CHAPTER III
CHAPTER III

OBJECTIVES AND METHODOLOGY

Objectives

After reviewing the relevant literature on the broad issue of farm power, some of the research gaps and issues were identified as pointed out in the earlier chapter. Keeping these issues in view, the following broad objectives were formulated for the present study.

1) To study the factors influencing the changes in the quantum of overall farm power stock and different sources.

2) To analyse the distribution pattern of farm power across regions and farms on selected farm households.

3) To study the utilisation pattern of farm power in agriculture and its relationship with intensification of farming, input use, output and employment levels, size of farms, different crops, operations, seasons and regions.
4) To assess the impact of mechanisation on the farm employment and output on the selected farms.

Area of the Study

With a view to get a better understanding of the variations in different sources of farm power, its utilisation patterns and efficiency, Tamil Nadu is selected for an in-depth study. Agriculture has taken big strides in this state during the last two decades towards sustained growth after green revolution with the advent of irrigation and other inputs.

As mentioned by Giriappa and Govindaraju\(^1\), Tamil Nadu has a relatively higher use of machine power especially pumps sets in farming activities. Further, the all India Livestock Census Reports of 1951 and 1982 show that this state has large quantum of irrigation pumps sets. These reports also reveal that there is a manifold increase in the quantum of agricultural machineries in Tamil Nadu. The machine power definitely influences the muscle power, cropping intensity, output and employment over the period of time. Though Tamil Nadu is agriculturally prosperous, it has different agro-climatic regions and hence the utilisation pattern and the diffusion of different sources of farm power vary accordingly. Therefore, it is proposed to carry out this study in Tamil Nadu and it is hoped that the results of this study will be useful for making

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suggestions and future implications on farm power in agriculture.

Data Sources

In the present study both primary as well as secondary data have been used. The secondary data were collected from various published sources such as, Livestock Census Reports, Season and Crop Reports, Tamil Nadu - An Economic Appraisal and Statistical Abstract.

The secondary data were used to trace the growth of farm power stock for about three decades. The study period of the secondary data analysis was 1961-89. Although, detailed and comprehensive data are available from 1951-1989, due to reorganisation of states and districts during the fifties, regional boundaries have changed considerably and hence the secondary data analysis is restricted to 1961-89. As the 1989 livestock census is the latest census which is readily available, it is worthwhile to make the analysis upto 1989. Thus, the reference period for secondary data analysis was 1961-89.

Data on the number of draught animals, agricultural machineries, human population engaged in agriculture (both cultivators and agricultural labourers), area cultivated, area irrigated, fertilizer applied and rainfall were obtained. Simple growth rate
For the stock of farm power in Tamil Nadu as a whole has been worked out and analysed. Following this, the growth rate has been computed for each source of farm power stock. The reasons and the factors which are responsible for changes in the farm power stock also have been discussed.

In Tamil Nadu larger districts were bifurcated (some districts were trifurcated) and new districts were carved out at various stages. Between 1961-89, 7 major districts have been carved out. They are: Dharmapuri was carved out from Salem. Periyar district was carved out from Coimbatore. From Trichy and Thanjavur, Pudukottai was formed. Madurai district was bifurcated into Dindugal Anna and Madurai. Ramanathapuram, Kamarajar and Pasumpon Thevar Thirumagan districts were trifurcated from Ramanathapuram. Tirunelveli was divided into Chithambaranar and Tirunelveli Kattaboman. The North Arcot was bifurcated into North Arcot Ambekar and Tiruvannamalai Sambuvarayer districts. The newly carved districts are merged into the parental districts and data were analysed accordingly.

However, for the present analysis, the districts which are carved out before 1982 have been grouped with parental districts as the data are available for more than one decade. Otherwise the analysis has been done for the parental districts. At present there are 21 revenue districts in Tamil Nadu.
Haryana district is completely urbanized and the agriculture is negligible here and hence this district has been dropped from the present analysis. Since new districts were carved out at various points of time, for comparative analysis, 11 districts were considered for analysis. The districts which were carved out from the original districts were combined with the original districts and analysis was done accordingly, while analysing the growth rate of farm power stock across districts, the districts were grouped according to different growth rates.

An analysis of the growth rate of farm power stock has been done for the period 1961-89. Simple growth rate of different sources of farm power has been worked out for state as a whole and across districts. Compound growth rate for total farm power stock and each source of farm power has been computed for Tamil Nadu as a whole and analysed accordingly. The changes in the growth rates of different types of farm power has also been examined.

