EWFIS Report-1

A REVIEW OF EARLY WARNING SYSTEMS PRACTICED IN SELECTED ASIAN COUNTRIES

Rezaul Karim Talukder

Strengthening of Early Warning and Food Information System Project
Ministry of Food, Dhaka
February 2000

A Review of Early Warning Systems Practiced in Selected Asian Countries

Executive Summary

The early warning systems practiced in India, Bangladesh, Pakistan, Malaysia, Nepal, Philippines, Korea and Thailand were reviewed for gaining understanding about formulation of an early warning system in Bangladesh. It was revealed that among the Asian countries India had a relatively well organized system of pre-harvest forecasting of crop production. Production forecasting is done through the following means: area and yield estimation, water balance and rainfall indices, monitoring of input use, watch on pests and diseases and remote sensing techniques. Early warning concerning food management system is practiced through monitoring of price, monitoring of market arrivals and food stocks with the government.

In Indonesia, compilation of agricultural statistics and forecasting is done through the Central Bureau of Statistics (CBS). Among the different types of food crop statistics generated and maintained through the CBS are area statistics, yield statistics, forecast of production, study of agricultural price behaviour and remote sensing technique of forecasting.

Malaysia upgraded the rice production forecasting method through participation in an Agroclimatic Impact Assessment Project developed by the United States National Oceanic and Atmospheric Administration (NOAA) and coordinated by the ESCAP. To monitor the impact of climate on the crop condition, two agroclimatic indices are used: General Monsoon Index (GMI) and Yield Moisture Index (YMI). These indices are calculated for the growing season and compared with the norms collected over the years in order to forecast rice production for the season.

Nepal developed a fairly impressive crop reporting system through the early warning project starting in 1982 with Food and Agriculture Organization assistance. Sophisticated Water Balance model was applied to paddy, maize and wheat crops, taking into account weekly rainfall, potential evapotranspiration, water holding capacity of the soil, seepage and percolation on weekly accumulated rainfall basis.

In Pakistan, crop forecasting is done mainly by survey method and is implemented by the Agriculture Department. Crop reporters, who are specially trained, collect the required information on acreage planted soon after the crop is sown and report to the headquarters. An 'integrated master sample plan' has been drawn in the country to cover the estimation of acreage and production of important crops through extension of the objective techniques of estimation.

In the Philippines, crop forecasting is generally done by two approaches: sample survey and agro-climatic assessment. In the survey method, four survey rounds are conducted annually covering at least 80,000 sample farmers nation-wide. The farmers are asked to report actual harvest of current season and expected production in the next season. In the agro-climatic assessment approach, Yield Moisture Index (YMI) and Generalised Monsoon Index (GMI) are used. The system involves analysis of weather data recorded by weather stations and the particular production indicator such as crop yield behaviour as influenced by weather data over time.

In Sri Lanka, crop statistics are collected at district level by the field staff of the Agricultural Economics Unit of the Department of Agriculture. The data are analysed at the Market Research Unit of the Agrarian Research and Training Institute (ARTI) and released in the form of bulletin, thus providing information on likely production with indication of possible shortfall or surplus in relation to the targeted level of production.

In Thailand, crop forecasting is done using acreage and yield models. The acreage model is specified as a linear function of lagged price of the product concerned, lagged price of the competing product, the amount of rainfall in the planting season, the distribution of rain and one year lagged planted area. The yield forecasting model is specified as a function of the amount of rainfall and the distribution of rain during the crop growth periods.

The history of early warning exercises in Bangladesh can be traced back to late seventies. A series of FAO, World Bank and USAID missions visited Bangladesh and suggested to establish an early warning system. A World Bank report in 1979 provided an outline of a proposed early warning system. In 1982, an USAID mission commissioned a study for the development of an early warning crop forecasting model. On the basis of recommendation of a FAO mission, a project entitled "Development of Early Warning System in Bangladesh" was initiated in 1984 with financial assistance from the government of Japan.

