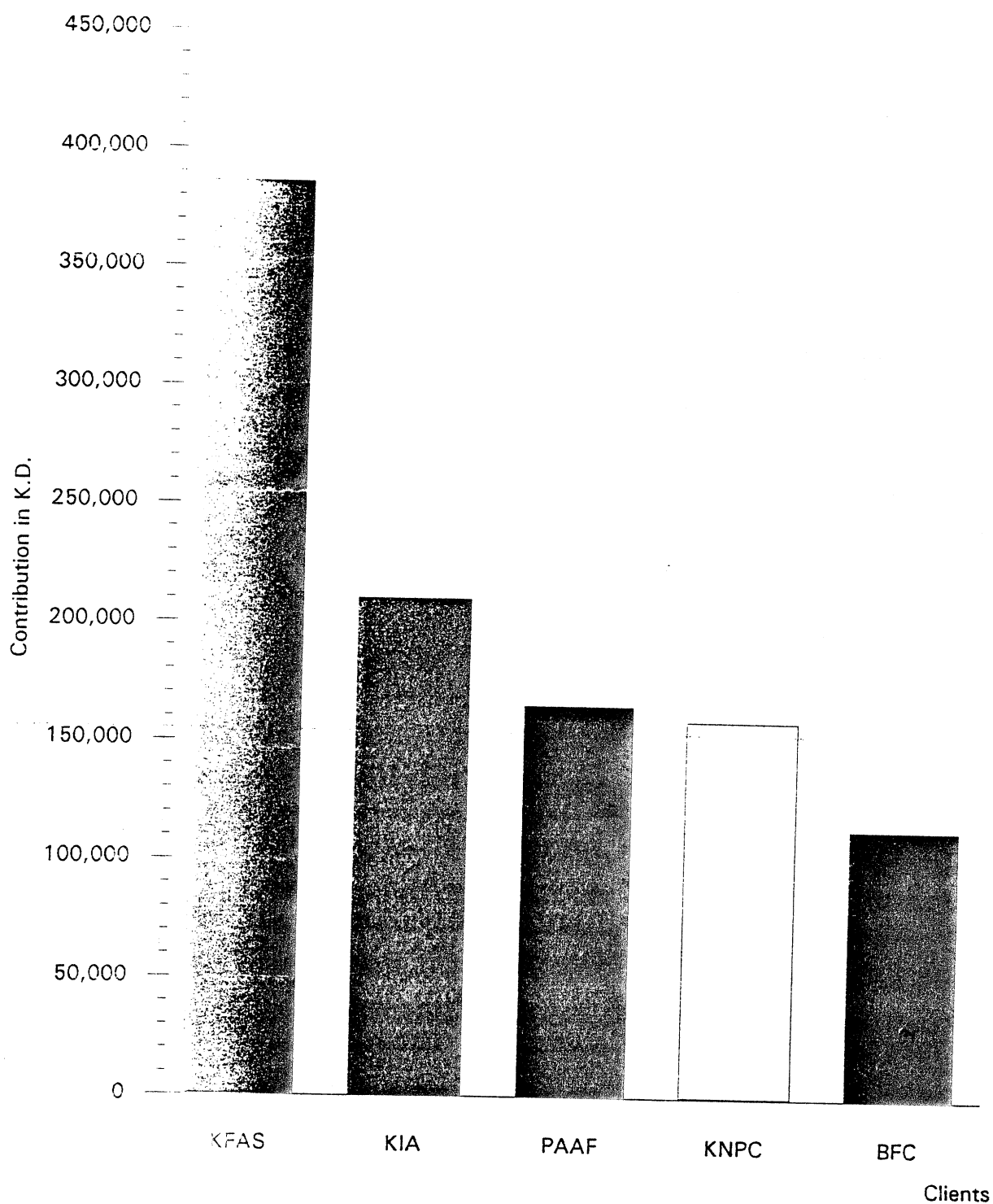
KISR contribution	=	K.D 1,424,708	=	20%
Clients contribution	=	K.D 5,694,887	=	80%

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED IN THE
FISCAL YEAR 1987/1988 PER SECTOR



(Figure 4)

MAJOR KISR CLIENTS DURING THE FISCAL YEAR 1987/1988



(Figure 5)

2.2. DIVISIONS:

2.2.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER DIVISIONS:

	<u>Number</u>	<u>%</u>
ENG	14	25.5
PP & MD	14	25.5
EES	10	18.2
FRD	10	18.2
WRD	4	7.2
TED	2	3.6
GENERAL	1	1.8

2.2.2. DIVISIONS RANKED IN A DESCENDING ORDER ACCORDING TO THE BUDGET OF THE CONTRACTUAL RESEARCH PROJECTS:

	<u>KISR Contribution (K.D)</u>	<u>Clients Contribution (K.D)</u>	<u>Total Budget (K.D)</u>
FRD	671,583	2,151,117	2,822,700
WRD	233,610	1,292,080	1,525,690
GENERAL	-	851,350	851,350
ENG	50,595	682,745	733,340
PP & MD	306,248	306,005	612,253
EES	148,125	316,590	464,715
TED	14,547	95,000	109,547

(Figure 4)

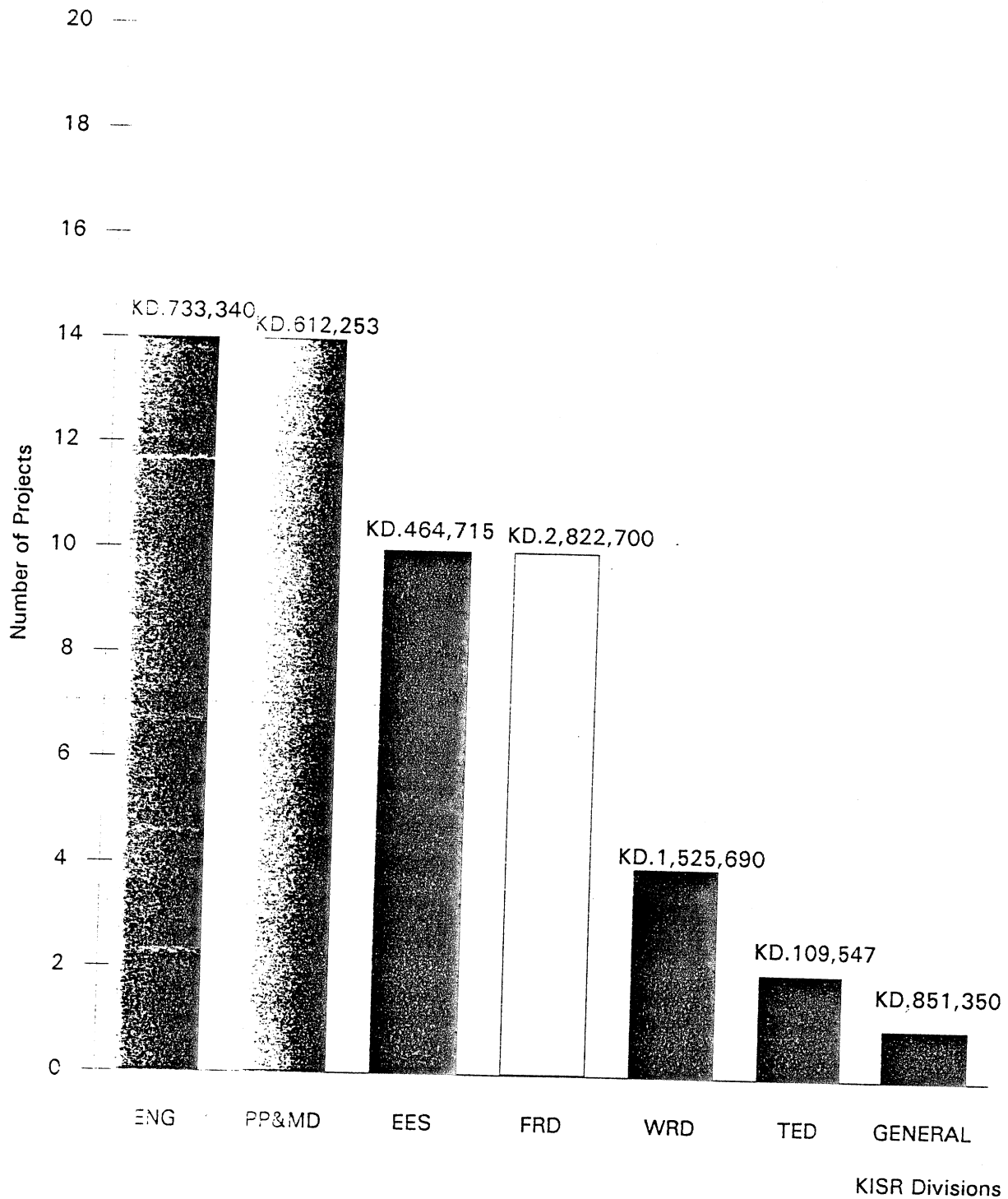
2.3. SECTORS:

2.3.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER SECTORS:

2.3.1.1. GOVERNMENTAL SECTOR:

Number of contractual research projects	=	32
Number of clients	=	13
Total budget of contractual research projects	=	K.D 5,622,327
Sector contribution	=	K.D 4,992,092=89%

TOTAL NUMBER AND VOLUME OF CONTRACTUAL PROJECTS
SIGNED IN THE FISCAL YEAR 1988/1989 PER DIVISION



(Figure 6)

Government sector clients:

	<u>Number</u>
Supreme Housing Council (SHC)	6
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	5
Ministry of Electricity & Water (MEW)	5
Environmental Protection Council (EPC)	3
Shuiba Area Authority (SAA)	3
Kuwait Fire Department (KFD)	2
Kuwait Oil Company (KOC)	2
Higher Planning Council (HPC)	1
National Housing Authority (NHA)	1
Kuwait National Petroleum Company (KNPC)	1
Kuwait Petroleum Corporation (KPC)	1
Kuwait Oil Tanker Company (KOTC)	1
Ministry of Planning (MOP)	1

2.3.1.2. PUBLIC/JOINT SECTOR:

Number of contractual research projects	=	9
Number of clients	=	4
Total budget of contractual research projects	=	K.D 1,156,075
Sector contribution	=	K.D 440,465 = 38%

Public/Joint Sector Clients:

	<u>Number</u>
Kuwait Foundation for the Advancement of Sciences (KFAS)	7
Kuwait Consulting & Investment Company (KCIC)	1
Kuwait United Poultry Company (KUPCO)	1
National Industries Company (NIC)	1

2.3.1.3. PRIVATE SECTOR:

Number of contractual research projects	=	7
Number of clients	=	7
Total budget of contractual research projects	=	K.D 58,428
Sector contribution	=	K.D 34,228 = 59%

Private Sector Clients:

	<u>Number</u>
Al-Bakheet Trading Establishment (BKTE)	1
Dar Al-Handasah Consultant (DHC)	1
Kuwait Scientific Center (KSCR)	1
Kuwait Lube Oil Company (KLOC)	1
Palms Agro-Production Company (PAPCO)	1
Shams Company for Physiotherapy (SHAMS)	1
Salem Al-Marzouk & SaBah Abi Hanna (SMSH)	1

2.3.1.4. OTHER REGIONAL AND INTERNATIONAL COMPANIES/ORGANIZATIONS:

Number of contractual research projects	=	4
Number of clients	=	4
Total budget of contractual research projects	=	K.D 226,965
Sector contribution	=	K.D 206,800 = 91%

Regional/International Clients:

	<u>Number</u>
Arab Fund for Economic & Social Development (AFESD)	1
Basra University (BU)	1
Getty Oil Company (GOC)	1
International Islamic Charitable Foundation (ISLAMIC)	1

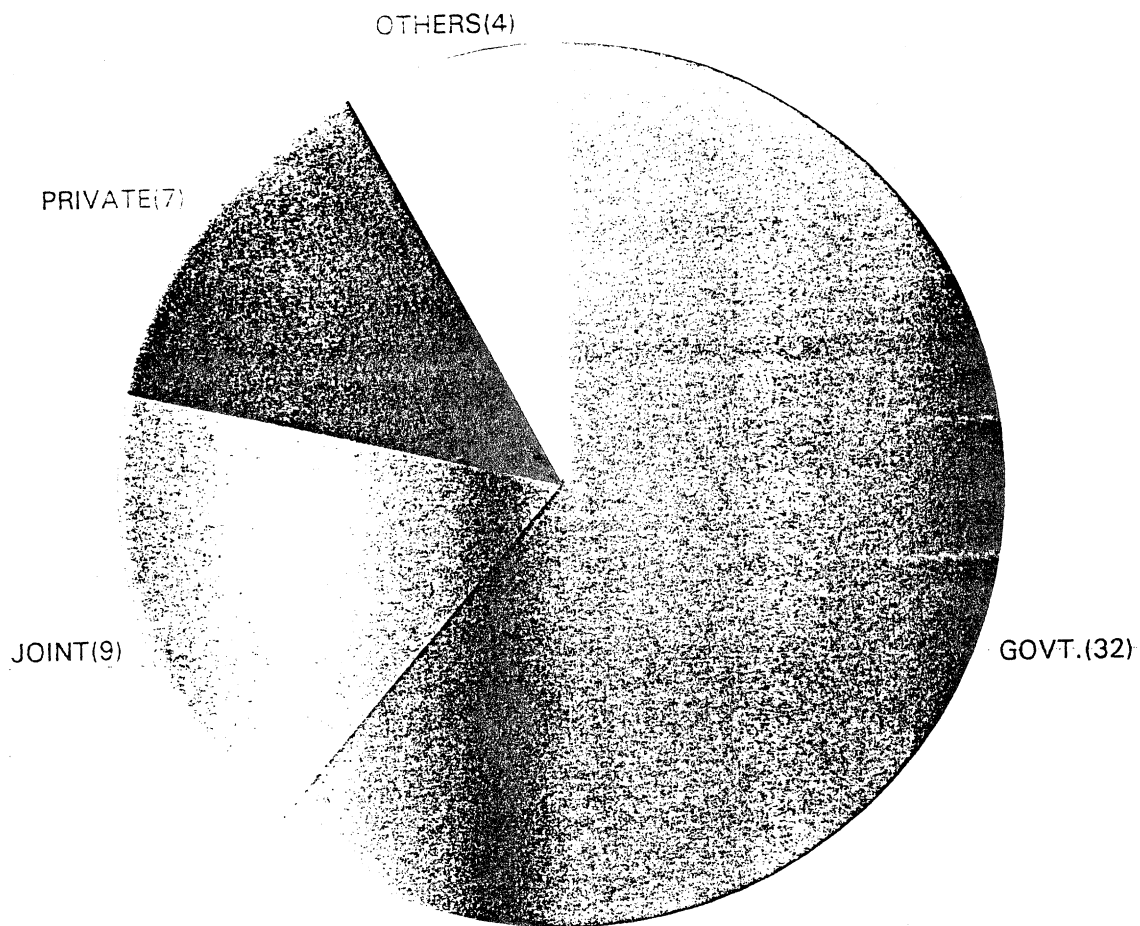
(Figure 5)

