**Study No. 175**

# EFFECT OF FARM MECHANIZATION ON AGRICULTURAL GROWTH AND COMPARATIVE ECONOMICS OF LABOUR AND MACHINERY IN WEST BENGAL


DEBASHIS SARKAR

DEBAJIT ROY

KALI SHANKAR CHATTOPADHYAY



**AGRO-ECONOMIC RESEARCH CENTRE**

**VISVA-BHARATI**

**SANTINIKETAN**

**2013**

# PREFACE

The present study entitled "Effect of Farm Mechanization on Agricultural Growth and Comparative Economics of Labour and Machinery" was undertaken at the instance of the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, Krishi Bhavan, New Delhi as a coordinated study, where the task of coordination has been entrusted with the Institute of Economic Growth, New Delhi. This report has been an individual centre's report on the study concerned carried out in West Bengal and prepared by our centre, AERC, Visva-Bharati, Santiniketan.

As mechanization of farming is expected to play a key role in bringing about growth in agriculture, there are policy efforts to promote mechanization, especially in the Eastern Indian states including West Bengal. However, the results of such efforts are yet to be enumerated, and it is here that the present study intends to assess the effect of this increased focus on mechanization on agricultural growth in West Bengal.

The study has been primarily entrusted with Mr. D. Roy and Mr. K S Chattopadhyay, while Mr. A Sinha, Mr. R Biswas, Mr. Md. A. Fazal, Mr. K. P. Paul and Mr. S. Banerjee provided immensely valuable assistance in data collection and processing under the active supervision of the undersigned. Extensive support has also been obtained from Mr. S Karmakar, especially in supervision of data collection and tabulation. I offer my deepest thanks to all of them.

On behalf of this centre, the undersigned takes the opportunity to thank the coordinating center IEG, Delhi for their painstaking work on coordination of this immensely important study across the individual centers, especially for organizing the entire study design with detailed chapterization and table formats.

Sd/-

Santiniketan
Date: 18.07.2013

(S Chakrabarti)
Hony. Director
A.E.R.C., Visva-Bharati

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# 1
# INTRODUCTION

## 1.1: BRIEF INTRODUCTION OF THE STUDY

The technological improvements in Indian agriculture since mid-sixties have brought about revolutionary increase in agricultural production. Interestingly, the growth rate of food grain production particularly in case of wheat and rice was much higher than the growth rate of population. The country was facing acute food shortages till eighties has now become not only self-sufficient but also a net exporter of foodgrains. This has been made possible due to evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes of farm products. The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies though mechanization. The increase in the use of human and bullock labour and rising wage rates and cost of up-keep of bullock further made the case of farm mechanization still stronger.

Farm mechanization has been helpful to bring about a significant improvement in agricultural productivity. Thus, there is strong need for mechanization of agricultural operations. The factors that justify the strengthening of farm mechanization in the country can be numerous. The timeliness of operations has assumed greater significance in obtaining optimal yields from different crops, which has been possible by way of mechanization. For instance, the sowing of wheat in Punjab is done up to the first fortnight of November. A delay beyond this period by every one week leads to about 1.50 quintals per acre decrease in the yield. This is also correct in the case of other crops and for other farm operations like hoeing, irrigation, harvesting, threshing and marketing which need to be performed at appropriate time, otherwise the yield and farm income is affected adversely. Secondly, the quality and precision of the operations are equally significant for realizing higher yields. The various operations such as land levelling, irrigation, sowing and planting, use of fertilizers, plant protection, harvesting and threshing need a high degree of precision to increase the efficiency of the inputs and reduce the losses. For example, sowing of the required quantity of seed at proper depth and uniform application of given dose of fertilizer can

only be possible with the use of proper mechanical devices. However, when such operations are performed through indigenous methods, their efficiency is reduced. Thirdly, the time taken to perform sequence of operations is a factor determining the cropping intensity. So as to ensure timeliness of various operations, it is quite inevitable to use such mechanical equipments which have higher output capacity and cut down the number of operations to be performed. This has helped in increasing area under cultivation and increase in cropping intensity. Higher productivity of land and labour is another factor, which clearly justifies farm mechanization. Not only the output per hour is more, the total labour requirement is also reduced. The displaced labour may of course be absorbed in the other alternatives created by the increased mechanization such as manufacturing, repair and service shops and the sale services. Thus, it only results in the shifting of the labour from one vocation to the other. As production increases with mechanization of the farm operations, it creates a good scope for commercialization of agriculture. Normally, there are good chances to reduce the cost of production if farm operations are mechanized as it saves labour, both human and bullock. In the absence of mechanization, the ever-increasing wage rate of human labour and cost of upkeep of draught animals could have increased the cost of production much higher. Further, large scale production means less per unit cost on the farms. Moreover, it reduces the weather risk and risk of non-availability of labour and thus wastage is minimized. Timely marketing is also made possible by quick mechanical transportation, cleaning and handling. Further, the area under fodder and feed for draught animals could be reduced due to decline in their use. The land thus released can be brought under commercial crops. The use of farm mechanization enlarges the employment opportunities both on farms and in non-farm sectors through increase in area under plough, multiple cropping, development of agro-industries and related services. On the other hand, displacement of human labour does take place and demand for semi-skilled labour in place of unskilled labour is increased. Also, the drudgery for human labour is reduced and unhygienic operations such as handling of farm yard manure can be done with machinery.

However, farm mechanisation in India has not progressed as desired although presently India is the top producer of four wheeled tractors with growing exports to markets like USA (Rajdou, 2009). In reality, Indian agriculture is far less mechanised than that of other South Asian countries viz., Bangladesh and Sri Lanka (Biggas *et al*., 2011). Similarly within India, the

extent of mechanisation is extremely varied and there are large regional disparities with Punjab and Haryana possessing the highest levels of mechanisation while the eastern states like West Bengal, Bihar and Orissa possess lowest. However, both central and state governments have taken several measures through two Central Sector Schemes viz., 'Promotion and Strengthening of Agricultural Mechanisation through Training', 'Testing and Demonstration and Post harvest Technology and Management' during 11th Five Year Plan. At the same time, mechanisation is also promoted through other programmes viz., Macro Management of Agriculture (MMA), Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM) and National Food Security Mission (NFSM) etc.

Under this backdrop, the present study intends to assess the effect of this increased focus on mechanisation on agricultural growth in West Bengal.

## 1.2: OBJECTIVES

The specific objectives of the study are:

1. to assess the impact of recent mechanisation on agricultural growth, if any in West Bengal;
2. to assess the pattern of mechanisation at the crop level and effect on production and productivity;
3. to assess the comparative economics of labour and machinery in West Bengal.

## 1.3: DATA BASE AND RESEARCH METHODOLOGY

The study has been conducted based on both primary and secondary data. For collection of primary data, all districts in West Bengal have been sub-divided into two groups based on density of tractors i.e. highest and lowest. Accordingly, one district from highest density i.e. Hooghly and other from lowest density i.e. Purulia have been selected randomly. Similarly by following the same methodology, one block in each district has been selected. The list of farmers of each block has been collected and the farmers have been sub-divided into three categories based on size of holdings i.e. marginal, small and medium. Then fifty farmers have been selected based on probability proportional to size. Thus all total 100 farmers have been selected to form the ultimate sample size of the study. The secondary data has been

collected from various sources i.e. farm level data from the cost of cultivation studies, government publications, books, journals etc. Tabular analyses along with econometric analyses have been adopted to fulfil the various objectives of the study.

## 1.4: ORGANISATION OF THE REPORT

The present study is organized into seven distinct chapters. The first chapter introduces the study with its backdrop and specifies the particular objectives of the study. It also describes the database used and methodology followed for the study. The second chapter describes the various mechanization programmes implemented in West Bengal and attempts to provide an outline of the broad trends in mechanization in the state. The results of the study are discussed in four technical chapters, viz. from the third to sixth chapter. In particular, the third chapter briefly describes the demographic profile and cropping pattern of the study region based on primary data collected through field survey. The focus of the present study is discussed in the fourth, fifth and sixth chapters. In fact, while the fourth chapter examines the costs of mechanization in various farm operations, the pattern of mechanization in the study region is examined in the fifth chapter. The sixth chapter attempts to examine and analyse farmers' perception regarding use of machinery and government assistance programmes to promote mechanization. Lastly, the seventh chapter summarizes the key findings, draws concluding observations based on the findings and attempts to outline the policy implications accordingly.

# 2

# MECHANISATION PROGRAMMES AND TRENDS OF MECHANISATION IN WEST BENGAL

## 2.1: MECHANISATION PROGRAMMES IN WEST BENGAL

India has small as well as big farms. Mechanical power has replaced bullock power on Indian farms. The contribution of mechanical power and electrical power to the total power availability on the Indian farm has risen to 70 per cent from 30 per cent during the last two decades, viz. 1990s & 2000s. In hilly parts of the country and remote areas, most of the farm operations are still being preformed manually or by animal drawn equipments and this will continue to be the case in future also. Hence, both small and large size machines would be needed. Average size of farm holdings has gradually reduced from 2.58 hectare to 1.57 hectare over the aforementioned period. Fragmentation will continue due to 'Laws of Inheritance' and 'Hindu Succession Act' where the father would divide the land amongst his sons. Labour shortage is being experienced at peak seasons due to the enactment of the National Rural Employment Guarantee Act and huge demand from the construction sector in cities; labour is available at a higher cost per hectare and this would increase the demand for mechanization. India is a growing economy and an increasing population can be supported by multiple cropping; hence, to perform the operations timely, high capacity machines in some places are required. Due to the high cost of agricultural machines, custom hiring/providing machines on rental basis are being promoted by the Government. Conservation Agriculture has emerged to encourage sustainable agricultural production. It refers to the system of raising crops without tilling the soil while retaining crop residues on the soil surface. There is minimum soil disturbance by adopting no-tillage solutions. The thrust areas of the Government include increase in the production and productivity of crops including horticultural crops, soya products, oilseeds and pulses. Increased participation of corporate through Corporate Farming has become very popular. Companies are entering into agreements with farmers through Contract Farming.

## 2.2: TRENDS OF MECHANISATION IN WEST BENGAL

Farm machines have not only increased the mechanical advantage, but also helped to reduce drudgery while performing the different agricultural operations. The contributions of agricultural mechanization in various stages of crop production could be viewed as saving in seeds, saving in fertilizers, saving in time, reduction in labour, increasing in cropping intensity and higher productivity.

The technological improvements in Indian agriculture since mid sixties have brought about revolutionary increase in agricultural production. Interestingly, the growth rate of food grain production particularly in case of wheat and rice was much higher than the growth rate of population. The country was facing acute food shortages till eighties has now become not only self sufficient but also a net exporter of food grains. This has been made possible due to evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes of farm products. The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies though mechanization. The increase in the use of human and bullock labour and rising wage rates and cost of up-keep of bullock further made the case of farm mechanization still stronger.

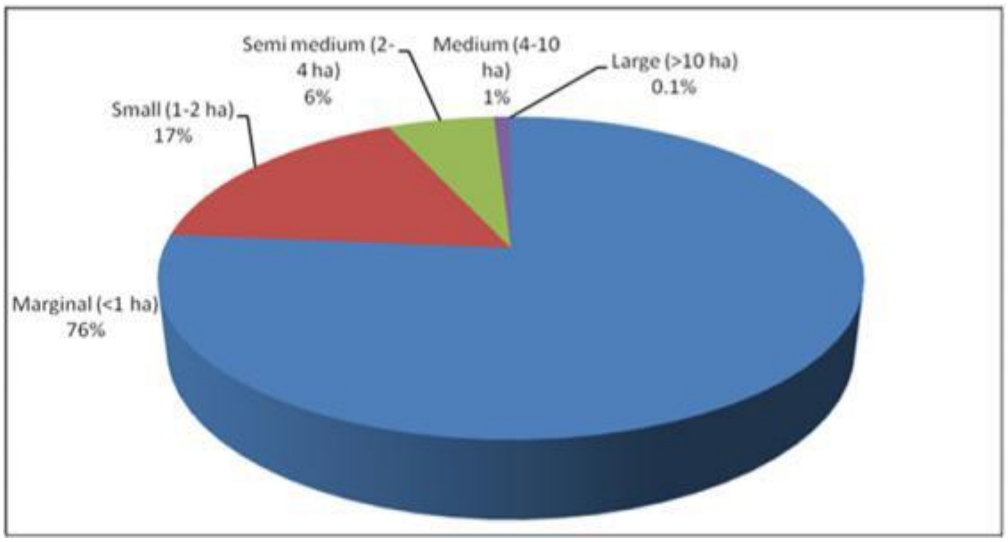


**Figure1: Status of land holdings in West Bengal**

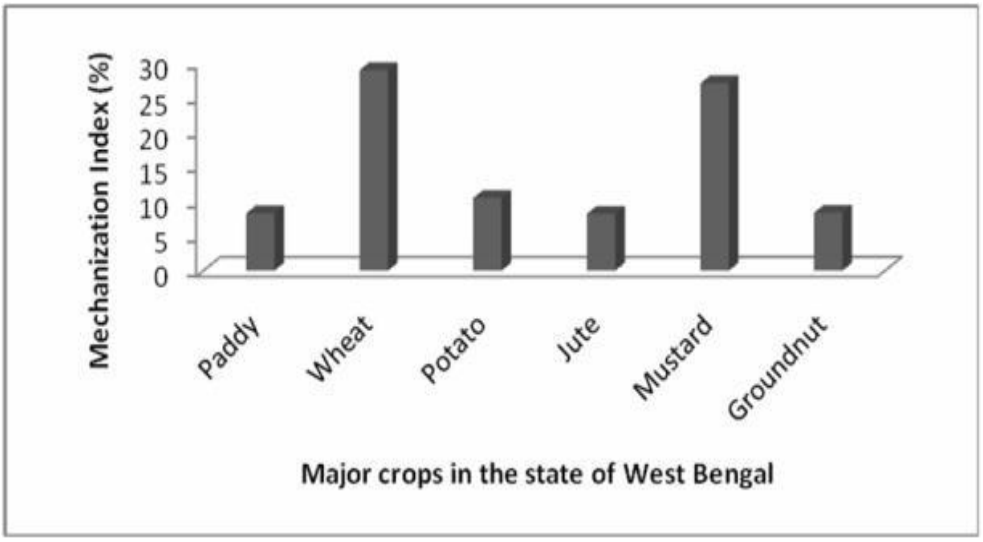


**Figure 2: Mechanization index of major crops in West Bengal**

The traditional farm tools and implement mainly relied on use of animate power. Improved farm tools, implements and machinery, which use both animate and mechanical power were devised from time to time. The average size of farm holding being small, animate power is widely used in many parts of the country. Mechanical power is making its impact in Indian agriculture with steady increase in land and labour productivity.

