CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION:

Energy is a basic requirement of human life, agriculture, industry, transportation, communication and all other economic activities of the present civilization. As far as India is concerned, agriculture constitutes the foundation of socio-economic structure, where seventy percent of the population is engaged in activities related to crop-animal-aqua production, processing and marketing.

Man derives his energy from the food he eats. An average Indian lives on a diet of 2000 food calories (unit of food calorie = 1000 units of calorie or 1 food calorie = 1kcl), and produces 60 watts of power when he works for 8 hours a day. Thus he generates energy roughly equal to 0.5 kwh. At a rate of Rs. 5/day/man, this amounts to a cost of Rs. 10 per kwh for heaved energy. A human being is an expensive source of energy. It is better to use him to organize, manage, steer, direct and govern rather than as a energy source.

Energy is both the fuel and the feed stock for agriculture. Primary energy is the fuel, solar energy is the feed stock material. Both are essential and indisensible for the efficient and optimal utilisation of energy in industrialised and commercialised agriculture which is evidenced from the Inclusion
proposals have been made for changes in agricultural policy in response to the energy-related concerns. Controversy exists over the correctness and feasibility of many of these proposals. It is of extreme importance, therefore, that the energetic relationships of agricultural systems have been known and understood. We must be able to correctly identify and measure the flow of energy in the system comparing crop and livestock production, food processing, distribution and preparation. We call such activities as agricultural energytics.

In recent years, the introduction and spread of modern technology have brought about a substantial increase in agricultural productivity in India. But the gains of such increased productivity are said to have been shared unevenly by various factors of production and administrative regions. There was evidence from different studies that there is some degree of growing inequality in factor shares in agricultural production. However, since most of these studies did not have any systematic data base over time and space, the results reported remained largely inconclusive. Besides, there were noticeable changes in factor use in farm production in the late seventies. But the nature, extent and impact of such changes at the macro level have not thus far been explored.

The share of capital in the total cost should increase and that of labour and land should decline with the advance in the level of agricultural technology. The impact of technology, which is generally land-substituting, on the share of land may be partly
nullified due to relatively faster increase in the value of land as compared to other category of factors mainly because of its scarcity, investment of capital in it and increase in its productivity. The share of labour would decline because both wage rate and the use of labour has been increasing at a much slower rate vis-a-vis other factors of production within a region. A technologically advanced crop would have a lower share of land and labour and a higher share of capital as compared to other crops. Under homogeneous agro-climate conditions, the share of factors for a crop are not expected to differ much among the regions. Based on these observations the following main objectives have been identified for this study. The study emphasizes the importance of energy in the agricultural activities for the period identified generally with Post Green Revolution. As identified in the literature, the classification of Green Revolution period showed variation depends on the individual researcher is concerned. It is also noticed that, there are three classifications for Green Revolution, those reflects, pre-Green Revolution, Green Revolution, and Post-Green Revolution. But the present study has considered the time period from 1966/67 to 1991/92, so that title of the thesis may looks slight different from other studies.

1.1 GREEN-REVOLUTION AND CHANGING SCENARIO OF INDIAN AGRICULTURE!

Since the early day's of 'green revolution' signs of cropping pattern imbalances were visible. Technological changes of mid-sixties caused significant area shifts in favour of crops like wheat and rice at the cost of area under coarse cereals, pulses and oil seeds. This shift was the combined effect of differential
rates of technological change among crops, irrigation bias of new technology causing shift of area out of dry crops into irrigated ones, and the encouragement policy of price support as well as market intervention for some crops but not for other around, by the Government. This brought distortions in cropping pattern in the form of relatively abundant supply of some crops (like wheat of which the Government had surplus stocks) and acute shortage of others (like pulses and edible oils which had to be imported at huge cost in terms of foreign exchange). These changes in cropping pattern were determined by factors like, agro-climatic conditions, technology, infrastructure, institutional environment, and profitability.

The single most important element in crop production strategy in the post-green revolution period is the improvement in agricultural technology consisting of high yielding plant varieties, intensive cultivation, greater use of fertilizers, increased irrigation and better techniques for ploughing, harvesting and plant protection. It has been noticed that even though High Yielding Varieties have been developed for a number of crops but their impact on production, productivity and costs varies across crops and regions.