2.4. MAJOR CLIENTS

	<u>Number</u>	<u>Clients Contribution</u>	
		<u>(K.D)</u>	<u>%</u>
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	5	2,875,750	50.5
Ministry of Electricity & Water (MEW)	5	1,531,080	26.9
Kuwait Foundation for the Advancement of Sciences (KFAS)	7	387,285	6.8
Kuwait Oil Company (KOC)	2	185,850	3.3
Arab Fund for Economic & Social Development (AFESD)	1	182,690	3.2

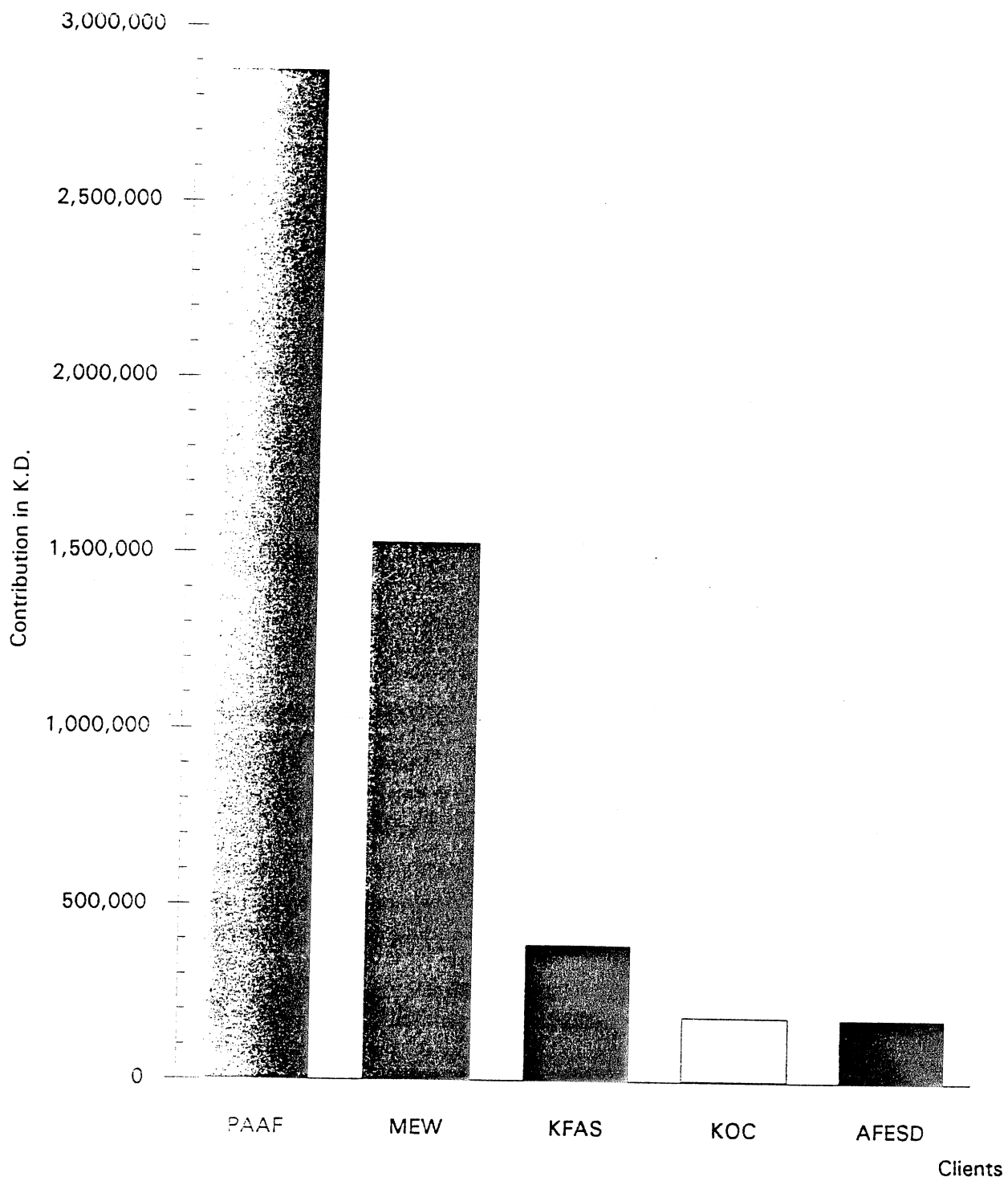
(Figure 6)

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED IN THE
FISCAL YEAR 1988/1989 PER SECTOR



(Figure 7)

MAJOR KISR CLIENTS DURING THE FISCAL YEAR 1988/1989



(Figure 8)

3.0 FISCAL YEAR 1991/1992:

3.1. EXPENDITURE:

Total number of contractual research projects signed during the fiscal year 1991/1992 was (2) projects with a total budget K.D. 408,462 distributed as follows:

KISR contribution	=	K.D. 82,462	=	20%
Clients contribution	=	K.D. 326,000	=	80%

3.2. DIVISIONS:

3.2.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER DIVISIONS:

	<u>Number</u>	<u>%</u>
TED	1	50
FRD	1	50

3.2.2. DIVISIONS RANKED IN A DESCENDING ORDER ACCORDING TO THE BUDGET OF THE CONTRACTUAL RESEARCH PROJECTS

	<u>KISR Contribution (K.D)</u>	<u>Clients Contribution (K.D)</u>	<u>Total Budget (K.D)</u>
TED	-	300,000	300,000
FRD	82,462	26,000	108,462

(Figure 7)

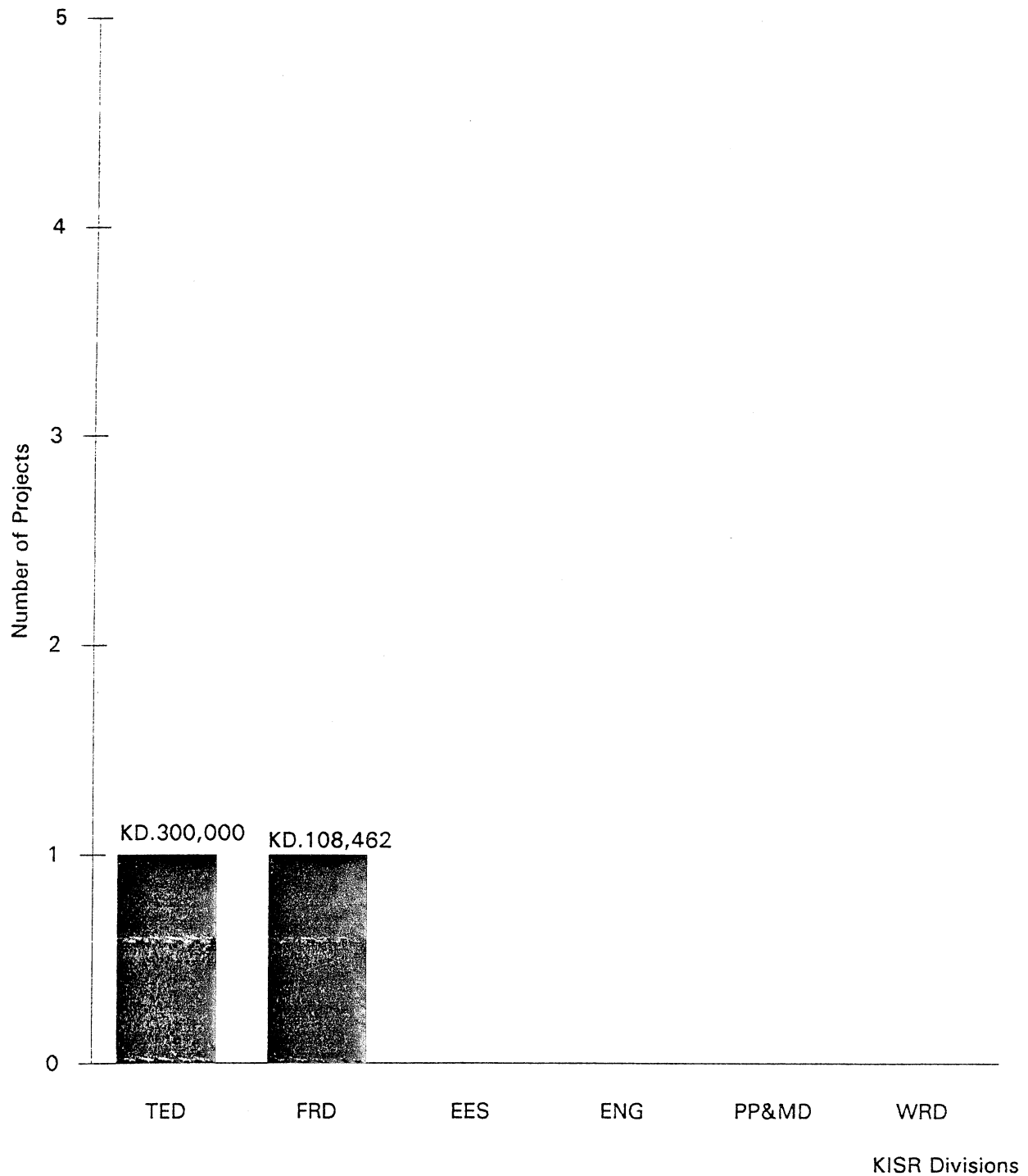
3.3. SECTORS:

3.3.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER SECTORS:

3.3.1.1. GOVERNMENTAL SECTOR:

Number of contractual research projects	=	2
Number of clients	=	2
Total budget of contractual research projects	=	K.D 408,462
Sector contribution	=	K.D 326,000 = 80%

TOTAL NUMBER AND VOLUME OF CONTRACTUAL PROJECTS
SIGNED IN THE FISCAL YEAR 1991/1992 PER DIVISION



(Figure 9)

Governmental sector clients

	<u>Number</u>
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	1
Ministry of Communications (MOC)	1
	(Figure 8)

3.4. MAJOR CLIENTS:

	<u>Number</u>	<u>Clients Contribution (K.D)</u>	<u>%</u>
Ministry of Communications (MOC)	1	300,000	92
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	1	26,000	8

(Figure 9)

4.0. FISCAL YEAR 1992/1993:

4.1. EXPENDING:

Total number of contractual research projects signed during the fiscal year 1992/1993 was (12) projects with a total budget K.D. 1,654,610 distributed as follows:

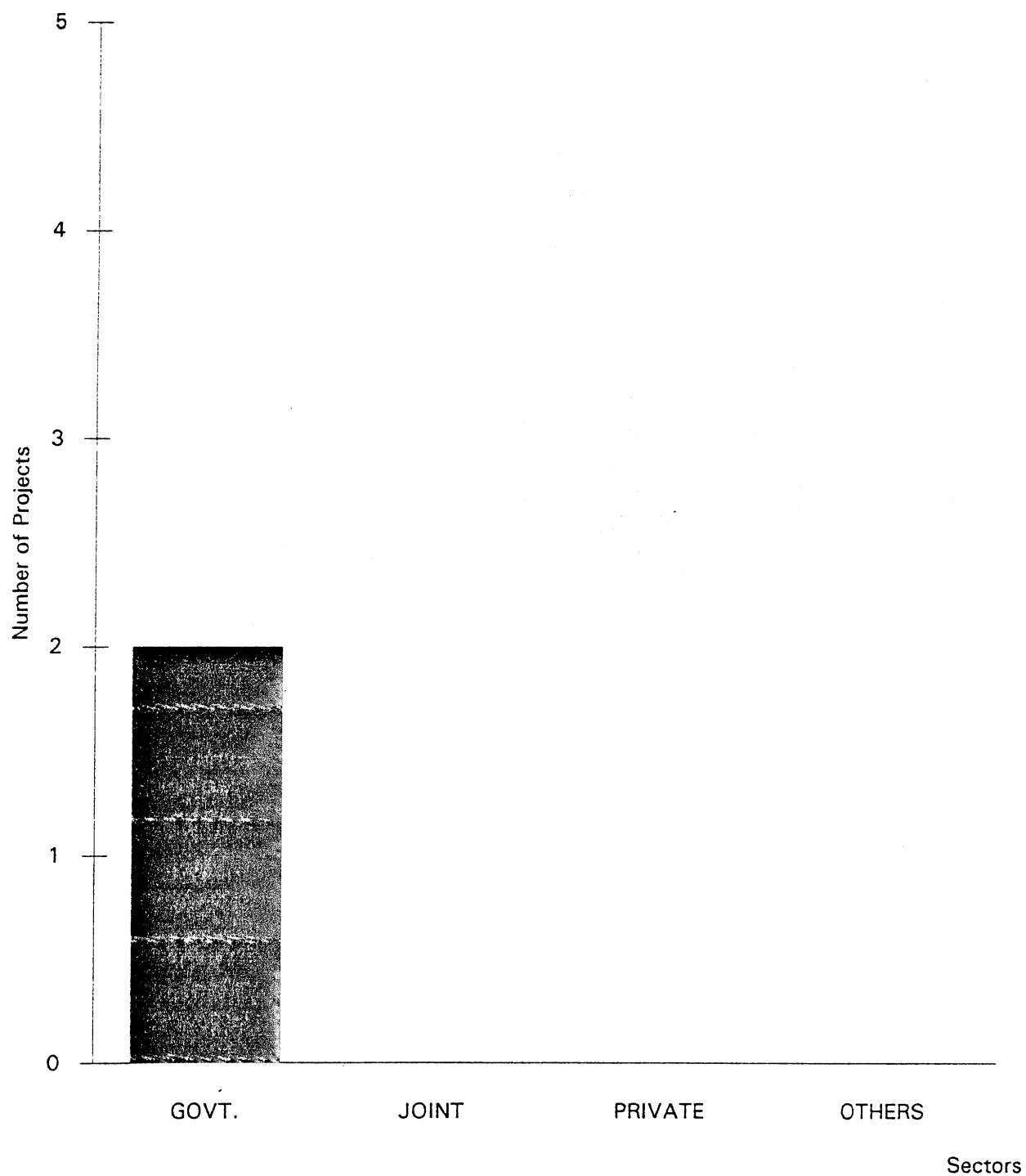
KISR contribution	=	K.D. 373,180	= 23%
Clients contribution	=	K.D. 1,281,430	= 77%

