The gist of the preceding three chapters in this study is that agriculture in Iran, in spite of a decline in its relative contribution in the gross domestic product and labour force absorption, continues to occupy a place of considerable importance in the overall economy, is affected to a significant extent by physical-cum-agro-climatic conditions, has experienced some important changes during the past couple of decades, and above all, is an under-researched area. To put the record straight, our analysis there showed and underlined the need of carrying out a study in the present mould. It, however, needs to be noted that in a study of the present type it is almost a convention to give details of the database, concepts and variables used and the methodological frame. The information pertaining to these aspects, in fact, constitutes the pivot around which a study of the present type must necessarily revolve. Besides, it has been increasingly emphasised that without an appropriate understanding of these crucial aspects, the conclusions emerging from the study can hardly be expected to be understood in their proper perspective. Subjective conjectures and ambiguities might create a number of biases and misconceptions in the minds of the readers, and these, in turn, tend to
obscure the fundamental issues involved in the study. The importance of information about these aspects of the study can, therefore, scarcely be exaggerated. With such considerations in mind and putting things in a clear perspective, an attempt has, accordingly, been made in this chapter to focus on the issues pertaining to the database, concepts and variables, and the methodological framework of the study.

Database

Generation of appropriate data on the relevant variables with a reasonable degree of accuracy constitutes an important step in any empirical investigation. These data can be either primary or secondary or both depending upon the source these are generated from. Furthermore, three types of data are generally used for empirical analysis. Such data can be of cross-section type or time-series type or a combination of both these types i.e., pooled cross-section and time-series data.

In the present study, wherever relevant, we have employed both time-series and cross-section data. It may be relevant to point out at the very outset that the time-series data were collected and compiled by us through secondary sources. The major sources of our data are the published reports and official records of the Islamic Republic of Iran, Ministry of Agriculture, Ministry of Economic Affairs and Finance, Central Bank of Iran and Statistical Center of Iran. Besides, the data furnished in Human Development Reports and other publications of the United Nations have also been used in this study. Regionwise data have been generated to compute the relevant variables for the period 1980-81 to 1995-96 by clubbing together the information available separately for various
provinces. Selection of this time period was partly dictated by the availability of data and partly by the accuracy and consistency of the data. In addition, depending upon the relevance of the context, we have also drawn upon the information available in other research works close to the theme of the present study.

**Concepts and Definitions**

In a study of the present type, it is essential to straighten out at the very outset the concepts and definitions used in the study. Although we have used the standard concepts and definitions as are commonly used by research workers, it is, nevertheless, advisable to give some clarification of these concepts and the procedure followed in computing the important variables used in the study. A brief description of the various concepts and terms as used in the present study is attempted below in the following pages:

**Level of Agricultural Development**

In this study, we are primarily concerned with the pattern of agricultural development in Iran during the post-Islamic Revolution era. The pattern of agricultural development can be examined in many different ways. For example, one can proceed in terms of comparing the agriculturally high growth areas with that of low growth areas both in terms of intake of farm inputs as well as volumes of agricultural production or levels of farm productivity. Alternatively, one can undertake to examine and analyse the pattern of various sets of fluctuations which characterise the agricultural sector and seek the relevant explanations for them. There are thus various possible ways of undertaking a theme like the present one.
Among the various options, however, visualised in its proper light, the pattern of agricultural development can be examined by looking at the level of agricultural development at various points of time. As such, level of agricultural development becomes one of the core concepts and variables in a study such as the present one. For measuring the level of agricultural development, we estimate the level of output per unit of land cultivated both in physical and value terms for each year and use it as an index of the level of agricultural development. For this purpose, instead of all crops, we have considered only eight important crops for inclusion in the present study. These eight crops are wheat, barley, rice, cotton, sugar beet, potatoes, onions and pulses. Considered together, these crops account for roughly 85 per cent of the gross cropped area in Iran. Level of productivity per acre (i.e., the index of the level of agricultural development) for each year is estimated by including these crops. Furthermore, to convert the output of each crop for different years at the constant prices in value terms, the average of the prices for the tricennium ending 1980–83 has been used. Apart from overall output per unit of land cultivated (both in physical and value terms), we have also extended this exercise in case of each of the crops separately. It needs to be pointed out here that in the case of rice, two sets of prices (i.e., for Gilan and Mazandaran varieties respectively) are announced by the government while production estimates are available only in the overall sense. To cope with this problem, we have used the average of these two prices for estimating the productivity of rice in value terms. We are aware of the fact that owing to the said problem we are either overestimating or underestimating the productivity estimates of this
crop in value terms as also in the estimation of overall farm productivity in value terms.

**Cropping Pattern**

Cropping pattern is an important concept used in empirical as well as analytical exercises pertaining to agricultural economics. Changes in cropping pattern are said to have for reaching socio-economic implications in an economy in which agricultural sector plays an important role. The prevalent viewpoint in this regard is that while a suitable cropping pattern provides maximum agricultural production with minimum use of farm inputs; an inappropriate cropping pattern, on the other hand might lead to sub-optimal allocation of resources on the part of the farmers. An important point worth noting in respect of cropping pattern in general is that this concept can be interpreted both in the static and dynamic senses of the term. While in the former sense, it may be construed to mean the proportion of area under different crops at a point of time; in a dynamic sense, on the other hand, it implies the proportion of area under different crops, changes in this distribution of area over a period of time and the factors determining this change in the distribution. Obviously, the concept is broader in a dynamic sense than in the static sense. In view of this, in the present study, therefore, we have followed the latter meaning of the term and view it as the proportion of gross cropped area allocated to different crops, changes taking place in it (if any) during the period under reference and the factors accounting for such changes. Furthermore, as regards determinants of cropping pattern, it can be maintained that although it is determined mainly by the environmental factors, like rainfall, soil
conditions, etc., yet the recent evidence suggests that the availability of irrigation facilities, inter-crop price relationships, relative productivity of different crops, changes in agricultural technology, marketing and transport facilities, growth of agro-industries, demographic conditions of the region, etc., also exercise considerable impact on the cropping pattern of an area.

