CHAPTER VIII

SUMMARY AND CONCLUSIONS
The main objective of this study is to analyse the agro-climatological basis for regional disparities in the agricultural situation of Iran with a view to identify certain major relationships between weather induced factors and the extent of area, production and productivity, which may be helpful in evolving appropriate strategies for agricultural development of Iran.

The study is focused on drought and its impact on Iranian agriculture. In a rational study of droughts and their impact on national economy, it is necessary to delineate the major climatic types. For such a study adequate assessment of the agro-climatic conditions of the country is an essential prerequisite. The relationships between agriculture and climate may be implicit in it as information from the literature and the reports of agronomists on the climatic requirements is invariably used in demarking appropriate agro-climatic boundaries of suitable, marginally suitable and unsuitable zones for each crop.
An agro-climatic resource analysis can provide the material for the classification scheme which is necessary for land-use planning of agriculture. In other words, to plan the most effective cropping pattern and supplemental irrigation for different zones and to obtain maximum yield from agriculture, proper knowledge of agro-climatic conditions is necessary. It is desirable to identify areas on the basis of ecological and agricultural factors which take a comprehensive view of suitable crop potentials and form the basis for a cropping pattern which can exploit the resources of the area to the maximum.

**Water Balance:** After a critical evaluation of various methods, Thornthwaite's method of water balance is selected and adopted for agro-climatic classification of Iran and the results of the study are mapped out for a clear identification of the drought-prone areas of Iran. The application of the method has brought out three broad climatic categories over the Iranian boundary, namely, arid, semi-arid and humid regions. These three climatic regions, cover 77.63%, 18.63% and 3.74% respectively of Iran's land. Our study concentrated only semi-arid region which appear to be more susceptible to drought-effect. The selected thirteen stations, situated in the different provinces of North-Western part of Iran, fall into the semi-arid climatic category. In the entire semi-arid tract of the Iranian region, the precipitation is at its least mostly in the months of May to October. In other
words, most of the semi-arid regions of Iran suffer from water deficit from May to October, and the magnitude of this deficit decreases from November to April. In this region the dry period appear to be an unfavourable climatic activity caused irregularities in the distribution of precipitation preventing it from meeting the full water need. On the other hand, in the semi-arid climates, even during the wet year, water deficiencies occur, however, with a reduced magnitude, alongwith a slight rise in the water surplus or soil moisture recharge. In this region water deficit prevails during May-October and if there is any water surplus, it will accumulate during January-April. It is interesting to note that the period April-June was found to be the most critical period specifically for major cereal crops in the semi-arid region. Thus, any failure to supply sufficient amount of water or irrigation to the crop during this period in these areas will affect the final yield and consequently the production levels either qualitatively or quantitatively get affected. In this context, the hypothesis about the effect of the period of water deficiency during the critical period of the crop needs to be tested at a more disaggregate level over the cultivated areas.

Droughts: It is, however, to be mentioned that the moisture regime of the semi-arid region is highly dependent on the vagaries of the Mediterranean monsoon, and particularly most of the precipitation of Iran comes from the eastward-moving depressions that originate over or near the Mediterranean sea
It is observed that irrespective of their climatic types, Iran experiences severe drought at least every five years. Even in the humid climate the impact of drought is severe, and water deficiency mostly occurs in the months of May to October and intermediate conditions in the month of August are more probable, but in this region due to prevalence of sufficient water resources the impact of drought seems alleviated. However, water balance studies during the period indicate that in the humid climates the driest year and the very severe drought year need not be coincidental but in the semi-arid climates the dry year will also be a severe drought year which leads to severe failure of crops and shortage of water.

The study shows that most parts of the North-West tract of Iran are susceptible to droughts varying in intensity and water deficiency, particularly during the active period of plant growth. However, the ability to project drought frequency is of importance to the prediction of drought severity and duration. Reservoir operation alone could minimize drought damage and its economic consequences of reliable techniques of long-range prediction could be developed.

