Special attention is given to Rwanda in Chapter 4 'The ecofarming project'. Finally, interactions between industrial countries and hunger in the world are analyzed and hints are given for helping to solve this complex of problems.
The interested reader is able to go into more detail by making use of the contact addresses and references (most of them German) given in the annex. The motto of this book is optimizing agricultural production with intensive methods but low-cost inputs.

VI AGROMETEOROLOGY

140 88 - 6/1

Agrometeorology
Review, climate, tropics, temperate regions, development, ecology, food production, environmental conditions
BISWAS, A.K.
Climate and development .
Development and Cooperation, 6, 1986, pp. 9-11

While the interdependencies of climate and development are self-evident, development planners have seldom considered climate as an explicit factor in the development process nor have climatologists generally played an active part in developing planning. The situation needs to be rectified as soon as possible so that the development process could be made sustainable on a long-term basis.
The aggregation of the climatic events that contributed to the prolonged drought in the Sudano-Sahelian region of Africa, the failure of the Russian grain harvest, erratic monsoons in the Indian subcontinent, the disappearance of the anchovy fishery off the coast of Peru, and the serious drought conditions in the western part of North America, was a global catastrophe of major magnitude. The gravity of the conditions that developed in 1972 can be best illustrated by the fact that the total world output of food declined from the preceding year for the first time in 20 years, due to the adverse climatic conditions. This serious situation shattered some people, who during the 1960s had prematurely and optimistically claimed that technological developments had freed modern agriculture from vagaries of climate. To some extent, such overconfidence can be accounted for by the generally benign nature of the climate in the 1960s. It became clear that climate still was a major factor for overall agricultural production and it will continue to remain so in the foreseeable future.
For the developing countries, which are located in the tropics and subtropics, climate should be considered as an important resource which provides certain opportunities for development but also simultaneously poses some constraints. Hence, development strategies should be formulated that specifically attempt to maximize the benefits such opportunities can bring but do not ignore the constraints imposed by climate.

141 88 - 6/2

Agrometeorology
Review, climate, crops, ecology, light, temperature, hydrological balance, productivity
FERWERDA, J.D.
The ecology of tropical crops. Part 2. Climate.
Span, 22, 1979, pp. 58-60

Plants and animals live in a physical and chemical environment of great complexity, and their ecology is determined by the intervention of many factors. Latitude, altitude, aspect, distance from the sea, and such extraneous factors as fire can all have profound effects on the distribution of both wild and cultivated plants.
Many attempts have been made to classify climates, but the result has generally been of little value to crop ecologists, because different crops rarely have identical climate requirements, although there is often considerable overlap between the conditions which they need. The numerical indices used for some of the climatic classifications are useful in specifying the requirements of individual crops. Thornthwaite's improved second classification seems to offer better possibilities for this purpose than Koppen's system.
Studies of the effect of climatic factors on specific physiological processes of tropical crop plants are important for a better understanding of their climatic requirements. Valuable information on the climatic requirements of crops may nevertheless be gained by collecting accurate data on their geographic distribution. At the same time, more basic knowledge of the physiological process affected by climatic factors may be obtained by studying crop development as a function of time, and in relation to climatic variables in the field.
Tropical agronomists are generally obliged to base the choice of their crops and management practices on macroclimatic data. These, unfortunately, are often scarce and incomplete, and not always reliable. The natural vegetation of any particular area may be more helpful in providing a better picture of its climate. Woody perennial crops with rather narrow ecological requirements (e.g. coffee, mango, oil palm, olive and tung) may also provide useful indications if they are grown in the area.
The author discusses the importance of light, temperature and hydrological balance as factors determining the distribution and potential productivity of tropical crops.

142 88 - 6/3

Agrometeorology
Review, book, ecosystems, greenhouse effect, carbon dioxide, climatic changes
BOLIN, B. et al.
The greenhouse effect, climatic changes and ecosystems.
John Wiley & Sons, Baffins Lane, Chichester, West Sussex, UK, 1986, 541 pp., hardcover £ 56.00, ISBN 0-471-91012-0

The problems of increasing atmospheric carbon dioxide concentration and possible future climatic changes have attracted considerable attention in recent years. A number of assessments of this problem have been made by national groups, notably in the USA. The problem is clearly an international one and an assessment at the international level therefore seems desirable to serve as a base for discussion and possibly, at some stage, for the development of an action plan. The present analysis is aimed at serving such a