The New Farm Technology

The New Farm Technology comprises bio-chemical and mechanical innovations. Bio-chemical innovations encompass HYVs of seeds, chemical fertilisers, irrigation and pesticides. Mechanical innovations, on the other hand, include tractor, thresher, combine harvestor, seed drill and so on. Owing to data limitations, however, we have defined new farm technology in a restricted sense only in that our concept of new farm technology covers only four farm inputs, namely, HYVs of seeds, chemical fertilisers, pesticides and insecticides. Irrigation has been given a separate treatment and has been included as an infra-structural input rather than as an integral part of new farm technology. Another important limitation of our concept of new farm technology is discernible particularly in respect of HYVs of seeds. In most studies, especially those conducted in India in the wake of green revolution since mid-sixties, one comes across area under HYVs of seeds as the indicator of adoption of new farm technology. In Iran, on the other hand, in spite of our best efforts, we could not elicit relevant quantitative information along these lines. Rather, we had to remain content with the information available in terms of quantity of improved (presumably HYVs) seeds distributed among the farmers and that too with the usual N.A (Not Available) tags. Accordingly, we are well aware of the
fact that our definition of the concept of new farm technology in the present context is rather narrow. But as pointed out earlier, data limitations restricted our choice rather quite strictly.

It is, however, important to note that the use of chemical fertilisers has registered a tremendous increase in the present-day agriculture across the world. In fact, this is an input of most critical significance in the process of agricultural modernisation. In the formulation of this variable, it was realised that there exist significant variations in the use of chemical fertilisers in Iran across various provinces/regions. As such, the consumption of chemical fertilisers in absolute terms, would not reveal the region’s comparative degree of fertiliser intake for agricultural development. To overcome this problem, we have used the concept of the ratio of fertiliser intensity. For our analysis, this variable has been defined as the proportion between the amount of total consumption (N P K) of chemical fertilisers used for agricultural purposes and Gross Cropped Area. Symbolically,

\[
\text{Fertiliser Use Ratio} = \frac{\text{Consumption of Chemical Fertilisers in a Year}}{\text{Gross Cropped Area in that Year}} \times 100
\]

It is pertinent to point out here that our concept of fertiliser use ratio underestimates the intake of the nutrients in that in addition to chemical fertilisers, the practice of using home-grown organic manures is also quite common in the countryside of most of the agrarian societies. And Iran is no exception in this regard.
Farm mechanisation or use of mechanical gadgets in agriculture is the other important component of new farm technology. It is said to have played a critical role in the modern system of agricultural production. It has been observed over the years that in areas of fast agricultural growth, farmers are making increased use of various types of mechanical gadgets such as tractors, pump-sets, combine harvesters, threshers, seed-drill, etc. To account for the farm mechanisation and in view of various data constraints, we have, in the present study, introduced the farm mechanisation through the use of tractors, since relevant data were available only for this mechanical gadget. Accordingly, in the present study, the level of farm mechanisaion as a variable has been used in the limited sense in that it pertains to the use of tractors only. The concept, as used in this study, has been defined as the Gross Cropped Area per tractor. Symbolically,

\[
\text{Tractor Use Ratio} = \frac{\text{Gross Cropped Area in a Year}}{\text{Number of tractors in that Year}} \times 100
\]

**Institutional Framework**

Although the term ‘institutional framework’ has been used quite extensively in empirical research, yet little attention has been paid in attempting a definition of it. The term has rather, been so frequently used in social science research that it has acquired a wide variety of meanings in social, economic, political senses, etc. In all these respects, the term has been used, in a rather loose sense. Accordingly, one fails to understand as to what does it really mean.
In simple words, institutional framework connotes those organisations / set ups or systems which are influenced through government action in one way or the other. In the present study, the term institutional framework has been used in an exceedingly limited way in that it includes only two important planks i.e., land reforms measures as have been implemented in Iran since early sixties, and agricultural price policy in vogue in the post–Islamic Revolution period. Again, it needs to be clarified that institutional farm credit, though essentially an institutional measure, has been treated by us as an infra-structural input in the present study. This has been done keeping into view the practice followed by many other studies.

**Agricultural Infrastructure**

While it has come to be increasingly realised that infrastructural facilities play an important role in the process of sectoral as well as overall growth of an economy, there is, nonetheless, no consensus as far as the meaning of the term is concerned. In view of this, the term infrastructure is used in theoretical as well empirical senses with a considerable degree of imprecision, which is quite understandable and inescapable as well owing to some sort of overlapping between institutional and infrastructural factors of agricultural growth.

A careful scanning of the available literature shows that the terms ‘*infrastructure*’ and ‘*social overhead capital*’ have come to be used synonymously for each other by some leading development economists, but not without some important omissions and commissions here and there. In essence, however, infrastructure connotes the basic services or
public utilities, which are necessary to the commodity-producing (in our case farm output) sectors of the economy. It has been argued that any service for getting itself included in social overhead capital must be characterised by four important characteristics i.e., (a) the services provided by the activity facilitate, or are in some sense basic to the carrying on of a wide variety of economic activities; (b) the services are provided in practically all countries by public agencies or private agencies subject to some public control and are provided free of charge or at rates regulated by the public agencies; (c) the services cannot be imported; and (d) the investment needed to provide the services is characterised by lumpiness (technical indivisibilities) as well as by a high capital/output ratio (provided the output is at all measurable). 

It is, however, pertinent to note that attempts at definition and conceptualisation of infrastructure specifically for the agricultural sector are few and far between. From the viewpoint of the present study, a broad definition of agricultural infrastructure seems to be most appropriate. As such, the term must include all such infrastructural facilities, both public and private, which provide economic services and which influence significantly, directly or indirectly, the economic functioning of the individual farm firm, but which are external to the individual farm firm. However, in view of numerous data constraints confronted by us in these important matters, we have in the present study made only a passing reference to extension services, education (i.e., schooling or investment in farm people), health, transport and communication. Data constraints did not leave much scope for us to include these infra-structural inputs, which
otherwise are quite important for the growth of the farm sector. Owing to these limitations, we have, therefore, defined infrastructural facilities in a narrow sense of the term in that we have concentrated, in particular, only on irrigation facilities, institutional farm credit, consumption of power and marketing infrastructure. An important point, which needs to be underlined in respect of institutional farm credit in Iran, concerns itself with the type of data available. In this case, while break-up of the amount outstanding in terms of the shares of Agricultural Bank and other commercial banks was available; it was not so in case of the amount of loans issued. Rather in the latter case, information was available regarding the amount of loan issued to the farm sector by all banks (i.e., both the Agricultural Bank and the other commercial banks). In this connection, it is relevant to point out that we worked out the amounts of loans issued by the Agricultural Bank and the other commercial banks by applying the proportions pertaining to the amounts of loans outstanding. The underlying assumption and limitation in respect of our estimates are, therefore, quite obvious.

