CHAPTER - I

INTRODUCTION

1.1 Introductory

Traditionally humans and animals were used for field operations and processing activities. As a result of introduction of mechanical powers, the process of farm mechanization began. Adoption of agricultural tools/machinery and other implements provide technology to facilitate agriculture by efficient utilization of inputs, besides reducing drudgery. Traditionally, Indian farmers relied on equipments, which were simple and could be easily fabricated by village craftsmen. Since introduction of mechanical power, agricultural engineering started gaining importance and thus organized professional activities started.

It is generally believed that the benefits of modern farm technology have been availed by large farms only. Even farmers with small holdings utilize selected improved farm equipments on custom hiring basis to improve productivity and thus, ultimate increase in quantum of production. Such use of improved farm implements and equipments is preferred with a view to reduce cost of production also.

Equipments for: (i) tillage, (ii) sowing, (iii) irrigation, (iv) plant protection, and; (v) threshing have widely been accepted by them. In such endeavour and response towards mechanization, Bullock drawn steel plough and disc harrow/cultivator have been adopted more by the small and semi-medium groups of farm holders. It is, however, interesting to note that 'adoption of improved mechanization inputs' has been low in the country. In regard to the uses of irrigation pumps to tractors, it varied from 13.85 per cent to 1.78 per cent. The adoption percentages were 1.78 for tractor, 13.85 for irrigation pumps, 2.15 for thresher and 23.00 per cent for bullock drawn harrow/cultivator.

(Source: Singh, Gyanendra "Data Book on Mechanization and Agro-Processing since Independence," CIAE, Bhopal, December, 1997)

It is to be noted here that the mechanical power threshers were introduced in the late sixties and by seventies; they became very popular, even amongst small farmers. It was more particularly used for threshing wheat crop. Because of utility of grains, as

well as Bhusha, thresher design in India required a separate threshing principle to that of designs of European and American countries. The R & D efforts of the scientists led to the development of 'spike tooth threshing mechanism' with 'aspirator blower,' which has, since been universally accepted in power threshers.

As far as manufacturing of agricultural machineries, tools and implements is concerned, the country is well equipped to meet the requirement of Indian farmers. India has been exporting farm implements. Tractors, irrigation pumps, engines, plant protection machinery, processing and dairy equipment are manufactured by organized sectors. On the other hand, (i) hand tools, (ii) bullock, and; (iii) tractor drawn machineries are manufactured by 'unorganized small scale industries (UOSSIs). Traditional tools and implements are mainly fabricated by village artisans. The Bureau of Indian Standards (BIS) is mandated to ensure equality manufacture and marketing of agricultural machinery. The Bureau also issues ISI quality certificate marks. The Government of India has established Farm Machinery Training & Testing Centres (FMTTC) to promote quality farm machinery. For items which are linked to safety and health hazards, it is mandatory to have minimum safety standards built into the design or in the installation of machinery during operation.

However, merely establishment of FMTTC, mandatory provisions of safety, issuing of quality certificates and ISI mark, etc. will not change the scenario of Indian agricultural sector. To ensure positive effects of farm mechanization on increase in productivity, reducing cost of cultivation and achieve comparative economics of labour and machinery farmers (particularly marginal and small) need to be promoted and incentivized for using farm machineries in their day to day agricultural practices. Favourable effects of farm mechanization on agricultural production also depend on the general willingness and high degree of responsiveness of farmers towards adopting mechanization as far as possible.

1.2 Farm Mechanization: Excluded Majority

It can be rather a dispiriting data based fact that the tractor density in India is about 16 tractors/1000 hectares, as against the world average of 19 tractors and 27 in USA per 1000 hectares of cropped area. Machine assisted resource conservation

techniques, such as (i) zero tillage, (ii) raised bed planting, (iii) precision farming, etc. are some of the alternative techniques of cultivation that are being considered necessary to counter the increasing threat to natural resources, notably: land and water. Even though farm mechanization is increasing in India, it is mostly region specific. The growth of agricultural mechanization is mainly hindered by the impediment of decreasing trend in operational land holdings. It is to be necessarily divulged here that marginal and small farmers, who cultivate about 85.00 per cent of the holdings and account for nearly 44.00 per cent of the total cultivated area, can not afford high cost agricultural machines. In fact, exclusion of majority of small and marginal farmers in India from the benefit of farm mechanization is caused mainly due to high cost of mechanization and lower credit worthiness. The use of farm machinery is also dependent on the availability of other infrastructural facilities and services in the rural areas. (DAC, MoA, Government of India, 2013).

One of the main factors responsible for 'poor response of farmers towards mechanization' may be mechanization of small and contiguous group of lands is found to be against economics of scale,' especially for activities like: (i) land preparation and (ii) harvesting thereby making individual ownership of agricultural machinery uneconomical. In order to make farm equipments and machines available to farmers at affordable cost, 'Farm Machinery Banks' are being established in different parts of some of the states facilitating the farmers to custom hire the machines and equipments. Besides increasing the power availability, this will help removing the disparity in regard to availability of farm power among various states and reduce the drudgery associated with various farm operations.