4.2. DIVISIONS:

**4.2.1. DISTRIBUTION OF CONTRACTUAL RESEARCH
PROJECTS OVER DIVISIONS:**

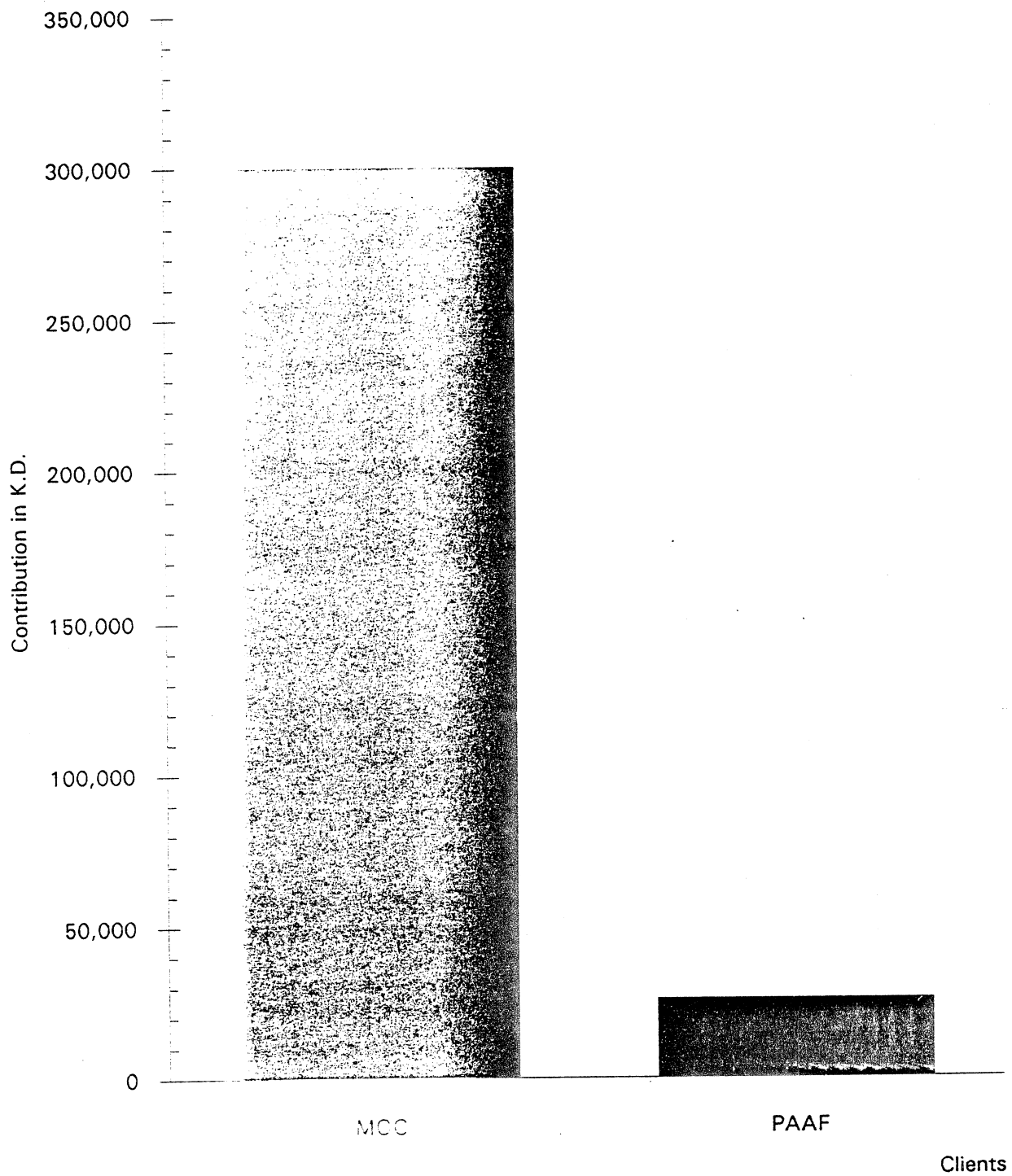
	<u>Number</u>	<u>%</u>
EES	4	33
ENG	2	17
PP & MD	2	17
FRD	2	17
TED	1	8
GENERAL	1	8
WRD	-	0

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED IN THE
FISCAL YEAR 1991/1992 PER SECTOR



(Figure 10)

MAJOR NISF CLIENTS DURING THE FISCAL YEAR 1991/1992



(Figure 11)

**4.2.2. DIVISIONS RANKED IN A DESCENDING ORDER
ACCORDING TO THE BUDGET OF THE CONTRACTUAL
RESEARCH PROJECTS**

	KISR Contribution (K.D)	Clients Contribution (K.D)	Total Budget (K.D)
ENG	29,450	624,770	654,220
EES	106,480	360,000	466,480
FRD	178,150	120,750	298,900
TED	-	85,000	85,000
PP & MD	25,310	57,700	83,010
GENERAL	33,790	33,210	67,000
WRD	-	-	-

(Figure 10)

4.3. SECTORS:

**4.3.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS
OVER SECTORS:**

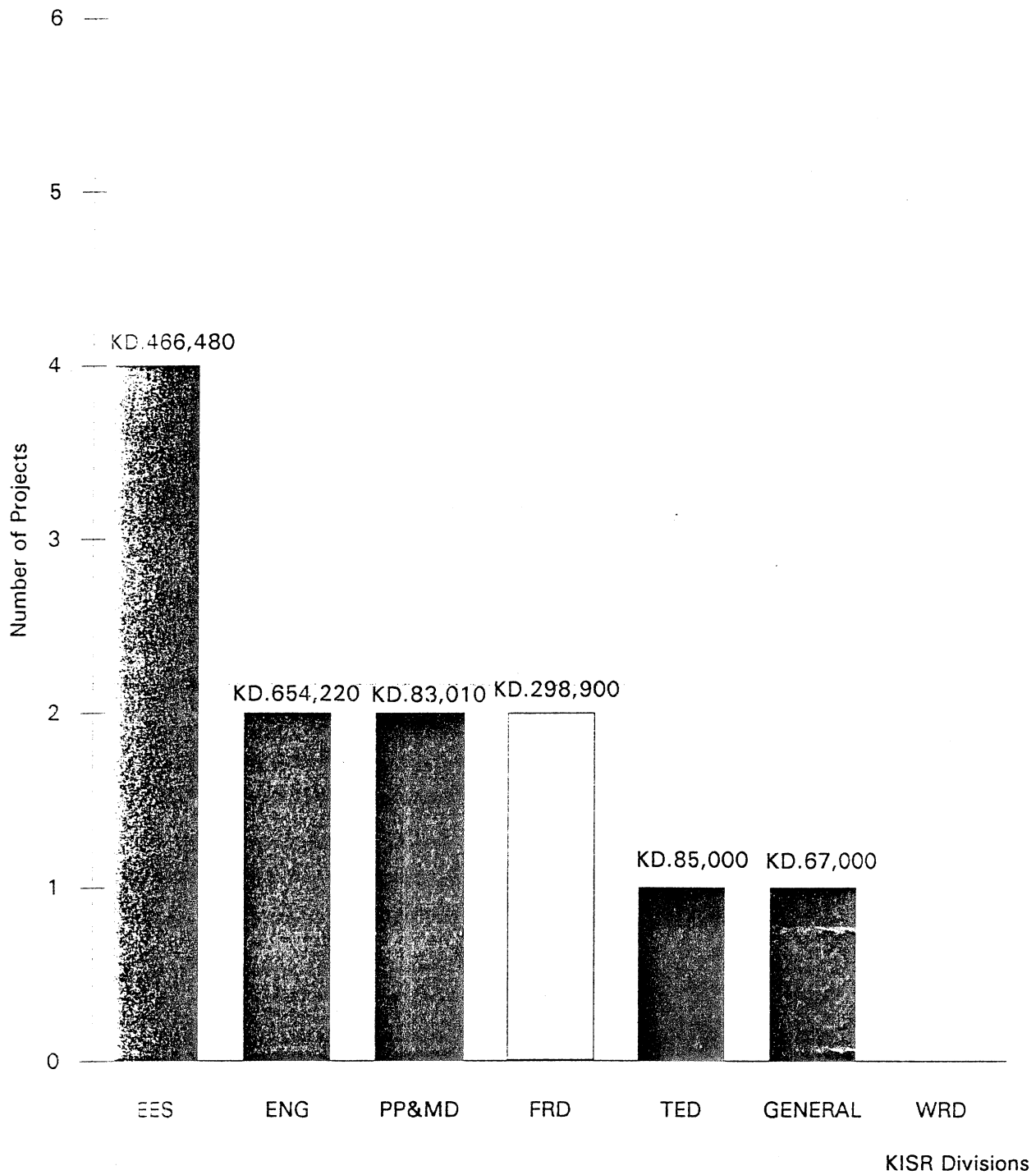
4.3.1.1. GOVERNMENTAL SECTOR:

Number of contractual research projects	=	7
Number of clients	=	6
Total budget of contractual research projects	=	K.D 1,249,690
Sector contribution	=	K.D 1,040,040 = 83%

Governmental sector clients:

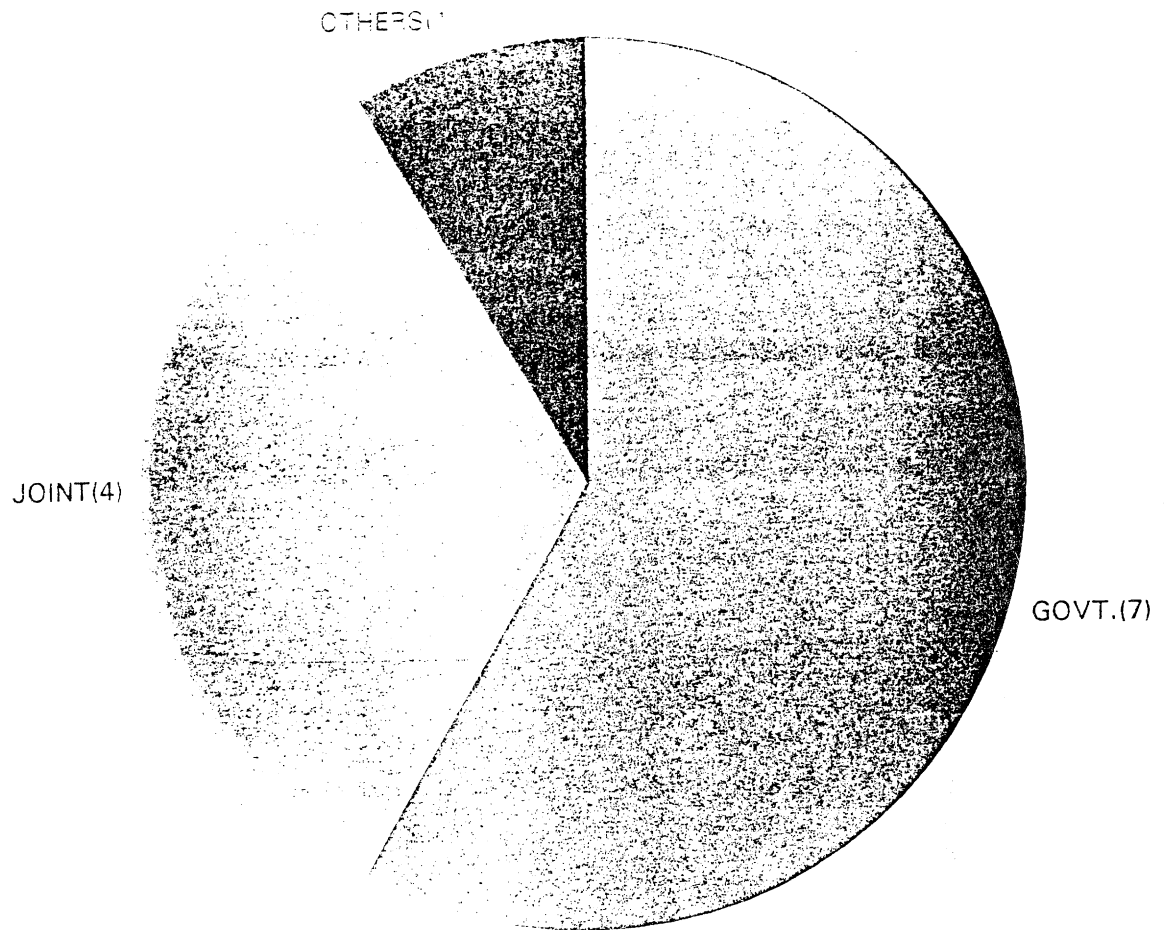
	<u>Number</u>
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	2
Ministry of Electricity & Water (MEW)	1
Environmental Protection Council (EPC)	1
Kuwait Petroleum Corporation (KPC)	1
Kuwait National Petroleum Company (KNPC)	1
Shuiba Area Authority (SAA)	1