Attempts were made to make early forecast of production of major foodgrain crops through the early warning project by utilizing the techniques of trend analysis, price analysis, water balance index and crop yield-weather regressions. Quantitative relationship between crop yield and selected weather variables were estimated for selected crop varieties in two districts namely Sylhet and Rangpur. With expiry of the project in 1988, the early warning exercises using the above approaches almost ceased to be continued. Since the need for early warning exercises continued to persist, the present project was undertaken and started functioning from 1998.

1. Introduction

A well developed early warning system for basic foodstuffs is a valuable tool for efficient food management in a country. Governments in most of the Asian countries make use of available information on crop prospects and related indicators in formulating their policies regarding import/export, procurement, distribution and other aspects of food management. Periodic pre-harvest forecast of area, yield and production of principal food crops are prepared in India, Bangladesh, Pakistan, Malaysia, Nepal, Philippines, Republic of Korea and Thailand. A brief review of the nature of early warning systems practiced in these countries is presented below:

2. India

Pre-harvest Forecasting of Production:

Among the Asian countries, India is considered to have a relatively well organized system of pre-harvest forecasting of crop production. There are two main crop seasons in India: Kharif and Rabi. About 60 percent of foodgrain production is harvested during Kharif season (July-December) and the rest during Rabi (December-May). Kharif crop is largely dependent on south-west monsoon rain which occurs during June to September and account for about 75 percent of annual precipitation.

The India Meteorological Department (IMD) continuously monitors rainfall and weather conditions in the country. It collects weekly rainfall data from 700 stations. Information on temperature, humidity and rainfall are issued on daily, weekly and seasonal basis. It also prepares statistical models based on study of long term data and tries to predict weather and rainfall behaviour on the basis of current meteorological information.

A unique feature of weather monitoring in India is the working of the weather watch group. The Central Ministry of Agriculture has set up a multi-disciplinary weather watch group which holds weekly meetings, particularly during the monsoon season. Representatives of IMD and Ministries of Irrigation, Energy, Fertilizers and officials dealing with research, production, input supplies take part in the meeting. The discussions relate to review of the rainfall and crop situation in different parts of the country, the implications of the latest weather situation in terms of agricultural operations and crop prospects and identification of measures required for dealing with the effects of drought or excessive rains and floods. In case of reports of pest attack, plant protection measures are propagated to the affected places. The group also monitors information on the levels of major irrigation reservoirs based on rainfall and advises the Irrigation Ministry for increased releases of water or conservation of the available supply for the next season. The agronomic practices to be followed in the wake of excessive rainfall or drought are also recommended.

Crop Forecasting on the basis of Area and Yield Estimation:

India has made significant advances in developing the land use system and the overall agricultural statistics system. Out of the total geographical area of 329 million hectare, complete land use statistics are available for 304 million hectares or about 93 percent of total geographical area. Out of the reported area of 304 million hectares, 86% is covered by a system of complete enumeration, 9% is covered by sample surveys and the remaining 5% by estimates of village level officials.

Regular updating of land records on complete field to field enumeration basis is a common feature in all States of India except Kerala, Orissa, West Bengal and some States of north eastern region In Kerala, Orissa and West Bengal also the Directorate of Economics and Statistics has implemented a scheme of building up village-wise land records register for creating basis for field to field enumeration in each season. This system is capable of giving highly reliable information on area under different crops.

For yield estimation, two approaches are followed: In the early part of the season, the state revenue/agricultural officials formulate their own assessment of crop outlook and prospects for their regions. The Market Intelligence staff also formulate their assessments on the basis of contacts with agricultural officers, farmers, traders, and other knowledgeable people in the localities. Subsequently, when crop cutting experiments starts, results of nearly 10 percent experiments supervised by the staff of National Sample Survey Organization are obtained as a preliminary indicator of trends in crop yields. The preliminary and quick estimates of area, yield and production are made available to the policy makers and planners. This information constitutes a key factor in the early warning system in India.