It has been estimated that about 18.00 per cent to 25.00 per cent of losses occur in the entire food supply chain from production to consumption. There is need to come upon that a 'three pronged strategy involving: (i) compression of supply chain by linking producers and markets, (ii) promoting processing in production catchments to add value before the produce is marketed, and; (iii) developing small scale processing refrigerated chambers or cold storage using conventional and non-conventional sources is required to reduce post harvest losses. Greater attention on

post harvest engineering research and development (which is complementary and pre-requisite also for effective and successful farm mechanization in India) is required for this.

Having understood the desirability and need of farm mechanization, policy efforts have been made (from time to time), by the Government of India. It mainly focused on promoting Mechanization in Eastern India through two Central Sector Schemes, namely: (i) Promotion and Strengthening of Agricultural Mechanization through Training, Testing and Demonstration, and; (ii) Post-harvest Technology and management during the 11th Five Year Plan. In addition, Mechanization is also being promoted under various other programmes, like MMA, RKVY, NHM and NFSM.

1.3 Objectives of the Study

In view of this increased focus on Mechanization of agricultural growth in the eastern region the present study intends to assess/examine the following objectives:

i. *To assess the impact of recent mechanization on agricultural growth, if any in eastern India.*
ii. *To assess the pattern of mechanization at the crop level and effect on production and productivity.*
iii. *To assess the comparative economics of labour and machinery in the region, and;*
iv. *To suggest measures, if any, on the basis of field survey.*

1.4 Methodology

With a view to address the objectives of the study, tabular analysis supplemented with economic analysis (wherever possible), has been followed as the broad empirical methodology. Major data sources for the study are primary data surveys in Bihar. This has been supplemented with the farm level data of the cost of cultivation studies, which gave operation wise labour use details for secondary data analysis.

For primary survey multistage sampling method has been adopted. As all the districts in Bihar are covered under some of the/any of the Mechanization Programmes (comprising: (i) Promotion and Strengthening of Agricultural Mechanization through Training, Testing & Demonstration, and; (ii) Post-harvest

Technology and Management so, in due consultation with the Co-ordinator of this study, i.e., IEG, University of Delhi, Delhi – 110 007 at the first stage, Bhagalpur district (covered under Mechanization Promotion Programme in the state during the 11th Five Year Plan) was selected. The district has performed well in terms of physical and financial targets and achievements.

At the second stage based on secondary information obtained from Agriculture Department's sources two villages/cluster of villages were chosen in two different blocks of the district. (One such village/cluster of villages was, where level of agricultural mechanization was very low or negligible while the other, where mechanization level was higher. In this way, Chandpur Deshari, Chandpur Kaneri and adjoining villages under Jagdishpur block were selected as village having no/less agricultural mechanization and Mohanpur Sojour Gobarain villages under Shahkund block of the district were identified as village with higher degree of mechanization.

At the third stage, a complete listing of all the households using machinery for farm operations was made. At the fourth stage of sampling, out of this complete listing, 50 households (Hhs) were selected randomly from each of the two sets of villages. Due care was taken to maintain proportionate sample size from the existing farm classes of the enlisted farm households.

The farm size wise distribution of the sample households may be seen in table below:

Table No. 1: Distribution of the Sample Households (Hhs) by Farm size Classes and set of Villages Chosen.

A.	**High Mechanized Strata/Villages**				
	Marginal	Small	Medium	Large	Total
	17	10	12	11	50
B.	**Low/Less Mechanized Strata/Villages**				
	28	14	04	04	50
Total (A+B)	**45**	**24**	**16**	**15**	**100**

Source: Field Survey data.

Reference Period

Reference period of secondary data used in this study is 2001-02 to 2009-10. For primary data, it was 2008-09 to 2010-11.

Summary of the Chapter

Traditionally, Indian farmers relied on equipments, which were simple and could be easily fabricated by village craftsmen. Since introduction of mechanical power, agricultural engineering started gaining importance and thus; organized professional activities started. Though farm mechanization is increasing in India, it is mostly region specific. Besides the region specificity, the growth of agricultural mechanization is mainly hindered by the impediment of decreasing trend in operational land holdings. One of the major factors for poor response of farmers towards mechanization may be that mechanization of small and contiguous groups of land is found to be against economics of scale. Having understood the conformity of farm mechanization with increased production level at lower costs of production; in course of time policy efforts have been made by the Government of India. In addition to two Central Sector Schemes (namely; (i) Promotion and Strengthening of Agricultural Mechanization through Training, Testing and Demonstration, and; (ii) Post-harvest Technology and Management during the 11th Plan Period programmes like; MMA, RKVY, NHM and NFSM are also being implemented for promotion of mechanization. In the above backdrop and based on the primary survey of 100 farmers randomly chosen (50 each from high and low mechanized villages/strata), this study seeks to study the effects of mechanization on agricultural growth and comparative economics of labour and machinery in Bihar.