The traditional animal operated country plough although give low output and require higher number of field operations are still being used by majority of the farmers. Animal drawn cultivator and puddler have gained popularity over the years due to higher output and better quality of work. Improved implements such as M.B. plough, puddler, disc harrow, peg tooth harrow, spring tine harrow and patella harrow, being more efficient, have been adopted. Use of sowing/planting devices for line sowing have also increased over the years as it helped the farmers in better management of costly inputs of seed and fertilizers. The growth in the number of sprayers and dusters for plant protection has also been significant. The number of draught animals has shown decline during the past few decades as a consequence of farm mechanization and high cost of animal upkeep.

In case of trend in population of farm machinery irrigation is one of the major energy-intensive operations. With the increase in gross irrigated area, the number of irrigation pumps has swelled from 20 thousand in 1950-51 to about 12.51 million in 2000-01. Electric pumps are preferred than diesel engine operated pumps due to lower cost and higher energy-use efficiency. One of the major problems has been the lack of adequate and timely

availability of electricity in rural areas due to which the diesel engines are kept as standby source of irrigation. The farmers are increasingly using power sprayers and dusters. Tractor is the basic machine on which most of the farm mechanization depends. Power tiller was introduced in the country in the sixties, but could not gain popularity like tractor due to its limitation in the field and on the road. The power tillers are being used presently in rice and sugarcane producing areas of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, West Bengal, Bihar and Maharashtra. Prime movers for irrigation are also used for operating threshing, chaff cutting, cane crushing equipment. Tractors are also used as stationary power source for such purpose. Use of power thresher, especially for wheat crop, became very popular in the seventies even among small farmers.

In case of status and trends of mechanization in West Bengal, it comes out that cost of machine during the period 2001-02 to 2009-10 accounted for about 3 percent to 4 percent of operational cost across crops like paddy, wheat, mustard and potato. In contrast, cost of bullock labour ranged between 12 to 15 percent on an average, especially for paddy, wheat and mustard. As ratio to total cost, cost on account of machinery ranged between 2 to 4 percent of total cost, where cost on account of bullock labour ranged between 8 to 10 percent on an average over the period 2001-02 to 2009-10. Further, as ratio to value of production, cost of machine labour accounted for 2.5 to 3.5 percent for paddy, wheat and mustard, while cost of bullock labour ranged between 9.5 to 11.5 percent. On the whole, it comes out that costs of machine labour accounted for a small fraction (less than 5 percent) each in case of operational cost, total cost or value of production. In sharp contrast, costs of bullock labour and especially human labour remain farm higher.

**Table 2.1: Share of machinery costs in operational costs (2001-02 to 2009-10)**

| Crop | Cost of Human Labour | Cost of Bullock Labour | Cost of machine labour | Operational cost | Cost of human labour as % of operational costs | Cost of bullock labour as % of operational costs | Cost of machine labour as % of operational costs |
|---|---|---|---|---|---|---|---|
| Paddy | 11117.32 | 2376.03 | 853.68 | 19275.86 | 57.67 | 12.33 | 4.43 |
| Wheat | 7937.93 | 2522.60 | 692.51 | 18963.51 | 41.86 | 13.30 | 3.65 |
| Mustard | 6104.17 | 1837.12 | 502.74 | 12602.32 | 48.44 | 14.58 | 3.99 |
| Potato | 13428.47 | 1741.00 | 1980.82 | 50669.17 | 26.50 | 3.44 | 3.91 |

*Source: Cost of Cultivation, MoA, DES, GoI*

**Table 2.2: Share of machinery costs in total costs (2001-02 to 2009-10)**

| Crop | Cost of Human Labour | Cost of Bullock Labour | Cost of machine labour | Total cost | Cost of human labour as % of total costs | Cost of bullock labour as % of total costs | Cost of machine labour as % of total costs |
|---|---|---|---|---|---|---|---|
| Paddy | 11117.32 | 2376.03 | 853.68 | 27243.90 | 40.81 | 8.72 | 3.13 |
| Wheat | 7937.93 | 2522.60 | 692.51 | 26029.72 | 30.50 | 9.69 | 2.66 |
| Mustard | 6104.17 | 1837.12 | 502.74 | 18432.94 | 33.12 | 9.97 | 2.73 |
| Potato | 13428.47 | 1741.00 | 1980.82 | 67909.53 | 19.77 | 2.56 | 2.92 |

*Source: Cost of Cultivation, MoA, DES, GoI*

**Table 2.3: Share of machinery costs in value of production (2001-02 to 2009-10)**

| Crop | Cost of Human Labour | Cost of Bullock Labour | Cost of machine labour | Value of Production | Cost of human labour as % of value of production | Cost of bullock labour as % of value of production | Cost of machine labour as % value of production |
|---|---|---|---|---|---|---|---|
| Paddy | 11117.32 | 2376.03 | 853.68 | 25758.22 | 43.16 | 9.22 | 3.31 |
| Wheat | 7937.93 | 2522.60 | 692.51 | 22714.63 | 34.95 | 11.11 | 3.05 |
| Mustard | 6104.17 | 1837.12 | 502.74 | 19237.45 | 31.73 | 9.55 | 2.61 |
| Potato | 13428.47 | 1741.00 | 1980.82 | 63601.82 | 21.11 | 2.74 | 3.11 |

*Source: Cost of Cultivation, MoA, DES, GoI*

Further, while comparing growth rates of costs of machine labour vis-a-vis bullock labour and human labour, we observed that for paddy, costs of machine labour grew much faster than that of bullock labour and human labour. This also holds in case of mustard and especially wheat, as cost of machine labour in case of wheat grew by more than 38 percent over the period concerned. It is only in case of potato that we observe that cost of machine labour has actually declined over the period concerned.

It is interesting to note here from table 2.1 to 2.3, it appears that the operational costs are lower than value of production but total costs are higher, except in case of mustard. Since these are average costs and returns in a sense, this in turn reflects the subsistence type of farming practiced in a highly marginalized economy like West Bengal.

**Table 2.4: Growth rate of costs (1996-97 to 2009-10)**

| Crop | Cost of human labour | | | Cost of bullock labour | | | Cost of machine labour | | |
|---|---|---|---|---|---|---|---|---|---|
| | Qty | Price | Total cost | Qty | Price | Total cost | Qty | Price | Total cost |
| Paddy | 0.23 | 5.70 | 5.97 | -4.29 | 7.65 | 3.04 | NA | NA | 6.41 |
| Wheat | 3.58 | 14.43 | 18.53 | -12.54 | 4.85 | -8.30 | NA | NA | 38.73 |
| Mustard | 1.17 | 6.51 | 5.22 | -1.72 | 6.30 | 3.25 | NA | NA | 8.49 |
| Potato | -3.36 | 5.82 | 2.26 | -5.33 | 8.08 | 2.31 | NA | NA | -12.92 |

*Source: Cost of Cultivation, MoA, DES, GoI*

**Table 2.5: Growth rate of production vis-a-vis costs (1996-97 to 2009-10)**

| Crop | Production | | | Cost of machinery | | |
|---|---|---|---|---|---|---|
| | Yield | Price | Value of production | Qty | Price | Total machinery cost |
| Paddy | 0.69 | 4.00 | 4.72 | NA | NA | 6.41 |
| Wheat | 3.55 | 7.66 | 11.48 | NA | NA | 38.73 |
| Mustard | 0.21 | 5.62 | 5.84 | NA | NA | 8.49 |
| Potato | -0.96 | 5.55 | 4.54 | NA | NA | -12.92 |

*Source: Cost of Cultivation, MoA, DES, GoI*

More importantly, it is observed that cost of machinery grew faster than the growth in value of production over the period 1996-97 to 2009-10. This holds true for paddy, mustard and especially wheat, where cost of machinery grew by 38.73 percent as compared to 11.48 growth of value of production. However, in case of potato only, we observe that there has been a negative growth of –12.92 percent in total machinery cost over the period, while there has been a positive growth in the value of output at 4.54 percent per annum over the same period. As such, it comes out that except for potato, costs of machinery has grown much faster than costs of bullock labour, human labour as well as value of production. This perceivably acts as a major constraint in the spread of mechanization of farming in the cultivation of crops like paddy, wheat and mustard.

# 3

# DEMOGRAPHIC PROFILE AND CROPPING PATTERN OF THE STUDY REGION

## 3.1: GENERAL OVERVIEW OF THE STUDY REGION

The present study has been carried out in parts of West Bengal, where two administrative blocks (one each from most mechanized district and least mechanized districts) were selected randomly as the study region. In this section, as a prelude to our main analysis, we attempt to briefly describe the demographic features of the study region. Such an attempt, besides sketching an overview of the study region, provides us with the basis for further analysis of the subject matter of the study.

### 3.1.1: DEMOGRAPHIC PROFILE

It has been observed during the survey that average household size of the sample farms works out to be 6.36 persons per family, which is particularly high among the medium farms. This is understandable as greater farm size in turn indicates greater economic affluence, which allows forming larger families. It could also be that fact that those with the joint families have large farm size because no intra-family division of land happened. However, such an argument does not hold for the small farms, as the average household size of the small farms is even lower than the marginal farms. Nevertheless, it is worth mentioning here that a strong gender bias in favour of male members is observed consistently in all size groups, particularly among the small farms. For the smaller farms the male to female ratio works out to be .724, followed by the medium farms (.737) and the marginal farms (.761).

**Table 3.1: Demographic profile (no. Of Persons)**

| Categories | Adults | | | Children | Total |
|---|---|---|---|---|---|
| | Males | Females | Total | | |
| Marginal | 230 | 175 | 405 | 106 | 511 |
| Small | 36 | 26 | 62 | 20 | 82 |
| Medium | 19 | 14 | 33 | 10 | 43 |
| Large | | | | | |
| Total | 285 | 215 | 500 | 136 | 636 |

*Source: Field Survey*

### 3.1.2: CASTE COMPOSITION

In case of caste composition of the sample households, it can be observed that the sample pool is dominated by households belonging to OBC (other backward classes) accounting for 45 percent of all sample households, followed by households belonging to general and other castes (30 percent). Among the caste composition of various size categories, it is observed that it is only the marginal size category in which we find representation of all castes (ST, SC, OBC and Others) in varying proportions. However, as we move to higher size categories, the caste composition changes in favour of OBCs and other general castes.

**Table 3.2: Caste composition (No of HHlds)**

| Categories | SC | ST | OBC | Others | Total |
|---|---|---|---|---|---|
| Marginal | 8 | 14 | 34 | 25 | 81 |
| Small | 3 | 0 | 9 | 2 | 14 |
| Medium | 0 | 0 | 2 | 3 | 5 |
| Large | - | - | - | - | - |
| Total | 11 | 14 | 45 | 30 | 100 |

*Source: Field Survey*

**Table 3.3: Distribution of Caste Composition (%)**

| Categories | SC | ST | OBC | Others | Total |
|---|---|---|---|---|---|
| Marginal | 9.88 | 17.28 | 41.98 | 30.86 | 100 |
| Small | 21.43 | 0.00 | 64.29 | 14.29 | 100 |
| Medium | 0.00 | 0.00 | 40.00 | 60.00 | 100 |
| Large | - | - | - | - | - |
| Total | 11.00 | 14.00 | 45.00 | 30.00 | 100 |

*Source: Field Survey*

### 3.1.3: EDUCATION PROFILE

Educational attainment of the head of the households may have far reaching implications on the adoption of modern farming techniques as well as on use of machinery in farming practices. As such, examination of level of education of the head of the households carries important significance in studies relating to adoption and spread of mechanization in farming. It is here that the following tables describe the state of educational attainment of the head of the sample farms, viz. the decision makers.

It can be observed here that about 45 percent of the head of the sample households have attained secondary or above level of education. Further, about 27 percent of the head of the households are educated at the primary level, while remaining 28 percent of the head of the households are illiterates. Among the size-classes, it is observed that the heads of the households belonging to the marginal and small categories have similar educational attainment, with comparable proportions of illiterates, primary educated and higher educated heads of households. However, none of the heads of medium farm households is illiterate.