TOTAL NUMBER AND VOLUME OF CONTRACTUAL PROJECTS
SIGNED IN THE FISCAL YEARS 1992/1993 PER DIVISION



(Figure 12)

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED IN THE
FISCAL YEAR 1990/1991 PER SECTOR



(Figure 13)

4.3.1.2. Public/Joint Sector:

Number of contractual research projects	=	4
Number of clients	=	2
Total budget of contractual research projects	=	K.D 374,660
Sector contribution	=	K.D 236,440 = 63%

Public/Joint Sector clients

	<u>Number</u>
Kuwait Foundation for the Advancement of Sciences (KFAS)	3
National Industries Company (NIC)	1

4.3.1.3. OTHER REGIONAL AND INTERNATIONAL COMPANIES/ORGANIZATIONAL:

Number of contractual research projects	=	1
Number of clients	=	1
Total budget of contractual research projects	=	K.D 30,260
Sector contribution	=	K.D 4,950

Regional/International Clients:

	<u>Number</u>
Islamic Educational Scientific & Cultural Organization (IESCO)	1

(Figure 11)

4.4. MAJOR CLIENTS:

	<u>Number</u>	Clients Contribution (K.D)	%
Kuwait National Petroleum Company (KNPC)	1	597,540	46.6
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	2	254,000	19.8
Kuwait Foundation for the Advancement of Sciences (KFAS)	3	209,210	16.3

Ministry of Electricity & Water (MEW)	1	85,000	6.6
Kuwait Petroleum Corporation (KPC)	1	52,750	4.1

(Figure 12)

5.0 FISCAL YEAR 1993/1994:

5.1. EXPENDITURE:

Total number of contractual research projects signed during the fiscal year 1993/1994 was (20) projects with a total budget K.D. 1,721,080 distributed as follows:

KISR contribution = K.D. 498,450 = 29%
 Clients contribution = K.D. 1,222,630 = 71%

5.2. DIVISIONS:

5.2.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER DIVISIONS:

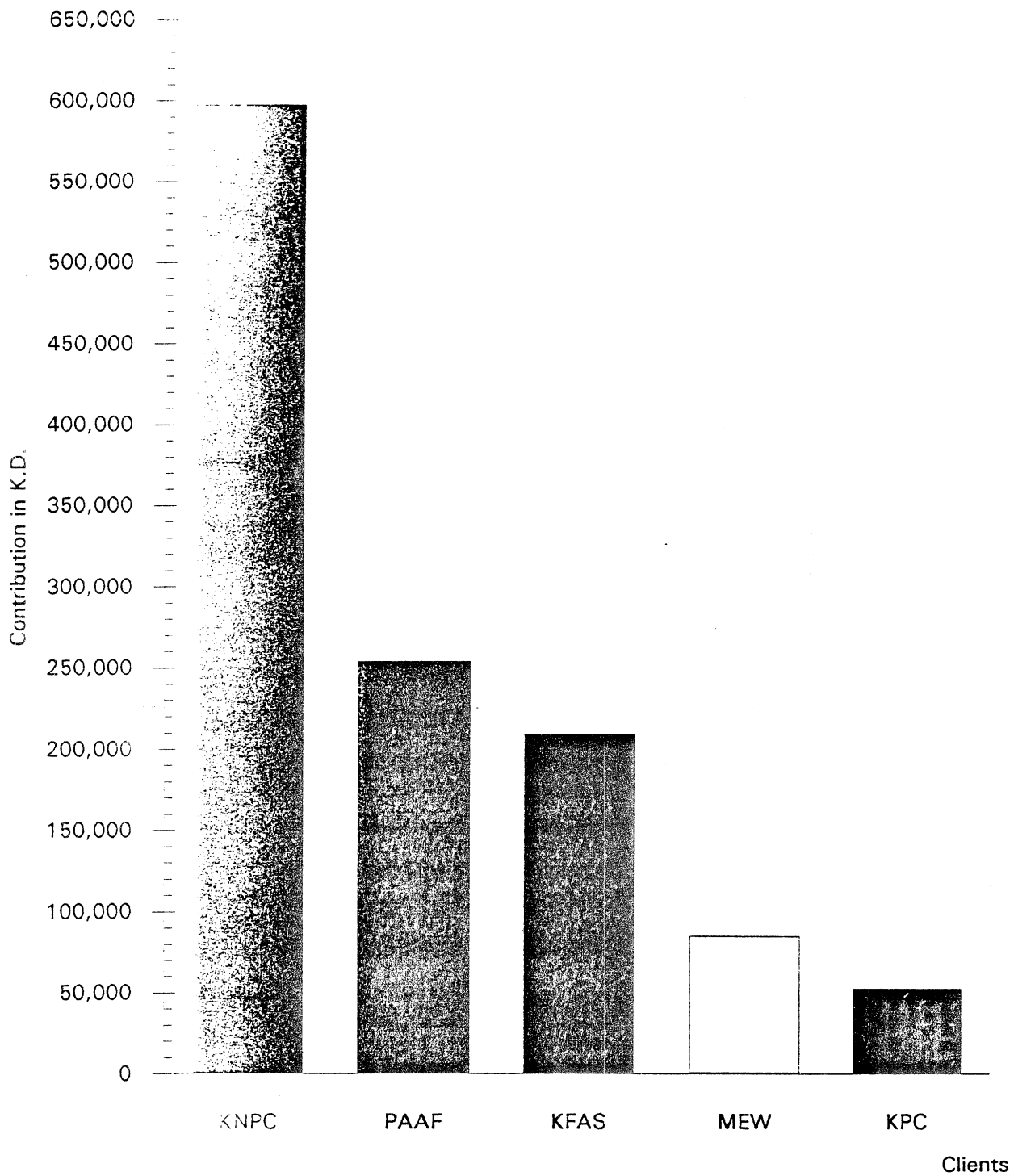
	<u>Number</u>	<u>%</u>
TED	7	35
PP & MD	4	20
EES	4	20
FRD	3	15
ENG	1	5
WRD	1	5

5.2.2. DIVISIONS RANKED IN A DESCENDING ORDER ACCORDING TO THE BUDGET OF THE CONTRACTUAL RESEARCH PROJECTS:

	<u>KISR Contribution</u> <u>(K.D)</u>	<u>Clients Contribution</u> <u>(K.D)</u>	<u>Total Budget</u> <u>(K.D)</u>
FRD	365,220	642,680	1,007,900
TED	22,380	284,330	306,710
PP & MD	94,850	156,220	251,070
EES	16,000	116,000	132,000
WRD	-	21,820	21,820
ENG	-	1,580	1,580

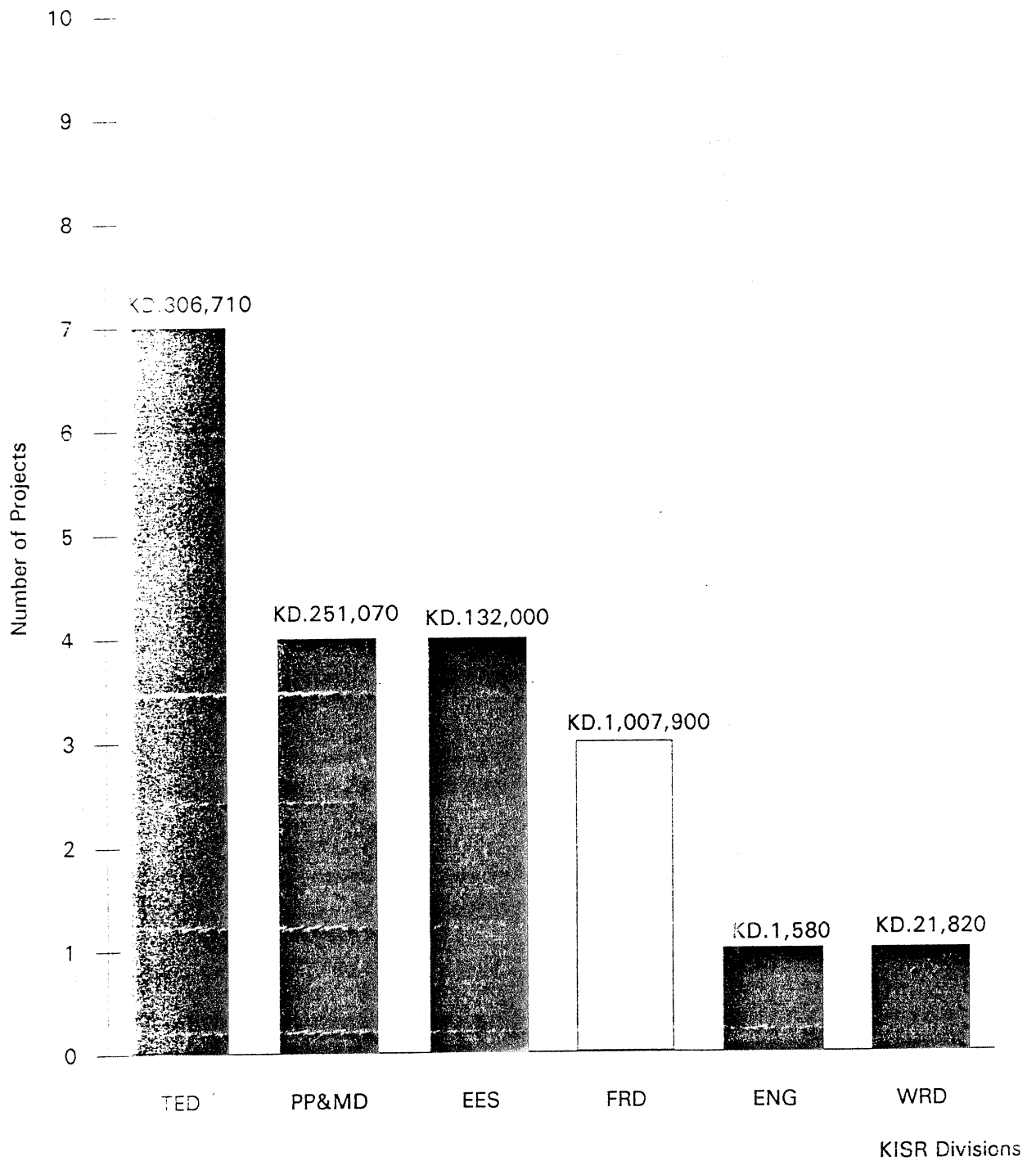
(Figure 13)

MAJOR KISR CLIENTS DURING THE FISCAL YEAR 1992/1993



(Figure 14)

TOTAL NUMBER AND VOLUME OF CONTRACTUAL PROJECTS
SIGNED IN THE FISCAL YEAR 1993/1994 PER DIVISION



(Figure 15)

5.3. SECTORS:

5.3.1. DISTRIBUTION OF CONTRACTUAL RESEARCH PROJECTS OVER SECTORS:

5.3.1.1. GOVERNMENTAL SECTOR:

Number of contractual research projects	=	11
Number of clients	=	10
Total budget of contractual research projects	=	K.D 1,259,920
Sector contribution	=	K.D 928,770 = 74%

Governmental sector clients:

	<u>Number</u>
Kuwait Oil Company (KOC)	2
Kuwait National Petroleum Company (KNPC)	1
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	1
Kuwait Petroleum Corporation (KPC)	1
Council of Ministers (COUNCIL)	1
Environmental Protection Council (EPC)	1
Kuwait University (KU)	1
Ministry of Planning (MOP)	1
Ministry of Public Health (MPH)	1
Ministry of Finance (MOF)	1

5.3.1.2. PUBLIC/JOINT SECTOR:

Number of contractual research projects	=	4
Number of clients	=	1
Total budget of contractual research projects	=	K.D 384,710
Sector contribution	=	K.D 217,410 = 57%

Public/Joint sector clients:

	<u>Number</u>
Kuwait Foundation for the Advancement of Sciences (KFAS)	4

5.3.1.3. PRIVATE SECTOR:

Number of contractual research projects	=	1
Number of clients	=	1
Total budget of contractual research projects	=	K.D 21,000
Sector contribution	=	K.D 21,000 = 100%

Private Sector clients:

	<u>Number</u>
LA'ALA Al-Kuwait Real Estate Co. (LA'ALA)	1

5.3.1.4. OTHER REGIONAL AND INTERNATIONAL COMPANIES/ORGANIZATIONAL:

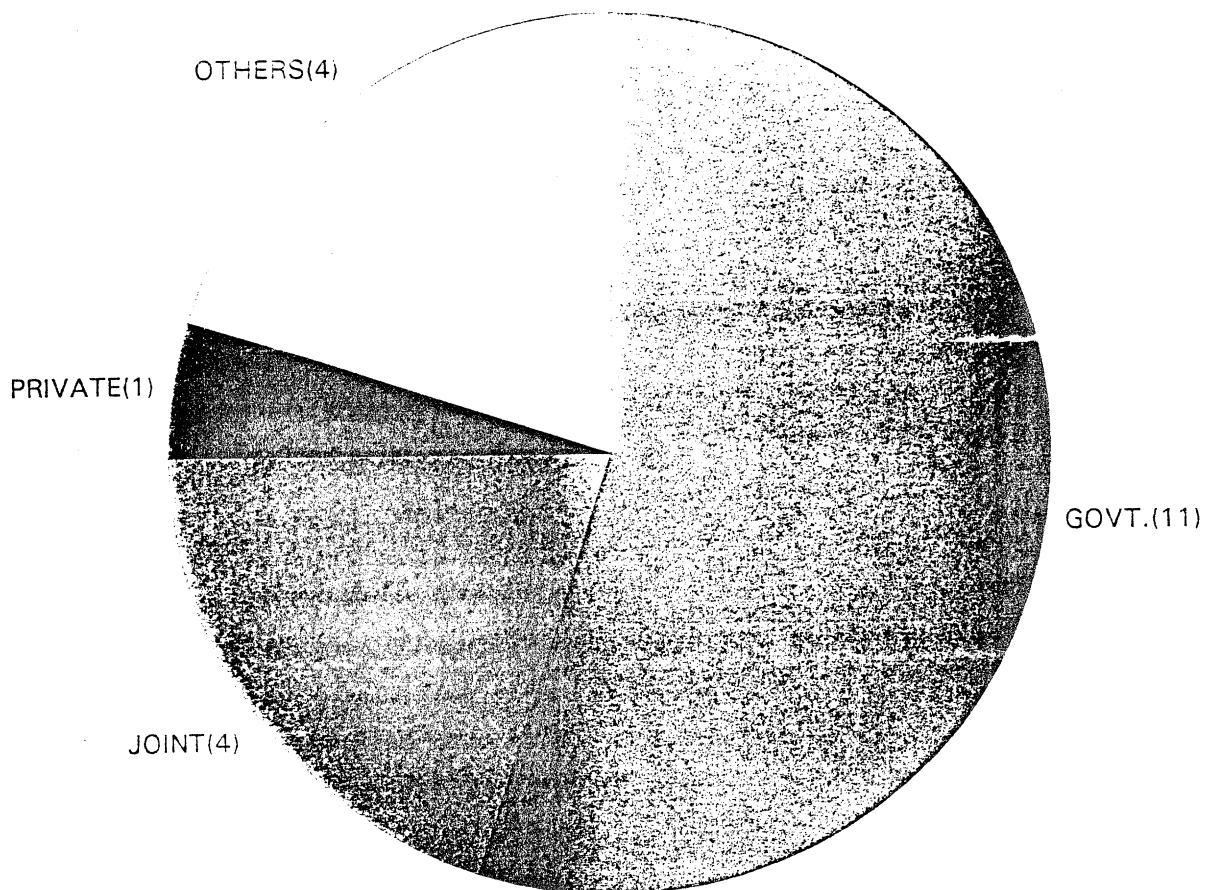
Number of contractual research projects	=	4
Number of clients	=	3
Total budget of contractual research projects	=	K.D 55,450
Sector contribution	=	K.D 55,450 = 100%

Regional/International Clients:

	<u>Number</u>
Public Authority for Assessment of Compensation for Damages Resulting from Iraqi Aggression (PAAC)	2
National Institute for Scientific Research & Environment (NIRE)	1
United Nations (UN)	1

(Figure 14)

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED IN THE
FISCAL YEAR 1993/1994 PER SECTOR



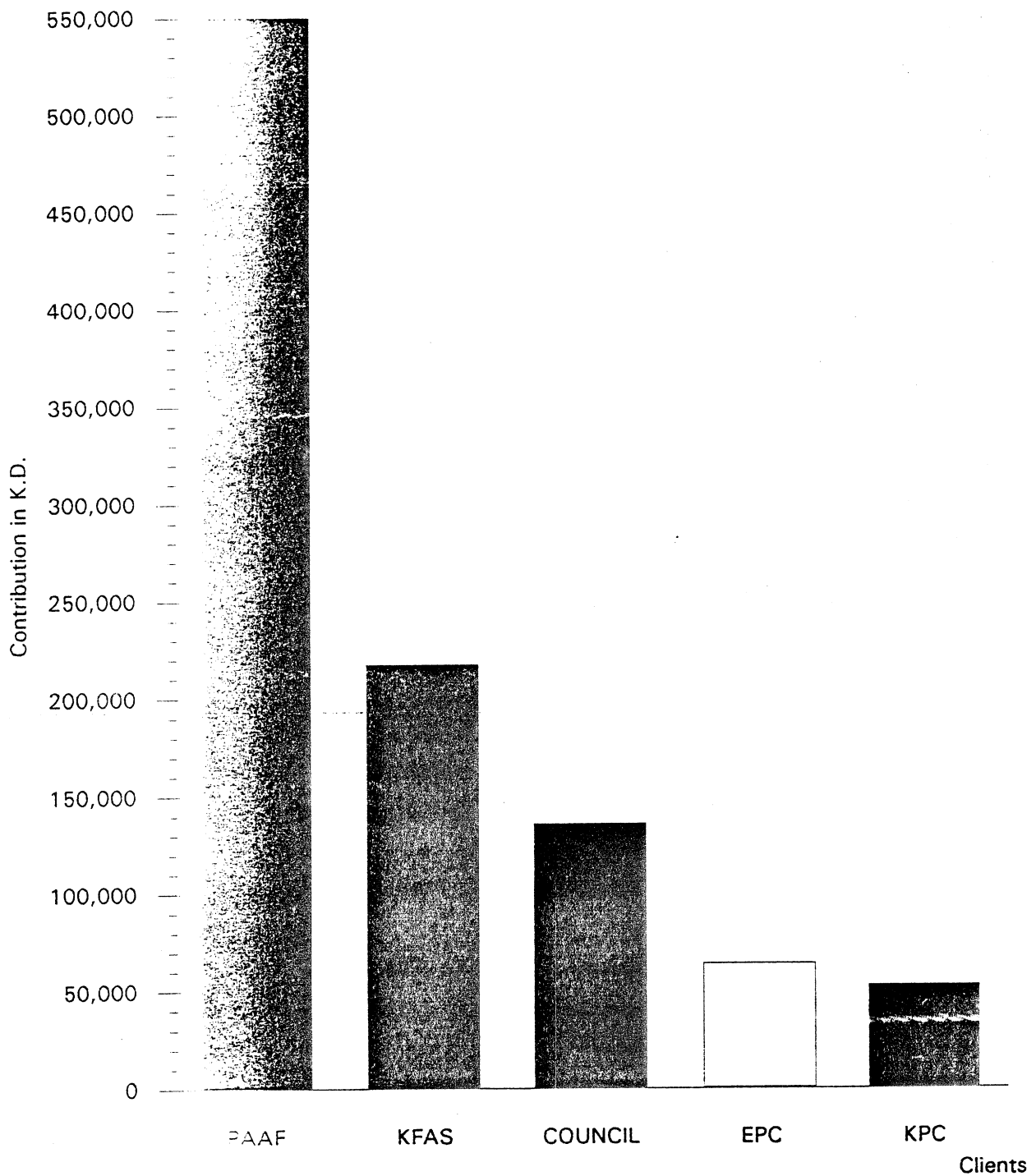
(Figure 16)

5.4. MAJOR CLIENTS:

	<u>Number</u>	clients <u>Contribution</u> <u>(K.D)</u>	<u>%</u>
The Public Authority for Agriculture Affairs & Fish Resources (PAAF)	1	550,000	45
Kuwait Foundation for the Advancement of Sciences (KFAS)	5	217,410	18
Council of Ministers (COUNCIL)	1	135,900	11.1
Environment Protection Council (EPC)	1	64,000	5.2
Kuwait Petroleum Corporation (KPC)	1	52,750	4.3

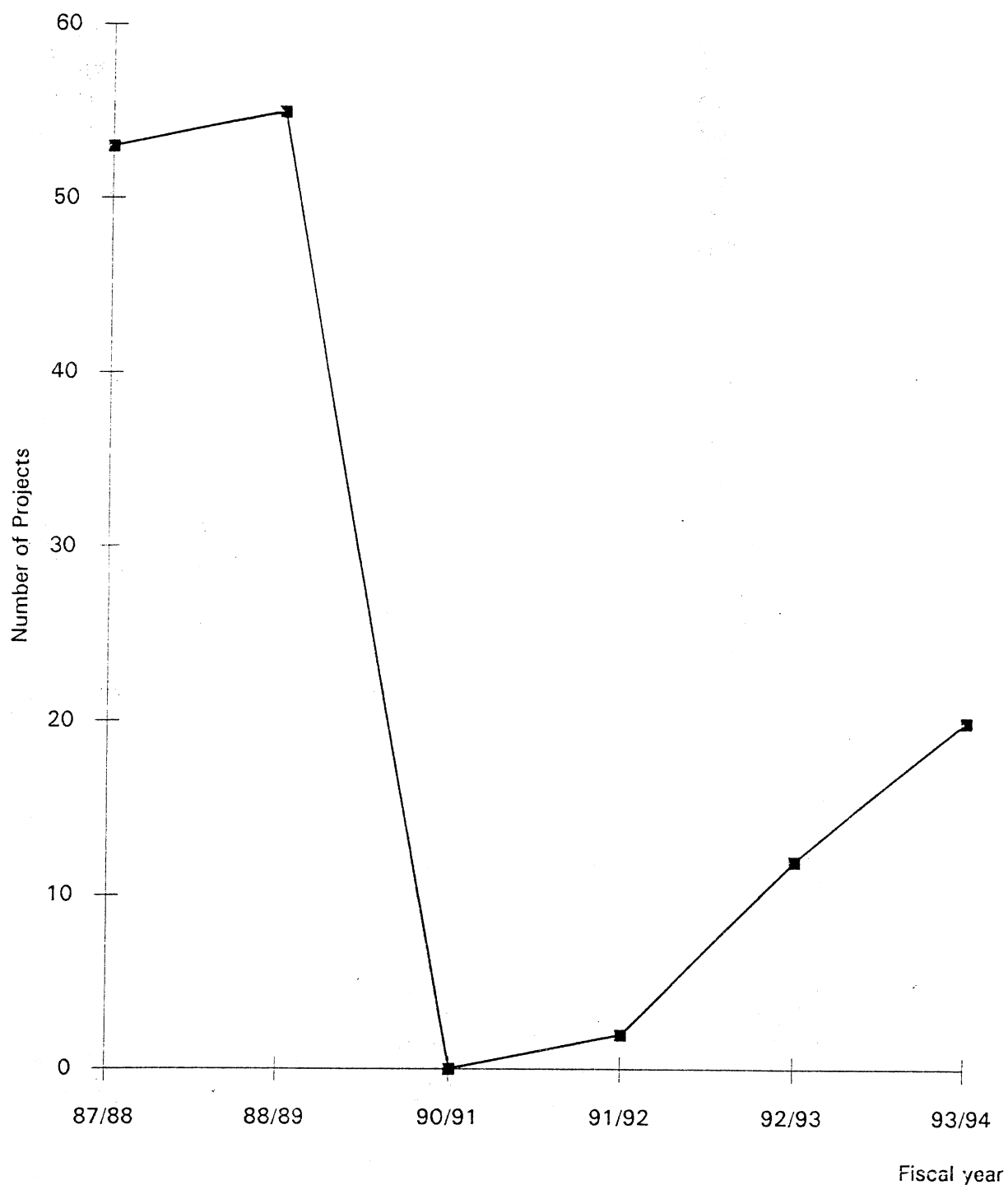
(Figure 15)

MAJOR KISR CLIENTS DURING THE FISCAL YEAR 1993/1994



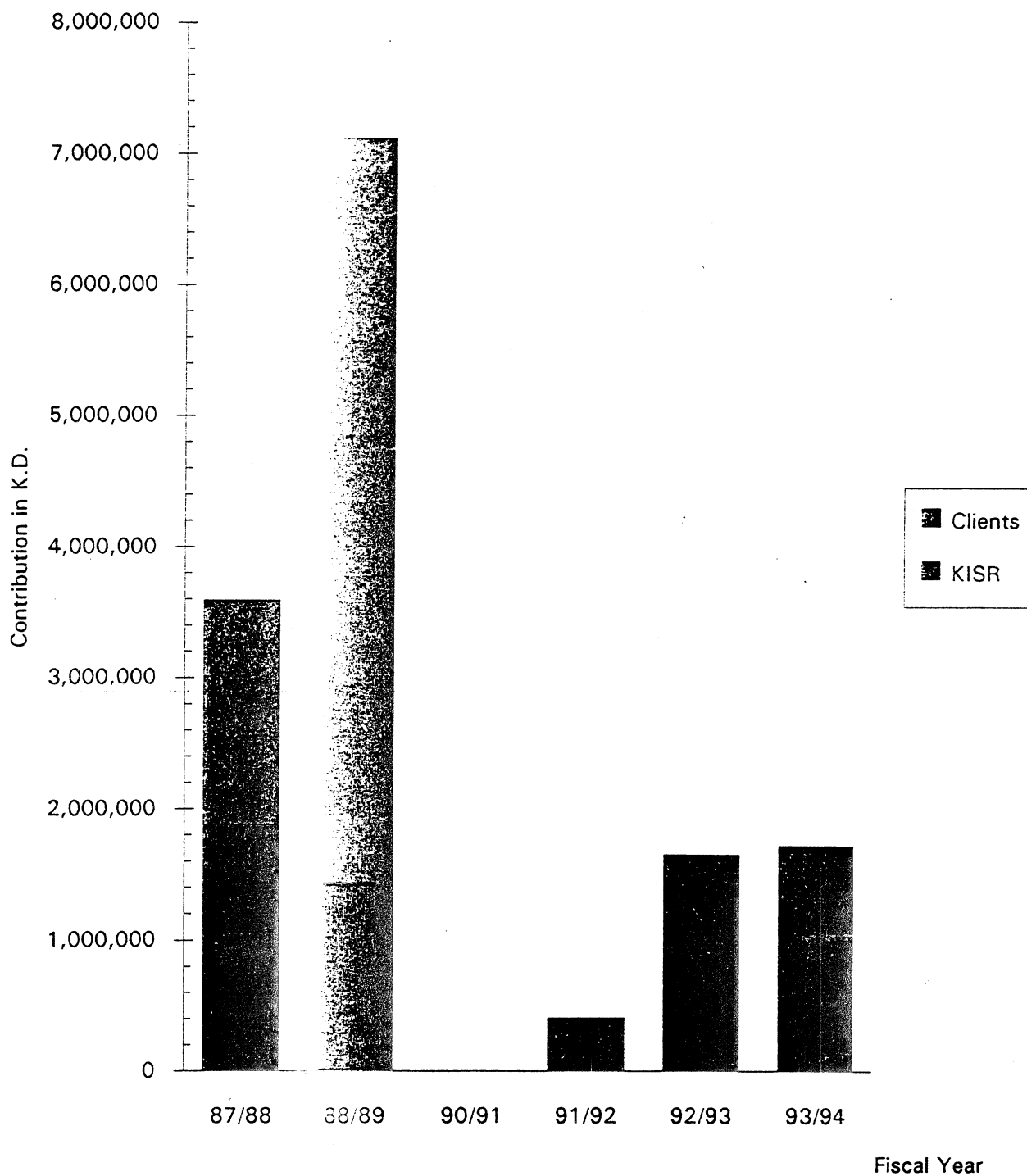
(Figure 17)