CHAPTER – II

MECHANIZATION PROGRAMMES AND TRENDS OF MECHANIZATION IN THE STATE

2.1 Prologue

In Bihar, the agricultural sector is faced with mainly four key challenges: (i) Nano-size of land holdings, (ii) low yields and high risks, (iii) biotic and abiotic constraints

in raising crop yields, (iv) weak institutions, and; poor infrastructure. With a view to bring Second Green Revolution in the eastern region of the country (particularly in Bihar) the agricultural activities being undertaken based on 'Rain God,' will have to be linked with science. There is need to move towards farming system from cropping system. Institutional assistance, technological transfer and innovation are the pre-requisites for the success of second green revolution. Blinking away the constraints and removing challenges before the agricultural sector of Bihar will not be possible, unless agricultural mechanization is emphasized.

As far as efforts of the Government to promote and strengthen mechanization in agricultural sector are concerned, since the year 2009-10 of the 11th Five Year Plan (i.e., 2007-08 to 2011-12) the following six schemes/programmes were undertaken:

i. Macro-mod Management of Agriculture (MMA)
ii. ISOPOM (Integrated Scheme on Oilseeds, Pulses, Oil palm and Maize),
iii. Jute Technology Mini Mission – II,
iv. National Food Security Mission (NFSM),
v. Rashtriya Krishi Vikas Yojana (RKVY), and;
vi. State Plan on Power Tiller Promotion Scheme (SPPTPS).

Under the above schemes, agricultural machines, tools and equipments are made available to farmers on subsidized prices. Bihar is known for its (i) good cultivable land, (ii) adequate soft water resources, (iii) human resources, and; (iv) climatic diversity. No doubt, the state has achieved a good position in regard to agricultural production and productivity; however, we couldn't have fully exploited our existing and actual potential. Agricultural Mechanization has significant role to play in enhancing the productivity of agricultural sector.

In view of the uses and importance of machines and tools in agriculture operations, the Government of India had launched Agricultural Mechanization Schemes since the year 2001-02. Response of farmers towards these schemes/programmes has, no doubt, remained encouraging. These schemes/programmes have been launched for causing to develop the following objectives:

(i) Maximum use of mechanized power in enhancing productivity, (ii) saving of time, money and energy, (iii) carrying out of crop planning on time, and; (iv) Management of crop preparation on time.

2.2 Present Status of Mechanization

A strong argument depicting comparative backwardness of the state in regard to Agricultural Mechanization can be its low KW/hectare use of machinery. The same for Bihar was 1.00 Kilo Watt/hectare. It was much lower than Punjab (3.75 KW/ha i.e., the highest in India and even lower than the national average (1.5 KW/ha. The level of agricultural mechanization was meant for the period 2009-10.

As per the execution guidelines of the Agricultural Mechanization Programme/Scheme 2009-10 it was to be launched in all the districts of Bihar. The programme of Farm Mechanization included: (i) MMA, (ii) ISOPOM, (iii) Jute Technology Mini Mission – II, (iv) NFSM, (v) RKVY, and; (vi) State Plan for Promotion of Power Tiller (SPPPT). Under these six schemes, farmers are provided with the implements, machines and/tools like the following:

(i) Tractor, (ii) Power Tiller, (iii) Zero till Seed-Cum-Fertilizer-Drill, (iv) Raised-bed Planter, (v) Sugarcane-Cutter Planter, (vi) Potato planter, (vii) Potato digger, (viii) Tractor driven reaper, (ix) Seed cleaner-cum-grader, (x) Mobile foot harvester, (xi) Power weeder, (xii) Power thresher, (xiii) Winnower, (xiv) Conoweeder (xv) Irrigation pipe, (xvi) Sprinkler, (xvii) Pump set (diesel/electric driven), (xviii) Rotavator, (xix) Combine harvester, (xx) wheel-ho, (xxi) Multi row seed drill, (xxii) Sprayer duster, and; (xxiii) Other power driven/human driven agricultural implements, machines, etc.

Here the specificity of agricultural machinery/tools distributed on subsidy under Agricultural Mechanization Programmes/Schemes can not be overlooked, so a brief discussion focusing on their guidelines for distribution is inevitable.

i. In regard to tractor/power tiller, subsidy will be payable on the make/model approved by the Department of Agriculture & co-operation, Ministry of Agriculture, Government of India.

ii. In regard to Combine Harvester, the testing of the machinery will be required by the organizations/institutions like (FMTTI/ISI) being run under the DAC, MoA, GoI.

iii. In the light of section 5.4.5 of the revised guidelines of Government of India, the agricultural implements/tools/machines, which have prices above Rs. 10,000/- but not tested by BIS, ISI and FMTTI, however, they are highly useful for the farmers will be quality tested by a Committee constituted under the Chairmanship of the Joint Director Agriculture (Engineering), Bihar, Patna as it was prevalent earlier. The same system will be followed in case of machinery/tools (human power driven/animal power driven).

iv. On new improved farm machineries, e.g., rotavator, conoweeder/leveler/marker, at least 25.00 per cent of the total sanctioned amount is to be necessarily utilized.

v. In case of Farm Machinery/Agricultural Implements supplied by the supplier/agency/seller, the particular machine/implement must be embossed. Except in case of small, human/animal driven farm machineries/implements. Such embossing must contain (i) name of the scheme/programme, (ii) name of the district, and; (iii) financial year, etc.

