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AGRO-CLIMATIC EARLY WARNING SYSTEM: EXPERIENCE OF ESCAP

(Note by ESCAP secretariat)

The views expressed herein are those of the author and do not necessarily reflect those of the United Nations Economic and Social Commission for Western Asia.

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I. Introduction

1. Early warning systems have been in existence in most of the ESCAP member countries vulnerable to food crisis. They range from rituals performed to bring long-awaited rains, to temporary migration of populations from areas threatened by droughts and floods. On the other hand, in some countries of South Asia elaborate "famine codes" have been employed for many decades to draw up contingency plans for preventing starvation deaths.

2. More than two-thirds of total agricultural land in the ESCAP region being dependent upon the bounty of weather, the importance of an early warning system can hardly be over-emphasized. Governments in most countries use the available weather information and other indicators regarding crop prospects in order to formulate their food management strategies. The existing national early warning systems vary in efficiency and effectiveness from country to country. In all cases, however, there is ample scope for continuously improving and strengthening the current crop forecast arrangements.

II. Basic ingredients of an Early Warning System

3. The basic prerequisites for a sound food early warning system include reliable weather information and crop reports on a timely and regular basis; and an institutional mechanism to collect, co-ordinate, analyse and disseminate dependable assessments.

4. In most countries of ESCAP region, Government agencies provide estimates of area and production of food crops on periodic basis. However, the quality and coverage of these estimates are not the same in all of them and often follow harvests rather than preceding them. Pre-harvest forecasts of area and/or production of major food crops are also

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prepared in many countries of the region, although the timing and methodology vary.

5. Timely availability of weather information, particularly of rainfall data, is obviously very important in mounting a food assessment programme. Most countries of the region have standing arrangements for collecting rainfall and other weather-related information, although geographical coverage in some needs to be improved. Information on other natural factors such as pest infestation and crop diseases are also important for crop assessment but the arrangements for obtaining data are not always adequate in the majority of the countries, unless the disaster is widespread.

6. There are several other physical factors influencing crop assessment work such as the impact of irrigation, fertilizer application and quality seeds. Information on them are not usually linked with the early warning system. Besides, there are economic factors like price trends, market arrivals, imports, stock levels, etc., of essential foodgrains which have a relevance in the context of building up a comprehensive food early warning system.

7. It is the institutional aspect on which greater emphasis has to be laid in connection with mounting efficient national early warning systems in the ESCAP region. The need for a well-coordinated and interlinked organizational structure in this regard has been well recognized. While it is admitted that the technical bases and capabilities of the countries require improvement through statistical sophistication, training of personnel at appropriate levels, etc., an essential requirement appears to be the strengthening of organization, administration and management of such a system.

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III. ESCAP/NOAA agro-climatic assessment programme

Rationale of the programme

8. It has been noted that almost all countries of the ESCAP region have some sort of arrangements for food early warning and crop assessment, although these operate with varying degrees of efficiency. Member Governments are making continuous efforts to improve the situation. It may be added here that since national food systems are extremely complex in nature and exposed to dynamic physical, social, economic and political influences, constant vigilance and alertness is needed on the part of food security managers. The willingness must be there to cope quickly with changes in the variables. For example, populations may outgrow planned storage levels; food deficit areas may become surplus producers; cropping patterns may change; and so on.

9. The National Oceanic and Atmospheric Administration (NOAA) of the United States has developed an agro-climatic model for drought early warning and tested it worldwide with success. It does not replace the existing crop assessment efforts, rather it complements and strengthens them. The programme had been launched with the objective of providing assistance to those countries which needed to improve and enhance their existing capabilities in this regard.

Objective of the programme

10. The objective of the drought early warning programme is to enable the participating countries to alert their food security decision-makers in respect of impending food shortages caused by drought. It is a useful tool for timely action because it can reliably predict food shortages upto 30 days prior to harvest. This lead-time allows administrators

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about 60 days before local foodgrain prices begin to rise in the drought-affected area and about 90 days before malnutrition begins to show. The lead-time enables the transfer of food into the distressed areas or import of food from overseas, if necessary. Such steps can mitigate the impact of drought in economic and social terms.