**Division of Iran into Regions**

The analysis of agricultural change during the post-Islamic Revolution era in Iran has been carried on, in the present study, at the level of the country as a whole. However, the examination of the change at that level concealed the fact of inter-regional variations to be taken cognizance of in the matter of agricultural development. In most of the existing studies on the theme of agricultural performance across the world, growing stress has been laid on the need for studying regional / inter-province variations. And again in those focusing on a particular region or a province, the need
for carrying out such an exercise at a still lower level has been emphasized. Such an exercise assumes considerable significance for purposes of meaningful policy formulation on several counts. First, analyses carried out at the aggregative level might conceal in themselves a lot of diversity of patterns and situations which tend to overwhelmingly characterise the agricultural sector in almost all the countries of the world. The empirical exercise at the level of the country as a whole, as such, tends to conceal the inter-regional as well as intra-regional variations in the pattern of agricultural development, the analysis of which otherwise, is central to policy formulation in this respect. Second, there is no reason to assume that the level of agricultural development is uniform throughout the country. In other words, it is quite possible that the performance of the agricultural sector, both in terms of volume of production and levels of farm productivity, may be quite high in some areas than in the others. To put the record straight, the possibility of some provinces / regions in the country being far more developed than the others cannot be ironed out completely. Likewise, one cannot completely rule out the possibility of a lot of differences between the cropping patterns of different provinces / regions in a relatively big country like Iran. In such a situation, any analysis at the level of the country as a whole is bound to conceal the sharp regional variations. In the absence of such critical province / region level information, agricultural development programmes will be less effective because administrative effort and financial resources are likely to get thinly distributed throughout the country. This, in turn, might further accentuate the pattern of lopsided pattern of development. Third, in addition to its...
usefulness in agricultural development policy formulation and implementation, regional analysis of the pattern of agricultural development can also help in the formulation of an effective long-term agricultural development programme for removing the region-specific constraints owing to which, the surety of overall growth to these regions has remained either largely elusive or at best only at a very low keel. In view of this, what is therefore imperatively needed to improve agricultural performance in these regions on a sustained basis is that first of all such agriculturally laggard regions need to be identified. After identifying them, their specific constraints need to be duly identified and thoughtfully examined. After this has been done, the appropriate remedial programmes need to be imaginatively designed and effectively implemented to tackle the various constraints as have been come across in the said process. It is only this type of approach that will help in finding a lasting solution to the problem of agricultural backwardness of these regions. And finally, apart from what has been said above, an analysis of the regional variations in the pattern of agricultural development can be immensely useful even in terms of its pure academic worth as well. For instance, the role of various natural, infrastructural, institutional and technological factors in making a particular region(s) agriculturally advanced or otherwise can be adequately captured only by a detailed study of regional variations in the matter of agricultural development within a country.

It is not out of context to mention here that the farm sector in Iran is characterised by considerable regional variations in terms of soil types, topography, rainfall, climatic conditions, etc. In view of what has been said
above, it is not deemed advisable to study the country as a single unit. Rather, for purposes of making the analysis relatively more purposeful, an attempt, therefore, needs to be made to provide a detailed and disaggregated view of the variations in the pattern of agricultural development across various agro-climatic regions in Iran. In precise terms, more meaningful insights can be obtained by discerning and analysing the pattern of variations in the matter of agricultural development within Iran at the disaggregated level. Therefore, at certain places in the study, the analysis has been carried on at the region level instead of that at the country level.

**Approaches at Regionalisation**

Broadly speaking, the foregoing discussion emphasises on the imperativeness of studying the regional pattern of agricultural development in Iran. As pointed out earlier, in any study pertaining to the pattern of agricultural development across different regions, the delineation of an appropriate spatial unit of analysis is of critical significance. And thanks to the extensive analytical and empirical research on the theme of regionalisation during the past couple of decades, this area of research seems to have experienced notable sophistication and experimentation. A number of methods of regionalisation have been suggested by regional scientists. As a consequence, many approaches are discernible for the delineation of regions of a country. Broadly speaking, the two approaches to the problem of forming uniform and formal regions are namely the *Aggregative Approach* and the *Divisive Approach*. In the *Aggregative Approach*, regions are formed through the progressive combination of
basic areal units exhibiting the greatest possible degree of similarity. In *Divisive Approach*, on the other hand, an area is split into smaller units showing the maximum possible dissimilarities. The choice of a particular approach, nevertheless, is guided partly by the objectives underlying a particular study, and partly by the availability of the requisite quantitative information at that level.

Among the various approaches of regionalisation, which are presently discernible in the empirical literature, one such method is in terms of administrative divisions of a country. As pointed out earlier in chapter II, Iran at present consists of 28 provinces. Therefore, province would be the most important regional unit, simply because most of the politico-administrative decisions are taken and implemented at the that level. Another regional scheme runs in terms of indicators of geographical and demographic homogeneity. Still, one can consider yet another scheme of regionalisation which may be based on the parameters of the level of agricultural development. In this regard, one can examine the patterns and factors associated with agricultural development in terms of some composite indices. Alternatively, one can undertake to classify the regions on the basis of their performance in production and productivity in relation to the country level average. There are, thus, a number of alternative ways to delineate regions. Needless to overemphasise, it is the very objective of a specific study that determines the basis for forming homogeneous agricultural regions. However, it is neither practicable nor essential to follow all the regionalisation schemes that have been proposed by different regional scientists or organisations in the area. For the present study, the
ideal picture certainly would have been to from regions on the basis of composite indices of cropping pattern, levels of farm productivity per unit of land cultivated, percentage of area irrigated, area under High Yielding Varieties of Seeds, so on and so forth. But the non-availability of sufficient data on these crucial variables of agricultural development constrained our choice in this regard. In view of such an important limitation, an alternative and possibly more suitable regionalisation scheme for the present study should run in terms of (i) clubbing of various provinces together as a regional unit, (ii) geographical regions demarcated on the basis of indicators concerning geographical and demographic homogeneity, and (iii) agro-climatic conditions. For analysing the pattern of regional variations in Iran in the matter of agricultural development in the present study more purposefully, we take into account these three sets of considerations for the formation of regions. Moreover luckily for us, we have available to us a scheme of regionalisation which has been found fairly workable by some other research studies as well. Accordingly, for making the analytical analysis in the present study rather more useful, the following five more or less homogeneous regions have been formed by us by clubbing together various provinces (for details see Map M – 4.1):

**Region I**
consists of the provinces of Gilan, Mazandaran, Zanjan, Tehran and Semnan.

**Region II**
comprises provinces of East Azarbaijan, West Azarbaijan, Kordestan, Kermanshah, Ilam, Lorestan and Hamadan.
Region III covers provinces of Esfahan, Markazi, Charmahal-Bakhtiari and Yazd.