2.3 Farm Mechanization in Bihar (during 11th Five Year Plan)

During the 2007-08 to 2011-12, the level of achievements (physical) in regard to farm mechanization in Bihar were quite satisfactory, rather much higher in comparison to performance in financial achievement terms. Except in the year 2011-12 (97.31%), physical achievements against targets in the four financial years were more than 100 and 200 percentages. Physical achievements during the years 2007-08, 2008-09, 2009-10 and 2010-11 were 154.03, 121.91, 296.88 and 242.54 per cent respectively (table 2.1).

As regards the financial achievement of Farm Mechanization Programmes/Schemes in the state of Bihar, the data in table 2.1 make us able to figure out that it (in no financial year could touch 100% per cent mark). It means, as a matter of fact, achievements always remained less than the financial targets set for particular years. It was the lowest in the year 2008-09 (60.15%) and highest in the year 2011-12 (87.27%). Achievements in the years 2007-08, 2009-10 and 2010-11 were (71.63%, 83.27% & 80.17%) respectively.

Here it is to be noted that range of subsidy on agricultural machineries/implements is very wide (i.e., from Rs. 3,000/- on 'conoweeder and nepshake sprayer' to Rs. 30,000/- meant for rotavator). It seems that the distribution of lower subsidy implements were higher, means more than the targets, whereas machines/farm implements with higher amounts of subsidies might have been availed/distributed in less than the targeted number. It could have possibly led to the situation of financial achievements of farm mechanization programme falling well below 100 per cent of the targets, while the physical achievements were well above 100 per cent of the targets.

Table No. 2.1: Progress of Agricultural Mechanization Programmes/Schemes in Bihar during 11th Five Year Plan.

(Amount in Rs. Lakh)

SN	Financial Year	Physical			Financial		
		Target	Achievement	%	Target	Achievement	%
1.	2007-08	31784	48956	154.03	2852.440	2043.130	71.73
2.	2008-09	86911	105956	121.91	16290.480	9798.430	60.15
3.	2009-10	103589	307533	296.88	15390.350	12815.190	83.27
4.	2010-11	120684	292708	242.54	15856.710	12712.740	80.17
5.	2011-12	287157	279429	97.31	24138.430	21065.250	87.27

Source: Government of Bihar, Dept. of Agriculture, year 2012-13.

2.4 Machinery Costs

In this section of the chapter (a) share in machinery costs in operational costs, (b) share of machinery costs in total costs, and; (c) share of machinery costs in value of production (meant for prominently grown crops as the average of 2001-02 to 2009-10 and in quite a few cases, average depended on the availability of data have been delineated.

2.4.1 Share of Machinery Costs in Operational Costs

Analysis of share of machinery costs in operational costs have been presented here based on dug up secondary data related to five crops namely: (i) paddy, (ii) wheat, (iii) maize, (iv) gram, and; (v) lentil. Share of cost of human labour as percentage of operational cost was found highest in case of paddy (54.24%) followed by maize, lentil, gram and wheat (37.97%, 37.39%, 30.28% and 26.87%) respectively. Cost of bullock labour as percentage of operational cost was found highest and lowest in cases of lentil and maize (9.53% and 3.00 %) respectively. In case of share of cost of machine labour out of operational cost wheat was ahead (20.60%) (table 2.2). Having an overview on the data in the table, it is cognized that share of cost of bullock labour in operational costs, in case of paddy (7.79%) was second highest after lentil followed by wheat and gram (5.36% and 3.98%) respectively. As far as share of cost of machine labour in operational costs is concerned, data in (table 2.2) espouses that after wheat, again lentil (18.87%) was there, followed by gram maize and paddy (18.60%, 13.32% and 10.30%) respectively.

Table No. 2.2: Share of Machinery Costs in Operational Costs (average of 2001-02 to 2009-10)

Crop (1)	Cost of Human Labour (2)	Cost of Bullock Labour (3)	Cost of machine labour (4)	Operational cost (5)	2 as % of 5 (6)	3 as % of 5 (7)	4 as % of 5 (8)
Paddy	5034.78	723.17	956.31	9282.33	54.24	7.79	10.30
Wheat	2715.59	541.79	2082.13	10107.88	26.87	5.36	20.60
Maize	3880.38	306.86	1361.34	10219.05	37.97	3.00	13.32
Gram	1755.03	230.83	1077.86	5794.98	30.28	3.98	18.60
Lentil	2019.49	514.78	1019.24	5400.90	37.39	9.53	18.87

Source: Compiled from the available data in the Reports of CACP, MoA, GoI for the years 2001-02 to 2008-09

2.4.2 Machinery Costs in Total Costs

In this section, attempt has been made to find out crop wise average shares of machinery costs in total costs, the secondary data under the columns of (i) cost of human labour, (ii) cost of bullock labour, (iii) cost of machine labour, (iv) total cost, and; (v) their respective percentages to total costs are the averages of the figures of 2001-02 to 2009-10, and in some cases, the averages were derived for the years of availability of data. Data in the table signals highest shares of cost of human labour and cost of bullock labour to total costs for paddy (34.82% and 5%) respectively, while the minimum for these two costs were recorded for gram and maize (16.95% and 2.03%) respectively. Cost of machine labour to total cost could be seen the highest in case of wheat and lowest for paddy (13.77% & 6.61%) respectively. It will

not be difficult to say with the help of data in table 2.3 that after paddy, maize, lentil and wheat were the crops, the shares of cost of which human labour to total costs were higher (25.68%, 19.52% and 17.96%) respectively. After paddy again lentil, wheat and gram are the crops, the shares of whose costs of bullock labour to total costs were quite higher than that of maize (4.97%, 3.58% and 2.23%) respectively. In regard to share of costs of machine labour to total costs, it is revealed by having a glance on data that after wheat (13.77%) gram, lentil and maize careered high machinery costs (10.41%, 9.85%, and 9.01%) respectively (table 2.3).