The level of cropping intensity is determined by several factors. The most important factor is the availability of water from natural (rainfall) and or man-made resources (irrigation). However, the scope for year round cropping activities in most states of India is severely constrained by the seasonal distribution of rainfall. To the extent this natural constraints
is relaxed by developing irrigation facilities, the level of multiple cropping improves. The flexibility in selecting appropriate cropping pattern is also enhanced when irrigation facilities such as make water available in a controllable form to the farmers throughout the year. It would, therefore, be reasonable to hypothesize that a greater part of inter-state, or inter-regional disparity in the level of cropping intensity could be due to the disparity in the pattern of development of irrigation facilities, both in qualitative and in quantitative terms. In general the level of cropping intensity is higher in the regions with higher percentage of net sown area irrigated and with higher intensity of land use with irrigation (GIA/NIA). However, it is futile to expect a one-to-one correspondent between irrigation and cropping intensity.

The other crucial variable that determine the level of cropping intensity is the availability of labour. The characteristics of the Indian agriculture based on land size holding India suggest that labour availability is an important determinant. The various farm management studies carried out in India showed that as the average size of holding increases, the average family size increases but not in the same proportion. As a result, per capita land goes up and population density declines with an increase in the holding size. In other words, an inverse relationship is established between cropping intensity and holding size. With modernization of agriculture, this relationship is undergoing changes. Tractorization and other labour-saving mechanical devices have altered the picture.
There are several other factors but generally speaking, there are basically three factors that determine the level of cropping intensity. Those are: (i) Supply of energy in the form of human labour, animal labour and mechanical devices, (ii) supply of water in the form of rainfall or irrigation and its distribution over the crop year, and (iii) the physical limits imposed by the adopted cropping pattern on the duration of cropping activities, during the crop year. The above discussion is indicative of the changes in cropping pattern, and cropping intensity which will put more pressure on energy demand in the form of human, bullock, mechanical and fertilizers and pesticides.

The area under paddy and wheat has continuously increased in many states at the cost of coarse cereals, millets, pulses, and cotton. As stated earlier, the reason for this growth is technological support, price support, infrastructure support including markets and irrigation, subsistence requirements, lesser price and yield risk are well known. The adverse effects of this development are: serious influence on the cropping pattern, widened regional disparities, increased instability in production and unplanned imports of commodities.

To remedy the situation, the elements of the green revolution strategy have to be reexamined and set right. This study will discuss the process as discussed in this study should include: breeding high yielding varieties of seeds, disease, pest, drought and flood resistance varieties of all crops, particularly coarse cereals, millets, pulses and oil seeds, exploiting the untapped
potential (mostly dry land areas) and raising the economic potential of fertilizer use development and management of irrigation facilities, market experience and product diversification, land development and farming comprehensive price policy integrating products by products, input and markets (including international).

The higher the cropping pattern index, the higher will be the agricultural productivity. This result is important in deciding how far high-yielding food grain technology, along with fertilizer and irrigation, needs to be pushed in comparison with growing more of high value crops in order to increase agricultural productivity in different regions. It appears that marginal manipulations in the cropping pattern in region can increase agricultural productivity significantly even if fertilizer and irrigation use-remain unchanged. The extension of machinery can play a big role in tapping the comparative advantage of different regions.

1.2 CLASSIFICATION OF ENERGY SOURCES:

According to the Indian Council of Agriculture Research, energy sources in agriculture sector can be classified as follows. On the basis of source, the energy sources can be classified as direct and indirect energy.

Direct sources of energy: The direct sources of energy are those which release the energy directly like human labour, bullock, stationery and mobile mechanical or electric power units, such as diesel engines, electric motors, power tillers and tractors. The
direct energy may be further classified as renewable and non-renewable sources of energy depending upon their nature of replenishment.

Renewable Direct Sources of Energy: In this category, the energy sources which are direct in nature but can be substantially replaced, are grouped. The energies that may fall in this group are human energy, animal, solar and wind energy, fuel wood, biomass, and agricultural wastes.

Non-Renewable Direct Sources of Energy: In this category, the direct energy sources which are not renewable at least in near future say next 100 years) are classified. Coal and petroleum products (hydrocarbon deposits!) will comes under non-renewable direct sources of energy.

Indirect Sources of Energy: The indirect sources of energy are those which do not release energy directly but release it by conversion process. Some energy is invested in producing indirect sources of energy. Seeds, manures(FYM), chemical fertilizers, and machinery can be classified under indirect sources of energy. Again, on the basis of their replenishment, these can be further classified into renewable and non-renewable indirect sources of energy.

Renewable Indirect Sources of Energy: Seed and manures can be termed as renewable indirect sources of energy as those can be replenished in due course of time.
Non-Renewable Indirect Sources of Energy: The energy sources which are not replenishable comes under non-renewable indirect sources of energy. For example, Chemicals, fertilizers and manufacturing machinery are the non-renewable indirect sources of energy.

1.3 CONVERSION OF ENERGY SOURCES INTO A UNIFORM MEASUREMENT:

To account for the total consumption of energy in agricultural sector by different sources one ran look through different conversion process. All the energy sources can be converted in to a single measure to estimate energy demand under selected crops. According to ICAR (1988), the conversion of energy sources were analyzed as stated in the following manner.