Region IV includes the provinces of Khorasan, Kerman, Sistan–V–Baluchestan.

Region V encompasses in its fold the provinces of Khuzestan, Kohgiluyeh–V–Boierachmad, Fars, Busheher and Hormozgan.

This is not to suggest that this attempt of ours concerning formation of regions is free from any limitation whatsoever. For instance, an important limitation which is conspicuously present in our attempt at regionalisation is that the various regions, as demarcated by us in the present study, have been formed mainly on the basis of agro-climatic and geographical considerations. However, in view of the provinces being used as the building blocks in the formation of these regions, the possibility of such considerations being overlooked to some extent through some inadvertent acts of omissions and commissions cannot be dismissed altogether. Our regional classification, therefore, at best approximates the said considerations. Moreover, our purpose here is just to discern and analyse the inter-regional pattern of agricultural development in Iran without going into an examination of the factors accounting for the observed pattern. Furthermore, in attempting a more disaggregated analysis of the agricultural change in Iran, our analysis of the pattern of regional variations in agricultural development as also for the country as a whole is also based on the province-wise secondary data available from 1980–81 to 1995–96. It is relevant to point out here that while reporting the pattern of
regional agricultural development in Iran, we have refrained from undertaking a detailed discussion of the technological, institutional and infrastructural factors. We are aware of the fact that even if such factors are available in abundance, the natural factors, which in any case are supreme in agriculture, can also distort the picture of inter-regional variations to a considerable extent. In our opinion, it is primarily the interplay between a wide variety of factors which is responsible for the differential pattern of growth in Iran across regions. Moreover, our analysis also suffers from the aggregation bias in that we have clubbed together provinces of various sizes in different regions. The results, emanating from our study should therefore be appreciated or otherwise in the light of such facts. These and other limitations apart, this attempt of ours is useful in several important ways. It is simple and easily intelligible in the sense that it does not involve the complexities of the statistical rigour. More importantly, it constitutes a synthesis of the two approaches mentioned above\(^1\) in the sense that we have split Iran into five regions, which in turn, have been formed by clubbing together as many as 24 provinces in terms of the three considerations as stated above.

**Methodology**

As mentioned earlier, the present study is a cross section-cum-time series study on the pattern of agricultural development in Iran during the post-Islamic Revolution era. The basic objective of the study is to examine and analyse the pattern of agricultural development in Iran in terms of the temporal growth of indicators included in it. For this purpose, we have made use of a number of statistical techniques in this study. While
a brief description of the methodology adopted for some important aspects of the study has been given in the appropriate chapter of the study, an overall view of some important tools of our research-kit is given below for setting the things in a more clear perspective. In particular, the methodology used in the present study can be broadly sub-divided into the following two parts:

(i) Tabular-Cum-Graphic Analysis

(ii) Economic Analysis

(i) Tabular-Cum-Graphic Analysis

To begin with, the pattern of agricultural development in Iran as also across its various regions is looked into with the help of tables over the period 1980–81 to 1995–96. In addition, for purposes of forming a broad preliminary judgement and in order to get a clear visual picture of the behavioural pattern of some key indicators of agricultural development in Iran as a whole the 16 years data on the relevant variables, wherever required, are also presented by means of graphs. Needless to overemphasize, these techniques are non-mathematical in nature as well as picturesque in outlook and appeal. Due to these considerations perhaps, these have been frequently and extensively employed by research studies for analysing the behavioural pattern of socio-economic variables. The present study is also guided by such considerations in this regard.

(ii) Economic Analysis

Economic analysis, in the present study, has been done by seeking plausible explanations to various issues taken up for empirical examination. And for purposes of economic analysis, the insights gained from the tabular
and graphic analysis have been further examined with the help of more rigorous statistical techniques. The research-kit, as employed by us for carrying out the objectives of the present study, consisted of the following:

**Measurement of Variability in the Farm Sector**

That agricultural production and yield rates throughout the world are characterised by instability or fluctuations is a well-known fact. As such, the pattern of instability characterising the pattern of agricultural development of an area must essentially constitute an important part of the empirical exercise to this effect. It is commonly held that volume of agricultural production, yield rate and level of farm productivity are subject to the following two categories of fluctuations, viz. The Periodic Fluctuations and The Irregular or Random Fluctuations:

**The Periodic fluctuations**

It is pertinent to note that in agriculture, apart from the growth factor, there are forces at work which prevent the smooth flow of the series in particular direction and display a simultaneous tendency to repeat themselves over a period of time. What needs to be underlined in respect of these forces is that these do not act continuously. These forces tend to produce an effect which can be classified as:

(i) **Seasonal Fluctuations, and**

(ii) **Cyclical Fluctuations**

(i) **Seasonal Fluctuations**

Farm production business, by its very nature, is seasonal in character. Accordingly, these variations or fluctuations occur on a regular basis and are caused largely by seasonal changes/factors. A characteristic feature of
the seasonal variations or fluctuations, however, is that these are caused by rhythmic forces which operate in a regular and periodic manner over a span of one year or shorter. In other words, these variations are due to forces which operate in a regular spasmodic manner and culminate into the same or almost same pattern year after year. Because of their recurring nature, these variations are considered as normal phenomenon and can be predicted with some reasonable degree of accuracy. To be more specific, nature being supreme in agriculture, seasonal variations in agriculture are caused by change in seasons or weather-induced changes or change in agro-climatic conditions such as amount and time of rainfall, humidity, sunshine, harvesting and post-harvesting seasons, etc. The analysis of seasonal variations in agriculture is useful in: (i) ascertaining if the seasonal pattern of a series pertaining to agricultural production, prices or other such critical variables is stable or is changing gradually or abruptly; (ii) examining the behavioural pattern of cyclical and irregular variations; (iii) planning future operations; (iv) formulation of policy decisions concerning the farm sector; and (v) comprehending accurately the behaviour of the phenomenon in time series data pertaining to the farm sector.