Monitoring of Input Use:

Information on rainfall and weather, when combined with that on canal water supplies, consumption of diesel and electricity for ground water irrigation, use of inputs like high yielding varieties of seeds, chemical fertilizers and plant protection materials provide important clues for forecasting production. In the case of seeds, breeder seeds are produced by the scientists in the research farms of the Indian Council of Agricultural Research. These seeds are multiplied on State Seed Farms to produce foundation seeds which are made available to contract farmers for multiplication. The seed thus produced is checked for purity and germination and packed as certified seeds which are made available to the farmers. Under this system, it is possible for the government to know the status of use of certified seeds in the country.

The system of fertilizer distribution in India is also well regulated. All imports are either done by the government or through authorized agencies. The internal production and imports are pooled and total supplies are made available to the producers at uniform prices in all parts of the country.

Watch on Pests and Diseases:

The possible incidences of pests and diseases are monitored through the crop surveillance scheme. A number of Central Pests and Diseases Surveillance Stations have been set up under the Directorate of Plant Protection. The purpose of the scheme is to detect the evidence of pests and diseases so that timely and effective mobilization of plant protection facilities can be ensured.

Rainfall Indices:

In order to relate the extent of rainfall in specific geographical location with the growth phenomena of different crops, rainfall indices for different crops have been developed covering a long period of time. In developing the indices, weights are assigned to each meteorological Division in respects of area and production in relation to their contribution in the total area and production of the crop(s) in the country.

This series of production weighted rainfall indices cover all important crops including paddy, sorghum millet maize, wheat, groundnut and sugarcane in all the major producing States in the country.

Remote Sensing Techniques:

India has made considerable progress in obtaining and analyzing data through remote sensing technique. The National Remote Sensing Agency at Hyderabad has been engaged in making land use assessment in the drought prone areas. Moreover, satellites such as IRS, SPOT and others offer a promise of great scope for application of remote sensing for agricultural crop monitoring and strengthening the Early Warning System in the country.

Early Warning Concerning Food Management System:

In order to cope with major fluctuations in production and prices of major food products, India has adopted a system of food management with a view to ensuring stability in supplies and prices of food products. About 25 percent of the total foodgrains marketed in India are channelled through fair

price shops. To ensure smooth functioning of the food marketing and distribution system, continuous watch is maintained on the functioning of the system.

Monitoring of Prices: Data on wholesale prices are collected on a daily basis from around 200 markets spread all over the country. Also, weekly prices are obtained from 520 markets through which most of the foodgrains are disposed of by the producers. Any abnormal rise or fall in the prices gives signal to the government about the impending shortage or surplus.

Monitoring of Market Arrival: Data on market arrivals are collected from major regulated and unregulated wholesale markets. A comparison of these data with normal flows in recent years provides an insight into the likely trends in supplies. In case there is a persistent downward trend in market arrivals, this is a signal for the likely emergence of shortage in response to which the government takes appropriate timely action to attain stability in supplies and prices.

Monitoring of Foodgrain Stock with the Government: One of the key signals in early warning system is provided by the changes in the level of foodgrain stock held by government in relation to the levels of buffer stock and operational stocks considered desirable. The major considerations in determining the size of operational stocks are : (a) the average level of off take of major cereals from the public distribution system under normal situation in recent years and (b) the requirements of operational stocks at different points of time in a year. The levels of stocks serve as a guide to the government in the formulation of appropriate policies on procurement of grains from domestic production and whenever necessary, for deciding on the quantum of grains to be imported.