TOTAL NUMBER OF CONTRACTUAL PROJECTS SIGNED DURING
THE FISCAL YEARS 1987/88-1988/89 AND 1990/91-1993/94



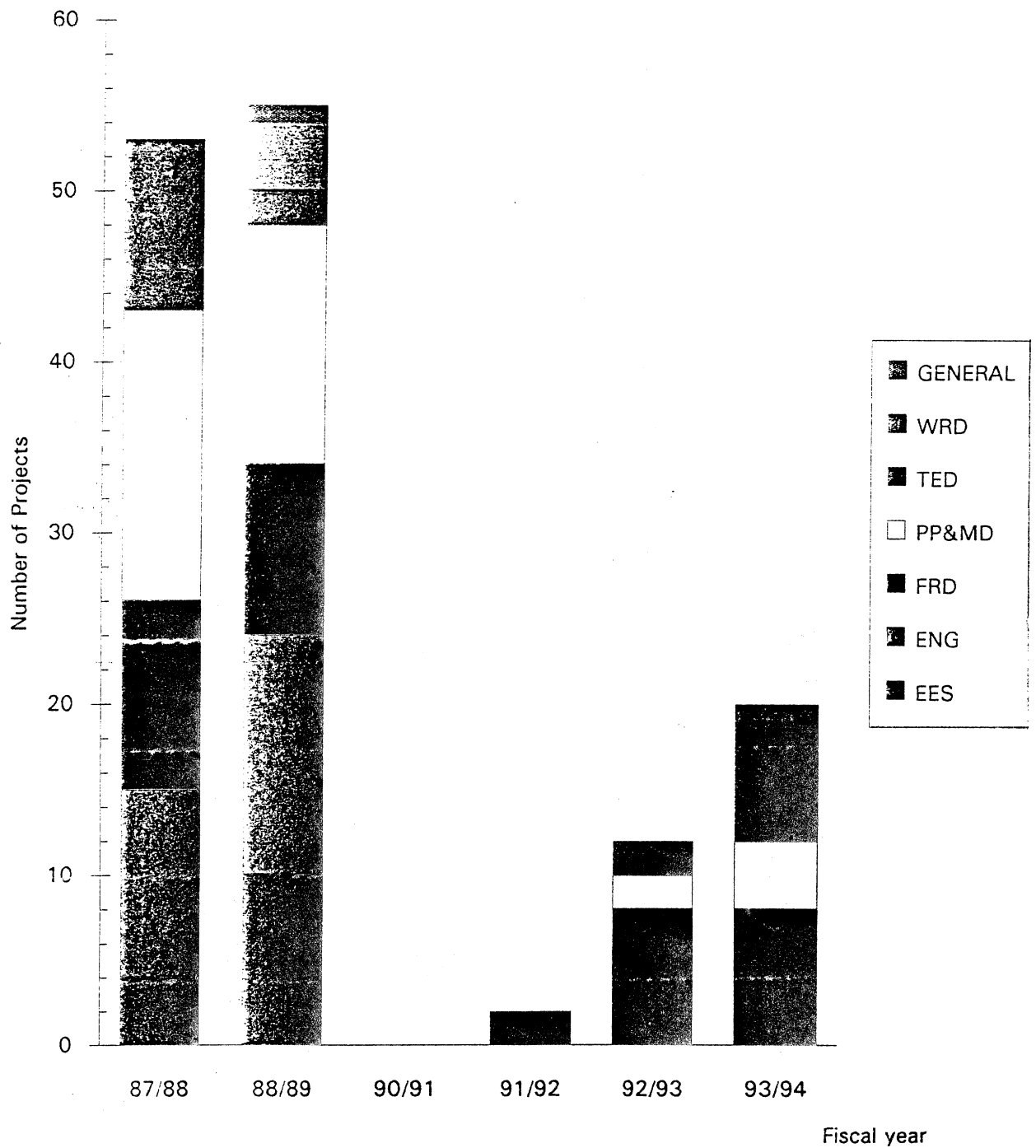
(Figure18)

**TOTAL VOLUME OF CONTRACTUAL PROJECTS SIGNED DURING
THE FISCAL YEARS 1987/88-1988/89 AND 1990/91-1993/94**



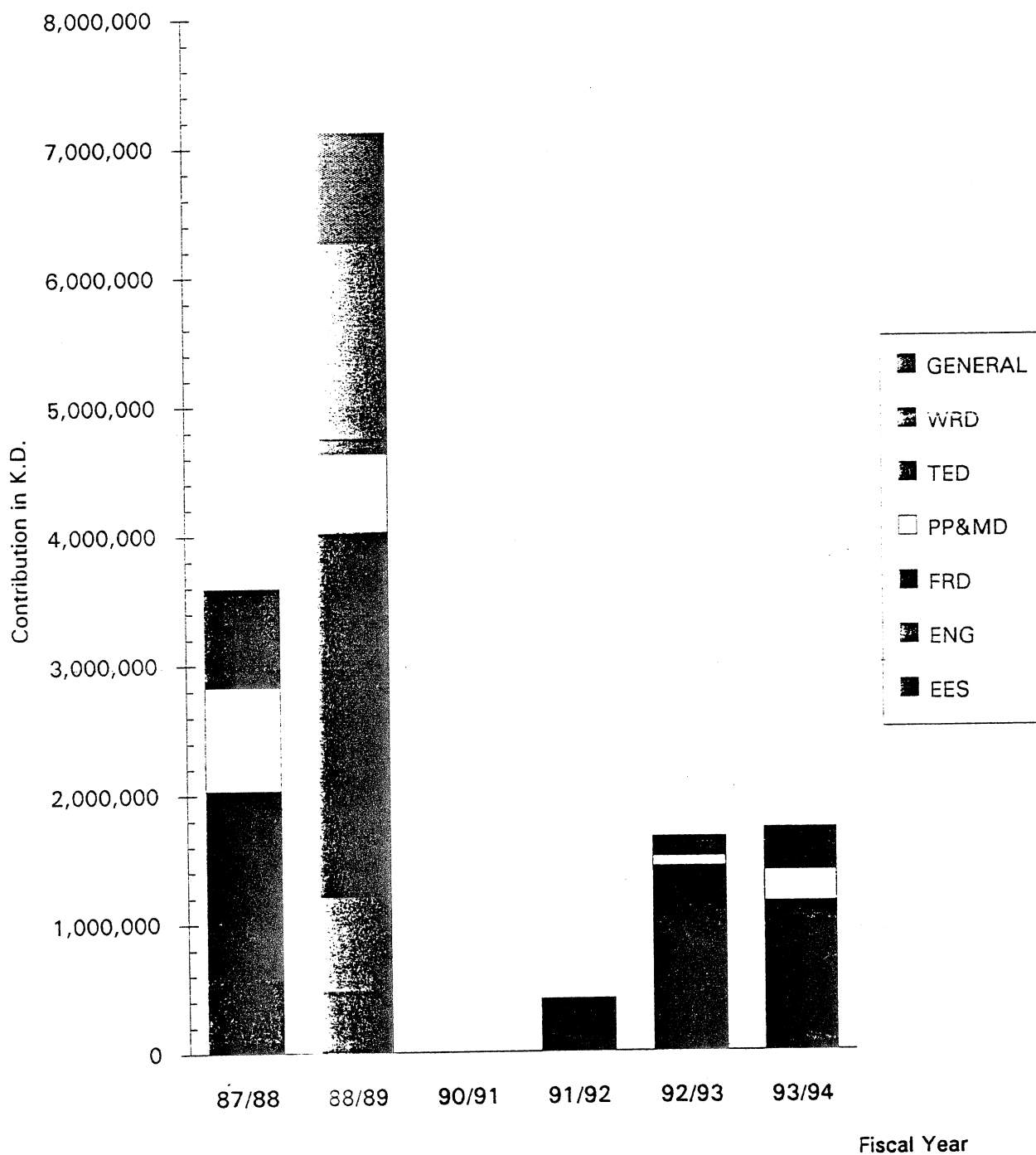
(Figure 19)

TOTAL NUMBER OF PROJECTS SIGNED DURING THE FISCAL
YEARS 1987/88-1988/89 AND 1990/91-1993/94 PER
DIVISION



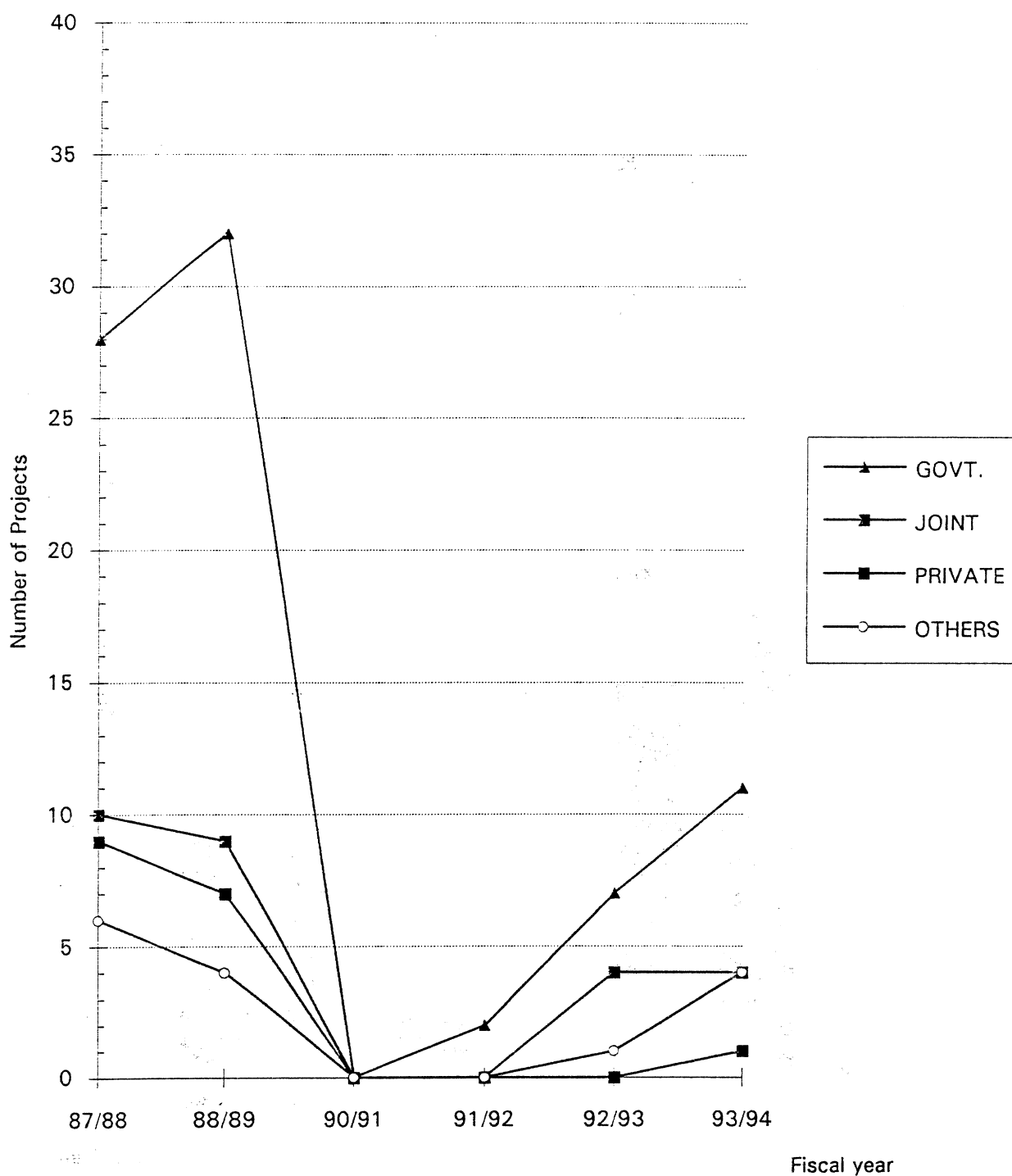
(Figure 20)