Crop Assessment Technology

11. Two indices are used in the NOAA model: (a) Generalized Monsoon Index (GMI) and (b) Yield Moisture Index (YMI). GMI is an analysis of the overall rainfall pattern during the monsoon season. It is based on the monthly rainfall records from each weather station and is weighted to reflect that rainfall in some months is more important for general crop growth than in others. It is a comparative measure relating rainfall pattern of the year under consideration to that of all past years. The historical records are analyzed by the computer to produce a "normal monsoon pattern" against which the present rainfall pattern is compared. GMI result is usually expressed as a probability, e.g., a value of .08 would mean that 92% of the weighted rainfall totals on record have higher values than the respective values at a particular weather station at the present year. A very low figure, therefore, indicates that the monsoon at the present year is significantly below the average and may well have a serious impact on crop yields. This measure is not crop specific, however, rather it indicates the general trend of the monsoon around the respective rainfall station, hence the expression, "Generalized Monsoon Index".

12. YMI, on the other hand, is crop specific. Therefore, it requires that a crop calendar be available for the area adjacent to each weather station reporting monthly rainfall. The crop calendar indicates the probable dates of various growth stages, i.e. planting, transplanting,

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tillering etc. for each crop. Weights are then assigned to rainfall to reflect the weather requirement for a particular crop in a specific development stage. This index is most often expressed on a scale of 0-100 with 50 as the mean. For example, a YMI value of 6 for the planting period of a rice crop would indicate serious difficulties with plowing and transplanting. On the other hand, a YMI value of 49 would indicate a more or less normal year.

13. In addition, the NOAA computer programme is capable of expressing past monsoon rainfall patterns in graphs. When the present year's emerging pattern is supperimposed over the graphs of past years, the year with the most similar pattern will become apparent, and that year can be used as a reference. General crop yields for that comparator year can then be consulted to obtain an indication of whether severe food shortages are likely to occur.

14. Both GMI and YMI are indices that can call attention to points on a map where abnormal rainfall conditions may be having a detrimental impact on future crop yields. They have proven reliable in past tests as they have enabled NOAA to pinpoint every major droguht in the world over the last decade.

15. However, these measures have one limitation. They do not indicate the extent of surface area around the weather station that is affected by drought. It could be a highly localized drought or could be quite widespread. A look at YMI for surrounding weather stations might help to establish spatial limitations but, if they are quite distant, the extent of the impact would remain a matter of speculation. Hence GMI and YMI are considered qualitative indices. They indicate the general "quality" of crop conditions but give little or no indication of the quantity of crops affected or the expected quantity of reduction in yiels.

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Decision-makers may be alerted by GMI and YMI vlaues but, if they want estimates of crop losses, then they must undertake a second stage of analysis which relies on crop area and yield statistics which are normally the responsibility of the crop yield estimating agency and not that of the weather bureau.

16. A new satellite technology has now been added to the agro-climatic impact assessment system. It relies on NOAA AVHRR Polar Orbiting Meteorological Satellite which records country data twice a day. Analysis of these data enables the production of specially enhanced colour imagery. Such imageries are capable of effectively differentiating between various levels of biomass radiation which in turn can indicate areas under moisture stress. Unlike the rainfall data from a weather station which does not provide any reliable estimate of the drought stress area, the satellite imagery clearly depicts the extent of a drought-affected region. Used in conjunction with GMI and YMI, the new technology can improve the effectiveness of the early warning system. The application of this tool requires satellite receiving facility and the data tapes recorded from satellite transmissions need to be transferred to micro-computer diskettes in order to enable projection on high resolution colour minitors. An archive of images, backed up by extensive field verification records, are needed to produce reliable drought severity estimates.

Regional seminar on agro-climatic assessment model for drought-related food shortages

17. ESCAP and NOAA launched the agro-climatic assessment programme in January 1984 through convening a regional seminar at Bangkok for the purpose. The United States Agency for International Development provided the requisite funds. The meeting was attended by a team of three multi-disciplinary experts from each of the nine ESCAP member countries:

Bangladesh, India, Indonesia, Nepal, Pakistan, Philippines, Malaysia, Sri Lanka and Thailand. The teams comprised senior-level food policy makers, meteorologists and agricultural experts.

18. The country representatives first reviewed the existing early warning systems operating in their respective countries. Later, the agro-climatic assessment technology was introduced and explained with audio-visual aid and computer use. The representatives expressed a keen interest in the programme and agreed to test the technology in their respective countries with a view to improving the existing early warning capabilities.