3. Indonesia

Compilation of agricultural statistics in Indonesia is done through the Central Bureau of Statistics (CBS), a non-departmental body working directly under the President of the country. Among the different types of food crop statistics generated and maintained through the CBS are area statistics, yield statistics, forecast of production, study of agricultural price behaviour and remote sensing techniques of forecasting. The method of generation of the statistics and their use in crop forecasting is briefly discussed below:

Area Statistics:

Data on area under principal food crops and other crops are collected every month by the Agricultural Extension Service (AES) stuff at sub-district level. The data collected include details about standing area at the beginning of the month, harvested area during the month, damage area due to insects or calamities and standing area at the end of the month. The field activities are jointly supervised by the local branch offices of the CBS and the AES. The field staff also collect data on the availability of agricultural tools and equipments, and other related data on irrigation, land utilization etc.

Yield Statistics:

Yield statistics are generated through crop cutting survey, conducted in three rounds every year (January -April, May-August, September-December). The plot size utilized in the crop cutting survey of rice, soybeans, peanuts and sweet potatoes is 2.5 square metres. The number of selected plot/sample in one particular year is approximately proportional to the area harvested. Combined with the figures on area harvested, statistics on yield rate give current estimate on production of principal food crops.

Forecast of Paddy Production:

Forecasting of paddy production by the CBS for each province in Indonesia for the coming year in conducted three times a year namely in the middle of February (the first forecast), the middle of June (second forecast) and the middle of October (third forecast). The method used in generally the regression technique in which it is generally assumed that the forecasting condition is relatively normal. The methodology of the respective forecasts is as follows:

a) The first forecast is carried out in two steps. The first step is to forecast the production of January - August and the second step is to obtain the production forecast of January-December by using regression function based on the result of the first step.
b) The second forecast is carried out by using similar procedure as applied to first forecast. The total production forecast is obtained by the summation of the actual production figure for January-April and the production forecast for May-December based on regression analysis.
c) The third forecast is also carried out by using the same procedure in which total production forecast is obtained as a total of the actual production figure for January - August and production forecast for September - December.

Farm Household Survey:

At the beginning of each year, a farm household survey is conducted to collect data on land ownership and utilization, crops and cropping patterns, use of volume of seeds, fertilizers and pesticides, and cost structure of farm enterprises.

The survey is integrated with the crop cutting survey. Form the household listing of the blocks selected, 2-6 farmers from each block are selected for the crop cutting survey and three farm households are chosen for the cost structure information. Results of the survey produce a lot of statistics for planning and policy formulation in developing agricultural sector, improving social welfare and the general living condition of the farmers.

Agricultural Prices:

Data on farmgate and retail prices are collected from the sample villages in each sub-district. The field staff of the local office of CBS collect data from the farmers in the selected villages on prices of agricultural products they sold during the reference month. Data are also obtained on labour wage, prices of fertilizers, pesticides and seedlings. Prices of essential items are also collected as an indicator of trend of cost living affecting the farmers.

Remote Sensing Technique:

Several pilot studies on application of remote sensing technique have been completed in Indonesia. Estimates of crop area and production for the North Lampung pilot study had very high coefficient of variation, while the second pilot had very high area estimate of wet land and very high area estimate of dry land compared with the data given by current procedure. It is hoped that with the launching of Tropical Earth Resource Satellite (TERS), identification of areas damaged due to pests, diseases or calamity will improve and thereby accuracy of overall forecast will improve significantly.

4. The Republic of Korea

The most important institution in Korea's national early warning system is the Statistical Bureau and its 145 branches. The Ministry of Agriculture and Fisheries of Korea (MAF) has made efforts to enhance reliability, objectivity and timeliness in obtaining and reporting data.

Drastic changes have occurred in the pattern of Korean diet since 1980. The per capita consumption of cereal grains have fallen rapidly. Korean consumers now demand more livestock, dairy foods, vegetables and fruits whose supply is much more erratic.

Thus the government has shifted its emphasis from increasing the production of basic food crops to that of livestock, dairy, fruits and vegetables, and the improvement of marketing structure of these products. This means that the government should be better informed on both production and market by building up a more sophisticated national early warning system to deal with the more erratic and dynamic problems.