The available data and the methodology followed to analyse the same helped to understand the importance of the share of various sources of farm power stock in the broad spectrum of farm power; the magnitude of the growth of farm power stock; the disaggregate - district wise - analysis reveal the extent of farm power availability; and the discussion
or the factors influencing the farm power stock could help in understanding and identifying the factors which contributed to the variations in the growth of farm power stock.

The primary data for the present study were collected from the "comprehensive scheme for studying the cost of cultivation of principal crops" (CCP). This scheme was initiated during 1971-72 by the Directorate of Economics and Statistics to study the cost structure of the major crops grown in 15 chosen states in India. Data for the present study relate to the principal paddy growing areas (two districts) of Tamil Nadu. The reference period is 1989-90. In the following, a description of the methodology which was used in CCP to collect the data and their features are discussed.

The main intention of the scheme is to gather relevant data on inputs and outputs to estimate the cost of cultivation of the selected principal crops grown in each state. These data serve as the basis for preparing reports of the Commission on Agricultural Costs and Prices (CACP) which are ultimately used by the Government of India to fix procurement prices as well as the support and issue prices for principal crops. Different crops are being studied in different years by rotation under this scheme.
Methodology for Data Collection:

The collection of the cost of cultivation data was initiated during 1971-72 by the Tamil Nadu Agricultural University (TNAU). In those days, the data were collected partly by survey and partly by cost accounting method. The cost accounting method has many advantages over survey method in terms of accuracy. Under cost accounting method, data on inputs and outputs are collected by whole-time field workers residing at the villages selected for the study on the basis of day to day observations. Thus, the field worker is in close contact with the selected farmers as they perform their agricultural operations. Therefore, it is believed that, cost accounting method has a distinct advantage over the survey method in terms of accuracy of the data collected, as it does not rely entirely on the memory of the cultivator. The latest data readily available for the year 1988-89, has been selected for the present study.

Initially, it was decided to collect and analyse the data for a 3-year period. Under CCP the sample farmers are continuously interviewed for 3 years. However, farm level data across crops, seasons, extensively vary among the plots and from year to year. Therefore, it has been decided to restrict the analysis for one year and data were collected.
Moreover, the sample households were personally visited to get more insights about the farming in general and farm power in particular. Information on items like, the access to different sources of farm power, fluctuations in wage/rent, marketing, the technique of operation, credit facilities and related issues were gathered as background information.

Sample Design:

A three-stage random sampling design with taluks as the first-stage units, villages/clusters of villages as the second stage units and households as the third and ultimate stage units was used in CCP. The procedure adopted for the selection of districts, taluks, villages and households is explained below.

1) Selection of Districts:

Thanjavur and Coimbatore districts were purposively selected for the present study as they have distinct features in agriculture. In other words, the general agricultural pattern in Thanjavur is different from what is in Coimbatore as illustrated in Table 3.1. For instance, the principal crop is paddy in Thanjavur and sorghum in Coimbatore. Assured river water is facilitating the irrigation in Thanjavur and well
Table 3.1: Agricultural Characteristics of the Sample Districts

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Districts</th>
<th>Tamil Nadu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thanjavur</td>
<td>Coimbatore</td>
</tr>
<tr>
<td>1) Cropping intensity</td>
<td>151</td>
<td>111</td>
</tr>
<tr>
<td>2) Irrigation intensity</td>
<td>86.43</td>
<td>42.67</td>
</tr>
<tr>
<td>3) Total farm power availability (hp/ha)</td>
<td>1.26</td>
<td>2.36</td>
</tr>
<tr>
<td>4) Major crop</td>
<td>Paddy</td>
<td>Sorghum</td>
</tr>
<tr>
<td>5) Fertilizer consumption Kg/ha</td>
<td>73</td>
<td>155</td>
</tr>
<tr>
<td>6) Major source of Irrigation</td>
<td>Canal</td>
<td>Wells</td>
</tr>
<tr>
<td></td>
<td>(94.65%)</td>
<td>(64.53%)</td>
</tr>
<tr>
<td>7) Annual Rainfall (in mm)</td>
<td>891.1</td>
<td>507.4</td>
</tr>
</tbody>
</table>


Note: Total farm power includes all sources of farm power i.e., human, animal and machines.