Human energy can be measured in the form of man-hour, which was equal to 1.96 Giga Joules. Woman power is measured in woman hour i.e 1.57 Giga Joules. Where as bullock power measured in pair-hour, was equal to 10.10 Giga Joules. However diesel and petrol energy was accounted in liter i.e 56.31 and 48.33 Giga joules per liter. Electricity measured in Kw-hour, was around 11.93 Giga Joules. Prime movers other than electric motors were measured in kgs i.e equal to 64.80 Giga Joules. Farm machinery energy measured in Kgs, which equals to 62.70 Giga Joules.

Nitrogen fertilizers energy can be accounted in Kgs i.e equal to 60.60 Giga Joules. Where as phosphate and potassium energy is measured in Kgs i.e 11.10 and 6.70 Giga Joules. Energy component in paddy measured as Kgs i.e 14.77 Giga Joules. Next comes to the straw, which accounted in Kgs, was equals to 12.50 Giga Joules of
energy equivalent. On the basis of this conversion rate, energy consumption per hectare under different crops were estimated and analyzed in the preceding sections. Among all the sources prime movers was accounted higher energy equivalent. next to farm machinery, nitrogen, diesel, petrol, and electricity respectively.

1.4 OBJECTIVES:

CO. To examine the inter state variations in cropping pattern and cropping intensity.

(2). To find the trends in factor shares and substitution possibilities over a period of time in Indian agriculture.

(3). To identify the nature- and intensity of mechanization in Indian agriculture.

(4). To examine the extent of fertilizer and pesticide demand in Indian agriculture.

(5). To estimate the spatial energy demand variations and energy intensities for selected crops across the states.

(6) To establish a relation that quantifies the impact of various factor inputs, including energy, on the agricultural output across states and by selected crops. Also to estimate the demand for energy in agriculture depending upon agricultural output and other factors.
1.5 DATA BASE:

For the purpose of the present study the period 1966-67 to 1991-92 is chosen. Keeping in view the availability of published data. The data is based on the survey undertaken with every five year intervals, namely 1966-67, 1971-72, 1976-77, 1981-82, 1986-87 and 1991-92 respectively. For some of the other important indicators like, crop wise energy demand, such as human, bullock, farm yard manure, seed, diesel, electricity, mechanical, fertilizers, and pesticides data is collected from different published, unpublished, and project works.

The study also collected secondary data from publications like Statistical Abstract of selected states, Statistical Abstract of India, Fertilizer statistics, pesticide statistics, ICAR publications, Indian agriculture in Brief, Indian Labour Statistics, Statistical compendium, Indian livestock census and CMIE reports etc. The published data is supplemented by primary data, available from other different studies, where ever necessary. Much amount of data used in this study has taken mainly from DESAg, Govt. of Indian and CMIE reports. Because DESAg is collecting data for every five years, that why some important inputs are not available for every year, so that the data from CMIE is also used in this study. On this reason the present study has concentrated on cross section data. Even though the study is considered the time period from 1966-67 to 1991-92, in some chapters data analysis was also under taken for other time periods, to get clarity in the subject matter is concerned.
1.6 HYPOTHESIS TO BE TESTED:

In order to identify the causal relation between Energy demand and Agricultural Production in the presence of other inputs, the following hypothesis has been established. The hypothesis can talk about the cause and effect relation between dependent and independent variable, such as Energy and Agricultural production. The present hypothesis has formed on the basis of available literature in the subject matter is concerned. As highlighted in several studies that, "there is direct relationship between energy demand and agricultural production", Which reflects when more and more energy used there should be greater agricultural production. It shows there is a positive relation between energy and agricultural production. This can be tested in the process of present study, with respect to selected crops and states.

1.7 METHODOLOGY:

The units of measurement used in this study are: Area under crop in thousand hectares, output in thousand tons, yield rate in kgs for each crop, labour input measured in physical units(lakhs), drought power in thousands, iron and wooden ploughs, sugarcane crushers, pump sets, and tractors measured in physical units, fertilizers and pesticides in lakh and thousands tons, energy consumption in Mega Joules, anti rainfall in millimeters. Cobb-Douglas production function has been applied for estimating the inter input substitution possibilities in the production of total output for selected crops in India as well as six major
agriculture producing states. The derived demand function (inverse) for energy was also estimated to identify the role of energy in agriculture production.