19. Tentative plans of action were prepared by each country and presented at the seminar. The main features of the plans included the arrangements for collection, compilation and analysis of weather (mainly rainfall) data and information on crop conditions; information flow charts between the various concerned agencies leading upto the food policy decision-makers (end-users); composition of co-ordinating mechanisms at the national and other levels; and the production and distribution of agro-climatic assessment bulletins on a timely and regular basis.

20. The crucial element in the implementation of the programme is the co-ordinated involvement of mainly three national agencies. The first is the weather bureau or the meteorology department responsible for collecting rainfall data. The second is the agency which estimates crop yields. And the third is the authority charged with food security. There may be other agencies whose involvement would further enhance the quality and timeliness of the assessment system. At any rate, a cohesive and integrated approach towards the production and distribution of the agro-climatic assessment bulletins is regarded as the main plank for the success of the programme.

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Technical training for system operation

21. Under the programme, a 10-day technical training workshop was organized. Three middle level technical personnel were selected from each of the nine participating countries for the training course. An integral part of the course was the use of micro-computers in the entry of historical rainfall data; GMI and YMI analysis of the data; interpretation of analytical results; and finally, the preparation of the agro-climatic assessment bulletin. The group training was followed up later with more specialized training of selected technicians at NOAA facilities in the United States.

Provision of micro-computers

22. As a part of the programme package, provision was also made to contribute micro-computers to each participating country in order to facilitate their implementation work. Micro-computers were generally located in an agency which was to play a central role in co-ordinating the activities of the programme. Local purchase of the hardware was preferred and encouraged as maintenance and rapairs would be easier. It was also aimed to avoid administrative complications of importing such goods.

Technical assistance missions to monitor programme implementation

23. Joint teams comprising ESCAP and NOAA experts had undertaken missions to the participating countries during the 1984 monsoon season as an activity under the programme. The purpose of the missions was to (a) facilitate the procurement of micro-computers; (b) review the mechanisms for data collection, analysis and dissemination through the

timely production of the bulletin; (c) monitor the institutional linkages for co-ordinated action; (d) provide update on micro-computer software and additional training of technicians, wherever necessary; (e) evaluate the effectiveness of index programmes in climatic impact assessment and discuss country suggestions for improvement thereof; (f) observe national satellite imagery facilities, where available; and (g) brief the high-level policy makers on the future evaluation of the programme.

24. The missions proved most useful in solving several problems that had arisen in individual countries, especially in respect of hardware procurement, bulletin preparation and distribution, and in promoting stronger institutional linkages.

Regional evaluation seminar on national agro-climatic assessment programmes

25. The seminar was designed and organized in February 1985 for a mid-course evaluation of programme implementation on a country-by-country basis. A second objective was to share experience among the participating countries with regard to technical problems faced in data collection and analysis, institutional co-ordination and other related aspects concerning the production of the agro-climatic assessment bulletin on a timely and regular basis. While recognizing that the project has proven beneficial, the meeting discussed issues concerning inadequacies of the qualitative nature of assessment; lack of personnel; and bottlenecks in achieving effective institutional co-ordination. Some countries were found to be ahead of others in project execution and had already issued bulletins on a regular basis. It was agreed that ESCAP/NOAA efforts should be continued for another year in order to ensure consolidation of the programme. As a sequel to this, it was suggested to mount a second series of ESCAP/NOAA joint technical assistance missions during the 1985 monsoon season.

26. A number of recommendations were made which included exchange of information and experience among the participating countries, arrangement of further training of technicians and study tours.

27. In addition, the seminar considered the application of satellite imagery technique as a tool for sharpening the agro-climatic assessment work. It was proposed to do so on a pilot basis in one or two selected countries where satellite imagery receiving facilities were available.

Technical assistance missions during 1985 monsoon season

28. The second series of missions had similar objectives as the first ones, except that more extensive discussions were held with the national remote sensing organizations in order to explore the possibility of applying satellite imageries for crop assessment.

29. It was found that most countries were regularly producing the agro-climatic assessment bulletin and that varying degrees of interest had been expressed by food security decision-makers in them. However, the decision-makers were not always satisfied with the qualitative nature of the food early warning advice. The agencies responsible for crop yield estimates seemed to be under pressure to provide more quantitative figures.

