SECTION 4

Planned Responses in Agricultural Management under a Changing Climate

4.1. Introduction

The purpose of this section is to study how agrometeorological information can be used in centralized planning for improving the adaptation of agriculture to variations in climate. This problem is particularly important in the USSR where, in spite of existing measures for yield stabilization, the fluctuations in annual crop production remain considerable. As a consequence there is, for example, an increasing tendency toward wastage of agricultural crops in favorable production years, incomplete utilization of the industrial capacities for processing agricultural products in bad years, and irregular employment of the agricultural population.

Two types of agrometeorological information can be identified that may be of use in the management process. Firstly, seasonal weather forecast data for the agricultural year would be of great practical use in determining the most appropriate strategies to be employed at particular locations (e.g., deciding on crop mixes, fertilizer applications, pest and disease control strategies, timing of activities, etc.). Such information is of special importance in deciding the most appropriate measures for stabilizing crop yields. Secondly, information on likely medium- to long-term changes in climate would indicate possible future conditions in agriculture that would affect the determination of optimal strategies for agricultural development. This information can be efficiently used at the state level, where large-scale measures are implemented for crop yield stabilization and economic adaptation to yield fluctuations. In the following, we shall consider only the second type of information, examining possible planning responses to a changing climate on the basis of model experiments. The models utilize agrometeorological information to calculate the likely productivity of crops under

M. L. Parry et al. (eds.), *The Impact of Climatic Variations on Agriculture*

a changed climate. This information can then be used to assess the economic viability of alternative agricultural strategies, e.g., alterations in regional specialization in agriculture, adjustments to the structure of interregional exchanges of production, and optimizing the use of industrial processing capacity to minimize waste and maintain low production costs.

4.2. A Scheme for Model-Based, Long-Term Agricultural Planning

A recent initiative to assist the process of long-term agricultural planning in the Soviet Union has been the wider and more efficient application of economic-mathematical models (Kiselev, 1979). Used as part of an automated system of plan estimations, models should help to reduce the lead-time and labor intensity involved in developing a plan, while also improving its final efficiency. One such system of models is examined in this chapter, its function being to provide an improved understanding of the intersectoral and territorial structure of the agricultural production environment (the "agro-industrial complex" – AIC), the imperfections of which are currently detrimental to the national economy.

4.2.1. A scenario approach to agricultural planning

For a given situation where the climate is changing over the longer term, the model system aims to provide plan estimations that ensure the maximum volume of final production over the period of the climate change, as well as to determine the most efficient ways of adapting to the changed conditions. In the course of an estimation it is necessary to calculate the optimal allocation of limited investments in determining the mix of crops, the extent of irrigation, the level of supply of material and technical resources, the level of harvesting capability and the delivery of agricultural products to the consumer.

A stochastic model of the Dantzig–Madansky type (Dantzig and Madansky, 1961) might be an effective tool for solving such a problem: identifying the maximum expected value of the final product under circumstances of random production capacity and taking into account the cost of overcoming weather anomalies with a given amount of capital investment. However, there are considerable computational difficulties in realizing such large-scale tasks. Moreover, even experiments directed to smaller-scale tasks indicate that when using such a model it is difficult for planners to analyze and evaluate the reliability of the simulated decision; the process of decision management becomes complicated because an expert does not always have a clear understanding of the extent to which the initial conditions (e.g., the probabilistic characteristics of production capacity, the possible damage to crops, the expenditures required to avoid damage, etc.) influence the decision made.

In view of these difficulties, it is considered appropriate to use a *scenario approach*, where the optimal strategy for agricultural development is calculated