5. Malaysia

The Present Methods of Forecasting Food Production:

The method used for forecasting the annual production of rice is based on the monthly field report on acreage normally under production, acreage prepared for planting, acreage sown or transplanted, acreage harvested, acreage damaged by pests, drought, flood, and the forecasted yield . Basically, the rice production for the season could be forecasted at any month of the season based on forecasted "acreage harvested" multiplied by "forecasted yield". At the beginning of the season, the factor "acreage harvested" is forecasted based on acreage normally planted. As the season progresses, the basis for forecasting the factor "acreage harvested" is replaced by a more accurate estimate such as acreage prepared for planting, acreage sown or transplanted and finally by the actual report on acreage actually harvested. Corrections are made for crop damage by pest, flood and drought as the incidents are reported.

The forecasted yield is based on the average normal yield of the area with adjustment made on the basis of crop outlook at various months and the last season's yield based on crop cutting trials. As the crop approaches the harvesting stage, the forecast becomes more and more accurate as more variables become known with greater accuracy.

The methodology for reporting is that on every 25th day of month, the extension agents make field inspections at each of crop blocks in their service areas. They make an estimate of the percent of the block under different crops through eye estimates. Since the actual acreage of the block is known, the estimate made in percentage can be converted to acreage and is reported as acreage.

A New Approach in Forecasting Rice Production:

In a effort to upgrade the rice production forecasting method, Malaysia is participating in an Agroclimatic Impact Assessment Project developed by the United States National Oceanic and Atmospheric Administration (NOAA) and coordinated by the ESCAP. To monitor the impact of climate on the crop condition, two agroclimatic indices are used: General Monsoon Index (GMI) and Yield Moisture Index (YMI). These indices are calculated for the growing season of the crop and compared to the norms collected over the years in order to forecast on the performance of the rice production for the season.

Data and Facilities for Developing a Forecasting System:

Even though Malaysia still lacks a sophisticated and quantitative crop production forecasting system, it is fortunate in that many of the data and facilities necessary for establishing one are already available. There are many types of data that are currently being collected that can be used for establishing forecasting model. Besides, the necessary data, facilities such as computer centre, soil laboratory, aerial photography, imagery interpretation and early flood warning system are also available. Thus Malaysia is about to enter the stage of using sophisticated method for crop forecasting.

6. Nepal

Nepal has developed a fairly impressive crop reporting system through the early warning project starting in 1982 with assistance of FAO. During the first phase of the project, different activities have been developed including analysis of incoming information on weather and crop conditions.

A sophisticated water balance model based on crop-weather analysis was applied to paddy, maize and wheat crops taking into account weekly rainfall, potential evapotranspiration, water holding capacity of the soil, rooting depth and actual moisture content, development stage of crop in the field, depth of standing water table in the field, percolation and overflow for complete paddy crop cycle on weekly accumulated rainfall basis.

The crop reporting system established by the Agricultural Statistics Division of the Department of Food and Agricultural Marketing has been made a regular system to report each month on all crop in the field. In order to provide facilities for pre-harvest forecasting, crop forecast survey on permanent farms was carried out with a random sub-sample taking 12-20 wards in each district and 5 sample farms from each Word. The range of information collected through the survey include crop varieties and fertilizer use, area intended for planting, area actually planted, method of sowing and planting practices, type and composition of manure and fertilizers used etc. All these data are used for the crop forecasting system.

The early warning project has initiated a series of detailed studies comprising stratification of the district in agro-ecological zone and a description of the agricultural systems in each stratum with extensive use of land use and land system maps.

7. Pakistan

The government of Pakistan introduced the objective survey technique in the compilation of area and production of major crops in year 1966-67. In the province of Punjab, a sample of 1014 on the basis of wheat acreage probability was drawn up in 1975 and the estimates are being compiled on the field reports submitted by functionaries of the Agriculture Department. The same approach has also been adopted in the Baluchistan, North-west Frontier and Sind provinces.