Irrigation is the main source of irrigation in Coimbatore district. The deltaic alluvium and red loamy soil is common in Thanjavur district whereas, it is mixed red and black soil in Coimbatore. In Thanjavur the rainfall is above the state's average (715 mm) and it is less in Coimbatore. The District Agricultural Development Programme (DADP) in India was first launched in Thanjavur during sixties as this district has large potential to be a model to implement the programme. And compared to Thanjavur the availability of farm power is more in Coimbatore district. Hence, it may be
interesting to study the regions which are having different agricultural characteristics, thus Thanjavur and Coimbatore districts have been selected for this study. The Maps 1 and 2 illustrate the sample regions respectively for Thanjavur and Coimbatore district.

Incidentally, the sample districts are falling in two different agro-climatic zones. According to Saxena⁴ the State of Tamil Nadu was classified into seven zones, each broadly homogeneous with regard to cropping pattern, irrigation, rainfall, soil types and so on. Thanjavur district falls in zone III which comprises Thanjavur district as a whole, parts of Pudukottai, Trichy and South Arcot districts. Coimbatore district falls in Zone II which covers the districts of Coimbatore, Periyar, parts of Salem, Trichy and Madurai districts.

2) Selection of Taluks:

According to TNAU research team, the total number of taluks to be selected was first decided, taking account of the size of the state. Then the number of taluks to be allocated to each zone was decided in terms of the proportion of the total principal cropped (in this case it was paddy) area in the state, which fall within each zone. For each zone, the allotted number of taluks were selected with
SAMPLE VILLAGES
1. PALAYAPALAYAM
2. PILLAIYARNATHAM
3. NANDAVANAPATTI
4. POYYUNDARKOTTAI
5. MALAVARAYANALLUR
6. RAMAGAI
7. THIRUKARAVASAL
8. THIRUPATHUR

STATE BOUNDARY
DISTRICT BOUNDARY
TALUK BOUNDARY
RIVER & STREAMS

Map 1

THANJAVUR

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SAMPLE VILLAGES

1. KARAVALUR
2. THONDAMUTHUR
3. JALLIPATTI
4. SINNAVEERAMPATTI

STATE BOUNDARY
DISTRICT BOUNDARY
TALUK BOUNDARY
RIVER & STREAMS

NOT TO SCALE
probability proportional to the area under paddy. Six taluks were selected in Thanjavur district of Zone III. In Coimbatore district (of Zone VI) four taluks were selected. Hence, only six taluks in Thanjavur district and four taluks in Coimbatore were selected for the present analysis.

3) Selection of Villages:

According to CCP, the second stage sampling, a village was selected randomly (by using random tables) by listing all the villages having area under the selected crop in the village in ascending order and cumulative cultivated area was worked out. If the selected village was not having 200 holdings, then, the second or third village (nearest to the main village) and having sufficient area under selected crop was added to the village making it into a cluster. Further, care was taken to see the selected village in addition to area under the main crop, should have the possibility of fitting in the other crop of secondary importance. The basic point was to have sufficient number of farmers involved in the study. The villages having 200 holdings representing different size holdings with enough observations were selected. Thus, altogether eight villages from six taluks in Thanjavur and 4 villages from four taluks in Coimbatore were selected.
4) Selection of Households:

From the selected villages/clusters all the holdings (cultivators) were grouped into five size classes. The size classes are classified as:

<table>
<thead>
<tr>
<th>Size group</th>
<th>Class intervals (in hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 0.99</td>
</tr>
<tr>
<td>2</td>
<td>1.00 - 1.99</td>
</tr>
<tr>
<td>3</td>
<td>2.00 - 3.99</td>
</tr>
<tr>
<td>4</td>
<td>4.00 - 5.99</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 6.00</td>
</tr>
</tbody>
</table>

A total of 10 holdings were selected from the five size classes in proportion to the number of holdings in each size class at random (by using random tables). There was every possibility that some of the cultivators so selected might have not responded with the field staff in furnishing the required data. In such cases, they have to be substituted by other cultivators. As such, for each class, in addition to the cultivators selected for the study, another set of cultivators roughly about 50 per cent of the cultivators got selected in each size class, were selected and kept as the reserve. In case any size class was not represented, the number of farmers to be selected in the missed class were selected from the next higher size group along with farmers to be selected in that size class. Thus, 80 cultivators from 8 villages were
selected in Thanjavur and 40 cultivators from 4 villages were selected in Coimbatore district for the present analysis.