**Table 3.4: Education of the head of the household** (No of HHlds)

| Categories | Illiterates | Primary | Secondary & Above | Total |
|---|---|---|---|---|
| Marginal | 24 | 20 | 37 | 81 |
| Small | 4 | 4 | 6 | 14 |
| Medium | 0 | 3 | 2 | 5 |
| Large | - | - | - | - |
| Total | 28 | 27 | 45 | 100 |

*Source: Field Survey*

**Table 3.5: Percentage distribution of education of the head of the household**(%)

| Categories | Illiterates | Primary | Secondary & Above | Total |
|---|---|---|---|---|
| Marginal | 29.63 | 24.69 | 45.68 | 100 |
| Small | 28.57 | 28.57 | 42.86 | 100 |
| Medium | 0.00 | 60.00 | 40.00 | 100 |
| Large | - | - | - | - |
| Total | 28.00 | 27.00 | 45.00 | 100 |

*Source: Field Survey*

However, among the adult population it can be observed that average educational attainment at the secondary or higher levels tends to increase with increase in farm size, while the proportion of illiterate adult members tends to increase with decrease in size. This is understandable as greater economic affluence of the larger farms allow family members to pursue higher education, while financial scarcity on the hand compels even the younger members of the family to engage in various vocations to support livelihood.

On the whole, it comes out that a half of all the adult members of the sample households have education at the secondary or higher levels, while about a quarter of adult members are educated at the primary level. The remaining quarter of adult population, however, is illiterate.

**Table 3.6: Education profile of the adult population** (Avg. No. Of Persons)

| Categories | Illiterates | Primary | Secondary & Above | Total |
|---|---|---|---|---|
| Marginal | 1.22 | 1.37 | 2.41 | 5.00 |
| Small | 1.00 | 0.93 | 2.50 | 4.43 |
| Medium | 1.20 | 1.40 | 4.00 | 6.60 |
| Large | - | - | - | - |
| Total | 1.19 | 1.31 | 2.50 | 5.00 |

*Source: Field Survey*

**Table 3.7: Percentage distribution of adult educated population** (%)

| Categories | Illiterates | Primary | Secondary & Above | Total |
|---|---|---|---|---|
| Marginal | 24.44 | 27.41 | 48.15 | 100 |
| Small | 22.58 | 20.97 | 56.45 | 100 |
| Medium | 18.18 | 21.21 | 60.61 | 100 |
| Large | - | - | - | - |
| Total | 23.80 | 26.20 | 50.00 | 100 |

*Source: Field Survey*

## 3.2: CROP STRUCTURAL COMPONENTS

To facilitate further analysis, it remains important to examine the nature of farming practiced in the study region. Here an attempt has been made to briefly describe the crop structural components in the study region by means of analysing the cropping pattern and availability of irrigation.

### 3.2.1: CROPPING PATTERN

In case of cropping pattern of the sample farm households, it is observed that the study region is dominated by cultivation of rice both in terms of area sown and crop duration. However, while other crops are cultivated under completely irrigated conditions, a large (42.39 percent) part of the area under rice remains rain-fed and un-irrigated. Other crops like wheat, rapeseed and mustard, potato, etc. are grown in relatively small areas. The crop duration index for the crop year 2008-09 works out to be 82.38 percent, which improved further in the following year 2009-10 to 84.23 percent. However, during the crop year 2010-11, the crop duration index dropped to 76.98 percent, indicating a fall in the utilization of available land for farming. This reduction in the crop duration index might have risen from factors like scanty rainfall, excessive heat, over precipitation, etc., but identification of such factors responsible for the decline in the crop duration index is not discussed under the purview of the present study.

**Table 3.8: Cropping pattern over all seasons: 2008-09**

| Crop | Area sown ($a_i$) | Number of months sown ($d_i$) | % of irrigated area under the crop |
|---|---|---|---|
| Rice | 0.74 | 4.82 | 57.61 |
| Wheat | 0.03 | 0.67 | 100.00 |
| Rapeseed and mustard | 0.09 | 1.02 | 100.00 |
| Potato | 0.26 | 1.44 | 100.00 |
| Crop Duration Index | $[(\sum a_i d_i)/12A]*100$= (4.0531/12* 0.41)*100 = 82.38% | | |

*Source: Field Survey*

**Table 3.9: Cropping pattern over all seasons: 2009-10**

| Crop | Area sown ($a_i$) | Number of months sown ($d_i$) | % of irrigated area under the crop |
|---|---|---|---|
| Rice | 0.76 | 4.81 | 57.83 |
| Wheat | 0.03 | 0.66 | 100.00 |
| Mustard | 0.09 | 1.05 | 100.00 |
| Potato | 0.26 | 1.44 | 100.00 |
| Crop Duration Index | $[(\sum a_i d_i)/12A]*100$= (4.1443/12* 0.41)*100 = 84.23% | | |

*Source: Field Survey*

**Table 3.10: Cropping pattern over all seasons: 2010-11**

| Crop | Area sown ($a_i$) | Number of months sown ($d_i$) | % of irrigated area under the crop |
|---|---|---|---|
| Rice | 0.72 | 4.56 | 58.77 |
| Wheat | 0.02 | 0.61 | 100.00 |
| Mustard | 0.09 | 1.00 | 100.00 |
| Any other crop | 0.27 | 1.50 | 100.00 |
| Crop Duration Index | $[(\sum a_i d_i)/12A]*100$= (3.7872/12* 0.41)*100 = 76.98 | | |

*Source: Field Survey*

### 3.2.2: IRRIGATED AREA

In case of availability of irrigation, the survey finds that about 47 percent of cultivated area is fed with irrigation from various sources. Availability of irrigation is observed to be the highest for the marginal farms (50 percent), followed by the medium farms (46 percent) and the small farms (42 percent). The higher irrigation availability by the marginal farms is not completely unexpected as it is often argued that plots with assured irrigation availability are subject to fragmentation into smaller plots, as compared to un-irrigated

tracts. Again, our data also suggests that a large proportion land of the medium farms is left un-irrigated.

Among the various sources of irrigation, it is observed that the major source of irrigation has been canal irrigation, followed by tubewells and other sources like river lift irrigation, pumping out water from small creeks, etc. It should be noted here that irrigation from tanks has not been observed in the study region.

**Table 3.11: Irrigation details** (Area Irrigated in ha.)

| Categories | Irrigated | | | | | Un-irrigated | Total |
|---|---|---|---|---|---|---|---|
| | Canal | Tubewell | Tank | Others | Total | | |
| Marginal | 0.20 | 0.08 | 0.00 | 0.00 | 0.28 | 0.28 | 0.56 |
| Small | 0.44 | 0.16 | 0.00 | 0.07 | 0.67 | 0.94 | 1.61 |
| Medium | 1.17 | 0.40 | 0.00 | 0.11 | 1.68 | 2.00 | 3.68 |
| Large | - | - | - | - | - | - | - |
| Total | 0.28 | 0.11 | 0.00 | 0.02 | 0.41 | 0.46 | 0.87 |

*Source: Field Survey*

**Table 3.12: Distribution of irrigated area by source** (%)

| Categories | Irrigated | | | | | Un-irrigated | Total |
|---|---|---|---|---|---|---|---|
| | Canal | Tubewell | Tank | Others | Total | | |
| Marginal | 35.85 | 14.18 | 0.00 | 0.00 | 50.03 | 49.97 | 100.00 |
| Small | 27.51 | 9.72 | 0.00 | 4.44 | 41.66 | 58.34 | 100.00 |
| Medium | 31.85 | 10.87 | 0.00 | 2.93 | 45.65 | 54.35 | 100.00 |
| Large | - | - | - | - | - | - | - |
| Total | 32.83 | 12.31 | 0.00 | 1.78 | 46.92 | 53.08 | 100.00 |

*Source: Field Survey*

# 4

# COSTS OF MECHANIZATION

## 4.1: COSTS OF MECHANIZATION VIS-À-VIS MARKETED SURPLUS AND VALUE OF PRODUCTION

Broadly speaking, mechanization means using machinery to perform tasks or to assist humans in performing tasks. Mechanization is the use of modern implements as well as motorized equipment like plough, harrow, ridger and also the use of agro-chemicals like insecticides, herbicides, fertilizers and improved seeds in the farm. However, while mechanization reduces labour costs, on the other hand, it increases capital expenses for machinery and equipment. As farmers in general are too poor to be able to buy the expensive machines, mechanization of farming often appears to them too costly to practice. Further, degree of mechanization depends much upon the specific requirements of the crops grown, nature of the crops, as also the season in which the crops are grown. Thus that capital costs incurred for mechanization in relation to marketable surplus and value of output remains crucial for the spread of mechanization, particularly in a country like ours where majority of the farms perform at the subsistence level. Here, an attempt has been made to examine the costs of mechanization vis-à-vis marketed surplus and value of output for the different crops grown in the study region.

To examine the costs of mechanization for different crops grown in the study region, first costs on account of various inputs applied in cultivation is compared across different crops. It can be observed that a total cost per hectare of land is the highest for potato, followed by summer paddy, kharif paddy and mustard. The costs of inputs in wheat cultivation have been the lowest among the crops cultivated in the study region. Among the various cost components, expenses on account of human labour claim a major share for almost all the crops concerned, except for wheat (which is cultivated mainly with family labour). Costs on account of hired machinery, however, varies from crop to crop, from less than 10 percent in case of potato to more than 27 percent in case of mustard. In case of the main crop, viz. kharif paddy, costs on account of hiring of machinery accounts for about ¼ of the total input costs incurred.

**Table: 4.1 (a) Input Costs (Rs/ha.)**

| Crop | Seed | Irrigation | Organic Manure | Fertilizer | Hired Labour | | | Hired Machinery costs | | | Pesticides/ Weedicides | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Bullock | Manual | Total | Tractor | Carriage | Total | | |
| Kharif Paddy | 1168.46 | 502.23 | 1237.97 | 3114.73 | 1397.04 | 11202.91 | 12599.94 | 3013.25 | 3669.73 | 6682.97 | 704.27 | 26010.58 |
| Boro Paddy | 926.20 | 2485.21 | 0.00 | 4015.40 | 999.95 | 15458.37 | 16458.32 | 3103.15 | 0.00 | 3103.15 | 1242.71 | 28231.00 |
| Potato | 17422.93 | 12584.68 | 2997.20 | 16392.71 | 3709.04 | 23271.63 | 26980.67 | 5316.11 | 3223.83 | 8539.94 | 3035.87 | 87954.00 |
| Mustard | 374.64 | 1477.72 | 1981.60 | 2342.96 | 891.09 | 7496.87 | 8387.96 | 1999.26 | 3747.13 | 5746.39 | 819.00 | 21130.27 |
| Wheat | 2668.71 | 1492.31 | 1507.47 | 1674.72 | 0.00 | 946.09 | 946.09 | 1753.98 | 0.00 | 1753.98 | 795.62 | 10838.91 |

*Source: Field Survey*

**Table: 4.1 (b) Percentage Distribution of Input Costs (%)**

| Crop | Seed | Irrigation | Organic Manure | Fertilizer | Hired Labour | | | Hired Machinery costs | | | Pesticides/ Weedicides | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Bullock | Manual | Total | Tractor | Carriage | Total | | |
| Kharif Paddy | 4.49 | 1.93 | 4.76 | 11.97 | 5.37 | 43.07 | 48.44 | 11.58 | 14.11 | 25.69 | 2.71 | 100 |
| Boro Paddy | 3.28 | 8.80 | 0.00 | 14.22 | 3.54 | 54.76 | 58.30 | 10.99 | 0.00 | 10.99 | 4.40 | 100 |
| Potato | 19.81 | 14.31 | 3.41 | 18.64 | 4.22 | 26.46 | 30.68 | 6.04 | 3.67 | 9.71 | 3.45 | 100 |
| Mustard | 1.77 | 6.99 | 9.38 | 11.09 | 4.22 | 35.48 | 39.70 | 9.46 | 17.73 | 27.20 | 3.88 | 100 |
| Wheat | 24.62 | 13.77 | 13.91 | 15.45 | 0.00 | 8.73 | 8.73 | 16.18 | 0.00 | 16.18 | 7.34 | 100 |

*Source: Field Survey*

In absolute terms, however, the highest cost incurred on account of hiring of machinery is the highest for potato, followed by kharif paddy and mustard. It should be noted here that as proportions to value of output, cost of machinery is the maximum (about 33 percent) for mustard, followed by kharif paddy (about 18 percent) and potato (about 11 percent). This in turn indicates that a major share (about one-thirds) of value produced in mustard cultivation is lost on account os use of various machines in the process of production. In case of the main crop kharif paddy, about 18 percent of the value produced is lost on account of use of machines. As such it comes out that mechanization of farming constitute a major component of expenditure in input application, especially for mustard and kharif paddy.

Further, as compared to marketed surplus of the crops produced, it comes out that for mustard, cost on account of machine use is more than (110 percent) the amount of marketed surplus. This for kharif paddy accounts for about 30 percent of marketed surplus. It should be noted here that in case of mustard, value of marketed surplus works out to be only about 30 percent in relation to value of output, in turn indicating higher a proportion of retention for farm family consumption. Again, in case of the main crop, viz. kharif paddy, it is observed that ratio of marketed surplus to value of output works out to be about 60 percent, which means that 60 percent of value produced in kahrif paddy is actually marketed. Costs on account of machine use constitute a share of 30 percent in relation to marketed surplus and 18 percent in relation to value of output.