Crop reporters who are specially trained collect the required information on acreage planted soon after the crop in sown and report to the headquarters. A second crop inspection is carried out at the time of maturity in selected villages and after adding the late sown area under the crop and accounting for area under fodder to arrive at final acreage estimates. An integrated master sample plan has been drawn in the country to cover the estimation of acreage and production of important crops through extension of the objective techniques of estimation.

8. Philippines

Crop forecasting, primarily on rice and corn, was first initiated and implemented in the Philippines in 1953 following the creation of the Bureau of Agricultural Economics (BAEcon.) in the Ministry of Agriculture and Food (MAF). The BAEcon. undertakes quarterly nationwide rice and corn forecasting surveys employing probability sampling. The production forecast, stock inventories and other variables related to consumption are used in the prediction of year-end supply of the basic cereals. Apart from crop and production estimates other relevant data such as crop damages due to pests and adverse climatic conditions are also collected and analysed.

Methods of Rice and Corn Forecasting (Sample Survey):

A two-stage stratified sampling design is adopted with the village as the primary sampling unit (PSU) and the household as the ultimate sampling unit. The allocation of samples by stratum is done by proportional allocation. Simple random sampling is applied in the selection of sample 'barangays' (villages). From the sample 'barangays' a complete list of households is done. Farming households are systematically drawn at the rate of $^1/_{15}$ and $^1/_{20}$.

Four survey rounds are conducted annually covering at least 80,000 sample farmers national-wide. The crop year starts from July 1 of the current year and ends on 30 June of the following year.

The first round is undertaken during the first 10 days of October but reflects estimates as of the first of October. At the time of the survey in October, about 27 percent of the 1st crop (July-December) is already harvested. Thus at the time of survey the sample farmers are asked to report harvested crop from July to September and forecast of crops to be harvested during October to December.

The second round of survey is undertaken during the first 10 days of January. In this survey, final estimates of the first semester (July- December) and forecast for next quarter (January - March) are obtained.

The third round is implemented during the first 10 days of April. About 44 percent of the second semester (January - June) crops are harvested at the time of the survey and the remaining 66 percent remains to be harvested. Farmers are asked to report actual harvest from January to March and expected output from April to June.

The final round provides the final estimate for the second semester and forecast for the beginning quarter of the next crop year. The processing of the survey data is so programmed that the results are released to the office of Minister and the interagency committee on Rice and Corn 14 days after the last day of field data collection.

Agro-Climatic Assessment:

This approach makes use of the agroclimatic crop indices as inputs in describing expected crop yield and production. The Yield Moisture Index (YMI), calculated from weighted monthly precipitation during the various stages of crop development is particularly helpful in the assessments. Generalized Monsoon Index (GMI), crop calendar, deviation from normal temperature, tropical cyclones etc. constitute important data inputs for the analysis.

The system involves analysis of weather data recorded by weather stations and the particular production indicator such as crop yield behaviour as influenced by weather data over time. The assessment is prepared for the regional level consisting of the coverage of about six provinces. In a region, the number of synoptic weather stations vary from two to seven.

To be able to aggregate the indices computed for these stations, weights are assigned to each station and the aggregated index for the regional level is obtained by:

$R(I) = \Sigma W_i I_i$

Where $R(I)$ = Aggregated crop index for the region.

W_i = Weight assigned to the ith weather station.

I_i = Crop/weather index from the ith weather station.

The weight assigned to a weather station is obtained by dividing the best subjective estimate of crop area covered by station to the total area in the region.

9. Sri Lanka

In Sri Lanka crop statistics are collected at district level by the field staff of the Agricultural Economics Unit of the Department of Agriculture. The data are analysed at the Market Research Unit of the Agrarian Research and Training Institute (ARTI) and released in the form of bulletin, thus

providing information on likely production with indication of possible shortfalls or above target achievements in production.