Table No. 2.3: Share of Machinery Costs in Total Costs (average of 2001-02 to 2009-10)

Crop (1)	Cost of Human Labour (2)	Cost of Bullock Labour (3)	Cost of machine labour (4)	Total cost (5)	2 as % of 5 (6)	3 as % of 5 (7)	4 as % of 5 (8)
Paddy	5034.78	723.17	956.31	14459.66	34.82	5.00	6.61
Wheat	2715.59	541.79	2082.13	15122.84	17.96	3.58	13.77
Maize	3880.38	306.86	1361.34	15107.33	25.68	2.03	9.01
Gram	1755.03	230.83	1077.86	10352.33	16.95	2.23	10.41
Lentil	2019.49	514.78	1019.24	10347.95	19.52	4.97	9.85

Source: Compiled from the available data in the Reports of CACP, MoA, GoI for the years 2001-02 to 2008-09

2.4.3 Machinery Costs in Value of Production

In this section of the chapter, attempt has been made to contemplate crop wise: (i) cost of human labour, (ii) cost of bullock labour, (iii) cost of machine labour, (iv) value of production, and; (v) their respective percentages to value of production. The figures in the table are the averages of 09 years period depending upon the availability of data during 2001-02 to 2009-10. Having a glance on data, it can be evinced that like share of machinery costs in operational costs, share of machinery costs in total costs, the same in regard to value of production were highest in case of paddy for human labour, bullock labour and machine labour in case of wheat (37.60%, 5.40%, 12.00%) respectively. A glimpse on data in table reveals higher share of cost of human labour for maize, cost of bullock labour for lentil and cost of machine labour for paddy as percentage of value of production (20.13%, 3.26% and 7.14%) respectively (table 2.4). One of the most interesting and substantial fact that is revealed is that shares of cost of (i) human labour, (ii) bullock labour, and; (iii) machine labour as percentage of value of production were minimum or the lowest for pulse crops only (i.e., gram and lentil 11.22%, 1.48% and 6.45%) respectively.

Table No. 2.4: Share of Machinery Costs in Value of Production (average of 2001-02 to 2009-10)

Crop (1)	Cost of Human Labour (2)	Cost of Bullock Labour (3)	Cost of machine labour (4)	Value of Production (5)	2 as % of 5 (6)	3 as % of 5 (7)	4 as % of 5 (8)
Paddy	5034.78	723.17	956.31	13391.18	37.60	5.40	7.14
Wheat	2715.59	541.79	2082.13	17354.17	15.65	3.12	12.00
Maize	3880.38	306.86	1361.34	19278.11	20.13	1.59	7.06
Gram	1755.03	230.83	1077.86	15637.21	11.22	1.48	6.89
Lentil	2019.49	514.78	1019.24	15793.16	12.79	3.26	6.45

In quite a few cases, in regard to some of the crops, the average of 9 years data might not be there due to non-availability.

Sources of data in table Nos 2.2 to 2.4 "Reports of the Commission for Agricultural Costs and Prices" (2001-02 to 2008-09)

2.5 Growth of Costs

In this section of the chapter, attempt has been made to figure out growth of costs (in percentage) in regard to: (i) quantity, (ii) price, and; (iii) total costs. All these components are contained in: (a) cost of human labour, (b) cost of bullock labour, and; (c) cost of machine labour. For want of data related to quantity and prices of costs of human, bullock and machine labour meant for the crops in reference for all the years (from 1996-97 to 2009-10), the analysis has been restricted to percentage change in growth of costs in the year 2008-09 as compared to 1996.

Having a glance on data in the table, it is revealed that except declines in cost of machine labour meant for lentil (-33.23%) and bullock labour for all the crops, there were increases in costs of human and machine labour of all the crops. While wheat showed highest increase in total cost of human labour (104.90%) followed by paddy, maize, gram and lentil (81.84%, 76.32%, 55.72% and 25.47%) respectively, paddy was ahead in regard to increase in total machine cost (465.64%) (table 2.5). On this front of increase in cost of machine labour, maize, wheat and gram came after paddy (292.97%, 223.53% and 106.78%) respectively.

2.6 Growth of Production

In this section, attempt has been made to see the changes in 'value of production' and 'total machinery costs.' For want of data again for all the crops and for all the years, the analysis was limited to percentage change in the year 2008-09 in comparison to the year 1996-97.