**Table: 4.2 Costs of Mechanization vis-à-vis Value of Output (Rs./ha.)**

| Crop (1) | Value of Output (2) | Hired Machinery Costs (Total) (3) | Marketed Surplus (4) | % of Machinery Costs to VoO - (3) as percentage of (2) | % of Machinery Costs to MS - (3) as percentage of (4) | % of MS to VoO - (4) as percentage of (2) |
|---|---|---|---|---|---|---|
| Kharif Paddy | 37234.48 | 6682.97 | 22146.36 | 17.95 | 30.18 | 59.48 |
| Boro Paddy | 46103.13 | 3103.15 | 38844.09 | 6.73 | 7.99 | 84.25 |
| Potato | 80666.54 | 8539.94 | 70330.51 | 10.59 | 12.14 | 87.19 |
| Mustard | 17422.90 | 5746.39 | 5221.07 | 32.98 | 110.06 | 29.97 |
| Wheat | 18336.88 | 1753.98 | 12832.83 | 9.57 | 13.67 | 69.98 |

*Source: Field Survey*

## 4.2: OPERATION-WISE COSTS OF MECHANIZATION

Mechanization of farming involves a wide range of activities performed in various stages of production. The machines in use may be operated by a number of power sources like, manual, animal, electrical, etc. In this section we attempt to examine the costs incurred on mechanization according to farming operations. A detailed break up of costs incurred on machines shows us that operations like plant protection and threshing is done completely manually, while irrigation operations are completely performed using electrical power. Harvesting operations are carried out using both animal and manual power sources. Other activities like ploughing, transportation and marketing are carried out using either animal operated or tractor power.

It thus comes out on the one hand that animal power is used extensively on different farm operation, besides manual, electrical and tractor power. In fact, the major cost items in farming operations comes out to be ploughing (Rs.11,702/- per hectare) which is mostly operated using animal power (58.67 percent). This is followed by irrigation operations (Rs.4935/- per hectare), which is entirely carried out using electrical power, and transportation and marketing (Rs.3287/- per hectare), which is mostly done using tractor power (85 percent).

On the other hand, it comes out that among the various operations performed with various power sources, tractor power is the highest used power source (Rs.7593/- per hectare) followed by animal power (Rs.7567/- per hectare), electrical power (Rs.4935/- per hectare) and manual power (Rs.1136/- per hectare). Hence it appears that in various farming operations, both tractor power and animal power remains crucial, while use of manual power is negligible. Use of electrical power however is limited and used for specific activities.

**Table: 4.3 (a) Costs of Mechanization – Operation-wise** (Rs./ha.)

| Operation | Animal Operated | | | | Manually Operated | | | | Power Operated | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost |
| Ploughing | 6865.22 | 0 | 0 | 6865.22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3783.27 | 869.19 | 283.03 | 4935.49 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 0 | 0 | 0 | 48.76 | 0 | 22.08 | 70.84 | 0 | 0 | 0 | 0 |
| Harvesting | 161.03 | 10.67 | 0 | 171.70 | 402.10 | 0 | 24.13 | 426.23 | 0 | 0 | 0 | 0 |
| Threshing | 0 | 0 | 0 | 0 | 587.64 | 0 | 51.82 | 639.46 | 0 | 0 | 0 | 0 |
| Transportation & Marketing | 480.04 | 0 | 50.43 | 530.47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

***Continued…***

| Operation | Tractor Operated | | | | Any Other | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost |
| Ploughing | 4836.83 | 0 | 0 | 4836.83 | 0 | 0 | 0 | 0 | 11702.05 | 0 | 0 | 11702.05 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3783.27 | 869.19 | 283.03 | 4935.49 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48.76 | 0 | 22.08 | 70.84 |
| Harvesting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 563.13 | 10.67 | 24.13 | 597.93 |
| Threshing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 587.64 | 0 | 51.82 | 639.46 |
| Transportation & Marketing | 2756.68 | 0 | 0 | 2756.68 | 0 | 0 | 0 | 0 | 3236.72 | 0 | 50.43 | 3287.15 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

**Table: 4.3 (b) Percentage Distribution of Costs of Mechanization – Operation-wise** (%)

| Operation | Animal Operated | | | | Manually Operated | | | | Power Operated | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost |
| Ploughing | 58.67 | 0 | 0 | 58.67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 100 | 100 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 0 | 0 | 0 | 100 | 0 | 100 | 100 | 0 | 0 | 0 | 0 |
| Harvesting | 28.60 | 100 | 0 | 28.72 | 71.4 | 0 | 100 | 71.28 | 0 | 0 | 0 | 0 |
| Threshing | 0 | 0 | 0 | 0 | 100 | 0 | 100 | 100 | 0 | 0 | 0 | 0 |
| Transportation & Marketing | 14.83 | 0 | 100 | 16.14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Continued…*

| Operation | Tractor Operated | | | | Any Other | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost | Hire charges | Input costs | Service & maintenance | Total cost |
| Ploughing | 41.33 | 0 | 0 | 41.33 | 0 | 0 | 0 | 0 | 100% | 0% | 0% | 100% |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% |
| Irrigation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100% | 100% | 100% | 100% |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% |
| Plant Protection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100% | 0% | 100% | 100% |
| Harvesting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100% | 100% | 100% | 100% |
| Threshing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100% | 0% | 100% | 100% |
| Transportation & Marketing | 85.17 | 0 | 0 | 85.17 | 0 | 0 | 0 | 0 | 100% | 0% | 100% | 100% |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% |

*Source: Field Survey*

# 5

# PATTERN OF MECHANIZATION

## 5.1: EXTENT OF MACHINERY USE

Mechanization of farming activities depends much upon the crops grown in the study region and crop-specific requirements of machines in various farming activities. In a country like ours, where majority of farms are marginal farms and crops are grown in fragmented and scattered plots, extent of use of machines is highly restricted. The economic status, soil quality, etc. also influence the adoption and extent of use of farm machinery. It is under this context that the present section of the study attempts to examine the pattern of mechanization of the sample farms in the study region.

It is here that we observe that the extent of use of manual machines is extremely common in the study region as almost all the farms (99 percent) use manual machines in some form or the other, and about a-thirds of the sample farms own manual machines. This is followed by the use of animal operated machines which can be observed among 58 percent of farms. Also machines operated with animal power are owned by 43 percent of farms. Again, 50 percent of the farms are found using electrical power operated machines (mainly for irrigation), while only 9 percent of farms own such power operated machines. Further, though none of the farms are found to own tractors, the use of tractors is quite extensive. In particular, about 45 percent of farms have used tractors either in ploughing operations or in transportation and marketing. However, none of the farms either used or own self-propelled machines in farming operations.

**Table: 5.1 Extent of Farm Machinery Use**

| Machinery type | No of farmers using the machinery (1) | No of farmers owning the machinery (2) | Total no of farmers (3) | (1) as % of (3) | (2) as % of (3) |
|---|---|---|---|---|---|
| Manual | 99 | 32 | 100 | 99 | 32 |
| Animal operated | 58 | 43 | 100 | 58 | 43 |
| Power operated | 50 | 9 | 100 | 50 | 9 |
| Tractor operated | 45 | 0 | 100 | 45 | 0 |
| Self propelled | 0 | 0 | 100 | 0 | 0 |

*Source: Field Survey*

It thus comes out that ownership of expensive machines like shallow tubewells, tractors, etc. is fairly limited in numbers owing to involvement of higher capital cost, but they are extensively used on hiring basis to perform various farming operations in the study region.

## 5.2: NUMBER OF FARMERS OWNING AND USING MACHINERY

Further investigation into ownership of machinery by the farms in relation to their use in various operations reveals that as much as 80 farms own animal operated machines for ploughing operations, while 50 farms own animal operated machines for transportation and marketing. Plant protection, harvesting and threshing operations are carried out entirely by manually operated machines, which are owned by 9, 59 and 29 farms respectively. While irrigation operations are entirely carried out using electrical operated machines, such machines are owned by only 9 farms out of 100 sample farms considered for this study.

**Table: 5.2 (a) Number of Farmers Owning Machinery – Operation-wise**

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other | Total |
|---|---|---|---|---|---|---|
| Ploughing | 80 | 0 | 0 | 0 | 0 | 80 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 9 | 0 | 0 | 9 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 9 | 0 | 0 | 0 | 9 |
| Harvesting | 0 | 59 | 0 | 0 | 0 | 59 |
| Threshing | 0 | 29 | 0 | 0 | 0 | 29 |
| Transportation & Marketing | 50 | 29 | 0 | 0 | 0 | 79 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

**Table: 5.2 (b) Percentage Distribution of Farmers Owning Machinery – Operation-wise**

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other | Total |
|---|---|---|---|---|---|---|
| Ploughing | 100 | 0 | 0 | 0 | 0 | 100 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 100 | 0 | 0 | 100 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 100 | 0 | 0 | 0 | 100 |
| Harvesting | 0 | 100 | 0 | 0 | 0 | 100 |
| Threshing | 0 | 100 | 0 | 0 | 0 | 100 |
| Transportation & Marketing | 63.29 | 36.71 | 0 | 0 | 0 | 100 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

It should be noted here that none of the farms own tractors or any other type of machines, though we have found earlier that about 45 percent of farms hire tractors for either ploughing or transportation and marketing. This is particularly because of the fact that owning a tractor requires huge capital investment, which is largely beyond the financially affordable limits of the resource-poor farms.

In case of use of machinery in various farming operation, it can be observed that ploughing operation are carried out using animal operated machines for 51 percent of the farms, while the remaining 49 percent of the farms carry out ploughing operations with tractor power. Similar observations can be made for transportation and marketing operations, where 50 percent of the farms use animal operated machines, while remaining 50 percent of farms use tractor operated machines. Again, harvesting operation are found to be carried out using animal power for 29 percent of farms, while the rest 71 percent of farms carry out harvesting operations manually. As has been found earlier, irrigation operations are entirely carried out with electrical power. About 50 percent of farms who own irrigation machinery opt for electrical power for irrigation activities. Further the plant protection activities are carried out entirely with manual power, which is opted by 98 percent of the farms. However, in case of sowing and weeding operations, no machines- either manual, animal operated of power operated, are used.

It thus comes out that though ownership of expensive machines is fairly restricted among the farmers owing to scarcity of investible finance; they extensively hire-in the machines to perform various farming operations. As such, ownership and use of machinery is two completely different aspects, especially in case of a highly marginalised economy like West Bengal.

**Table: 5.3 Number of Farmers using Machinery – Operation-wise**

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other | Total |
|---|---|---|---|---|---|---|
| Ploughing | 51 | 0 | 0 | 49 | 0 | 100 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 50 | 0 | 0 | 50 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 98 | 0 | 0 | 0 | 98 |
| Harvesting | 29 | 71 | 0 | 0 | 0 | 100 |
| Threshing | 0 | 100 | 0 | 0 | 0 | 100 |
| Transportation & Marketing | 50 | 0 | 0 | 50 | 0 | 100 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

**Table: 5.4 Percentage Distribution Farmers Using Machinery – Operation-wise**

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other | Total |
|---|---|---|---|---|---|---|
| Ploughing | 51 | 0 | 0 | 49 | 0 | 100 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 100 | 0 | 0 | 100 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 100 | 0 | 0 | 0 | 100 |
| Harvesting | 29 | 71 | 0 | 0 | 0 | 100 |
| Threshing | 0 | 100 | 0 | 0 | 0 | 100 |
| Transportation & Marketing | 50 | 0 | 0 | 50 | 0 | 100 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

## 5.3: TIME USE OF MACHINERY

In case of time-use of machinery in farming operations, it can be observed that animal operated machines have consumed the maximum time, especially in harvesting operations (3434 hours). This is followed by manually operated machines, which consumed more than 317 hours in total on an average, especially in harvesting operations. However, electric powered machines like the tubewells and tractors have consumed very little time as compared to the animal operated and manually operated machines. In particular, while electric tubewells have consumed about 26 hours of usage on an average, the tractors are operated only 6 hours for ploughing and 5 hours for transportation and marketing. In percentage terms, it can be observed that in case of ploughing activity 95 percent of time spent on ploughing is consumed by animal operated machines; while tractor operated machines consume only 5 percent of total time allotted for ploughing. Similarly, in case of transportation and marketing, about 92 percent of total time allotted has been devoted to animal operated machines, while similar tasks are performed by tractor operated machines only in about 8 hours. Now, we have seen earlier that costs on account of animal operated machines and tractor operated machines are comparable and constitute the largest cost components in costs of mechanization.

As such, it turns out that though with comparable costs, the tractor operated machines perform similar tasks as the animal operated machines much faster and saves a lot of valuable time. Clearly, the time-advantage in mechanization of farming is clearly reflected here, especially at comparable costs. Also, the percentage of farmers using 'animal-operated' and 'tractor-operated'

for transportation and marketing is exactly the same, while the time usage percentages are 92% and 8% respectively, reflecting time-advantage of machinery-use.