The National Food Policy Committee chaired by the Secretary to the cabinet makes use of these information to decide on the import/export of food commodities. The present system gives an indication of possible shortfalls in production as compared with the targeted acreage. It does not base its calculation on climatic data analysis but on actual based on visual assessments.

As regards climatic data, the Department of Meteorology has sufficient data on daily rainfall, maximum and minimum temperatures, wind velocity, etc. for most of the key agricultural areas. The annual precipitation follows a distinct bi-modal pattern and the country receives rainfall from two monsoon, the north-east monsoon (October - January) referred to locally as the Maha season and the south-west monsoon (April-July) known locally as the Yala season. The rainfall distribution and the mean monthly rainfall over many years indicate that the precipitation is adequate for two seasons' cultivation in the wet zone of the country.

10. Thailand

In Thailand, early warning exercises are done by the Ministry of Agriculture and Cooperatives, and the Ministry of Commerce. Data concerning the early warning system are collected and compiled continuously and systematically. These data are routinely utilized through cooperative and communicative networks among various Departments under the Ministry of Agriculture and Cooperatives and the Ministry of Commerce.

Crop Forecasting based on Acreage and Yield Model:

Acreage Model

The acreage model is specified as a linear function of lagged price of the product concerned, lagged price of the competing products, the amount of rainfall in the planting season, the distribution rain and one year lagged planted area. Dummy variables are also included to obtain the interval estimate of area planted.

To forecast the planted area early in the season before the rainfall distribution data are available, the mean values from the past two years are used in the model. The upper bound forecast for planted area is then determined by substituting into the model the values for the planted are in the previous year, price of the concerned product in the previous year and the value (1) for the dummy variable.

Yield Model

The yield forecasting model is specified as a function of the amount of rainfall and the distribution of rain during the crop growth period. Usually the crop growth period is from early June to the end of October. In general, the linear form of the function is assumed and is written as :

$$Y_t = b_O + b_1 R_t + b_2 \delta R_t^2$$

Where : Y_t = Crop yield per rai in year t

R_t = Amount of rainfall from June to October in year t

δR_t^2 = Variance of rain during the crop growth period in year t

The expected sign of the coefficient b_1 is positive which means that the crop yield increases as the rainfall increases. The sign of coefficient b_2 is expected to be negative implying that higher the variation in rainfall, the lower the yield is expected to be.

A seasonal technique for forecasting crop yield considers only the rainfall during the crop growth period. This approach classifies the historical rain data over 14 years into one of the five different groups namely good rain, above normal rain, normal rain, drought and severe drought.

The yield data are also classified into these five groups for the corresponding years so as to coincide with the classification of rain for the same period. When it is determined that the amount of rainfall into a particular crop growth period falls into a particular group, the average yield of that group is then used as the forecasted yield. The reliability of this forecasting technique, however, depends on the accuracy of historical data on yield and rainfall.

11. Bangladesh

The history of early warning exercises in Bangladesh can be traced back to late seventies, Following a couple of food crisis resulting from natural disasters, the international circles strongly advised the government to set up some institutional structure with the capability of dealing with early assessment of production, monitoring production, stocking and distribution of basic foodstuffs. A series of FAO, World Bank and USAID missions visited Bangladesh and dealt, directly or indirectly, with the improvement of agricultural statistics and the establishment of an early warning system. A World Bank report in 1979 provided an outline of a proposed early warning system. In 1982, a USAID mission commissioned a study for the development of an early warning crop forecasting model. The USAID assistance was provided in the context of its support to the Food and Fertilizer Planning and Monitoring Unit, established in 1979, within the Ministry of Planning. In 1983, this unit was renamed as the Food Planning and Monitoring Unit (FPMU) and was transferred to the Ministry of Food. On the basis of recommendation of a FAO mission, a project entitled "Development of Early Warning System in Bangladesh" was initiated in 1984 with financial assistance from the Government of Japan.