(ii) Cyclical Fluctuations

The oscillatory movements in a variable pertaining to farm activity which represent consistently recurring rises and declines are usually termed as cyclical fluctuations. Prosperity (or period of boom), decline (i.e., recession), depression and improvement (i.e., recovery) are the well-known four phases which characterise the cyclical fluctuations. The
upswings and the downswings in farm production business depend upon the cumulative nature of the economic forces (affecting the equilibrium of demand and supply) and the interplay between them. These fluctuations differ from seasonal variations in two important ways. **First,** as compared to the seasonal variations, these are of longer duration. **And second,** these do not ordinarily exhibit regular periodicity as we come across in respect of seasonal fluctuations. That these variations differ widely in amplitude, timings and patterns and as such do not display regular periodicity is an important feature of the cyclical variations which cannot be ignored. Also, since these variations get closely mixed-up with irregular variations, therefore in their case, it becomes relatively more difficult to isolate the effect of cyclical and irregular variations. In spite of this, however, the cyclical oscillatory movements are important in: (i) predicting the turning points in agricultural activity; (ii) estimating and forecasting about the future; (iii) framing of appropriate stabilisation policies in respect of agricultural production and incomes; and above all (iv) isolating and analysing the effect of irregular variations.

(iii) **The Irregular Fluctuations**

Popularly also known as erratic, episodic, accidental, unpredictable, residual or random fluctuations, these variations do not repeat themselves in a definite or set pattern time after time. Rather, on the other hand, these movements display an abrupt rise or a sudden fall in indicators of agricultural growth at certain instants of time. Among other things, these are normally caused by variations in numerous non-recurring sporadic factors such as famines, excess or inadequacy of rainfall causing floods or
droughts, sudden locusts attack on standing crops, sunlight, abrupt change in agro-climatic conditions, etc. i.e., due to the factors which tend to behave in a very erratic and unpredictable manner. Accordingly, these variations normally encompass all types of short-term fluctuations other than trend, seasonal and cyclical movements. These movements sometimes are so intense or powerful that these are capable of giving rise to new cyclical or other variations. That these result from chance factors and are subject to neither isolation and exclusive analysis nor to error-free forecasting or estimation is an important point worth underlining in their case. Rather, unpredictability remains an essential feature of these fluctuations.

Measurement of Instability in the Agricultural Sector

In the available literature, various methods have been suggested to study the phenomenon of instability which characterises the farm sector. Some such measures of instability as have been widely used in the context of the agricultural sector are:

1 Graphic Method

Graphic method is the simplest method of studying the variations or fluctuations. In this technique, the data are plotted on a graph. The variations or fluctuations are judged by looking at the shape of the graph. The simplicity and directness of this method notwithstanding for a while, it is uneconomical, suffers from an element of subjectivity and devoid of rigorous statistical estimation. As such, its usefulness for making predictions is exceedingly limited.
2 Dispersion

Dispersion is another important measure employed in empirical research to measure variability. Among the various measures of dispersion, Standard Deviation is the most important measure because of the scientific rigour involved in its estimation. It is extremely useful in judging the representativeness of the mean and is an extensively used measure. Since standard deviation is the square root of the mean of the squared deviations from arithmetic mean, it is also called root mean square deviation. Symbolically,

\[
\text{Standard Deviation } (\sigma) = \sqrt{\frac{\sum y^2}{N}}
\]

Where \( y = Y - \bar{Y} \)

\( Y = \) Given values of the distribution

\( \bar{Y} = \) Arithmetic Mean of the distribution

\( N = \) number of observations.

Co-efficient of Variation

The use of co-efficient of variation is quite common in empirical research. It is generally used in comparing the variability of two or more than two series. The value of co-efficient of variation and consistency/stability are inversely related to each other. The co-efficient of variation is estimated by the following formula:

\[
\text{C.V. } = \left( \frac{\sigma}{\bar{Y}} \right) \times 100
\]

Where;

\( \text{C.V.} = \) Co-efficient of Variation
\[ \sigma = \text{Standard Deviation of the Variable} \]
\[ \bar{Y} = \text{Arithmetic Mean of the Variable} \]

It needs to be underlined that co-efficient of variation is usually expressed in percentage terms. The co-efficient of variation \( I_a \) (Instability Index a) will be one of the measures of comparative instability sets of non-trended data series. This index is given by the following formula:

\[ I_a = \frac{100}{\bar{Y}} \sqrt{\frac{\sum (Y - \hat{Y})^2}{N - 1}} \]

Where:
- \( Y \) = Variable being examined
- \( \bar{Y} \) = Arithmetic Mean
- \( \hat{Y} \) = Estimated Value of \( Y \) Variable
- \( N \) = Number of observations

An important limitation of the co-efficient of variation which needs to be brought to the fore here is that the above formulation of the co-efficient of variation is not usually used to calculate stability or its counterpart. It is owing to the fact that most variables pertaining to the time-series data exhibit some trend which is required to be removed.

In view of what has been said above of the co-efficient of variation, it is not unimportant to stress that for constructing a true measure of instability, it is first essential to remove any trend element from the series. Having observed this, one can undertake to use a linear trend corrected measurement of variation which approximates this instability index. The trend can be approximated by a linear function. The following form of the index has been used in empirical investigation by some research workers.
Where,

\[ N = \text{Number of annual observations} \]

\[ T = 1, 2, \ldots, N \]

\[ \hat{Y} = \text{Fitted value computed as } \log Y_t = a + bT + uT \]

Read carefully, the above equation states that the instability index \( I_b \) is simply the standard deviation of the observed error term \( uT \).