Data Description and Concepts

The CCP has enormous data on inputs and outputs relating to the selected principal crop as well as to all other crops grown on the sample holdings. In addition to these, the schedules which were canvassed by the TNAU contain data on imputed and paid out costs. However, only those aspects of the data which are relevant to the present study are described here. The data could broadly be divided into two groups (a) those pertaining to each plot within a farm household; and (b) those pertaining to the household as a whole. Since it has been decided to use both plot level and household data, the relevant concepts are explained as below.

Plot Level Data:

There are two main crop seasons in the sample area: the kharif (first) season (July-October), and the rabi (second) season (November-February). In some pockets of the selected districts farmers cultivate summer (March - June) crop (third season). Plot-wise inputs, output and other details for different crops grown over the crop-year include the following.
1) Land: The cropped area of each plot is given in hectares.

2) Material Inputs: The use of seeds, manure and chemical fertilizer is given in quantity as well as in value units for each plot (1988-89 prices). The quantum of chemical fertilizers consumed is separated into NPK (nitrogen, phosphate, potassium) units and however, the value given is the aggregate value of all three types of fertilizers. The plot-wise value of pesticides used is also given.

Irrigation Charges: In case of canal and tank irrigated crops as the water rate chargeable from time to time under the Government (Tamil Nadu) Irrigation (levy of water rate) Rules - 1965 was taken into account. In case, the crop was irrigated by lift irrigation, the electrical charges or diesel charges as the case may be were determined to each plot under the crop.

Land Revenue and Taxes: Land revenue and other taxes were charged at the rates levied by the Government. Allocation of cost was done for each plot under the crop.

Farm Power Use: The various agricultural operations such as, ploughing (it includes the seed-bed preparation and levelling), sowing/transplanting, manuring, irrigation, harvesting and threshing are
carried out by different farm power sources for agricultural production. For each operation, the use of human, animal and machine power is given in terms of labour hours, bullock power hours and machine hours respectively for each plot.

The human labour-hours further separated into family, permanent and casual labour categories. And within each category, it was grouped into male, female and child. Draught animal power use for each plot was identified as owned and hired. The type of machines used, such as tractor, tiller, pumpsets (diesel and electric), thresher and sprayer is identified. Whenever, the machines were hired, the hours contributed to respective farm operation were given in concerned machine hours. Owned and hired machine hours are given separately. However, data are not available on the horse-power of the machines especially when hired machines were used.

Labour charge was evaluated at the prevailing wage rates paid per day (eight hours) in that locality for men, women and children. Family labour was imputed at the same rate as hired labour. The same procedure was adopted for draught animals. Whenever, prevailing wage rates were less than the minimum wages fixed by the Government from time to time under the Minimum Wages Act 1948, the minimum wages were taken into account in computing human labour cost.
The charges for agricultural machineries were worked out at the prevailing hire rates paid per hour in that locality for each machinery. In case, machineries were hired, the actual rent paid for the concerned machinery was taken into account. The charges for the machineries were computed for each plot under crop.

**Output Value:** Plotwise output value has been documented. Output value for both main and by-products was collected.

**Household Level Data:**

1. **Land:** In the sample, most of the farmers are owner-cultivators. Few farmers are having leased in and mortgaged in land and few farmers have leased out/mortgaged out a portion of the land they own, for specific seasons or for the entire crop year.

Data are available on the net sown area which is a part of the operational holding. This area is cultivated by the farmer during the crop year and excludes any uncultivated land or current fallow for the crop year. Garden land also excluded from net sown area. In the study region, on most of the farms the garden land is being occupied by perennial crops such as coconut. Apart from this, such area is negligible and hence there is little difference between net sown area and size of the operational holding in most cases.
Information on irrigated and unirrigated land from the net sown area is available. Gross sown area (also by irrigated and unirrigated) has been computed through the aggregation of the area under each crop during all seasons.

2. Farm Power Sources: The number of different sources of farm power like human labour, draught animals and machineries is available. The family human labour includes the male, female and children above 12 years who are engaging in their farm business. The number of attached farm servants - normally engaged for farm work and cattle tending - and their annual wage rates are available.

The number of draught animals which are above three years used for farm and non-farm operations were accounted. In the study area, bullocks are predominantly used, although cows and buffaloes are utilised.

Similarly, the number of all types of machineries like tractors, tillers, pumpsets, sprayers, threshers and so on which are used (possessed) for carrying out agricultural operations was documented.

Method of Analysis

The number of different sources of farm power stock has been converted into hp units for comparative analysis. The methodology for conversion has been
adopted from the report of the NCA. Conversion has been done both for secondary and primary data analysis.