Early Warning Practices in Vogue

Attempts were made to make early forecast of production of major foodgrain crops through this project by utilizing the techniques of trend analysis, price analysis, water balance index and crop yield -weather regressions. Quantitative relationships between crop yield and selected weather variables were estimated for selected crop varieties in two districts namely Sylhet and Rangpur. Weekly equations were estimated to examine the impact of selected weather variables at different stages of crop growth on crop yield. The predicted values of yield were calculated using the data series for 1968-84. Before expanding the work for the whole country, the project was terminated in 1988.

After expiry of the project, exercises on early warning, in its technical sense, seemed to be discontinued, although crop yield and production forecasting remained to be practised using subjective methods with acreage and prospective yield data obtained form the DAE and the BBS. According to the prevailing practice, information on area forecast is obtained from the DAE which generates information on areas to be planted to a crop on the basis of physical/economic environment and opinions of cross section of farmers, through the network of extension agents working at grass-root levels. The target area is monitored and revised on the basis of changed circumstances. Area forecasting is also done by the BBS on the basis of relatively objective criteria through the sample survey of seasonal land use pattern across the country. In recent times information on gross and net are planted to different crops are being generated through satellite imageries, obtained and analysed by the SPARRSO. Information on prospective yield are also generated by the DAE, BBS and SPARRSO on the basis of combination of subjective and objective methods in which climatic variables, input use, price changes and remote sensing techniques are used by the relevant organizations.

An important instrument for early warning is the statistical estimation of yield and production forecasting which was initiated by the FAO sponsored Early Warning Project and was discontinued with the termination of the project in 1988. Thus the need for strengthening early warning system continued to persist in the country.

New Initiatives on Early Warning Practices

In view the persistent need for early warning system, a new project entitled "Strengthening Early Warning and Food Information System" was undertaken by the government. The project started functioning from April 1998 with an intended tenure of three years. However, the filling in of a few key positions of consultants is yet to be completed. Meanwhile, statistical model for estimation of yield forecast of major crops has been formulated and formats for recording information on varying aspects of production, consumption and distribution of food have been developed. The project is expected to provide useful set of information on prospective supply and demand conditions of food for efficient food management in the country.

REFERENCES

Angus, J.F. (1981). Forecasting of Rice Yields in the Murrumbridge and Murray Valley: A Feasibility. study. CSIRO. Institute of Earth Research Division of Land Use Research, Canberra.

Chawla, H.L. (1985). Country Paper on Early Warning System in India. Report on the FAO Workshop on Early Warning System in Developing Countries in the Asia and the Pacific Region. FAO, Rome.

Damesco, M.D. (1985). National Early Warning System: Philippine Experience. Report on the FAO Workshop on Early Warning Systems in Developing Countries in the Asia and the Pacific Region. FAO. Rome.

FAO, (1985) Report on the FAO workshop on Early Warning System in Developing Countries in the Asia and Pacific Region. FAO, Rome.

FAO, (1990). Development of An Early Warning System in Bangladesh: Project Findings and Commendations. Food and Agriculture Organization of the United Nation, Rome.

Giasuddin, M. (1985). An Early Warning System in Bangladesh. Report on the FAO Workshop on Early Warning System in Developing countries in the Asia and the Pacific Region. FAO, Rome.

Haque, M.Z. (1987). Agronomic Factors and Crop Forecasting Proceedings of the Seminar on Food Security and Food Situation Monitoring, held in Dhaka on 3-4 January. Dhaka.

Hossain, D. (1987). Crop Estimation System in Bangladesh. Proceedings of the seminar on Food Security and Food Situation Monitoring held in Dhaka on 3-4 January. Dhaka.

Paik, B. (1985). National Early Warning System on Rice Supply in Malaysia. Report on the FAO Workshop on Early Warning System in Developing Countries in the Asia and the Pacific Region. FAO, Rome.