TOTAL VOLUME OF PROJECTS SIGNED DURING THE FISCAL
YEARS 1987/88-1988/89 AND 1990/91-1993/94 PER
DIVISION



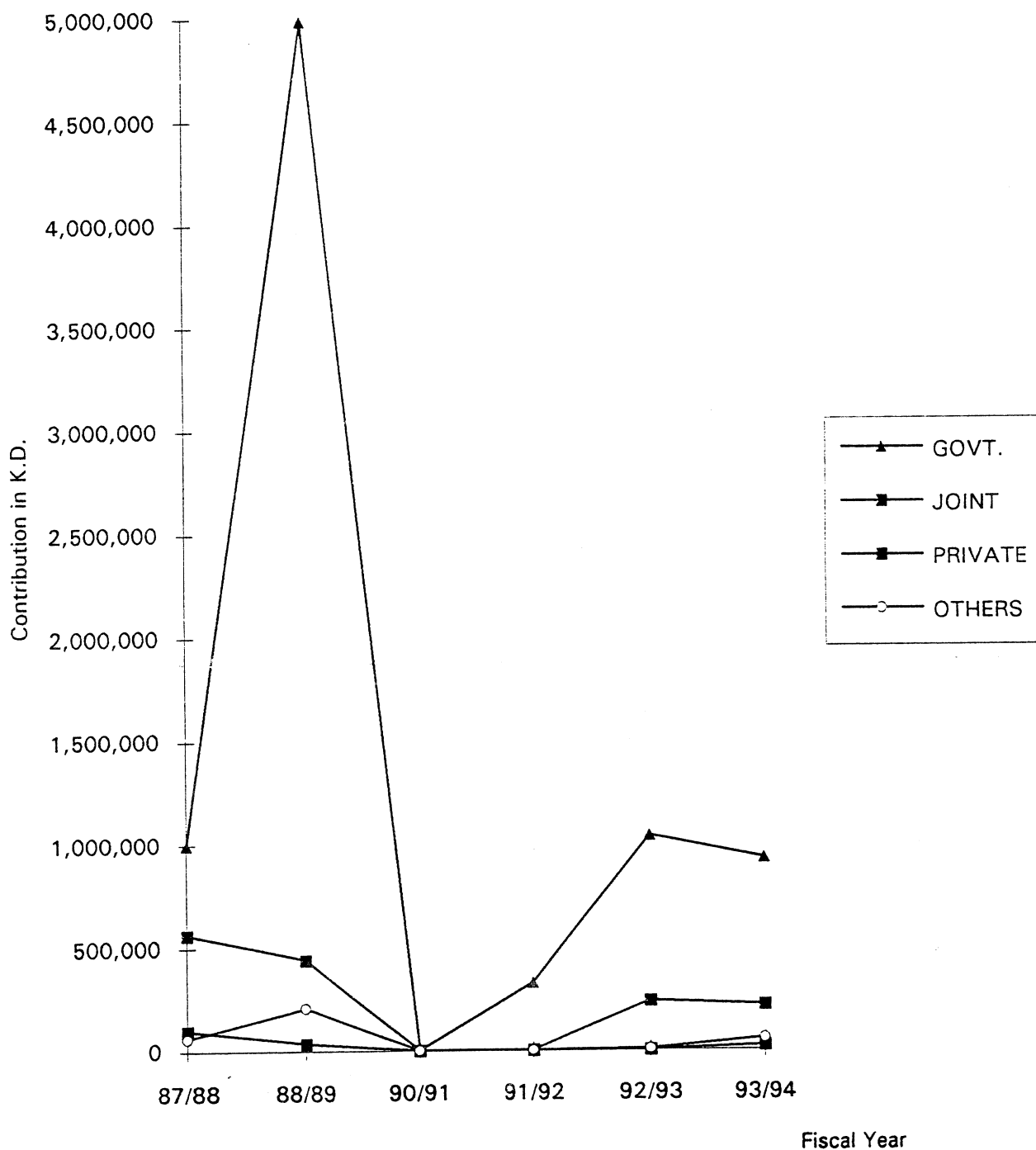
(Figure 21)

TOTAL NUMBER OF PROJECTS SIGNED PER SECTOR DURING
THE FISCAL YEAR 1987/88-1988/89 AND 1990/91-1993/94



(Figure 22)

**TOTAL CONTRIBUTION OF VARIOUS SECTORS FOR
CONTRACTUAL PROJECTS SIGNED DURING FISCAL YEARS
1987/88-1988/89 AND 1990/91-1993/94**



(Figure 23)

Contribution of KISR to National Socio-economic Development Plans

As stated in KISR objectives, mission is to promote scientific and applied research, particularly in matters relating to industry, natural and food resources, and other primary constituents of the national economy, in an endeavor to serve the goals of economic, technological and scientific development, and to offer advice to the government and other sectors.

To achieve such objects, KISR has forced to conduct applied research and development activities closely linked to national needs, whether in the study of national resource base, environment and means of diversifying the national economy, or in solving the problems of individual users in various sector of the economy (4).

The proceeding section has illustrated and outlines KISR performances and outputs and links with various in Kuwait. To account for such efforts, the followings are there case studies exemplifying KISR impacts on socio-economic development plans.

Characterization of spent Catalysts (Petroleum, Petrochemical and Materials Division).

The extent and cause of deactivation of catalysts from different residue hydro-processing units in Kuwait refineries were identified. The characteristics of spent catalysts from two different types of reactor units were compared, and the deactivation patterns of the catalysts in both were examined. Catalysts from both types of reactors had been deactivated primarily by deposition of carbon and metals, particularly vanadium and nickel. In the fixed-bed unit, which consists of a series of reactors, the first two reactors had been deactivated predominantly by foulant metal (vanadium) deposits, whereas the last two had been deactivated primarily by coke deposition. Spent catalyst from the expanded bed type of residue processing unit contained a mixture of highly fouled (high vanadium content) and partially fouled (low vanadium content) catalysts, considerable changes in the physical dimensions (pellet-length distribution) were noticed for the spent catalysts from this reactor unit. Vanadium concentration within a catalysts pellet was maximum near the edge and decreased to a minimum at the center, indicating that pore-mouth plugging by vanadium deposits was the main cause of deactivation in residue hydroprocessing units.

Development of Catalyst Rejuvenation Process

Two processes were developed for reclaiming and rejuvenating of spent catalysts. The reclamation process, applied to partially fouled spent catalysts, involves deolling, sieving, mechanical separation and decoking as unit operations. The rejuvenation process, applied to medium and highly fouled spent catalysts, involves, in addition to the unit operations of the reclamation process, a foulant-metal leaching step. Detailed studies were conducted on the unit operations below.

Decoking

Decoking studies were directed to gaining a better understanding of the changes brought about to the Catalysts physico-chemical characteristics and performance by varying the parameters that influence the coke-burning rate. Furthermore, optimum regeneration conditions to maximize activity recovery without damaging the catalysts useful properties were established. Maximum surface area and activity recovery were noticed for catalysts regenerated under the following conditions: start-up temperature 400 C, oxygen content 2-5% (Vol.) and gas flow rate per unit weight catalyst 1.5 l/h. Extensive sintering and activity loss were noticed at higher start-up temperatures. A substantial decrease in the amount of molybdenum and increase in the alumina phase transformations were noticed at higher temperatures. Proportion of longer particles (> 2.5 mm) than did the heavy portions. About 95% of the catalysts original HDS activity was recovered for this catalyst by a simple decoking procedure, indicating that the light catalyst portions reclaimed by mechanical separation are suitable for reuse.

Mathematical Modelling

Kinetic models for leaching and decoking processes were developed. For leaching neither chemically controlled nor diffusion-controlled kinetics completely explained the results. A model based on mixing chemical (low leaching) with diffusion kinetics (high leaching) gave a reasonable prediction of the results. Similarly, for coke combustion, the reaction rate was not controlled by either the chemically or diffusion-controlled regions.

Preliminary Economic Assessment

A preliminary economic assessment of the rejuvenation process based on three options showed the following results. With option iii, dealing with light catalyst

portions, the internal rate of return (IRR) is 28% which is above the accepted level of profitability in Kuwait. With option II, dealing with the rejuvenation of light and medium-dense catalyst, the project is commercially feasible, the internal rate of return (IRR) is about 24% within the commercially accepted profitability levels in Kuwait. With option I, which deals with the rejuvenation of the entire spent catalyst (heavy, medium and light portions), the project would generate a negative cash flow in the first year of production and a positive profit thereafter IRR is 13.4% which is below the minimum attractive rate of return (15%). In short options II and III are commercially feasible, whereas, whereas option I is not.

Conclusion

The project fulfilled its stated objectives. In addition to the development of economically feasible and technically effective processes for reclaiming and rejuvenating spent hydroprocessing catalysts, it was possible, through on-the-job training, to enhance the experience of four Kuwait research staff in areas related to the field. Although the developed processes were found feasible, a number of improvements are recommended to optimize them and to reduce the environmental effects of some by-products.

Foulant-metal Leaching

The purpose of the foulant metal leaching studies was to develop a process for the selective removal of the main metal foulant (vanadium) from catalyst pores and increase the catalyst surface area, porosity and activity. A major emphasis was placed on the factors influencing the selectivity, the activity improvement and the mechanism of vanadium leaching. Two routes were taken to leach foulant metals from the catalyst: the first, the deoiled spent catalyst containing coke and deposited metals in the sulfide form was treated with chemical reagents, in the second, the deoiled spent catalyst was decoked, and the resulting coke-free catalyst containing the metals in the

oxide form was chemically treated. The selectivity for vanadium extraction was better, and activity recovery was higher for the coked than the decoked catalyst. Reagents containing a mixture of a complexing agent and an oxidizing agent were more effective for vanadium leaching from the coke catalyst. For decoked catalyst, the complexing agent alone was effective for leaching, but selectivity and activity recovery were low. The relationship between the amount of vanadium removal and the recovery of surface area, pore volume and hydrodesulfurization (HDS) activity were examined. The HDS activity and the physical and mechanical properties of the catalyst rejuvenated by this route (leaching with coke) were close to those of the fresh catalyst. The observed differences in the leaching behavior of the metals from coked and decoked catalysts were attributed to differences in the oxidation of the metals present in both types of catalyst. A synergistic oxidizing-complexing mechanism appeared to be responsible for the enhanced leaching and improved selectivity for vanadium removal from the coked catalyst.

Mechanical Separation

Research on mechanical separation was designed to develop a process for reclaiming partially contaminated catalyst from the heavy fouled high density portion using mechanical separation techniques based on density differences. Two gravity separation techniques-shaking table and jigging-were used, and their separation efficiencies were evaluated. In general, jigging was found to be the more effective giving better size-and density-grading of the catalyst pellets. Operating parameters were optimized for efficient separation using water and kerosene as liquid medium. Kerosene was the more advantageous, since catalyst deolling prior to the separation step can be omitted. The light portions represented about 25-30% of the total spent catalyst. They contained a low percentage of the foulant metal (vanadium) and a higher.

Fisheries and Marine Biology & Oceanography (Food Resources Division)

The Fisheries, Marine Biology & Oceanography Program was oriented toward the development of a long-term strategy and plan for the fisheries of Kuwait.

Major achievements include:

- provided management recommendations for the shrimp fishery based on technical data gathered, on:
 - manipulation of closing dates,
 - establishment of a two stock management policy,
 - mesh size regulation,
 - closure of fishing in Kuwait Bay,
 - importance of three mile coastal zone wherein trawling is forbidden,
 - optimization of the biovalue of the landings, and
 - moratorium on new licenses and removal of boats,
- established ageing techniques of local finfish fishery,
- provided a conservation measures for coral reefs and pearl oyster stocks,
- established monitoring scheme for oceanographic parameters, and
- devolved a "Strategic and Master Plan" for the optimal long term development of Kuwait's Fisheries.

Contributions to the Industry

Aquaculture

The technology developed at the MFD for culture of Sobaity, Hamoor and Bulti has direct implementation to increase the availability of fresh fish in the local market. The present annual shortfall in the local supply of fresh fish is about 7,500 tons and it is estimated that the gap between supply and demand of fresh fish will increase over the next 15 years. Aquaculture is the practical and more economical way to produce fresh fish to the market. The technology developed and refined at MFD encouraged the government to establish a semi-private company (Bubiyah Fisheries Company) to invest on aquaculture. As a result of the commercial production of fresh fish has already been established in Kuwait by Bubiyah Fisheries Company and currently 160 tons of fish is being produced annually and 400 tons is expected to be produced within the next 2 years. It is estimated that about 2,000 tons of cultured fish can be produced annually within the next 15 years.

The production technology developed for Sobaity can yield import reduction of over 1,200,000 K.D. per year, or 12,000,000 K.D. over a ten year period. It is expected that production will exceed these values as the technology is refined, and costs are reduced.

MFD has also developed an economical technology for the growout of Bulti in brackish water integrated with vegetable farming in Wafra and Al-abdally. This integration could increase the efficiency of water use and the utilization of farm facilities without increasing the present amount of pattern of utilization of irrigation water. The commercial analysis demonstrated that such integration system is profitable at production rate 2.5 t/year per well. Assistance by MFD to the farmers include providing a structural layout/diagram of the fish farm and supply of tilapia fry as well as supervision on the overall layout of operation of the farm.

Integration of Bulti production with alfalfa production alone can conserve resources and also make major reductions in fish import costs. Conservatively over the next few years this development can help produce 600 tons of Tilapia per year, also with an impact substitution value of over KD. 1,200,000.

Fisheries and Marine Biology & Ocenography

Management of the resources has required detailed studies of biological life cycles, oceanographic parameters, and fish growth, age, and fishing effort. The objectives of this program have been to obtain the essential data to make sound recommendations that will help the Government increase and maintain higher fishing yields in total, and per unit of effort.

The outcome of research activities on shrimp stock assessment and implementation of the recommendation to conserve the shrimp stock, played a significant role in the enhancement of the stocks.

Application of stock management measures recommended through research activities has led to an increase in shrimp catch from 1,500-2,000 tons in the early 1980's to 4,000-5,000 tons in 1988/1989. This increase of 2500 metric tons per year has an annual export value in excess of KD. 12,000,000. This increase in catch is believed to be mainly due to the implementation of the recommendation based on MFD research and to the enforcement of the regulation to preserve the shrimp stocks.

In addition, the research included work on various marine ecosystems such as the coral reef and the pearl oyster stocks. The production of these ecosystems can benefit socially and economically.