**Table: 5.5 (a) Total Number of Hours of Usage – Operation-wise** (hrs./ha.)

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other |
|---|---|---|---|---|---|
| Ploughing | 115 | 0 | 0 | 6.07 | 0 |
| Sowing | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 25.55 | 0 | 0 |
| Weeding | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 12.15 | 0 | 0 | 0 |
| Harvesting | 34.34 | 238.92 | 0 | 0 | 0 |
| Threshing | 0 | 66.89 | 0 | 0 | 0 |
| Transportation & Marketing | 58.03 | 0 | 0 | 4.84 | 0 |
| Any other | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

**Table: 5.5 (b) Percentage Distribution of Number of Hours of Usage – Operation-wise**

| Operation | Animal Operated | Manually Operated | Power Operated | Tractor Operated | Any Other | Total |
|---|---|---|---|---|---|---|
| Ploughing | 94.99 | 0 | 0 | 5.01 | 0 | 100 |
| Sowing | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 0 | 0 | 100 | 0 | 0 | 100 |
| Weeding | 0 | 0 | 0 | 0 | 0 | 0 |
| Plant Protection | 0 | 100 | 0 | 0 | 0 | 100 |
| Harvesting | 12.57 | 87.43 | 0 | 0 | 0 | 100 |
| Threshing | 0 | 100 | 0 | 0 | 0 | 100 |
| Transportation & Marketing | 92.30 | 0 | 0 | 7.70 | 0 | 100 |
| Any other | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Field Survey*

## 5.4: OPERATION-WISE MACHINERY USE

In this section, a detailed analysis of use of machines in various farm operations has been examined. In particular, use of machines in each of the activities like ploughing, sowing, irrigation, weeding and interculture, plant protection, threshing, harvesting, transport and marketing- has been discussed here in detail.

First, in case of ploughing operations it can be observed that among animal operated sources of power, plough has been used extensively in farming, while other animal operated machines like disc harrow, cultivator, etc. have not been used. Again, power tiller operated machines like rotavators are also not used. However, among tractor operated machines, only plough has been used extensively, while other tractor operated machines like disc

harrow, cultivator, rotavator, etc. have not been used. In terms of costs, about 59 percent of costs on account of ploughing has been incurred for animal operated plough, while the rest 41 percent cost got expended on tractor operated plough. However, as tractor operated plough is superior in terms of time-efficiency; it is observed that only 5 percent of time is consumed in tractor operated plough, while the rest 95 percent of time has been consumed by animal operated plough.

**Table: 5.6 (a) Ploughing and Seedbed Preparation** (absolute nos) (Per ha.)

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| Animal operated | | | |
| | Plough | 115 | 6865.22 |
| | Disc Harrow | 0 | 0 |
| | Cultivator | 0 | 0 |
| Power tiller operated | | | |
| | Rotavator | 0 | 0 |
| Tractor operated | | | |
| | Plough | 6.07 | 4836.83 |
| | Disc Harrow | 0 | 0 |
| | Cultivator | 0 | 0 |
| | Rotavator | 0 | 0 |
| Total | | 121.07 | 11702.05 |

*Source: Field Survey*

**Table: 5.6 (b) Ploughing and Seedbed Preparation** (%)

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| Animal operated | | | |
| | Plough | 94.99 | 58.67 |
| | Disc Harrow | 0 | 0 |
| | Cultivator | 0 | 0 |
| Power tiller operated | | | |
| | Rotavator | 0 | 0 |
| Tractor operated | | | |
| | Plough | 5.01 | 41.33 |
| | Disc Harrow | 0 | 0 |
| | Cultivator | 0 | 0 |
| | Rotavator | 0 | 0 |
| Total | | 100% | 100% |

*Source: Field Survey*

In case of sowing activities however, no machine whatsoever is observed to be used by the sample farms. In fact, sowing activities are carried out entirely with human labour with their bare hands. This is a common practice not only in the study region, but also in all parts of the state. Machines like seed drill, zero till seed drill, row plantar, etc. not used in general. Only a few exceptional farms opt for such machines to sow seeds, especially in paddy cultivation.

We must mention here that though there has been much effort from the part of the government to spread the use of sowing machines like zero till seed drill under various government programmes, application of such machines is fairly limited in reality, at least in the study region.

**Table: 5.7 (a) Sowing and Planting (absolute nos)**

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| Manually operated | | | |
| | Seed drill | 0 | 0 |
| Animal operated | | | |
| | Seed drill | 0 | 0 |
| | Drill plough | 0 | 0 |
| | Mustard drill | 0 | 0 |
| | Row planter | 0 | 0 |
| | Sugarcane planter | 0 | 0 |
| | Potato planter | 0 | 0 |
| Power tiller/Tractor operated | | | |
| | Seed drill | 0 | 0 |
| | Zero till drill | 0 | 0 |
| | Sugarcane planter | 0 | 0 |
| | Potato planter | 0 | 0 |
| | Cultivator | 0 | 0 |
| | Rotavator | 0 | 0 |
| Total | | 0 | 0 |

*Source: Field Survey*

**Table:5.7 (b) Sowing and Planting** (%)

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| Manually operated | | | |
| | Seed drill | 0 | 0 |
| Animal operated | | | |
| | Seed drill | 0 | 0 |
| | Drill plough | 0 | 0 |
| | Mustard drill | 0 | 0 |
| | Row planter | 0 | 0 |
| | Sugarcane planter | 0 | 0 |
| | Potato planter | 0 | 0 |
| Power tiller/Tractor operated | | | |
| | Seed drill | 0 | 0 |
| | Zero till drill | 0 | 0 |
| | Sugarcane planter | 0 | 0 |
| | Potato planter | 0 | 0 |
| | Cultivator | 0 | 0 |
| | Rotavator | 0 | 0 |
| Total | | 0% | 0% |

*Source: Field Survey*

In case of use of machinery in irrigation activities, it has been observed that much expense has been borne out on account of irrigation activities with diesel-pumps. The use of pumps that run directly on electricity has not been observed in the study region.

**Table: 5.8 (a) Irrigation (absolute nos)**

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| | Diesel pump | 23.55 | 4935.49 |
| | Electric Pump | 0 | 0 |
| Total | | 23.55 | 4935.49 |

*Source: Field Survey*

**Table:5.8 (b) Irrigation (percentages)**

| Source of Power | Machine | Total Number of hours | Total Cost |
|---|---|---|---|
| | | | |
| | Diesel pump | 100 | 100 |
| | Electric Pump | 0 | 0 |
| Total | | 100% | 100% |

*Source: Field Survey*

In case of weeding and interculture operations too, the survey finds that all weeding and interculture activities (if carried out at all) it done with human labour with bare hands. No machines in any form have been used for weeding practices or interculture activities. This too is a common feature in West Bengal agriculture, which is reflected in the study region.

**Table: 5.9 (a) Weeding and Interculture (absolute nos)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manually operated | 0 | 0 |
| Animal operated | 0 | 0 |
| Power tiller/Tractor operated | 0 | 0 |
| Self-Propelled | 0 | 0 |
| Total | 0 | 0 |

*Source: Field Survey*

**Table: 5.9 (b) Weeding and Intercultural (percentages)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manually operated | 0 | 0 |
| Animal operated | 0 | 0 |
| Power tiller/Tractor operated | 0 | 0 |
| Self-Propelled | 0 | 0 |
| Total | 0% | 0% |

*Source: Field Survey*

In case of plant protection operations, we observe that only manually operated machines like sprayers have been used for plant protection activities, with quite low time consumption and cash expenditure. No other animal operated or tractor operated or self-propelled machines are used for plant protection activities. In fact, plant protection activities in the study region are confined to spraying pesticides or insecticides in fields, in which only sprayer machines are used.

**Table: 5.10 (a) Plant Protection Equipment (absolute nos)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manually operated | 12.15 | 70.84 |
| Animal operated | 0 | 0 |
| Power tiller/Tractor operated | 0 | 0 |
| Self-Propelled | 0 | 0 |
| Total | 12.15 | 70.84 |

*Source: Field Survey*

**Table: 5.10( b) Plant Protection Equipment (percentages)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manually operated | 100 | 100 |
| Animal operated | 0 | 0 |
| Power tiller/Tractor operated | 0 | 0 |
| Self-Propelled | 0 | 0 |
| Total | 100% | 100% |

*Source: Field Survey*

During harvesting operations, no mechanized tools such as tractor operated reaper or self- propelled reaper are used by the farmers. Only sickle (manually operated) and animal operated potato digger are found to be used in the study area.

**Table: 5.11 (a) Harvesting (absolute nos)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manual Sickle | 238.92 | 426.23 |
| Animal operated potato digger | 34.34 | 171.70 |
| Tractor operated reaper | 0 | 0 |
| Self-Propelled reaper | 0 | 0 |
| Total | 273.26 | 597.93 |

*Source: Field Survey*

**Table: 5.11 (b) Harvesting (percentages)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Manual Sickle | 87.43 | 71.28 |
| Animal operated potato digger | 12.57 | 28.72 |
| Tractor operated reaper | 0 | 0 |
| Self-Propelled reaper | 0 | 0 |
| Total | 100% | 100% |

*Source: Field Survey*

In case of threshing operations, we find that only manually operated paddy threshers are used by the farmers. The threshers are used by the farmers during threshing of paddy in both kharif and summer season. No other mechanized thresher machines like power operated thresher, tractor operated thresher, etc. are used by the sample farms of the present study.

However, we must add here that in West Bengal, it is often observed that threshing activities are carried out using motorized threshing machines, which is nothing but manually operated threshers attached with motors / pump sets. However, such instances have not been observed in the study region, and only paddy threshed with manual pedal action is found.

**Table: 5.12 (a) Threshing (absolute nos)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Source of Power | 0 | 0 |
| Power operated thresher | 0 | 0 |
| Tractor operated thresher | 0 | 0 |
| Paddy thresher | 66.89 | 639.46 |
| Maize thresher | 0 | 0 |
| Groundnut thresher | 0 | 0 |
| Any other (specify) | 0 | 0 |
| Total | 66.89 | 639.46 |

*Source: Field Survey*

**Table: 5.12 (b) Threshing (percentages)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Source of Power | 0 | 0 |
| Power operated thresher | 0 | 0 |
| Tractor operated thresher | 0 | 0 |
| Paddy thresher | 100 | 100 |
| Maize thresher | 0 | 0 |
| Groundnut thresher | 0 | 0 |
| Any other (specify) | 0 | 0 |
| Total | 100% | 100% |

*Source: Field Survey*

In case of transportation and marketing activities, both animal operated and tractor operated carriages are used. Nevertheless, use of tractors in terms of time is fairly limited to only about 5 hours as compared to 58 hours of animal operated carriage. But in terms of cost, it is observed that carriages with tractor trolleys are much costlier as compared to animal operated carriages. Hence, farmers' choice in favour of animal operated carriages can easily be apprehended, as animal operated transportation and marketing activities involves far less costs than tractor operated trolleys.

**Table: 5.13 (a) Transportation and Marketing (absolute nos)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Animal Operated | 58.03 | 530.47 |
| Tractor trolley | 4.84 | 2756.68 |
| Total | 62.87 | 3287.15 |

*Source: Field Survey*

**Table: 5.13 (b) Transportation and Marketing (percentages)**

| Source of Power | Total Number of hours | Total Cost |
|---|---|---|
| Animal Operated | 92.30 | 16.14 |
| Tractor trolley | 7.70 | 85.17 |
| Total | 100% | 100% |

*Source: Field Survey*

# 6
# FARMERS' PERCEPTIONS

## 6.1: REASONS FOR USING MACHINERY

Use of machines in agriculture has a number of benefits for which farmers opt for mechanization farming operations. Apart from increasing yield rate, mechanization saves valuable time, reduces drudgery as also economical under certain conditions. In this section an attempt has been made to examine farmers' perception regarding the reasons behind adoption of mechanization.

For this an opinion poll has been carried out where the farmers' were asked to rank the reasons behind adoption of mechanized farming. The results of the opinion survey reveal that 70 percent of the farmers held time-efficiency of mechanized farming as the prime reason (rank I) behind mechanization. In other words, farmers are keen to adopt mechanized farming as mechanization saves valuable time with quicker operations, allows maintaining timeliness of crucial activities, and thereby provides further scope monitoring or expansion of acreage.

**Table: 6.1 (a) Reasons for Using Machinery (absolute nos)**

| Reason | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Higher Yield | 19 | 29 | 16 |
| Economical | 11 | 15 | 39 |
| Quicker operations | 70 | 14 | 8 |
| Reduces drudgery | 0 | 41 | 34 |
| Any other | 0 | 1 | 3 |
| Total | 100 | 100 | 100 |

*Source: Field Survey*

**Table: 6.1 (b) Reasons for Using Machniery (percentages)**

| Reason | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Higher Yield | 19 | 29 | 16 |
| Economical | 11 | 15 | 39 |
| Quicker operations | 70 | 14 | 8 |
| Reduces drudgery | 0 | 41 | 34 |
| Any other | 0 | 1 | 3 |
| Total | 100% | 100% | 100% |

*Source: Field Survey*

The second major reason (rank II) behind adoption of mechanized farming, as opined by 41 percent of respondents, comes out to be the fact that mechanization of farming operations reduces drudgery. Further, the third major reason (rank III) behind mechanization of farming is that mechanization turns out to be economical as compared to non-mechanized operations. Hence, the major reasons behind mechanization as held by the respondents turn out to be certain qualities of mechanization as quicker operations, reduction of drudgery and economical in order of importance.

## 6.2: OPERATION FOR WHICH MACHINERIES ARE USED

Again, opinion survey has been conducted to examine farmers' preference of operations for which machines are used. Here too, the answers are ranked according to the preferences of the farmers. The ranking by the farmers reveals that ploughing is the main activity for which machines are used, as 50 percent of farmers ranked ploughing as the prime reason behind use of machines. Similarly, the second major operation for which machines are used comes out to be irrigation, as held by the respondent farmers. Further, the third major operation for which machines are used comes out to be transportation and marketing operations, as held by the respondent farmers.