Data reveal decline in total machinery costs of lentil (33.23%). Higher change in value of production could be seen in case of wheat (203.15%). The increases in values of production for paddy, gram, lentil and maize were (153.11%, 115.52%, 88.92% and 13.73%) respectively (table 2.6).

2.5. GROWTH OF COSTS (in 2008-09 over 1996-97)

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	-9.88	101.40	81.84	-76.05	114.27	-48.68	167.91	111.21	465.64
Wheat	-19.90	155.70	104.90	-68.32	150.00	-20.80	41.32	451.16	223.53
Maize	-12.03	100.30	76.32	-73.29	185.01	-23.86	75.29	124.33	292.97
Gram	159.54	-40.11	55.72	-95.29	220.13	-84.93	---	---	106.78

Lentil	-15.25	48.01	25.47	-23.34	20.13	-7.89	-61.84	74.96	-33.23

Source: Compiled from the available data in the Reports of CACP, MoA, GoI for the years 1996-97 & 2008-09

2.6. GROWTH OF PRODUCTION VIS-À-VIS COSTS (in 2008-09 over 1996-97)

Crop	PRODUCTION			Cost of Machinery		
	Yield	Price (value of production /yield)	Value of Production	Qty	Price (rate)	Total machinery cost
Paddy	-13.54	192.90	153.11	167.91	111.21	465.64
Wheat	-6.41	223.93	203.15	41.32	451.16	223.53
Maize	-52.77	140.78	13.73	75.29	124.33	292.97
Gram	-8.33	135.09	115.52	---	---	106.78
Lentil	-16.93	127.42	88.92	-61.84	74.96	-33.23

Source: Compiled from the available data in the Reports of CACP, MoA, GoI for the years 1996-97 & 2008-09

Summary of the Chapter

In Bihar, agricultural sector is faced with mainly four key challenges: (i) nano size of land holdings, (ii) low yields and high risks, (iii) biotic and abiotic constraints in raising crop yields, and; (iv) weak institutions accompanied by poor infrastructure. As far as efforts of the Government to promote and strengthen mechanization in agricultural sector are concerned since the year 2009-10 during the 11th Five Year Plan, i.e., agricultural machines, tools and equipments are being made available to farmers on subsidy basis mainly under the six schemes/programmes, viz., (i) MMA, (ii) ISOPOM, (iii) Jute Technology Mini Mission – II, (iv) NFSM, (v) RKVY, and; (vi) State Plan on Power Tiller Promotion Scheme. Range of subsidy on agricultural machineries/implements being very wide (from Rs. 3,000/- only on conoweeder to Rs. 30,000/- only meant for rotavator). Though small implements were distributed largely, which had led to exceeding the physical targets in some years, so big machines could be distributed in less than targeted numbers. Share of cost of human labour as percentage of operational cost was found higher in case of paddy. Cost of bullock labour as percentage of operational cost and machine labour as percentage of the same were found higher in cases of lentil and wheat respectively. Further, higher shares of the cost of human labour and cost of bullock labour to total cost were found for paddy respectively. Cost of machine labour to total cost could be seen the higher in case of wheat and lower for paddy. It is interesting to have the determinate observation that the share of machinery cost in regard to value of production was higher in case of paddy for human labour, the same for bullock labour and machine labour in case of wheat. Data reveals higher share of cost of human labour for maize, cost of bullock labour for lentil and cost of machine labour for paddy' as percentage of value of production. The most interesting and substantial facts revealed here, are that shares of cost of (i) human, (ii) bullock, and; (iii) machine labour as percentage of value of production were minimum or the lowest for pulse crops only. As far growth of costs in human labour, bullock labour and machine labour in the year 2008-09 as compared to 1996-97 is concerned maximum increase in human labour was observed in case of wheat, higher decline in bullock labour was seen in case of gram and higher increase in machine labour was found in paddy. The

growth of production during the period (in percentage terms) was quite higher in value of production terms for wheat. Like the growth of costs scenario quite higher increase in machinery cost was observed in case of paddy again.

CHAPTER – III

DEMOGRAPHIC PROFILE AND CROPPING PATTERN OF THE STUDY REGION

This chapter, by and large, includes analytical discussions related to following contextual aspects:

i. General overview of the study region. Demographic profile, caste composition, education profile etc., have been figured in this general overview.

ii. Crop-structural Components: Under this sub-section attempts have been made to bring out data-based analytical discussion related to: (a) Cropping pattern, and; (b) Irrigation area, etc.

3.1 General Information: Demographic Profile

In this section, efforts have been made to bring forward farm class wise average family size (including male, female their total) and adult ratio of the surveyed sample households (Hhs). A glance on table suggests highest average family size in case of medium farm households (5.87) followed by small, large and marginal (5.58), 5.33 and 4.43) respectively. The overall family size per household was found 4.97. Average numbers of adult female members were also higher in medium and large farm classes (2.81 and 2.53) respectively. Number of adult female in per household of surveyed marginal and small farm size were 2.07 and 2.50 respectively, whereas the total was 2.36. In case of adult male per household, small farms were ahead (3.08) followed by medium, large and marginal (3.06, 2.80 and 2.36) respectively (table No. 3.1). Average number of children per household was found higher in small and marginal farm classes (3 and 2.80) respectively indicating willingness to have larger family size among lower income group families. Larger average family size in case of medium and large farm households might be due to their normal practice of living in joint family system. On overall level, the average size of family including children was estimated at 7.73. Small and medium farm households comprised larger family size (including children) calculated at 8.58 and 8.44 respectively followed by marginal and large (7.22 and 7.13) respectively (table 3.1). It is interesting to note that male female ratio was most unfavourable in case of surveyed small households (0.811), while on overall level, it was 0.903. This shows gender bias among small land holding class. In case of marginal households, it was 0.877.