The Problem of Instability of Agriculture: The choice of semi-arid region as a study area rests on the fact that it not only has a vast proportion of agricultural region but it also has the dubious distinction of having low growth and low productivity. Unstable agricultural production and
productivity in this region is caused by climatic fluctuations. In 1982-83, nearly 55% of the country's net sown area covered by the semi-arid region and almost two-thirds of the area under cultivation in this region was brought under rainfed farming. Thus, the role of drought-prone areas in the retardation of Iranian agriculture progress is not marginal, and initial neglect of these regions persuaded by adverse climatic events have further compounded with the advent of new forces of agricultural development. It should be a matter of great concern (for the policy-makers in Iran) that this part of Iran has either decelerated or has shown very low rates of growth especially in cereals and cash crops. In 1982-83, 52.4% of wheat and 45.9% of barley, the two major cereal crops of Iran, 75.4% of pulses and 68.3% of legume fodder were grown in the semi-arid region. Of course, the area under other crops was found to be very minor in the country. These percentages also show the importance of the semi-arid region in the agrarian economy of Iran. From 1972-73 to 1982-83, the net cultivated area in the semi-arid region declined by 8.2%, whereas in the other two regions, i.e., arid and humid, the net cultivated area increased by 13.54% and 25.1% respectively. The gains and losses in the area cultivated were due to change in irrigated and rainfed areas. There was a net decline in the rainfed area whereas there was an expansion of irrigated area (more than half of this area expansion was from the arid region only)
Cropping Pattern: Wheat is the most dominant crop in Iran, accounting for 56% of the net cultivated area and more than half of this area is in the semi-arid region. During a decade study in the semi-arid region, total area under wheat declined by 13.93%, whereas in the arid and humid regions it showed an increase. Both the arid and the humid regions experienced high level of increase in their wheat production, whereas the semi-arid region suffered a drop in production. Moreover, in the semi-arid region, the average productivity of wheat per hectare was also substantially lower than the national average during the study period.

Thus, the semi-arid region is characterised by low or negative rates of growth in major crops. Lack of data both at micro and macro levels has crippled our study from bringing out greater details about the causes and consequences of deceleration or stagnancy of agricultural output in the semi-arid region. But it is quite clear from the tables and figures (in Chapter IV & V) that the semi-arid agriculture is mostly susceptible to the environmental factors and their fluctuations. For quite a few semi-arid provinces, accelerated growth in production for crops like oilseeds, legume fodder, and garden crops is accompanied by similar trends in their yields per hectare. But this does not necessarily mean that the contribution of area is negligible. In some parts of the country increased productivity has played a remarkable role in the relative acceleration
of growth in the production of major foodgrains, whereas the dominant contribution to relatively increased growth rates in production of garden-crops was both from area and productivity as a whole, during the study period.

Hence, the major causes for production instability in the semi-arid region turns out to be yield fluctuations, and variability in annual yield growth rates. And its corresponding impact on production instability, however, appear to be increasing over the decade. On the other hand, correlated changes in area and yield show decreasing tendencies to reinforce the variability in output growth rates. Synchronised movements in the year-to-year changes in area and yield levels have got neutralized progressively over the decade. This indicates another reason for agricultural growth deceleration in the semi-arid region. In this region during the study period the improvement in the yield of major crops is found to have not received much attention. And the impact of drought and the resultant water stress seems to be one of the remarkable phenomena for yield reduction. However, the semi-arid regions are often regarded as underdeveloped areas of the country. This is mainly due to the frequent setbacks caused by recurring droughts and the adjustments made to cope with drought.

In 1982-83, out of 9.8% of arable land in Iran, 6.5% was actually cultivated and the remaining one-third was left fallow. With the fast developing production technology no
land remains a marginal land in the strict traditional sense of the term. Yet the fact remains that for sometime to come, these areas would remain low-productivity lands. However, if investments with regard to the provision of water and development infrastructure are made in a rationally phased manner, there is no reason why a major part of these lands cannot be brought under cultivation within one decade. In other words, over the country, the scope for increasing production in the semi-arid region as also in two other regions (i.e., arid and humid) is considerable even if no improvement in production technology is assumed, which is not at all a logical assumption in a dynamic situation, we may observe that there is the possibility of enhancing production at least by 30 percent by cultivating all available arable land. When the productivity levels in all the three regions come into consideration, the agricultural output over the country will increase remarkably. Of course, much of these efforts, however, depend upon the availability of the main input, irrigation, especially in the semi-arid region.