A version of the above index (i.e., Massels index) in a linear form has been adopted by UNCTAD to examine the price stability of several primary products. This index \( I_c \) simply incorporates the derivation of \( Y \) from a linear trend and multiplies the result by 100 i.e.

\[
I_c = \frac{100}{\bar{Y}} \sqrt{\frac{\sum_{i=1}^{N} (Y_i - \hat{Y})^2}{N}}
\]

It is pertinent to note here that with the exception of co-efficient of variation, all the above described measures have one fundamental defect from the analytical point of view. These are, at best, adhoc measures. In spite of their being reasonable, they are bereft of any clear theoretical underpinnings.

The elementary statistical theory observes that for a simple multiple regression, the co-efficient of multiple determination is given by:

\[
R^2 = 1 - \frac{\sum_{i=1}^{N} (Y_i - \hat{Y})^2}{\sum_{i=1}^{N} (Y_i - \bar{Y})^2}
\]
Where,

\[ \hat{Y} = \text{Estimated value of } Y \]

It can be re-written as:

\[
\sum_{i=1}^{N} (Y_i - \hat{Y})^2 = (1 - R^2) \sum_{i=1}^{N} (Y_i - \bar{Y})^2 \frac{(N - k)(N - 1)}{(N - k)} \frac{N}{N - 1}
\]

Where, \( \sum(Y - \bar{Y})^2 \) is divided by the number of degrees of freedom, it becomes the square of standard error (\( \text{SEE}^2 \)) of the regression estimates.

\[
\text{SEE}^2 = \frac{\sum_{i=1}^{N} (Y_i - \hat{Y})^2}{N - k}
\]

Where \( k = \text{Number of independent explanatory variables} \)

\[
\text{SEE} = \sqrt{\frac{\sum_{i=1}^{N} (Y_i - \hat{Y})^2}{N - k}}
\]

\[
\text{SEE} = \sqrt{\frac{\sum_{i=1}^{N} e_i^2}{N - k}}
\]

Where,

\[ e_i = Y_i - \hat{Y} \]

Finally, we arrive at and use the following formula of instability index

\[
\text{Instability Index (I)} = \frac{\sqrt{\sum_{i=1}^{N} e_i^2}}{\text{SEE}}
\]

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Averages and Percentages

The theme of the present study is to examine and analyse the pattern of agricultural development in Iran during the post–Islamic Revolution era. This theme has been explored in terms of an examination of the various issues. For this purpose, guided by the requirements of the study, we have made use of averages and percentages in the present study. It is pertinent to note that as tools of economic analysis, both averages and percentages have found favour with a fairly large number of researchers. Needless to stress, while the use of averages gives an overall view of the whole mass of data, that of percentages, on the other hand, helps in making the analysis more meaningful in the sense that these reflect the relative weights of the concerned variables.

Differentials (d_i)

With the purpose of bringing out the pattern of agricultural development in Iran in clear perspective, we make use of the differential technique in the present study. This technique helps in capturing the overall change / growth in the values of the variables included in the present study. The average annual change / growth has been measured by dividing the overall change / growth (d_i) with the number of years involved in between the initial year and the terminal year. The following formula has been used for working out the differentials in the study.

\[ \text{Differential (d_i)} = \frac{V_n - V_0}{V_0} \times 100 \]

where:

- \( V_n \) = Value of the variable in the nth year
Index Numbers

Index numbers are said to be the important barometers of the performance of an economy as also of its given sector(s). As statistical devices, they are frequently used in empirical research to measure the net amount of change in a group of inter-related variables. Depending upon the requirement, we have also made use of this important technique to measure the change that has taken place overtime in respect of some important variables included in the present study. It is important to note here that in the construction of index numbers, the selection of base year is said to be of critical significance. In this regard, it is not out of place to mention that for some crucial variables, we have taken the average of the triennium ending 1982-83 as the base.

Regression Analysis

Regression technique as a tool of economic analysis has tremendously grown in importance in recent years and has come to be considered as a very powerful tool in the kit-bag of an empirical economist. It is generally used for lending precision to the analysis primarily because it helps in determining the exact degree of relationship between the dependent and the independent variable(s). This technique helps us in estimating the value of the dependent variable, when the value of the independent variable(s) is given.

For carrying out the objective of the present study, the method of Ordinary Least Squares (OLS) as applied by us to Double – log Model is given below:

\[ V_0 = \text{Value of the variable in the initial base year.} \]
\[ Y = a X^b \]

\[ \log Y = \log (a X^b) \]

\[ \log Y = \log a + b \log X \]

\[ \log Y = a + b \log X, \quad \text{where } a = \log a \]

\[ \log Y_t = a + b \log X_t + u_t \]

where \( \log Y \) = Dependent variable

\[ a = \text{Intercept} \]

\[ b = \text{Regression co-efficient} \]

\[ \log X = \text{Independent variable} \]

The regression co-efficient would have a negative sign if there is inverse relationship between the two variables and, a positive sign on the other hand, if there exists a direct relationship. A ‘\( t \)’ test is applied for testing the significance of regression co-efficient at the given level of significance. The co-efficient of determination (\( R^2 \)) has also been estimated to indicate the variation in the dependent variable which can be attributed to the independent variable.

**Trend Growth Rate**

With the objective of looking at the pattern of temporal behaviour (or trends) of the variables included in the study, an attempt has been made to quantify the trends by estimating the growth rate of indicators of agricultural development for the country as a whole as well as its five regions. This has been facilitated by the availability of the relevant data spanning over a fairly long period of time between 1980–81 and 1995–96. It is, nevertheless, important to note that there are a host of estimation techniques for the computation of the trend growth rate. The possibility of
some of these techniques giving misleading results cannot be ruled out. However, among the options available to us, our choice for the following one was dictated by several considerations such as limited objective of the study, simplicity involved in its estimation, and above all its finding favour with a fairly large numbers of other research workers. Growth rates have been estimated by fitting a function of the following semi-log type:

\[ \log Y = a + bT \]

Where:

- \( Y \) = Dependent variable
- \( a \) = Intercept
- \( b \) = Coefficient of time variable (\( T \))
- \( T \) = Time variable

In the above equation, growth rate (per cent per annum) has been estimated by multiplying \( b \) with 100, i.e.