Table No. 3.1: Demographic Profile *(Average)*

Size Classes	Adults			Children	Total
	Males	Females	Total		
MARGINAL	2.36	2.07	4.43	2.80	7.22
SMALL	3.08	2.50	5.58	3.00	8.58
MEDIUM	3.06	2.81	5.87	2.56	8.44
LARGE	2.80	2.53	5.33	2.47	7.13
TOTAL	2.71	2.36	4.97	2.76	7.73

Primary source: Field level data.

3.2 Education Profile Head of Households

An inquisitorial attempt has been made in this section to examine farm class wise literacy of the head of surveyed households and their level of education (viz., primary, secondary & above). Out of the 100 farm families surveyed 64.00 per cent Hhs were found qualified in the broader group of secondary and above, 27 educated up to primary level and only 9 were illiterate. On having a glance on the table, it is observed that more than half of the total number of farmers in each farm size group, i.e., marginal, small, medium and large had education up to secondary and above level (23, 18, 11 and 12) respectively (table 3.2(a)).

Table No. 3.2 (a): Education of the Head

(No. of Households)

	Illiterates	Primary	Secondary & Above	Total
MARGINAL	05	17	23	45
SMALL	02	04	18	24
MEDIUM	01	04	11	16
LARGE	01	02	12	15
TOTAL	09	27	64	100

Primary source: Field level data.

3.2 (a) Education: Percentage Distribution

This section deals with farm class wise literacy and/illiteracy status of heads of sample households. The scenario has been presented in percentage terms. It is evident that large and small farmers i.e., heads of households had larger percentages of education up to secondary and above level (80 & 75) in comparison to medium and marginal (68.75 and 51.11) respectively. Maximum percentage of heads of sample households having education up to primary level was seen in case of marginal farmers (37.78) followed by medium, small and large (25, 16.67 and 13.33) respectively. In regard to illiteracy, as per normal belief marginal and small farm households were ahead (11.11 and 8.33%) respectively. Lower percentages of illiterate heads of sample households could be seen among the categories of medium and large farmers (6.25 and 6.67) respectively (table 3.2 (b)). On overall level, the percentages of illiterates, qualified up to primary and secondary and above of heads of households were found to be 9, 27 and 64 respectively.

Table No. 3.2 (b): % Distribution of Education of the Head

	Illiterates	Primary	Secondary & Above	Total
MARGINAL	11.11	37.78	51.11	100
SMALL	8.33	16.67	75.00	100
MEDIUM	6.25	25.00	68.75	100
LARGE	6.67	13.33	80.00	100
TOTAL	9.00	27.00	64.00	100

Primary source: Field level data.

3.2 (b) Education Profile: Adult Population

This section tries to reach at a definite conclusion related to literacy and illiteracy levels of the adult population of sample households. Having a glance on related table, it is revealed that maximum average number of adult family members of households surveyed who obtained, education up to secondary and above level belonged to small farm size (3.42) followed by medium (3.25). This might be due to maximum average family size of small group of farm households (8.58) and very large span under secondary and above strata of educational status (that is meant here from class-V to graduation and above) (table 3.2 (c)). Adult population of sample household having education up to primary level (in average term) was maximum in case of marginal (1.65) followed by medium, large and small (1.44, 1.27 and 1.00) respectively. Average number of illiterates was highest in medium farm size class (1.18) closely followed by small, large and marginal farms (1.16, 1.07 and 1) respectively. On overall level, the average number of illiterate adult population per household was 1.08. This calls for a literacy promotion drive in the areas of study.

Table No. 3.2 (c): Education Profile of the Adult Population *(Avg).*

	Illiterates	Primary	Secondary & Above	Total
MARGINAL	1.00	1.65	1.78	4.43
SMALL	1.16	1.00	3.42	5.58
MEDIUM	1.18	1.44	3.25	5.87
LARGE	1.07	1.27	2.33	4.67
TOTAL	1.08	1.40	2.49	4.97

Primary source: Field level data.

3.2 (c) Distribution of Adult Educated Population

An effort has been made in this section to present primary data based analysis related to distribution of adult educated population farm class wise (in percentage terms). Here again, three parameters have been taken into consideration, viz., (i)

illiterates, (ii) primary, and; (iii) secondary and above (consisting the range from class – V to graduation and above). The data in table help us to figure out that largest proportion of adult educated population found illiterate belonged to large farm size class (22.91%). Marginal adult educated persons topped in having education up to primary level (37.25%) and small farm size adult members of sample households were ahead in education of secondary and above level (61.29%). About 50.00 per cent of the total adult members of surveyed households did possess education up to secondary and above level. 21.73 per cent were illiterate and remaining 28.17 per cent got education up to primary level (table 3.2 (d)). The reason for largest proportion of small farm size adult persons having education in the class of secondary and above (61.29%) could be its largest average family size (8.58) and, very big range/span of this educational category (i.e, from class –V to graduation and above).

