Significance of weather and climate for agriculture

Agricultural activities are very sensitive to climate and weather conditions. An agricultural decision-maker can either be at the mercy of these natural factors or try to benefit from them. The only way to profit from natural factors is to take them into account and learn to know them as well as possible. Agrometeorological information, in practice mainly climatological data, is essential in planning agricultural production. The following decisions should not be made without knowing climate conditions: land use and management, selecting plants and breeds of animals, and crop production practices such as irrigation, pest and disease control and crop-weather relationships. The specific climate-related information needed is presented below:

Before giving recommendations about land use it is necessary to know the environmental conditions. Parameters required to quantify these conditions are the monthly or 10-day-period rainfall data, solar radiation, temperature and the climatological risks (frosts, hail etc.).

In order to select plant species or varieties, a prior agroclimatologic characterization is required. This is determined using weekly, daily and hourly temperature, rainfall, solar radiation, evaporation, wind speed, evapotranspiration and relative humidity.

To assess the suitability of an environment to animal production knowledge of the effects of radiation, wind, precipitation, temperature and relative humidity is essential.

For pest management and plant diseases the minimum weather data set required should consist of temperature and humidity or derived parameters such as accumulated heat or degree-days. Moisture (relative humidity, rainfall and wetness duration) is an essential variable in most plant disease prediction schemes and also for predicting outbreaks of some insect pests.

Real time meteorological information can also be effectively used in agricultural production process. The timing of different activities, e.g. sowing, ploughing, fertilizing and pest and disease control, should be done when weather conditions are most favorable. For example the spreading of pesticide will succeed if weather is

moist and warm (not hot) and not very rainy or windy. Hay should be made before a period of several dry days so that the hay has enough time to dry. The harvesting of wheat is also most effective during a dry period. If the wheat is threshed while it is damp it becomes predisposed to damages. Although these examples concern agriculture in mild climates, the meaning of real-time meteorological information can be broadened to activities in the tropics as well.

Because climate conditions are different around the world, the importance of climatological information and real-time meteorological information is emphasized differently. In Finland, for example, real-time weather information is more important than in central parts of Africa because the weather in Finland is less predictable. In fact, it is sometimes difficult to appreciate the importance of climatological infor-

mation in Finland because this information is considered self-evident. On the other hand, the climatological knowledge is often insufficient in the developing countries. The importance of climate, as an agricultural aspect, is even more crucial if the geographic situation of the developing countries and the global warming of the atmosphere are taken into account. If the climate of these regions becomes even more warm and dry, food production can be a tremendous problem. This is why climate-related knowledge should also be promoted in developing countries.

Agrometeorological information can increase agricultural yield. The quality and quantity of agricultural production can be increased and production costs decreased, for example with more optimized use of fertilizers and pesticides. If climatological data is available, the probability of unfavourable meteorological phenomena can be calculated and the related risks estimated. With climatological data it is also possible to recognize bad weather conditions and to be more prepared to minimise the damage. Agricultural activities are weather-sensitive and it would be inefficient not to use climatological and meteorological information.

Three examples of the successful utilization of meteorological information for the benefit of food production are presented.

Citrus disease

Belize is a mainly agricultural country and the citrus crop is the second in importance. However, some pests and diseases may endanger successful crop production. One of these diseases is Premature Fruitdrop Disease which in some years can cause a loss of more than 50% of citrus yield in some regions. This fungus disease develops when the temperature is low, the weather is cloudy or lightly rainy and the leaves of the citrus plant are wet. The national meteorological service has started to produce specific weather forecasts so that properly timed fungicide applications can be made.

lf the yearly production of citrus fruit is considered to be more than 3 million boxes and the price per box about USD 4, the value of the additional yield can be as much as USD 6 million. The yearly budget of the local national meteorological service in Belize was about USD 300 000 in 1992. The savings made through this single service will thus cover generously the annual total costs of the national meteorological service. The annual value of the additional yield can also be compared with the total yearly budget of the meteorological cooperation project financed by Finland. The share of Belize was about USD 200 000 per year and thus the annual benefits from these citrus disease forecasts can be more than ten times as much as these costs.

Fishing

There are two storm seasons in Sierra Leone, one in March and the other in October. During these months fishing has been avoided. Climatic analysis for both of these months indicates a high probability of occurrence of storms for seven days, absence of storms for seven days and uncertainty in the forecasts for the remaining 16 days. The economic benefit of being able to fish dur-

ing an additional period of 14 days each year would amount to approximately USD 400 000 whereas the cost of preparing and issuing these forecasts would be less than USD 10 000.

Groundnut storage

In many countries groundnuts are stored in heaps in the open air. This kind of storage is favoured because it permits continuos ventilation with the relatively dry air. In Gambia the groundnut harvest might wait for the government buying agent up to three months. Of course, all this time the groundnut harvest is vulnerable to rain. Short-range rainfall forecasts would facilitate the protection of stored groundnuts. The farmers could be warned against impeding rain, and they could cover the crop or move it inside.

The price of the wetted groundnut harvest is estimated to be 60% of the price of successfully stored harvest. The respective numerical values are USD 90 and 150 per ton and the average yearly crop is 100 000 tons. The value of one single good forecast for impeding rain, even if only 10% of the harvest could be saved, is then 600 000 USD. On the other hand, the average annual budget for the National Agrometeorological Service in Gambia from 1982 to 1984 was about USD 180 000. The benefits of this single service could finance annual agrometeorological activities about three times. ◆