Code of Practice for Energy Conservation in Buildings (Energy Division)

The economic boom experienced by Kuwait since the commencement of oil production in the early fifties, coupled with the low price of electricity for the consumer (KD 0.002/KWh) for over 20 years, resulted in a rapid expansion in the construction and development field year after year and brought about an increasing demand for electrical energy. The annual increase for this demand was in the range of 20-50% during the fifties and sixties, reduced to around 10-14% in the past few years. The building sector (residential, commercial and institutional buildings) accounts for the bulk of the national demand for electricity. Further, in view of the extremely hot summers, the air conditioning equipment is estimated to account for 60-70% of the peak demand and 50-60% of the annual energy consumption of buildings. In response to the rapid increase in demand for electricity, therefore, conservation measures had to be introduced to curtail the energy requirements for the air-conditioning of buildings. The Ministry of Electricity and Water (MEW) was quick to appreciate the implications of the situation early in 1975, and worked in cooperation with the Ministry of Public Works (MPW), towards devising appropriate measures to conserve energy. Since the electrical consumption in buildings represented a large portion of the total produced, emphasis was justifiably placed on the application of the thermal insulation and other conservation measures in buildings.

As an interim measure in 1980, MEW (1983 a) introduced temporary guidelines and regulations for the application of thermal insulation by limiting the allowed overall conductive value (U) for walls and roofs. The guidelines were based on rather limited field experience and on manufacturer's data for the thermal properties of construction materials. MEW concluded an agreement with the Kuwait Institute for Scientific Research (KISR) to conduct the necessary investigations leading to the development of a comprehensive code. The results of the investigations coupled with practical experience, served as a basis for the present Code of Practice for Energy Conservation in Buildings (1983 b). The present code of practice lays out rules and regulations governing the application of thermal insulation and other conservation measures (such as area and type of glazing, shading, ventilation and air infiltration control) in the construction of new buildings. The code specifies limits to peak load requirements for air-conditioning and lighting for different types of buildings according to end use. To meet these basic requirements, the code stipulates that certain minimum standards for energy conservation measures be adhered to.

These standards requirements set the minimum requirements for wall and roof insulation and for glazing. The code further stresses the necessity of taking appropriate measures to ensure that ventilation levels are within the acceptable values as recommended by ASHRAE (1977) and of using heat recovery devices when the fresh air intake exceeds 25% of the supply air.

The basic energy conservation standards for different types of buildings were arrived at through extensive analytical investigation to assess the impact of a variety of energy conservation measures on the peak load and total energy consumption for different type of buildings. An economic optimisation analysis was then performed to come up with the optimum combination of measures relating to national and consumer interest. The development of the basic requirements thus consisted of four major stages as follows:

- An analysis of the effectiveness of various conservation measures on the peak load and annual energy consumption of a selection of typical residential, commercial and institutional buildings in Kuwait.
- An economic optimisation for the selection of the best conservation measures to maximise the benefits to the national economy without jeopardising the interests of consumers.
- Definition of a peak cooling load criterion and associated minimum levels of energy conservation measures.
- Definition of simple and standard methods of peak load calculation for verification of compliance with the code.

The procedure for verification and approval of electrical system design, and electrical equipment and appliances, existed prior to the introduction of the code for energy conservation. However, it was extended to include the regulations related to energy conservation. The breakdown of responsibilities of the various agencies with the enforcement of the code is as follows:

- MEW: Approval of W/m^2 calculations for A/C and lighting. Approval of all electrical drawings before obtaining building permit from the Kuwait Municipality. Approval of all conservation measure. Approval of KW/t for A/C systems and equipment.
- Kuwait Municipality (KM): Approval relating to compliance with zoning regulations. Inspection, during construction, of insulation materials and 0 glazing application.
- MPW: Testing and certification of building materials, including all insulation materials and systems.

The impact of the energy conservation code can be observed in three different areas; economical, environmental and sustainment of energy resources. An estimate on the economical impact of the code over a period of eight years since its implementation was conducted on the houses built by the National Housing Authority and the total savings were found to be KD 147.5 million. This figure is expected to rise even further if the commercial and institutional sectors were included in the estimate. Since the generation of electricity is and will continue to be based on burning of fossil fuel with the reject heat being dissipated into the Gulf, then any reduction in the rate of burning and the total amount of fuel used would necessarily reduce the level of air and water pollution associated with the process. Reducing the rate of burning and the amount of fuel used would also reduce the rate of oil to fuel conversion for the generation of electricity resulting in a less oil consumption for electric power generation.

Performance and Achievements of KISR

Since 1981, when an Amiri-decree enacting law was promulgated, KISR has a new definition of mission and objectives, and has achieved the autonomy that demands greater responsibility and stringent criteria of performance. The aim of KISR was thus to embark a new phase of consolidation and greater effectiveness that reflects the interest and desire of Kuwait to make it a vehicle of progress in the country.

To achieve its objectives KISR management has in addition to recruiting qualified nationals and expatriates (see table 1 and figures 1 & 2), has established six research program (division) in addition to several units, namely:

- o Food Resources
- o Water Resources
- o Petroleum, Petrochemical and Materials
- o Environment and Earth Science
- o Engineering
- o Techno-economics

A survey of research projects executed in contractual basis was carried out, KISR in whereby their funding, in part or in totality, was secured by clients. The survey encompasses distribution, divisionwise and sectorwise, of the contractual research projects carried out during the fiscal years 1987/1988-1988/1989 and 1991/1992-1993/1994.

It is to be pointed out that the survey covers two periods of time, before and after the Iraqi occupation to Kuwait, in an attempt to evaluate the impact of the crisis on KISR's human resources, research activities and sectorial needs priorities.

The surveyed research projects have been categorized for each fiscal year according to the follow terms:

- (a) Expenditure
- (b) Divisions (entrepreneur at KISR)
- (c) Sectors
- (d) Major clients

Contribution of KISR to National Socio-economic Development Plans

As stated in KISR objectives, mission is to promote scientific and applied research, particularly in matters relating to industry, natural and food resources, and other primary constituents of the national economy, in an endeavor to serve the goals of economic, technological and scientific development, and to offer advice to the government and other sectors.

To achieve such objects, KISR has forced to conduct applied research and development activities closely linked to national needs, whether in the study of national resource base, environment and means of diversifying the national economy, or in solving the problems of individual users in various sector of the economy (4).

The proceeding section has illustrated and outlines KISR performances and outputs and links with various in Kuwait. To account for such efforts, the followings are there case studies exemplifying KISR impacts on socio-economic development plans.

KISR Future Research Plans

Needless to say, R & D activities are not only sustaining and continuous processes, but rather is a changing process regarded as an integrated and important portion of the national Socio-economic development plans. Realizing these issues, KISR management planned to develop strategical research Programme for KISR every five years to allow for any adjustment, change needs requested by government agencies and other sectors in the economy.

The Forth Strategic Program (1995-2000) was prepared with full Knowledge of KISR's prior organizational developments, and also with understanding or cognizance of the meaningful accomplishments which had already been achieved. Past and current achievements serve as realistic indicators of whether or not the proposed plans could be executed during the plan period. At this 1995 critical stage in Kuwait's national reconstruction and development, KISR is being especially challenged to use this Fourth Strategic Program Plan to bring science and technology squarely into the national development process. KISR endeavors to fulfill this challenge, inspire of the sectoral and national constraints which it faces, or will presumably face in the future.

The guidelines for the preparation of this documents were, therefore, based on the constraints which were perceived to exist at this time, and on KISR's perception of the over-all implications which the anticipated sectoral/national constraints will have on its ability to carry out its function over the next five years.

Organization and Implementation of R & D Planning Process

A Task Force was formed with several committees to assure preparation of the optimal Program Plan. The compositions and responsibilities of the committees were as follows:

Steering Committee

The Steering committee which was chaired by the Director General, included the Deputy Director Generals, the Assistant Director General, and the Director of the

Division of Policy and Planning. This Steering Committee had the following responsibilities:

1. Provide over-all guidance and guideline refinements for documents preparation.
2. Review each of Division inputs.
3. Review the consolidated draft document as prepared by the Core Preparation Committee.
4. Arrange for external review of the draft of Fourth Strategic Program.
5. Review the revised draft.
6. Submit finished document to the Board of Trustees for input and approval.
7. Submit the approved document to relevant external organizations.

Operational (Divisions) Input Committees

The Operational Input Committees, one for each Program, were comprised of Program Managers, Program Element Managers, selected specialists, and 4-6 (in each Program) outstanding sectoral leaders. These Operational Input Committees had the following responsibilities:

1. Review past achievements and draft priority plans for the next five years.
2. Submit Proposed Program to the Director General.

Core Preparation Committee

The Core Committee, comprised of the Assistant Director General, Director of the Division of Policy and Planning, senior advisors and selected research specialists, had the following responsibilities:

1. Serve as the conduit between the Steering Committee and both the Research Programs and Support Divisions.
2. Prepare "white papers" on subjects which may be useful or that should be considered by the operational Input Committees as they prepare their drafts.

3. Prepare concise, clear versions of each Program or Division/Unit and consolidate each into an over-all standard, uniform KISR document.
4. Submit the draft KISR Strategic Program to the Committee.

Following the input preparation steering Committee review, the draft Program Plans were subjected to iterations and reiterations at all Committee levels, with the goal of providing a special documents that will most effectively position KISR for optimal contributions and impacts during this next five year period, in accord with the Amiri Decree 28.

The draft documents were then presented to external groups (special workshop seminars/discussions) and were next reviewed by a Management Review Panel of external leaders and specialists in order to obtain yet another critical review of KISR's modus operandi, and resource allocation and use, while targeting output toward national and sectoral problems, wherein KISR's contributions should be most meaningful and tangible.

The final draft recommended the adoption of the following sit research Programme and their element:

1. Food & Biological Resources Programme.

Elements:

- (A) Aridland Agriculture.
- (B) Mariculture & Fisheries.
- (C) Biotechnology.
- (D) Food Technology.

2. Water Resources Programme.

Elements:

- (A) Hydrology.
- (B) Water Desalination.

- (C) Wastewater Treatment & utilization
- (D) Water Management.

3. Environmental & Earth Sciences Programme.

Elements:

- (A) Environmental Science & Management.
- (B) Desertification Control.
- (C) Hydraulics & Coastal Engineering.

4. Support of the Oil Sector Programme

Elements:

- (A) Oil Production.
- (B) Petroleum Rationing..
- (C) Polymers & Petrochemicals.
- (D) Corrosion.

5. Engineering Systems Programme.

Elements:

- (A) Energy.
- (B) Building Technologies.
- (C) System and Control.

6. Techno-Economic Programme

Elements:

- (A) Economic Studies.
- (B) Applied Decision Science.

Remarks and conclusions

Although statistics, evidences and several case studies have indicated and affirmed the importance of R & D in any Socio-economic industrial development, not with standing, several studies and statistics indicated that the concept of R & D is meager in the Arab world and that no enough attention and necessary supports or acknowledgments have been made. This has been reflected in one form or another such as absence of R & D role in national development plans, absence of explicit research policy, failure to allocate resources allocated to R & D to reach 1% from GNP as recommended by Vienna plan of action etc.

Kuwait, as an oil producing country, has pacing since independence in 1961 to develop her society and raise the standards of living and modernized the country. The decision-makers in Kuwait have realized the importance of R & D in achieving any national development plan, and thus have established several institutions dealing with R & D such as: Water Resources development center, food research center. Building research laboratory, Kuwait University, Kuwait foundation for the advancement of sciences, environmental protection council, agriculture research department and the Kuwait institute for scientific research as an applied research execution center. Ever since its endowment, KISR has developed several R & D programs attract various specialists, encompass multiple activities, acquire the best available equipment's in the market, establish strong relation and cooperation with local and foreign firm, and institutions.

As the report indicates, KISR has executed (in terms of numbers and dinars) multiple activities and projects for most active, production and service sectors. Nevertheless, as a developing country, Kuwait faces several impediments and deal with various problems that are usually known to any R & D center particularly, the ones reside in the Arab word.

The striking and unique dilemma faced KISR and led to minimize its activities and hurdle its advancement was the complete demolition's, looting and disruptions occurred due to the Iraqi aggression . However, with full supports from the government and the national assembly and due to sincere devotion of KISR's employees, KISR has started to gain momentum and regain its previous standards, image and capabilities.

To conclude, the workshop should stress mainly on the role, capabilities and mechanism to be adopted by nation R & D centers to promote R & D concepts in their homelands to assure full participation and involvement of R & D activities in Socio-economic development plans prior to any outlooks or ambitions to deal with sophisticated issues mentioned earlier that might implicitly incur political matters and involvement.

References

- (1) UN. December 1987. Proceeding of an Expert Group Meeting on Strengthening Research and Development Capacity and Linkage with the Production Sectors in Countries of the ESCWA Region.
- (2) Ibid.
- (3) Fourth Strategic Program Plan (1995-2000). Kuwait Institute for Scientific Research. Kuwait March 1995.
- (4) A Statement of Principles. Kuwait Institute for Scientific Research Kuwait 1982.

Contents

Introduction	1
The Kuwait Institute for Scientific Research Establishment,.....	3
Achievements and Future Plans	
Historical Considerations	3
Evolution of Scientific/Technology- Related.....	5
Development Techniques	
The Planning Process.....	5
Preparation of Sectoral, Sub-Sectoral, National.....	7
or Problem-Related Assessment or Plans	
use of Project System.....	7
Establishment of Demonstration Projects, Pilot.....	7
Facilities or Commercial Entities	
Advancement of Education and Development.....	8
of Knowledge	
Consideration in Selecting Research Thrusts.....	8
Additional Factors Considered in Reviewing Program.....	10
and Program Element objectives and Proposed Projects	
Current Impediments to R & D.....	11
International Relations.....	12
Performance & Achievements of KISR.....	19
Contribution of KISR to National Socio-economic.....	60
Development Plans	
KISR Future Research Plans.....	73
Organization & Implementation of R & D.....	73
Planning Process	
remarks and Conclusions.....	77