Thus the major operations for which machines are used are ploughing, irrigation and transportation operations. These three activities / operations are ranked I, II & III with 50 percent, 50 percent and 38 percent farmers' opinions.

**Table: 6.2 (a) Operations for which the machines are used (absolute nos)**

| Operation | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Ploughing | 50 | 37 | 23 |
| Sowing | 0 | 0 | 0 |
| Irrigation | 20 | 50 | 15 |
| Weeding | 0 | 0 | 0 |
| Plant Protection | 0 | 0 | 0 |
| Harvesting | 0 | 0 | 0 |
| Threshing | 25 | 13 | 24 |
| Transportation & Marketing | 5 | 0 | 38 |
| Any other | 0 | 0 | 0 |
| Total | 100 | 100 | 100 |

*Source: Field Survey*

**Table: 6.2 (b) Operations for which the machines are used (percentages)**

| Operation | Rank 1 | Rank 2 | Rank 3 |
|---|---|---|---|
| Ploughing | 50 | 37 | 23 |
| Sowing | 0 | 0 | 0 |
| Irrigation | 20 | 50 | 15 |
| Weeding | 0 | 0 | 0 |
| Plant Protection | 0 | 0 | 0 |
| Harvesting | 0 | 0 | 0 |
| Threshing | 25 | 13 | 24 |
| Transportation & Marketing | 5 | 0 | 38 |
| Any other | 0 | 0 | 0 |
| Total | 100% | 100% | 100% |

*Source: Field Survey*

## 6.3: APPROPRIATE MACHINES FOR VARIOUS OPERATIONS

Further, we have also conducted opinion survey to examine farmers' perception regarding appropriateness of particular machines for specific farming operations. Here, the farmers are asked to answer which among the alternative machines is the most appropriate for specific operations.

In case of ploughing operations, it is interesting to note that as much as 50 percent of the farmers held animal operated plough as the most appropriate machine for ploughing, while only 18 percent of the farmers held tractor operated machines as the most appropriate. This is due to the fact that ploughing with tractors cannot till land that is extremely small, whereas animal operated plough can easily till them. As such, the a large part of the marginal farms may favour animal operated plough. Again, it should be noted here that though rotavator is not used in practice by the respondent farmers, about 38 percent of them held rotavators as the most appropriate ploughing machine.

**Table: 6.3 Ploughing**

| | Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|---|
| Animal operated | | | | |
| | Plough | 50 | 100 | 50 |
| | Disc Harrow | 0 | 100 | 0 |
| | Cultivator | 0 | 100 | 0 |
| Power tiller operated | | | | |
| | Rotavator | 0 | 100 | 0 |
| Tractor operated | | | | |
| | Plough | 18 | 100 | 18 |
| | Disc Harrow | 0 | 100 | 0 |
| | Cultivator | 0 | 100 | 0 |
| | Rotavator | 32 | 100 | 32 |

*Source: Field Survey*

In case of sowing operations, it has been observed earlier that none of the farmers use any form of machines for sowing. In fact, sowing operation is carried out entirely by human labour with their bare hands. Interestingly enough, it has been observed that the farmers held sowing with human labour as the most appropriate method, and did not consider any machine like seed drill or drill plough as appropriate for sowing activities.

**Table: 6.4 Sowing and Planting**

| | Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|---|
| Manually operated | | | | |
| | Seed drill | 0 | 100 | 0 |
| Animal operated | | | | |
| | Seed drill | 0 | 100 | 0 |
| | Drill plough | 0 | 100 | 0 |
| | Mustard drill | 0 | 100 | 0 |
| | Row planter | 0 | 100 | 0 |
| | Sugarcane planter | 0 | 100 | 0 |
| | Potato planter | 0 | 100 | 0 |
| Power tiller / Tractor operated | | | | |
| | Seed drill | 0 | 100 | 0 |
| | Zero till drill | 0 | 100 | 0 |
| | Sugarcane planter | 0 | 100 | 0 |
| | Potato planter | 0 | 100 | 0 |
| | Cultivator | 0 | 100 | 0 |
| | Rotavator | 0 | 100 | 0 |

*Source: Field Survey*

Considering irrigation operations, the farmers are clearly divided in their opinion regarding appropriateness of particular machines. In fact, while 46 percent of the farmers held that diesel pump sets are appropriate machines for irrigation activities, about 54 percent of farers held electric pumps as the most appropriate machine. Though, electric pumps are not found in the study region, it comes out that the farmers prefer electric pump sets over diesel pump sets for carrying out irrigation activities.

**Table: 6.5 Irrigation**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Diesel Pump | 46 | 100 | 46 |
| Electric Pump | 54 | 100 | 54 |

*Source: Field Survey*

In case of de-weeding and intercultural operations 100 percent of the farmers considered manually operated tools as the most appropriate machine for de-weeding and interculture operations. Animal operated machines or power-tiller tractor operated machines are not considered appropriate for de-weeding, as the precision level required for de-weeding and interculture operations cannot be maintained with animal operated or tractor operated machines.

**Table: 6.6 Weeding and Interculture**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Manually operated | 100 | 100 | 100 |
| Animal operated | 0 | 100 | 0 |
| Power tiller/Tractor operated | 0 | 100 | 0 |
| Self-Propelled | 0 | 100 | 0 |

*Source: Field Survey*

Similarly, in case of plant protection too, the farmers held manually operated machines as the most appropriate, and not the animal operated or tractor operated machines. Here, manually operated machines indicate sprayer machines, which are used by farmers manually with human labour. They do not think any other alternative as appropriate for plant protection operations.

**Table: 6.7 Plant Protection equipment**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Manually operated | 100 | 100 | 100 |
| Animal operated | 0 | 100 | 0 |
| Power tiller/Tractor operated | 0 | 100 | 0 |
| Self-Propelled | 0 | 100 | 0 |

*Source: Field Survey*

However, as per the farmers' opinion retarding appropriate machines for harvesting we find that majority (77 percent) of the farmers consider manual sickle as the most appropriate machine / tool for harvesting. Only 23 percent of farms opined that animal operated potato digger is the most appropriate machine for the said purpose. In fact, the crops grown are mostly harvested traditionally using human labour with manula sickles. Use of

machines like tractor operated reaper, self-propelled reaper or harvester is fairly restricted in the state. It is only during the last few years that harvester machines are introduced in certain agriculturally advanced districts like Burdwan for harvesting of paddy.

**Table: 6.8 Harvesting**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Manual Sickle | 77 | 100 | 77 |
| Animal operated potato digger | 23 | 100 | 23 |
| Tractor operated reaper | 0 | 100 | 0 |
| Self-Propelled reaper | 0 | 100 | 0 |

*Source: Field Survey*

In case of threshing of crops, it is observed that all the sample farmers consider paddy thresher as the most appropriate machines for the task. It has been observed that often paddy threshers are attached to motors or pump sets to speed up the task, but such instances have not been found in the study region. No other machine is considered as appropriate for threshing operations.

**Table: 6.9 Threshing**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Power operated thresher | 0 | 100 | 0 |
| Tractor operated thresher | 0 | 100 | 0 |
| Paddy thresher | 100 | 100 | 100 |
| Maize thresher | 0 | 100 | 0 |
| Groundnut thresher | 0 | 100 | 0 |
| Any other (specify) | 0 | 100 | 0 |

*Source: Field Survey*

Finally, in case of marketing and transportation, all of the farmers consider tractor trolley as the most appropriate machine, though a substantial part of crops grown are transported and marketed through animal operated machineries.

**Table: 6.10 Marketing and Transportation**

| Most Appropriate Machine (1) | Number of farmers (2) | Total no of farmers (3) | % of farmers (2 as % of 3) |
|---|---|---|---|
| Animal Operated | 0 | 100 | 0 |
| Tractor trolley | 100 | 100 | 100 |

*Source: Field Survey*

## 6.4: MAJOR PROBLEM WITH THE MACHINERY

As has been mentioned earlier, though mechanization of farming operation has obvious advantages, it requires the initial investment on capital goods, viz. the machines. At the same time there are other problems associated with the use of machinery in farming like maintenance of the machines, availability of parts, etc. As such, during the survey farmers were asked questions regarding various problems associated with the use of machineries in different farming operations, which enables us to detect the constraints in way of mechanization of agriculture in general.

It is observed that according to the perceptions of the farmers, about 10 percent of the farmers find animal operated plough expensive to purchase, while about 14 percent opined that it is not readily available for hire services. The rest 76 percent of the farmers preferred not to answer this particular question as they do not have any other major problems with animal operated plough. In case of ploughing activities, about 26 percent of the farmers consider tractor operated plough as expensive to purchase, while another 14 percent considered that it is expensive even to hire tractor operated plough. Further, about 26 percent of the farmers responded that tractor operated plough is not readily available for hire at a time when it is actually needed the most. As such, it comes out that in case of animal operated plough, there are much less problems as perceived by the farmers as compared to tractor operated plough. The major difference between the two comes out to be the fact that tractor operated plough involves much higher costs as compared to animal operated plough, though it can perform similar task much quicker and more efficiently.

In case of sowing and transplanting operations, none of the farmers ranked any problem faced while using machines as no machines are actually used in these activities in the study region. Transplanting and sowing operations are carried out entirely with human labour with their bare hand, and no machines like seed drill etc. are used. This phenomenon also holds for de-weeding activities too, where no machines are used for de-weeding and interculture.

On the part of the irrigation activities, a large section of the farmers (41 percent) found diesel and electric pumps as not readily available for hire when they are needed the most. Only a few (6 percent) of farmers alleged that yield rate after using diesel pump machines is not as expected, while another

few (3 percent) farmers alleged that there are no government support on purchasing diesel pumps.

Again, in case of harvesting activities, a small segment of the sample farmers (9 percent) consider that yield rate is not as expected after harvest using manual sickle. They in fact perceive that harvester machines can provide a higher yield rate as compared to manual sickle. However, the rationality behind such consideration remains highly doubtful in reality.

Further, in case of threshing activities, while a few farmers (32 percent) consider threshing machines as expensive to purchase, other few (13 percent) consider high maintenance costs of threshing machines as the major problem. At the same time, about 8 percent of the farmers alleged that hire facility of threshing machines is not available, while 9 percent consider that yield rate after using threshing machines if not as expected.

Lastly in case of marketing and transportation activities, a small part of the sample farmers (9 percent) perceive that tractor trolleys are expensive to purchase as compared to animal powered carts. As such they find it difficult to buy or rent one at the time of marketing or transportation from field to threshing floor or from threshing floor to market.

**MAJOR PROBLEMS WITH MACHINERY USED (% of farmers reporting as rank 1)**

**Table: 6.11 (a) Ploughing**

| Power Source | Machine | Expensive to purchase | Hire facility not available | Expensive to hire | High maintenance cost | Repair facilities unavailable | Repair & service facilities expensive | Yield not as expected | Not easy to use | No government support | Any other | % of farmers not reporting any reason | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Animal operated | Plough | 10 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 100% |
| | Disc Harrow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Cultivator | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Power Tiller | Rotavator | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Tractor | Plough | 26 | 26 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 100% |
| | Disc Harrow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Cultivator | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Rotavator | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Manual | Seed drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Animal | Seed cum fertilizer drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Drill Plough | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Mustard drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Row planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Sugarcane planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Potato planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |

*Source: Field Survey*

**Table: 6.11 (b) Sowing and Planting**

| Power Source | Machine | Expensive to purchase | Hire facility not available | Expensive to hire | High maintenance cost | Repair facilities unavailable | Repair & service facilities expensive | Yield not as expected | Not easy to use | No government support | Any other | % of farmers not reporting any reason | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manual | Seed drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Animal | Seed cum fertilizer drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Drill Plough | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Mustard drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Row planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Sugarcane planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Potato planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Tractor | Seed cum fertilizer drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Zero till drill | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Sugarcane planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Potato planter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |

*Source: Field Survey*

**Table: 6.11 (c) Irrigation, Weeding and Plant Protection**

| Operation | Machine | Expensive to purchase | Hire facility not available | Expensive to hire | High maintenance cost | Repair facilities unavailable | Repair & service facilities expensive | Yield not as expected | Not easy to use | No government support | Any other | % of farmers not reporting any reason | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Irrigation | Diesel Pump | 0 | 41 | 0 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 50 | 100% |
| | Electric pump | 0 | 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 100% |
| Weeding, etc. | Manually operated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Animal operated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Tractor/ power tiller operated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Self-propelled | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Plant protection | Manually operated | 23 | 1 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 67 | 100% |
| | Power tiller operated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Tractor operated | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Self-propelled | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |

*Source: Field Survey*

**Table: 6.11 (d) Harvesting, Threshing and Marketing**

| Operation | Machine | Expensive to purchase | Hire facility not available | Expensive to hire | High maintenance cost | Repair facilities unavailable | Repair & service facilities expensive | Yield not as expected | Not easy to use | No government support | Any other | % of farmers not reporting any reason | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvesting | Manual sickle | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 91 | 100% |
| | Animal operated potato digger | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Tractor operated reaper | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Self-propelled reaper | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Threshing | Power operated thresher | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Tractor operated thresher | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Paddy thresher | 32 | 8 | 0 | 13 | 0 | 0 | 9 | 0 | 0 | 0 | 38 | 100% |
| | Maize thresher | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Groundnut thresher | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Any other (specify)…….. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| Marketing | Bullock | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Camel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Horse | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Donkey | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Any other animal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100% |
| | Tractor trolley | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91 | 100% |

*Source: Field Survey*

## 6.5: USEFULNESS OF THE MACHINERY

Mechanization of farming operations no doubt has certain advantages over non-mechanized faming. The machines used in various activities have their advantages as also their disadvantages. However, such disadvantages are ignorable considering the usefulness of the machines in various activities. As perceived by about ¼ of the farmers, the major usefulness of using machines is that it results in higher yield. Another major usefulness of the machines is that it allows better land utilization, as perceived by about 19 percent of the respondent farmers. Lastly, about 6 percent of the respondent farmers opined that machines are particularly useful as it reduces drudgery in farming activities.