**Crop-Weather Interaction:** In the crop-weather investigation of the semi-arid region, it is observed that there is a close relationship between crop production and climatic events. The period of 1972-74 was an unfavourable climatic condition, for the most part of the semi-arid region of Iran. In this period the output levels of two major crop namely, wheat and
barley showed a steep decline, simultaneously, the climatic figure also moves in fairly the same direction. At the other extreme, the period of 1981-83 recorded a favourable climatic condition bring about the highest yield and production of wheat and barley in this region. In other words, the intensity and frequency of climatic trends accompany crop fluctuation in the semi-arid region. In this attempt the regression analysis also shows a positive relationship between the production (or productivity) levels and the selected climatic factors. Thus, in these homo-climatic provinces of the semi-arid category, there is a close relationship between the crop fluctuations and climatic trends, and in this region whenever or wherever the occurrence of drought is observed the yield and output of selected crops appear to be affected.

Prospects and A Strategy: Broadly speaking, most of the agricultural crops in Iran do not appear to have favourable conditions of development below the 40% isoline of Moisture Adequacy Index unless otherwise raised as irrigated crops. If systematically studied on a weekly or monthly basis, this index should provide valuable information on the liability to drought and therefore, the climatic suitability of a region for agricultural development.

In most parts of the semi-arid regions of Iran, however, water resources particularly in the critical period of crop cultivation are insufficient to meet the irrigation requirements
of the cultivated land. It is necessary to so utilise the available water in these areas as to secure the maximum crop production per unit of water, extending at the same time the benefit of irrigation to as many farmers as is technically and economically feasible. This requires the adoption of the best technique of irrigation and adoption of cropping patterns which taking into account the constraint of limited irrigation supplies.

It is worth to note that inspite of the availability of considerable amount of surface water in the semi-arid region, the yield of agricultural production in this region suffered from the curse of drought-effect. This may be due to the mis-management of water use in this area. Furthermore, in many regions there are potential water resources which, with the necessary know-how and funds, could be developed. Much additional water can also be made available by improving water conservation, proper method of exploitation and sound management policies, by increasing the efficiency of use of existing water-resources.

A review of Iran's Five Plans reveals that there has been no specific consideration for the development of drought-prone areas. And drought-prone areas were not recognized as a separate unit for planning during the last plan period. A look at certain broad features of development show signs of a stagnant agricultural sector specifically in the semi-arid
region. It should be considered that what reorientation is necessary to insulate the economy of the drought-prone areas from the violent fluctuations in productivity due to recurring droughts. So far the drought problem in Iran has not been studied individually. Thus, it is suggested here that appropriate strategies should be evolved to reduce regional imbalances for promoting agricultural productivity specially in the semi-arid region of Iran. And also an attempt should be made to quantify the data relating to land-use, cropping pattern and cropping intensity. In calculating seasonal and peak project irrigation supply, the main variables to be considered include cropping pattern, cropping intensity, project size, irrigation requirements, level of supply in terms of crop production, and efficiency of the distribution system.

Where the drought is severe relief measures are the obvious answer. The entire country cannot be made drought-proof. What is to be done is to tide over the bad years in the chronically drought affected areas is to evolve a method by which the economy of the population can be improved optimally well with the potential available in the environment. Broadly speaking, depending upon the level of infrastructural development and integration of agriculture in drought-prone areas with the rest of the economy, a variety of measures ranging from provision of assured irrigation to crop insurance schemes, have to be evolved to counter the weather
induced instability in agriculture. The farmer's choice of adaptations and adjustments is ultimately influenced by the risk generated by agro-climatic circumstances. In this connection the selection of crops depends on the total water demand, timing of the need for water in relation to the supply, and the ability of the crop to endure drought without damage. It is essential to choose only deep rooted crops which use soil moisture from greater depth, non-traditional and drought resistant crops must be introduced in the region. If the cropping pattern is selected keeping in view the moisture budget of the soil it can lead to better production.

It is, however, to be reiterated that the available information about the drought-prone areas of Iran is not sufficient enough for formulating specific strategies for development and for indicating the feasibility of different programmes. However, some suggestions have been specified in a general way in Chapter VII, and are not repeated here again. In our view, many more investigations and more extensive research based on local environmental physical and socio-economic conditions are required before a viable economic programme can be implemented effectively in drought-prone areas of Iran.