Annual growth rate (\%) = \( b \times 100 \)

Alternatively, the exponential equation \( Y = a e^{bT} \) converted into the following log form can be used.

\[ \log Y = \log a + T \log b \]

In the above equation, per cent growth rate is given by the following formula:

Percent Growth Rate = \( \left[ \text{Anti log} (\log b) - 1 \right] \times 100 \)

It is not out of place to mention that the growth rates have been estimated by us to indicate the growth in the area, production and yield of various crops. The growth rates have been estimated for the total period 1980-81 to 1995-96, as well as for the sub-period namely, the earlier phase
representing the period when the Iranian economy was badly trapped by war with Iraq i.e., the period falling between 1980-81 to 1987-88 and the later phase covering the period from 1988-89 to 1995-96, which represents the period of planning in the post-Islamic Revolution era.

**Chi-Square Test ($\chi^2$)**

Originally discovered by Helmert in 1876 and later developed and introduced in statistical studies by Karl Pearson, a renowned statistician, in 1900, the $\chi^2$ test, as an instrument of research, is one of the most simple, elegant and extensively used non-parametric statistical inference procedures. It is applicable to a very large number of problems in diverse areas of research. For instance, this test provides a technique whereby it becomes possible to (i) test the goodness of fit, (ii) compare a number of frequency distributions, and (iii) determination of association and relationship between attributes. Viewed from these angles, it can be labelled as a test of independence, homogeneity and goodness of fit. And if the data conform to some theoretical distribution i.e., normal distribution or the binomial distribution, this test helps in assessing the significance of the difference between the observed and the expected frequencies. Thus, it is a measure of actual divergence of the observed and the expected frequencies. It is relevant to point out that if the difference between the observed and the expected frequency does not exist, the value of Chi – Square is zero and in the event of the existence of the difference between the two sets of frequencies, the Chi – Square would be positive or negative. The difference between the two may be on account of sampling fluctuations. In this case the value of Chi – Square may arise due to sampling fluctuations.
The $\chi^2$ test first calculates a $\chi^2$ statistic and then sum differences of observed values from the expected values. The equation for this function is

$$\text{Chi-Test} = P(x > \chi^2)$$

where:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

or simply

$$\sum \frac{(O - E)^2}{E}$$

and where:

- $O_{ij}$ = actual frequency in the $i$th row, $j$th column
- $E_{ij}$ = expected frequency in the $i$th row, $j$th column
- $r$ = number of rows (i.e., from 1, 2, ……… r)
- $c$ = number of column (i.e., from 1, 2, …… c)

Chi-Test returns the probability for a $\chi^2$ statistic and degrees of freedom, d.f., where d.f. = $(r-1)(c-1)$

**DECOMPOSITION ANALYSIS**

**Area Effect and Yield Effect on Crops Output**

The decomposition analysis of growth in agricultural output has occupied an important place in agricultural economics literature. The increase in agricultural production has traditionally been explained in terms of the area and yield components. Therefore, it is important to examine how much of the total increase in production is accounted for by increase in area under cultivation and how much by change in productivity. We examined this question with reference to all the crops covered in the present study. Denoting the output of crops in 1980-81 as $q_1$ and in 1995-96 as $q_2$ the increase in output is expressed as $e = q_2 - q_1$. We have decomposed $e$ into two parts, $e$, resulting from increase in area under cultivation (area
effect) and \( c_2 \), resulting from improvement in productivity (yield effect).

The area effect then is \( c_1 = (a_2 - a_1) \cdot y_1 = a_2 \cdot y_1 - q_1 \) and the yield effect is \( c_2 = (q_2 - q_1) - c_1 = q_2 - a_2 \cdot y_1 \) where \( a \) refers to the area under cultivation and \( y \) to the yield per hectare and the subscripts refer to 1980-81 and 1995-96 respectively. Then \( c_1 / c \) accounts for the share of area in increase in total output and \( c_2 / c \) indicates the yield effect in total output. 10

Gini’s Concentration Ratio And Inter-Class Concentration Index (ICC_i)

The pattern of distribution of ownership of landholdings assumes critical significance in any study pertaining to agricultural development. Accordingly, an attempt has been made in the present study to compare the pattern of distribution of ownership of land holdings in Iran in the post – Islamic Revolution period with that of pre – Islamic Revolution period. This has been done in terms of computation of Gini’s Concentration Ratio Co – efficients for the years 1973 and 1992 which represent the said periods. These co-efficients have been estimated by using the following formula:

\[
\text{Gini’s Concentration Ratio} = \frac{1}{10000} \left[ \sum_{i=2}^{n} P_{i-1} Q_i - \sum_{i=2}^{n} P_i Q_{i-1} \right]
\]

Where, \( P_i = \text{cumulative percentage of households of the } i^{th} \text{ group} \)

\( Q_i = \text{cumulative percentage of the area owned by } i^{th} \text{ group} \)

It needs to be underlined that the scale of Gini coefficient extends between 0 to 1. While 0 signifies the absence of any concentration, 1, on the hand, implies perfectly asymmetrical distribution. In actual practice, the value of Gini’s concentration co-efficient lies between these two extremes.
It however needs to be noted that the use of Gini’s Concentration Ratio is problematic on two counts. First, it fails to draw a distinction between various types of concentrations. And second, in the event of its being used to study the structural changes in the distribution over time, it does not tell us as to which part of the distribution undergoes a change. In view of these important limitations, we have, in addition to Gini’s Concentration Ratio, also used Inter-Class Concentration Index (ICC_i) for purposes of attempting a comparison of the relative position of various size-group in the two periods. The following procedure has been adopted to calculate an index of inter-class concentration (ICC_i).

\[
ICC_i = \frac{q_i/Q}{p_i/P} \times 100
\]

Where \( p_i \) and \( q_i \) are the number of households and area owned by the \( i \)th ownership holding category and \( P \) and \( Q \) are, respectively, the total number of ownership holdings and the area owned in the country. This index works out the ratio between a group’s share in the area owned and its share in the number of households. A figure less than 100 suggests that the land owned by the group of equal distribution of level. A figure greater than 100 shows the contrary.