The availability of different types of farm power stock both in terms of numbers and hp units have been examined across size of land holdings and districts. While doing so, the factors that are responsible for the variations in the possession of farm power stock also have been highlighted. The availability of farm power stock is analysed in terms of both per household (farm) and per unit of land (hectare) area.

The aggregate farm power used for various farm operations, crops, seasons and so on by both owned and hired sources has been examined in terms of hp hours. In fact, data collected from the CCP were in hours unit of each farm power type as already explained under plot level data. But for the purpose of both comparative and comprehensive exercise the hours were converted into hp hours by adopting the report of the NCA.

The use of different types of farm power for specific farm operations on farms of different operations, crops, seasons, sizes and so on has been computed by the aggregation of the plot-wise, crop specific data at farm level. Though, detailed information on the above aspects were readily available due to time constraint analysis was carried out for farm (aggregate) level and not across plots. Added to this, plot wise analysis might not have shown any
pattern as the inputs use and the decision making process are decided at farm level.

Disaggregated analysis of the use of farm power (in hp hours) across districts and size of holdings for different crops, farm operations, wet and dry lands, seasons and sources has been attempted. Throughout the present study, the use of farm power has been analysed in relation to per hectare of cultivated land. The important factors influencing the use of farm power have been examined through regression analysis.

The data on the use of farm power have been used to group the farm households in terms of their intensity of farm power use, to give broad intensity categories like low farm power intensity farms (LFPIF), low-medium farm power intensity farms (LMFPIF), medium intensity farm power farm (MIFPF), high-medium farm power intensity farms (HMFPF), high farm power intensity farms (HFPIF). These classifications were done for the economic analysis of farm power. While analysing the economic aspects of farm power use in farming use of pumpsets (hp hours) was not considered for various reasons as explained in Chapter VII.

Farm level use of inputs and the production of output has been obtained through the aggregation of the plot-wise and crop-specific data. The data on inputs include expenditure on seed, fertilizers, pesticides, manure, irrigation charges and land revenue. The value of different inputs was collected for the analysis of
cost structure of farm inputs. The output value has been computed for both main and by-products. Per hectare inputs cost and output value has been worked out for the analysis.

The input cost, net return and the relationship of these aspects with the intensity of farm power use is done. Also the application of the physical units for selected inputs like farm power and fertiliser across land holdings, intensity of farm power use and districts has been examined.

In the present exercise an attempt also has been made to study the differences in yield level, inputs cost, gross output (return) and net returns in relation to intensity of farm power use for six selected crops. The impact of farm mechanisation on the use of animate (labour and animal) power is studied. Level of mechanisation has been related with the use of animate power (labour and animal power) has been related to find out the magnitude of the impact. Similarly, the differences in the inputs cost, gross output (value) and net returns have related with the level of mechanisation across different land holdings. The contribution of farm power use to yield (returns) in relation to other factors has been examined with a regression model. Also through an equation influences of different types of farm power use over returns has been done. Detailed method of analysis has been explained in the appropriate section of each chapter.
### Notes and References


2. Between 1961 and 1989 seven districts were carved out from larger districts in Tamil Nadu as listed below.

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Name of the original District</th>
<th>Bifurcated/ Trifurcated Date &amp; year</th>
<th>New Name of the district</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Salem</td>
<td>Bifurcated 2-10-1965</td>
<td>Salem and Dharmapuri</td>
</tr>
<tr>
<td>2</td>
<td>Tiruchy &amp; Thanjavur</td>
<td>Carved from 01-1-1974</td>
<td>Trichy, Thanjavur &amp; Pudukottai</td>
</tr>
<tr>
<td>3</td>
<td>Coimbatore</td>
<td>Bifurcated 17-9-1979</td>
<td>Coimbatore and Periyar</td>
</tr>
<tr>
<td>4</td>
<td>Ramanathapuram</td>
<td>Trifurcated 15-3-1985</td>
<td>Ramanathapuram, Pasumpon Thevar Thirumagan and Kamarajar</td>
</tr>
<tr>
<td>5</td>
<td>Madurai</td>
<td>Bifurcated 15-9-1985</td>
<td>Madurai and Dindugal Anna</td>
</tr>
<tr>
<td>6</td>
<td>Tirunelveli</td>
<td>Bifurcated 20-10-1986</td>
<td>Tirunelveli Kattaboman and Chithambaranar</td>
</tr>
</tbody>
</table>

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