purpose and is the result of an agreement between UNEP, WMO and the International Council of Scientific Unions (ICSU), the organizations which jointly implement the World Climate Program.
In the present assessment the following major questions have been considered: How much CO_2 has been and will be released into the atmosphere as a result of fossil-fuel combustion? What are the natural sources and sinks of carbon (the global carbon cycle) and what projections can be made of future atmospheric CO_2 concentrations? What are the expected increases of other greenhouse gases which affect the Earth's radiation budget? How will global and regional climates change as a result of increases in CO_2 and other greenhouse gases? When and how will climatic changes be detected? It is possible to design climate scenarios which can be used for climate impact studies? What changes of sea level can be expected as a result of a warming of the atmosphere? What are the responses of terrestrial ecosystems to direct effects of an increased atmospheric concentration of CO_2 and climate change?
For each one of these questions, one or a few scientists have been asked to summarize our present knowledge and, in doing so, also to present the main uncertainties and controversial opinions that exist. These contributions have been exposed to critical reviews by panels of scientists in respective fields who have expressed their views either during panel meetings, by correspondence or in direct personal contact with the authors. The aim has been to arrive at analyses of the different aspects of the problem areas that describe current knowledge in a balanced and well-documented manner.
With the presentation as a background, the UNEP/WMO/ISCU International Conference on the Assessment of the role of carbon dioxide and other greenhouse gases in climate variations and associated impacts was held in Villach, Austria, in October 1985.
Included in this volume is also the Conference Statement from Villach, which is aimed at serving the nations of the world and the international organizations concerned in attending to the problem of possible future changes of the global climate.
Abstract from Bulletin of the International Society of Soil Science, Netherlands

143 88 - 6/4

Agrometeorology
Semiarid tropics, climate, ecological conditions, drought, temperatures, physical stress
ICRISAT
Coping with physical stress.
ICRISAT Research Highlights 1986, pp. 23-25

Limited and erratic rainfall is the major handicap faced by farmers in the semiarid tropics. The problem is compounded by high temperatures, nutrient-poor soils, sandstorms (in some places) and long periods of drought. Developing crop lines that cope with such physical stresses is another challenge facing scientists in trying to help farmers stabilize crop production.

Although drought experiments are carried out under field conditions in widespread areas of the semiarid tropics, as well as at ICRISAT Center, rainfall at a critical stage in the experiment can invalidate the data obtained and result in a waste of time and resources. A rainout shelter allows drought treatments to be imposed at controlled times and, thus, experiments can proceed unhindered throughout the year. It will be particularly useful in studying the effects on crop growth of temporary dry spells during the rainy season and in understanding genotypic differences in response to drought stress.
Groundnut physiologists put the shelter to immediate use with an experiment on drought recovery response. A schedule of experiments with groundnut, sorghum, pearl millet and early-maturing pigeonpea has been worked out for the next two years.
Useful results were obtained in 1986 from continuing field experiments. Forty-two groundnut genotypes identified in earlier drought-resistance screening were tested in a rainfed trial at the drought-prone Anantapur Research Station in southern India. The cultivar NC Ac 17090 gave 40% more total biomass than the local control TMV 2. Three genotypes with resistance to foliar diseases also did well. One, cultivar ICG (FDRS) 55, yielded 1.8 tonnes of dried pods per ha after receiving only 300 mm of rain.
In West Asia and the Mediterranean region, where ICRISAT's cooperative chickpea program is based, cold is the principal physical stress. The major biotic stress is ascochyta blight, which flourishes in cold, damp weather. Chickpea lines, sown in winter, can give increased yields over those traditionally sown in spring, provided they carry tolerance of both cold and ascochyta blight. In the screening of 355 newly bred lines in 1986, 90 were found tolerant to ascochyta blight, 91 to cold, and 10 to both stresses. The 10 lines tolerant to both will be used extensively in the ICRISAT/ICARDA chickpea hybridization program.
Tolerance to cold is also an important factor in breeding improved sorghum lines for the highlands of Mexico. The ICRISAT cereals team evaluated 6 elite lines this year for adaptation to the low temperatures of the highlands. Their average yield of 5.02 to/ha was excellent, but further evaluations will be necessary under farmers' dryland conditions.

144 88 - 6/5

Agrometeorology
Review, book, proceedings, humid and subhumid tropics, lowlands, crop protection
RIJKS, D. and MATHYS, G.
Agrometeorology and crop protection in the lowland humid and subhumid tropics.
Proc. of a Seminar, Cotonou, Benin, 1986, 276 pp.; Distributor: CTA, Postbus 380, 6700 AJ Wageningen, Netherlands

This seminar was organized jointly by the National Meteorological Service, the International Institute of Tropical Agriculture (IITA) and the Secretariat of the World Meteorological Organization; it was cosponsored by the Food and Agriculture Organization (FAO), the United Nation Development Programme (UNDP) and the Technical Centre for Agricultural and Rural Co-operation (CTA).