**Table: 6.12 Usefulness of the Machinery**

| | Type of use | No of farmers | % of farmers to total number of farmers |
|---|---|---|---|
| Farmers finding the machinery useful | | | |
| Type of use | | | |
| | Higher Yield | 25 | 25 |
| | Better land utilization | 19 | 19 |
| | More number of crops | 0 | 0 |
| | Reduced drudgery | 6 | 6 |
| | Higher social esteem | 0 | 0 |
| | Higher income | 0 | 0 |
| | Any other | 0 | 0 |

*Source: Field Survey*

## 6.6: ASSISTANCE RECEIVED FROM GOVERNMENT MECHANISATION PROGRAMMES

It is quite interesting to find in our survey that the farmers are not even aware of any government programs that promote mechanization in this region. In general, the government announces various assistance programs for increasing mechanization with an aim to attain higher production and better utilization of land. As far as mechanization in agriculture is concerned both central government and state government announce different types of assistance like subsidies on purchase of machine, subsidies on consumables, training to impart knowledge to the farmers regarding use machineries etc. However, this survey finds that the farmers are neither aware of any such

programme, nor they have received any benefits or any assistance for mechanization of farming in the study region.

We must add here that the assistance programmes under different government schemes are too little to suffice the huge requirement by the resource-poor farms. Further, only a few larger farms reap out the profit from such programmes, while the rural mass remains completely deprived of such assistance schemes.

**Table: 6.13 Awareness and Assistance received under government programmes**

| Awareness/Assistance | Type | No of farmers | % of farmers |
|---|---|---|---|
| Farmers aware of the programs | - | 0 | 0 |
| Farmers not aware of the programs | - | 100 | 100 |
| Farmers who received assistance under the programs | - | 0 | 0 |
| Type of assistance received | Subsidy on purchase of machine | - | - |
| | Subsidy on consumables | - | - |
| | Demonstration of best practices | - | - |
| | Training to use machines | - | - |
| | Cash incentives to use machines | - | - |
| | Complementary input provision | - | - |
| | Any other | - | - |

*Source: Field Survey*

## 6.7: USEFULNESS OF GOVERNMENT MECHANISATION PROGRAMMES

As none of the farmers have received any assistance from the government in mechanization of farming activities, the usefulness of such programmes cannot be judged under the present circumstances.

**Table: 6.14 Usefulness of the Programs**

| Usefulness/type of use | Type | No of farmers | % of farmers |
|---|---|---|---|
| Farmers who found the programs useful | NA | NA | NA |
| Farmers who haven't found the programs useful | NA | NA | NA |
| Type of use | Learnt new techniques of mechanization | NA | NA |
| | Got cash/subsidy for machines | NA | NA |
| | Any other | NA | NA |

*Source: Field Survey*

## 6.8: INCREASE IN AREA AND PRODUCTION AFTER USING MACHINES

One of the major impact of mechanization of farming activities is that is positively affects productivity of crops as well as allows scope for bringing new land under cultivation. This is particularly because of some specific advantages of machines like precision, speed and timeliness of important activities like ploughing, sowing, irrigation and harvesting. It also reduces drudgery and crop losses at various stages of production. As such, we have attempted here to examine whether mechanization has in fact affected farming in a positive manner in the study region or not.

As perceived by the farmers, it can be seen that production has increased especially for mustard, wheat, rice and potato; which is particularly due to an increase in the yield rate as there has been no change in the acreage of these crops. In particular, after mechanization, production of mustard has increased by 10.2 percent, while productions of wheat, paddy and potato have grown by 5.26 percent, 4.61 percent and 1.88 percent respectively. The farmers unanimously perceive such increases in yield rate as caused by the introduction of machines in farming operations. The farmers in fact stress mainly upon the advantage of timeliness of activities, which in turn brings about increase in yield rate of the crops.

**Table: 6.15 Increase in area after mechanization**

| Crop | % of area increase | % of production increase | % of production increase reported to be due to machines* |
|---|---|---|---|
| Paddy | 0 | 4.61 | 4.61 |
| Potato | 0 | 1.88 | 1.88 |
| Wheat | 0 | 5.26 | 5.26 |
| Mustard | 0 | 10.20 | 10.06 |

* *percentage of production increase after introduction of machines*

*Source: Field Survey*

# 7

# SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

## 7.1: OVERVIEW OF MECHANISATION POLICIES AND TRENDS IN WEST BENGAL

The technological improvements in Indian agriculture since mid sixties have brought about revolutionary increase in agricultural production. The country was facing acute food shortages till eighties has now become not only self sufficient but also a net exporter of food grains. This has been made possible due to evolution of high yielding crop varieties, increased use of chemical fertilizers, development of irrigation facilities and plant protection measures accompanied by effective price support programmes of farm products. The increased use of purchased inputs in agriculture necessitated to raise their use efficiencies though mechanization. The increase in the use of human and bullock labour and rising wage rates and cost of up-keep of bullock further made the case of farm mechanization still stronger.

The traditional farm tools and implement mainly relied on use of animate power. Improved farm tools, implements and machinery, which use both animate and mechanical power were devised from time to time. The average size of farm holding being small, animate power is widely used in many parts of the country. Mechanical power is making its impact in Indian agriculture with steady increase in land and labour productivity. Animal drawn cultivator and puddler have gained popularity showing an annual growth rate of 3.11% and 7.93% respectively due to higher output and better quality of work. Improved implements such puddler, disc harrow, peg tooth harrow, spring tine harrow and patella harrow, being more efficient, have been adopted. Use of sowing/planting devices for line sowing have also shown a growth rate of 6.5% as it helped the farmers in better management of costly inputs of seed and fertilizers. The growth in the number of sprayers and dusters for plant protection has also been significant.

In case of trend in population of farm machinery irrigation is one of the major energy-intensive operations. With the increase in gross irrigated area, the number of irrigation pumps has swelled from 20 thousand in 1950-51 to about 12.51 million in 2000-01. Electric pumps are preferred than diesel engine operated pumps due to lower cost and higher energy-use efficiency.

Therefore, the growth rate of electric pumps was 8.20% as against 4.89% in diesel pumps. One of the major problems has been the lack of adequate and timely availability of electricity in rural areas due to which the diesel engines are kept as standby source of irrigation. The farmers are increasingly using power sprayers and dusters. The estimated population during 1995-96 was 0.25 million and is expected to be 0.31 million in 2000. Tractor is the basic machine on which most of the farm mechanization depends. The number of tractors was just 8000 in 1950-51, which steeply went up to 2.64 million in 2000-01 showing a growth rate of 10.3%.

In case of trends of growth in mechanization in West Bengal, it comes out that except for potato, costs of machinery has grown much faster than costs of bullock labour, human labour as well as value of production over the period 1996-97 to 2009-10. This perceivably acts as a major constraint in the spread of mechanization of farming in the cultivation of crops like paddy, wheat and mustard.

## 7.2: FINDINGS FROM ANALYSIS OF PATTERN OF MECHANISATION

Broadly speaking, mechanization means using machinery to perform tasks or to assist humans in performing tasks. Mechanization is the use of modern implements as well as motorized equipment like plough, harrow, ridger and also the use of agro-chemicals like insecticides, herbicides, fertilizers and improved seeds in the farm. However, while mechanization reduces labour costs, on the other hand, it increases capital expenses for machinery and equipment. As farmers in general are too poor to be able to buy the expensive machines, mechanization of farming often appears to them too costly to practice. Further, degree of mechanization depends much upon the specific requirements of the crops grown, nature of the crops, as also the season in which the crops are grown. Thus that capital costs incurred for mechanization in relation to marketable surplus and value of output remains crucial for the spread of mechanization, particularly in a country like ours where majority of the farms perform at the subsistence level.

It comes out from our study that ownership of expensive machines like shallow tubewells, tractors, etc. is fairly limited in numbers owing to involvement of higher capital cost, but they are extensively used on hiring basis to perform various farming operations in the study region. As such, ownership and use of machinery is two completely different aspects, especially in case of a highly marginalised economy like West Bengal. With

comparable costs, machines perform similar tasks as the animals, but at a much faster rate and saves a lot of valuable time. Clearly, the time-advantage in mechanization of farming is clearly reflected here, especially at comparable costs. This is why we find that with comparable costs, the tractor operated machines are gaining popularity in the study region especially in operations like ploughing, marketing and transportation. However, in case of sowing activities, the survey finds that the farmers do not use any machines. Similarly, in case of de-weeding and interculture, no machines are used in the study region. In case of plant protection, manual sprayers are used while in harvesting manual sickles are used. In threshing, we find that manually operated thresher machines are used extensively, and irrigation activities are carried out using diesel pump sets. Nevertheless, animal operated plough and carriages are still operative on a large scale in the study region, particularly among the smaller farms.

## 7.3: FARMERS' PERCEPTION

Use of machines in agriculture has a number of benefits for which farmers opt for mechanization farming operations. Apart from increasing yield rate, mechanization saves valuable time, reduces drudgery as also economical under certain conditions.

It is here that the present study observes that 70 percent of the farmers held time-efficiency of mechanized farming as the prime reason (rank I) behind mechanization. In other words, farmers are keen to adopt mechanized farming as mechanization saves valuable time with quicker operations, allows maintaining timeliness of crucial activities, and thereby provides further scope monitoring or expansion of acreage. The second major reason (rank II) behind adoption of mechanized farming, as opined by 41 percent of respondents, comes out to be the fact that mechanization of farming operations reduces drudgery. Further, the third major reason (rank III) behind mechanization of farming is that mechanization turns out to be economical as compared to non-mechanized operations. In fact, the major operations for which machines are used are ploughing, irrigation and transportation operations. It is interesting to note that as much as 50 percent of the farmers held animal operated plough as the most appropriate machine for ploughing, while only 18 percent of the farmers held tractor operated machines as the most appropriate. Further, in case of irrigation operations, the farmers are clearly divided in their opinion regarding appropriateness of

particular machines, where electric pumps are slightly more preferred over diesel pumps. Similarly, in case of plant protection too, the farmers held manually operated machines as the most appropriate; while appropriate machines for harvesting is considered to be the manual sickle. Again, in case of threshing of crops, it is observed that all the sample farmers consider paddy thresher as the most appropriate machines for the task., while in case of marketing and transportation, tractor trolley appear as the most appropriate machine.

## 7.4: THE PROBLEMS AND SUGGESTIONS FOR IMPROVEMENT OF MECHANISATION PROGRAMMES

As has been mentioned earlier, though mechanization of farming operation has obvious advantages, it requires the initial investment on capital goods, viz. the machines. At the same time there are other problems associated with the use of machinery in farming like maintenance of the machines, availability of parts, etc.

In the present study, about 26 percent of the farmers consider tractor operated plough as expensive to purchase, while another 14 percent considered that it is expensive even to hire tractor operated plough. Further, about 26 percent of the farmers responded that tractor operated plough is not readily available for hire at a time when it is actually needed the most. Similar observations are made in case of other expensive machines like electric / diesel tubewells or pumps, tractor trolleys, seed drill, etc. In case of thresher machines, apart from being expensive to purchase, the major problem turns out to be maintenance costs involved. Similarly, in case of electric / diesel pumps, one of the major problems is that the farmers do not receive any subsidy to purchase pumps. Further analysis reveals that the farmers do not even know whether there is any policy that provides subsidy or assistance in purchasing expensive farm equipments.

In the face of such problems, apparently it appears that it is not possible to cover each and every farm household under government subsidy or assistance programmes. However, certain measures could be taken to promote mechanization of farming among the farming community, as-

First, the government should consider forming users' cooperatives and link them to Self Help Groups and Micro Finance Schemes to overcome the problem of finance and investible capital to purchase expensive farm

equipments like tractors, pump machines, etc. This should also ensure effective maintenance of expensive equipments and promote mechanization among farming community. The burden of capital loans could be shared among the members of the Users' Group as well.

Second, some less expensive machines like power sprayers and thresher machines could be subsidized. The subsidies should be granted not to individual farmers, but to cluster of farms, say of 10 hectares. This is particularly needful as at the time of harvest, even less expensive machines like threshers are not readily available to the farmers. Forming small clusters of farms could resolve the problem.