Seminar on satellite imagery application

30. As discussed at the regional evaluation seminar held in February 1985, Thailand and Malaysia were selected on a pilot basis for the application of satellite technology in the early warning system. In that connection, technicians of these countries were trained in the interpretation of the colour enhanced satellite imagery. Field verifications were also conducted in the two countries during the 1985 monsoon season.

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31. In order to review the results, a seminar was held in early November 1985. The basic features of the technology, including the colour enhancement system, were presented on a personal computer using a high resolution imagery board. The results of field tests in Thailand and Malaysia were regarded by the seminar as positive. Several agencies in the two participating countries expressed keen interest in getting involved in the praticial application of this technology.

32. It is planned to add the satellite technology element to the next phase of the programme, provided that requisite funds are available.

Cost effectiveness of the programme

33. The programme is cost effective, especially as regards the technology which relies on rainfall data. For countries that have adequate weather station coverage, rapid communication systems, and reliable historical rainfall records, no additional infrastructure costs need be borne to operate the system.

34. Under the on-going ESCAP/NOAA programme, the participating countries concerned did not have to bear any significant cash cost. The cost of the seminar, technical training, micro-computers and country technical missions were borne by donor funding. The participating countries did, however, have to spare their concerned senior level officers to attend the seminars, assign technical staff to attend the technical training, and allot manpower to conduct data analysis and produce agro-climatic assessment bulletins on a monthly basis.

35. As regards the satellite technology, a receiving station or access to data from stations located in neighboring countries is a necessity. For those countries willing to apply this technology, donor funding is

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being sought to meet the costs of hardware necessary to transfer data from tapes to computer diskettes, and to display the imagery on a personal computer. Training for this purpose is also to be provided free of charge. Hence, little cash cost is envisaged on the part of the participating countries for this phase provided they have access to the raw satellite data.

36. Uptodate, the programme has been implemented with a total estimated cost of around US$200,000, of which an amount of US$170,000 has been channelled through ESCAP. Dividing the total cost by the number of participating countries, per country cost comes to about US$22,000, a relatively small amount in terms of the potential benefit that can be derived. The countries concerned did not have to bear any of these cash costs.

VI. Concluding Remarks

37. The agro-climatic assessment programme currently being implemented in the ESCAP region is still at a formative stage and not enough time has passed to fully evaluate its efficacy. However, the participating countries have already demonstrated a lively interest in the technology inasmuch as it could have a worthwhile effect on their short-term planning and forecasting of crop conditions as well as on their disaster management efforts. However, it is only one facet in the search for solutions to food production problems in the ESCAP region. Once the system becomes fully operational in all the participating countries, it will need a built-in modality in order to take care of the dynamic factors in the food production scenarios of the region.

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38. One noteworthy feature of the programme has been the institution of complex inter-departmental arrangements in the recipient countries for its operationalization, leading to the timely production and use of the assessment bulletins. More strenuous efforts must be made to consolidate and fully stablize these arrangements. This will no doubt be a time-consuming exercise, given the complicated nature of Asian farming systems and slow-moving administrative structures.

39. Because of the dynamic nature of a food crisis early warning system, much can be gained by a careful "condification" of the system. It will yield several advantages. It may help identify "gaps in the methodologies" and hence opportunities for improvement. It may serve as a training manual for food crisis managers from other areas. Finally, a codified description will clearly allocate functional responsibilities of different "actors" in the system at various stages of disaster management. The Bengal Famine Code of 1913 may be cited as an example. The code was compiled to cope with food crisis in drought-stricken areas of Bengal Province in British India. It has served as a basic manual incorporating many modifications over the years dictated by changing social, economic and physical conditions. The ESCAP/NOAA agro-climatic assessment programme may similarly gain much through the compilation of a similar manual.

40. The agro-climatic impact assessment technology is relatively simple and cost-effective. It is possible to transfer the technology in other regions of the world with appropriate modifications to suit local conditions. The requirements of developing the necessary information base, hardware and training can be met without much difficulty. However, all these arrangements need to be examined in detail and considered carefully in light of specific needs of the countries of a

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particular region. ESCAP will be prepared to look into these possibilities on the basis of mutual advantage and consistent with available resources.