**ICOR Index**

The incremental capital output ratio index (or ICOR index) is a useful tool which focuses upon the significance of capital in development planning. It helps the planners in testing the consistency of the desired rate of growth and the resources for the economy as a whole as well as for its various sectors. In other words, ICOR index helps in determining the
capital requirements and the growth rate of an economy as also of its different sectors. The incremental capital output ratio (ICOR) is a dynamic concept which measures the relation between increments to the capital stock and increases in output or income \( \Delta k / \Delta y \). It refers to all that has been added in a recent period to the capital or output. In the present study, for purposes of determining the efficiency rate of investment in the agricultural sector in comparison to other sector of the economy in Iran, we use ICOR index. This index, as employed in the present study, measures the ratio of total gross fixed capital formation in a year to the changes in value added in that year.

While conclusive evidence about the behavioural pattern, of the incremental capital output ratio does not as yet seem to exist, the empirical evidence concerning this important aspect of this ratio over time is indicative of the fact that this ratio first tends to rise, then declines as the process of development gains momentum and even becomes stable over a long period of time.

**Limitations of the Study**

It would rather be too presumptuous on our part to claim that the present study is free from any limitations whatsoever. On the other hand, as is generally true of most empirical studies based on secondary data, there are quite a few limitations which have crept into the present study as well. Some important limitations of this study can be described as under:

**First,** it is important to observe that the analysis undertaken in the present study is based on the secondary data pertaining to the period falling between 1980-81 and 1995-96. To put the record straight, the study
excludes the information concerning the farm sector of Iran for the year 1979–80. This has primarily been done due to the fact that on careful scrutiny of the available data numerous inconsistencies in the data were found for the said year. We preferred to drop the information for the said year instead of using the inconsistent information hoping that this step of ours, in all probability, would not seriously impair the result emanating from the study. Second, the secondary data gone into the making of the study have been drawn from diverse sources. The data generated and published by various official agencies in Iran for the same year showed lots of variations from each other. It was, in particular, observed to be so for the period immediately following the Islamic Revolution. Under these circumstances, we were solely guided by the consistency criterion in the matter concerning the selection of data. And third, in respect of many critical variables of agricultural growth, either the desired information did not exist at all or it was found to be considerably inadequate in the event of its existence. For instance, separate data were not available for net sown area, gross cropped area, net irrigated area, gross irrigated area so on and so forth. Likewise, in spite of our best intentions, it was not possible for us to cover in the present study an important agricultural sideline like animal husbandry and dairying owing to the said data constraints.

Admittedly, the above-mentioned and numerous other data constraints limited our options in exploring the issues exhaustively. Accordingly, our analysis in the study is largely governed by the nature of the available secondary data as have been brought out by various official agencies from time to time. On our part, we have exercised every possible
caution in ensuring the compatibility of the data used in the study. In view of these facts about data, while there is the need for adopting some degree of caution for evaluating the results emanating from the present study, it also stresses the need for strengthening the data base of Iranian agriculture.

It is important to observe that regardless of above-mentioned data limitations, the methodological framework, as conceived and developed for the present study, has a definite advantage over the less formal methods of economic investigations. Furthermore, in spite of its simplicity and easy comprehensibility, the research - kit of the study is capable of meeting its various requirements. As such, the approach adopted in the present study on the whole, permits in seeking precise and meaningful answers to various issues taken up for empirical exploration.
NOTES AND REFERENCES


3. For details, see Albert O. Hirschman (1960), ibid, pp. 83-84.

4. It needs to be pointed out that in our attempt in this regard we have come across only one such attempt. The said attempt, for example, can be attributed to William H. Nicholls (1963) who includes transportation, education, agricultural research and extension services, banking and credit institutions in agricultural infrastructure. It is, nevertheless, important to observe that over time power, means of communication, health services, etc., have also come to be included in the category of agricultural infrastructure.


7. It may be reiterated that against the present strength of 28 provinces, there were 24 provinces in Iran at the time of undertaking this study.


10. Some other studies have followed this regional classification even though the basis for doing so has not been spelt out clearly. See for example, Mojtaba Almasi (1992), “Agricultural Production, Marketing and Pricing Policy in Iran”, An Unpublished Ph.D Thesis submitted to Aligarh Muslim University, Aligarh, p. 44.

11. To remind ourselves, these two approaches are the Aggregative Approach and the Divisive Approach respectively.

12. The Range, The Inter-quartile Range, The Quartile Deviation, The Mean Deviation, The Lorenz Curve, etc., are the other important measures of dispersion.


15. For instance, growth rates can be computed through Simple Growth Rate Technique, Compound Growth Rate Technique or through Exponential Growth Rate Technique. Simple growth rate, though simple and easy to estimate, does not give the true rate of growth of the variable based as it is only upon the initial and final values of the variable. Moreover, its suitability is limited by the fact that the variable under consideration advances by constant amount per unit of time. Compound Growth Rate also known as geometric rate of growth, quite like the simple growth rate is based upon only the initial and final values of the variable and is considered to be the best suited growth rate in the event of variable’s changing at a
constant rate. However, it is not representative of all the values of the given variable. Besides, it is difficult to calculate. The Exponential Growth Rate is similar to the Compound Growth Rate with the underlying difference that it is based upon all the values of the variable and not just upon its initial and the final values. Furthermore, since it is computed through regression technique, it is considered to be appropriate when the variable is changing at different rates. Besides, various growth curves, viz. The Modified Exponential Curve (through the Method of Three Selected Points and Method of Partial Sums), Gompertz and Logistic Curve or Pearl-Reed Curve (through Method of Three Selected Points, Yule’s Method, Hotelling Method and Successive Approximation Method) are some other methods for estimating growth over time. However, guided by the criteria of simplicity and extensive application of the method, we have preferred to use exponential method to estimate the trend and growth rate in respect of various variables included in the present study.


18. This is owing to the fact that Incremental Capital Output Ratio (ICOR) is affected by a wide variety of factors such as availability of natural resources, growth of population, amount of capital employed and changes in it overtime, degree and nature of technological advance, rate of growth and composition of investment, education, use of social and economic overheads, level and pattern of industralisation, employment policy of the government, relation between factor prices, efficiency with which additional equipment is handled, quality of managerial and organisational skills, changes in the pattern of exports and imports, etc.

19. For example, this has been brought out in several empirical studies pertaining to the development experience of quite a number of developed countries. Some important studies in this regard are: Colin G. Clark (1940), “The Conditions of Economic Progress”, Macmillan and Co. Ltd., London p.580; Simon Kuznets (1954),