## 7.5: POLICY IMPLICATIONS

Based on the findings of the study, outline of certain key policy implications can be made here as follows-

First, there is a definite productivity gain in mechanization of farming; the government should further promote mechanization across the farming community. Hence, measure of mechanization should be attached as sub-schemes of different successfully running major schemes. [Attention: Ministry of Agriculture, Government of India]

Second, after decades of modernization and mechanization drives, still a large section of the farming community remains outside the benefits of farm mechanization, especially the smaller farms. Hence, the government should aim at spreading mechanization among the smaller farms through, say, formation of cooperatives or users' groups under different schemes. [Attention: Ministry of Agriculture, Government of India]

Third, to resolve the problems of scarcity of investible finance, users' groups or the cooperatives should be formed under mechanization schemes, and should be linked with banks through micro finance schemes. [Attention: Ministry of Agriculture, Government of India]

Fourth, as a large part of the farming community do not know about various mechanizations schemes operative at present, the existing schemes under which mechanization is promoted should be communicated to all the members of the farming community using mass-communication media like radio / television. [Attention: Department of Agriculture, Government of West Bengal]

Lastly, the government could promote use of machines by the poorest of the farms through custom hiring of various expensive farm equipments. The task of coordination can be entrusted to NGOs or SHGs. Necessary steps may be taken in this regard, so that mechanization could spread across the farming community. [Attention: Department of Agriculture, Government of West Bengal]

# Annexure I

## Comments (1) on the Draft Report from the Coordinator

by

- C.S.C. Sekhar, IEG, Delhi

General Observations: The report is well-written overall. Most of the calculations have been carried out as per the suggested tabulation scheme and chapterization is also as suggested. The chapter-wise comments are given below.

**Please provide a one-paragraph summary of each chapter at the end of the chapter**

**Chapter 2**:

1) This chapter is all over the place and needs to be well-focused. This chapter needs to discuss the trends and features of mechanization in West Bengal. In particular, you may like to delete the discussion of price policy of CACP on page 10, which although interesting is not directly relevant here. Much of the discussion on desirability of mechanization, paddy cultivation etc may also be deleted. Paragraph 1 on page 12 is clearly a repetition and may be deleted. Also, when growth rates are reported for the first time in a chapter, the time period may be mentioned. For example, on page 13, chapter 2, it is mentioned that "Animal drawn cultivator …….. showing an annual growth rate of 3.11% and 7.93% respectively……". What is the time period of these growth rates?

2) There are some interesting points in tables 2.1 to 2.3 which went unnoticed. It appears that the operational costs are lower than value of production but total costs are higher, except in case of mustard. Since these are average costs and returns in a sense, can you say something about subsistence farming in West Bengal (WB) (based the basic microeconomic theory of production)? Try such analytical explanations alongwith description of the tables.

3) Mention the source fully and correctly below these tables. For example, if the table is based on cost of cultivation data mention "Cost of Cultivation, MoA, DES, GoI".

4) In table 2.4, the sum of growth rates of quantity and price should roughly equal the total cost and similarly the sum of growth rates of yield and price should equal that of value of production. Check the figures for Mustard.

**Chapter 3:**

1) Table 3.1: This table should contain absolute number of males, females and children. It cannot contain fractions.

2) Table 3.8-3.12: The calculations in these tables are incorrect. The "A" in the denominator is the net sown area, which is the sum of irrigated and unirrigated area in table 3.11. However table 3.11 also appears incorrect. The irrigated area under canal for allfarm size-groups does not add up to total irrigated area. Similarly for other sources. Kindly correct this table first. The total of irrigated and unirrigated areai.e. the last row, last column entry in this corrected table constitutes "A". Accordingly recalculate tables 3.8 to 3.10. **These are important tables and kindly carry out the corrections carefully.**

**Chapter 4:**

1) Table numbers need to be renumbered in this chapter as 4.1 and so on. But I make the comments based on the numbers as given.

2) In table 3.2, the % of machinery costs to MS in case of mustard is 110.06%. Check this since the corresponding percentages for other crops are very different. Also this does not match well with tables 2.1-2.3, where mustard shows up as a crop with higher revenue than other crops. Normally higher revenue crops are sold on the market.

**Chapter 5:**

1) Table 3.3 needs correction as it cannot contain fractions in the first two columns

2) In section 5.3 (time use), 3.5 and 3.6(b) can be compared to support comments about time advantage of machinery. For instance, although the percentage of farmers using 'animal-operated' and 'tractor-operated' for transportation and marketing is exactly the same, the time usage percentages are 92% and 8% respectively.

**Chapter 6:**

1) Tables 6.1 to 6.4: Have all 100 farmers been asked these questions? If so, how is it that there is such a high number for "percentage of farmers not reporting any reason"? Kindly check

2) Kindly give a good summary for this chapter.

**Chapter 7:**

Please make this chapter focused and give a summary of all the major issues analyzed. Policy implications do not seem to emerge out of the analysis. For instance, the first policy implication mentions that there is "definite acreage and productivity gains in mechanization" while table 6.8 shows that there is no increase in area. Similarly the remaining policy implications are not supported by your analysis. Kindly make policy suggestions based only on the results of the study.

| S No. | Table | Comments |
|---|---|---|
| 1 | Table no. 2.4 & 2.5, page no. 16 | The sum of growth rates of quantity and price should roughly equal the total cost (table 2.4) and similarly the sum of growth rates of yield and price should equal that of value of production. Check the figures for Mustard in table 2.4 |
| 2 | Table no. 3.1, page no. 17 | Actual numbers should have been given here. Entries in this table cannot be in decimals as number of males and females cannot be a fraction. |
| 3 | Table no. 3.6, page no. 20 | Calculation in this table depends on previous correction (table 3.1 on page 17). Please correct accordingly |
| 4 | Table no. 3.8, 3.9 and 3.10, page no 21 | The total area "A" in this table is the net sown area, which is equal to the sum of irrigated and unirrigated area in table 3.11 (page 22). |
| 5 | Table no 3.1 onwards, page no 24 | Please relabel the table nos. from chapter 4 onwards according to chapter no. |
| 6 | Table no. 3.3, page no. 29 | First two columns should be absolute numbers. Cannot be in fractions |

# Annexure II

## Comments (2) on the Draft Report from the Coordinator

by

Ankush Agrawal, Indian Institute of Technology Delhi, New Delhi

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My congratulations to the Head and the Visa-Bharti team for completing the survey with in time and thanks for the report. I am listing my observations on the report below. I have gone through the comments provided by Dr C S C Sekhar and have tried not repeat them.

One general observations is that the report does not cite any table/ figure in the text. For example, (i) on p. 13 the diagrams/ figures are drawn and I did not find any discussion them, and (ii) Tables 3.8-3.10 are not cited. It helps the reader if the text is supplemented by the citation of the corresponding table/ figure. Also the numbering of tables need to be aligned with chapter number (e.g., Table 3.3 in Chapter 5, p. 29. there are many such instances).

**Chapter 2**

p. 9: Please mention the exact time period in: "The contribution of mechanical power and electrical power to the total power availability on the Indian farm has risen to 70 per cent from 30 per cent during the last two decades... Average size of farm holdings has gradually reduced from 2.58 hectare to 1.57 hectare." (also see Dr Sekhar's comments).

p. 9: "Organic farming in India is set to get a major boost with the market being over $130 million" Needs citation/ source

p. 10: It is not clear whether "the Commission" in pars 1 and 2 is CACP. The para 1 is perhaps the only place in the document where this acronym is used, hence, it is better to expand it (this will help even those with relatively less knowledge of the sector interpret the report better).

p. 10: para 2: "As per the data supplied by States, the prices of seed for wheat for 2004-05 were likely to increase by... " We are referring to the year 2004-05, why the word "likely to increase"?

p. 11: I think that the first para on this page should rather be the first para of the chapter.

p. 11: "Farm mechanization may be viewed as package of productivity, reduced crop losses and improved quality of grain or product." I am not sure of this definition.

p. 11: "The contributions of agricultural mechanization in various stage of crop production could be viewed as saving in seeds (15-20%), saving in fertilizers. The contributions of agricultural mechanization in various stage of crop production could be viewed as saving in seeds (15-20%), saving in fertilizers" citation needed

p. 11: At least three references listed on this page are not there in the references section (p. 61).

p. 12 "The general information available from Directorate of Agriculture, Government of West Bengal indicates that West Bengal state is the leading producer of paddy and second largest producer of potato (30% of country‟s production) in the country." please drop this line. It is already there on p. 11.

Please see if it is better to combine rest of the above para on p. 12 with first para on p. 11.

p. 12, para 2: this is again a discussion on Indian agriculture under the head "**TRENDS OF MECHANISATION IN WEST BENGAL"** needs to be fit in elsewhere.

p. 13, para 1: please see the comment on para 2 for p. 12.

The para 2 on p. 13, and paras 1 and 2 on p. 14 seems to discuss the Indian situation (and not West Bengal). It is not clear whether the information is on India or West Bengal (the head of the section indicates India though).

**Chapter 3**

p. 17: There seems to be some error with the column "Total".

p. 17: "It has been observed during the survey that average household size of the sample farms works out to be 6.36 persons per family, which is particularly high among the medium farms. This is understandable as greater farm size in turn indicates greater economic affluence, which allows forming larger families." Could it be that those with the joint families have large farm size because no intra-family division of land happened there?

p. 17: In Table 3.1, kindly provide total number of males, females, adults, children etc (already indicated by Dr Sekhar)

p. 18: OBC stands for Other Backward Classes (not Castes)

p. 18: "Educational attainment of the head of the households is expected to have far reaching implications on the adoption of modern farming techniques as well as on use of machinery in farming practices" I am not sure.

p. 19: what do the numbers in Table 3.6 denote?

**Chapter 4**

p. 26, para 1: There seems to be a typo error in "It machine in use may be operated by a number of power sources like, manual, animal, electrical, etc." and "A detailed break up of costs incurred on machines shows us that operations like plant protection and threshing is done completely manually, while irrigation operations are completely performed using performed using electrical power. "

p. 28: Table 3.7(b), There are some problems possibly with the computation of percentage figures here. Consider for instance, the number 100 for 'Input costs' of harvesting when 'Animal Operated'. Check the entries in other columns/ rows.

**Chapter 5**

p. 29: Table 3.3, it seems that instead of absolute numbers, the percentage figures have been provided here.

p. 31 "As has been found earlier, irrigation operations are entirely carried out with electrical power and about 50 percent of farms opt for electrical power for irrigation activities." It is confusing statement. Is it that 50 % of the farms are not irrigated. If yes, it can be mentioned in the footnote.

p. 32: "In percentage terms, it can be observed that in case of ploughing activity 95 percent of time is consumed by animal operated machines, while similar tasks are performed by tractor operated machines in just 5 percent of total time allotted for ploughing." Not sure whether it is correct to say and infer that way.

**Chapter 6**

p. 41: I am not sure whether one can interpret and say "The second major reason (rank II) behind adoption of mechanized farming, as opined by 41 percent of respondents, comes out to be the fact that mechanization of farming operations reduces drudgery. " I think it should be rank 1 responses of all the farmers that we should be concerned with. The same applies for both the paras under section 6.2.

p. 54: Could you please indicate how the '% of production increase' in Table 6.8 have been computed?

# Annexure III

## Action Taken Report

The study is essentially based on the chapter design and table formats provided by the coordinating centre, viz. IEG, Delhi itself. However, an attempt has been made here to address the comments made by Dr. Ankush Agrawal, Indian Institute of Technology, Delhi and by Dr. C.S.C. Sekhar, IEG, Delhi to further develop the study. The specific actions taken to finalize the study are listed below as:

1. The write-up of Chapter 2 has been thoroughly revised and necessary changes (as suggested have been made). (Sections 2.1 & 2.2)
2. Additional observations coming out from table 2.1 to 2.3 has been incorporated.
3. Source of secondary data has been mentioned fully in each table in Chapter 2.
4. Data presented in table 2.4 has been checked and no modification made.
5. Table 3.1 has been modified as suggested.
6. Full form of OBC has been corrected.
7. Necessary changes have been made in explanations of table 3.1 and 3.6.
8. Explanations of the figures in table 3.6 have been mentioned in title of the table.
9. In table 3.11, total irrigated area equals irrigation from various sources like canal, tubewell, tank, others.. As such, irrigated area from various sources adds up to total irrigated area. Total irrigated area + total un-irrigated area constitutes net sown area, say "A", which is the denominator for calculating tables 3.8 to 3.10. Even though, all tables from 3.8 to 3.12 have been recalculated, but nothing was found incorrect.
10. Table numbers in Chapter 4 have been changed as suggested.
11. Table 3.2 (now 4.2) has been checked, and per cent share of machinery costs to MS in case of mustard worked out at 110.06%. This may be

due to the fact that in West Bengal, mustard is mostly consumed at home by the smaller farms. The farmers usually convert mustard seeds into mustard oil in oil mills under custom hiring basis.

12. Typing mistakes as suggested in Chapter 4 have been corrected.
13. Table 3.7 (b) [now 4.3 (b)] has been checked, and no changes appeared necessary. The number 100 indicates 100 per cent.
14. Table 3.3 (now 5.1) has been corrected as suggested.
15. Statements regarding machine-use in irrigation activities have been changed as suggested.
16. Statements regarding machine-use in ploughing activities have been changed as suggested.
17. Table 6.1 to 6.4: All farmers have been asked the questions, but not all farmers reported any reason.
18. The ranking of reasons behind adoption of mechanized farming are as opined by respondents, the researcher has very limited scope for providing his own perception.
19. '% of production increase' in Table 6.8 has been computed comparing data before and after introduction of machines.
20. Chapter 7 essentially tries to maintain the chapterization scheme prepared by IEG, Delhi. However though, an attempt has been made here to make chapter 7 more focused.
21. Policy implications are primarily based on the major findings of the study. Please go through sections 7.2 to 7.4.

Sd/-

Santiniketan
Date: 18.07.2013

(S Chakrabarti)
Hony. Director
A.E.R.C., Visva-Bharati

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