The aim of this seminar was to promote the application of agrometeorological knowledge and data to monitor and forecast pest, weed and disease development, provide agrometeorological data designed to improve the efficiency of crop protection measures and to render them less costly, and to establish a dialogue between the Crop Protection Services and the Meteorological Services with a view to determining the need for agrometeorological information and recommending specific crop protection techniques. Fifty-five participants from 17 countries attended the seminar.
The purpose of Session 1 was to discuss the seminar's objectives. Session 2 dealt with meteorology and the development and movement of major migratory pests. The influence of meteorological factors on population density and movement was described. These meteorological factors also influence the development of intermediate hosts. Taking advantage of meteorological factors allows proper timing of the treatments and, thus, reducing their costs and concomitantly the crop losses.
Session 3 dealt with the research undertaken at IITA on certain crops. Detailed information was given on the cassava whitefly, sorghum midges, sweet potato weevils and cowpea pests.
Session 4 discussed maize and rice protection. An exhaustive list of maize pests was given in a document dealing with the relationship of their development to weather. Specific examples of the economic effects of disease and practical control measures were presented in the form of case studies.
Session 5 dealt with cotton, groundnut and banana pests. A paper on bananas showed clearly how agronomic studies can help meet the objectives of the seminar by providing data on the relevant techniques, and the use of agrometeorological data in crop protection.
Session 6 dealt with modeling. The first paper clearly and logically described the principles governing in this field. A second paper covered the use of a model for the millet ear miner (Raghuva albipunctella) and the grasshoper (Oedaleus senegalensis).
In various sessions, the participants from Benin, Côte d'Ivoire, Ethiopia, Ghana, Guinea, Nigeria and Sierra Leone gave details on the use of agrometeorological data in crop protection practices in their respective countries.
At the end of the seminar a roundtable was held. The following six items were discussed:
- definition of users' information requirements;
- choice, evaluation and adaptation of the techniques to be used;
- collection, analysis and accessing of observations and data;
- practical application of the various techniques;
- dissemination of data to users;
- feedback on the technical and economic value of data provided.

Finally, recommendations were given for different aspects of agrometeorology and crop protection.

145 88 - 6/6

Agrometeorology
Review, microclimate, traditional methods, manipulation, radiation, heat, moisture, wind, rain, hail
STIGTER, K.
Traditional manipulation of microclimate factors: knowledge to be used.
ILEIA Newsletter, 3, 1987, pp. 5-6

The practices of microclimate management and manipulation traditionally applied have recently been extensively reviewed. The examples given indicate that what is done in such manipulation is basically to change deliberately the different flows of energy (radiation, heat and kinetic energy of bulk movement). From worldwide searches for examples of the most promising practices in low-external-input agriculture, four areas could be selected: shading, mulching, wind protection and surface modification (e.g. ridging, weeding, irrigation). To those can be added for Africa: drying and storage.
An example of techniques/systems still successfully in use in restricted areas are the many variants of multistoried homegardens of Mount Kilimanjaro (Tanzania). Shade and air movement manipulation are especially important. A wider introduction of such agroforestry is expected to have favorable socioeconomic implications.
A good example are the sometimes very high (up to 3 m) mounds/ridges found in different geographically small regions in Africa. Another still very successful but labour-intensive traditional cultivation method with soil conservation and erosion prevention capacities which have attracted more than average attention is Ingola (or Ingoro). It is very locally practised, for example by the Matonga in Tanzania. Soil dug from pits is spread over the neighbouring soil after the latter had been covered with grass cut on the spot. In this way a network of ridges and holes comes into being on sloping soils, like a fertile erosion-preventing mulch.
Among those techniques/systems no longer suited to changing conditions are some of the traditional small-scale storage techniques, although minor modifications have been shown to give promising results in some cases. Also among these are several forms of shifting cultivation and some indigenous agroforestry systems involving dispersed trees, crops and livestock, which are disappearing because the limits of the carrying capacities having been surpassed.
The recent development of systems of alley cropping shows how such traditional ideas can be used to develop, test and validate new viable farming systems.

146 88 - 6/7

Agrometeorology
Review, book, semiarid zones, agrometeorology, plant protection, food production, production loss, pests, diseases
RIJKS, D. and MATHYS, G.
L'agrometeorologie et la protection des cultures dans les zones semi-arides (Agrometeorology and crop protection in semiarid zones)
CTA-Report of a Workshop, Niamey, Niger, 1986, pp. 399; CTA, Postbus 380, 6700 AJ Wageningen, Netherlands

FAO statistics on food production mention that 1/3 to 1/2 of the production is lost on account of pest damage during crop growth or storage. Agricultural research has demonstrated that there is often a close connection between the development of these pests and atmospheric conditions, temperatures and water-soil conditions. As a result of this research, practical approaches and methods should be elaborated which would enable meteorological services to supply information at opportune times about the rate of pests' development. Such assessments would then enable smallholders and agricultural organizations to take adequate measures when urgently needed. This meteorological information is also required to start large operations of crop protection at the right time, thus helping improve the input/output balance.
Numerous discussions followed the papers presented during the workshop, leading to many general conclusions. These conclusions were grouped in themes corresponding to the workshop's introduction. In all these discussions, the necessity of interdisciplinary cooperation was repeatedly emphasized.