This study examined 6 principal crops namely rice, wheat, Jowar, groundnut, cotton and sugarcane, that are produced in selected states in India. The states are Andhra Pradesh, Bihar, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal. The selection of states for the present study has been undertaken on the basis of the available resource endowments and institutional setup which may reflects the nature of agriculture, and also expecting the wide variations on those states. For example, West Bengal and Bihar states resembles traditional nature of agriculture, whereas Punjab and Uttar Pradesh in the sense of modern agriculture, and Andhra Pradesh and Tamil Nadu reflects mixed features. At the same time even though the study considered six principal crops for crop wise comparison, in some states one or two crops are almost neglected in production.

The main inputs considered here are area under crop(land), labour, draught power, agricultural machinery and implements (capital) such as iron and wooden ploughs, sugarcane crushers (run by bullocks as well as power), pumpsets (diesel as well as electric), and tractors, fertilizers, pesticides, energy and rain fall. Total production under crops in India along with 6 major states has been taken directly from published source. Labour input was measured in number of workers engaged in agriculture sector for each state over the period under consideration. The data on this variable refers to 1971, 1981, 1991 and 1991 census.
with respect to India and different states. Draught power was accounted by considering the total number of cattle and buffaloes used for work in agriculture in India and selected states.

Agricultural machinery and implements such as wooden and iron ploughs, sugarcane crushers, oil and electric pumpsets, and tractors were measured in number of equipment engaged in agriculture sector in whole India and selected states.

In case of fertilizers, the total consumption of fertilizers in India, as well as different states has been considered for the purpose of analysis. Regarding pesticides, total consumption with respect to different states and whole India was considered.

With regard to energy, the source wise energy consumption for selected crops was considered. Here human, bullock, FYM, and seeds were treated as renewable forms of energy, whereas diesel, electricity, mechanical and fertilizers as non-renewable forms of energy sources. Total energy consumption under each crop was used to estimate the total energy consumption with respect to different states and whole India.

Rainfall data, was measured by the average rainfall in different states over the period under consideration.

1.8 NATURE OF THE PRESENT STUDY:

The present study has been divided into 7 chapters. The first chapter can talk about the general introduction of the existing
problem. and other methodological aspects. In chapter 5 the emphasis is on the cropping pattern and cropping intensity, along with the data analysis undertaken for some important issues such as profiles of selected states, factors affecting growth performance, area irrigated by different source, net state domestic product (from agriculture), economics of crop cultivation, potential yields of HYVs, Index numbers of area, production, and yield, Index numbers of net area sown, cropping intensity, cropping pattern, and productivity, average annual rainfall, and per capita water availability etc.

The third chapter concentrates on explaining the factors shares in Indian agriculture, labour absorption under different crops, value of agricultural inputs and outputs, total cultivators and labourers, draught power, index numbers of agricultural labourers, and Index numbers of wholesale prices of different agricultural commodities and inputs.

The nature of mechanization in Indian agriculture with respect to selected states was examined in the chapter 4. This chapter provides an overall view of trends in agricultural inputs, general nature of farm mechanization in Indian agriculture etc.

Chapter five focuses upon fertilizer and pesticides consumption in Indian agriculture with respect to the selected states. This chapter also analyses the area under HYVs of rice, wheat, and jowar, the quantity of plant nutrients received from the soil, and per hectare consumption of fertilizers etc.
The chapter 6 has been discusses the core problem of energy demand and energy intensities, with other aspects like, conversion of various energy sources, power utilisation in agriculture, average energy consumption, and regression equations for selected crops and selected states. Output and energy demand equations. In the final chapter 7, summary of entire study is presented along with policy recommendations. The limitations of the study were also highlighted at the end of the chapter.

1.9 SUMMARY:

On the basis of above highlighted reasons, the energy is an important input in modern agriculture in order to produce more amount of output. One should be aware of the role of energy in Indian agriculture with respect to adoption of modern technology, which reflect the capitalistic feature of Indian agriculture since Post Green Revolution.

It is recapitulated from the earlier discussion, that the use of energy intensive inputs has increased, in Indian agriculture with the spread of Green Revolution technology. Further, future has cautioned that the capacity to produce enough food for the existing population in 2000 years, will depend on its efforts to provide energy-intensive inputs such as fertilizers, pesticides, and irrigation facilities.

Finally, another most important priority area of research is to undertake studies on alternative farming systems in their entirety by incorporating the analysis of energy intensities, resource endowments, and management skills in farming which
reflect the development of agriculture sector. It has been generally identified that, there is a direct relationship between energy input and energy output (food) in agriculture production. To maintain this, unless some thing is done at macro level, soon the agriculture sector will be in the grip of a severe energy demand crisis. In the preceding chapters, the chapter f deals with the nature of cropping pattern and cropping intensity in Indian agriculture and selected states. Along with this some other relevant issues are also analyzed.