Table No. 3.2 (d): % Distribution of Adult Educated Population

(In %)

	Illiterates	Primary	Secondary & Above	Total
MARGINAL	22.57	37.25	40.18	100
SMALL	20.79	17.92	61.29	100
MEDIUM	20.10	24.53	55.37	100
LARGE	22.91	27.20	49.89	100
TOTAL	21.73	28.17	50.10	100

Primary source: Field level data.

3.3 Caste Composition

In this part of the chapter, attempt has been made to circumspectly discuss farm class wise caste composition of sample households. Castes here consist of SC, ST, OBC and others. On having a glance on data in the table, it is looked into that except 1 in medium farm class belonging to Scheduled Caste (SC), no sample households came under SC and Scheduled Tribe (ST) category from large and medium farm classes. Out of the 31 households of medium and large farm classes, 22 belonged to Other Backward Classes (OBC) and 8 to group of others. Number of SC households was the highest in marginal farm classes (10) with little number in small farm size (02). OBC households were the highest in number in marginal farms (32) followed by small, medium and large (20, 13 and 9) respectively. In the category of others,

obviously, large farm households dominated (06) followed by marginal (03) and 2 each in small and medium farm size classes (table No. 3.3 (a)).

Table No. 3.3 (a): Caste Composition

(No. of Households)

	SC	ST	OBC	Others	Total
MARGINAL	10	---	32	03	45
SMALL	02	---	20	02	24
MEDIUM	01	---	13	02	16
LARGE	---	---	09	06	15
TOTAL	13	---	74	13	100

Primary source: Field level data.

3.3.1 Distribution of Caste Composition

This section deals with percentage distribution of caste composition in the surveyed villages. Data related to SC, ST, OBC and others have been collected and analyzed here. Data provide ground to count upon largest proportion of sample households belonging to OBC from small farms (83.34%), SC belonging to marginal farm group (22.22%) and large farm households coming under others group of caste (40 %). Among small and medium farms households, SC members were also present, though in much lower number than marginal farms (8.33% and 6.25%) respectively (table No. 3.3 (b)). After small farms, medium, marginal and large farms were found to have strongly present under OBC category (81.25%, 71.11% and 60.00%) respectively. Under the caste category of others large farm households were followed by medium, small and marginal households (12.50%, 8.33% and 6.67%) respectively. On aggregate level, OBC farm households dominated (74.00%), equally followed by SC and others (13.00%) each.

Table No. 3.3 (b): % Distribution of Caste Composition

(%. of Households)

	SC	ST	OBC	Others	Total
MARGINAL	22.22	---	71.11	6.67	100
SMALL	8.33	---	83.34	8.33	100
MEDIUM	6.25	---	81.25	12.50	100
LARGE	---	---	60.00	40.00	100
TOTAL	13.00	---	74.00	13.00	100

Primary source: Field level data.

3.4 Irrigation Status

This section elaborately covers farm class wise irrigation details of surveyed households. The description of both irrigated and unirrigated areas has been presented in this part of the chapter. Source wise irrigation details (viz., (i) canal, (ii) tube-well, (iii) tank, and; (iv) others) are also inherent.

Irrigated and unirrigated areas in the table are total of respective farm size classes. A glance on table make us able to recognize that large and medium farm households owned larger total areas under irrigated conditions (2.48 ha and 1.20 ha) as compared to marginal and small farms (0.21 ha and 0.66 ha) respectively.

The areas under unirrigated conditions across the farm size went on increasing with increase in farm size. The farm class wise total areas were 0.55 ha, 1.33 ha, 2.07 ha and 5.23 ha for marginal, small, medium and large farm households respectively (table 3.4 (a)). It is interesting to note that largest area (including all size classes) was irrigated through tube-wells (4.41 ha), i.e., mostly through private tube wells followed by others, means other sources of irrigation (0.41 ha).

Table No. 3.4 (a): Irrigation Details

(Area in ha)

	Irrigated					Unirrigated	Total
	Canal	Tubewell	Tank	Others	Total		
MARGINAL	---	0.16	---	0.05	0.21	0.34	0.55
SMALL	---	0.55	---	0.11	0.66	0.67	1.33
MEDIUM	---	1.00	---	0.20	1.20	0.87	2.07
LARGE	---	2.43	---	0.05	2.48	2.75	5.23
TOTAL	---	4.14	---	0.41	4.55	4.63	9.18

Source-wise Areas irrigated and Unirrigated are total of respective farm size groups

3.4.1 Distribution of Irrigation area by Source

Exposition related to percentage distribution of irrigated area by source and farm class wise has been made in this section. Data in the table helps to suggest that a little more than half of the total area under cultivation (50.43%) was unirrigated. It reveals that distribution of irrigated areas is marginally lower among the surveyed households (49.57%). No irrigation was available through canal and tank in the study area. Medium and large farm households were found to have availed tube well (privately owned) irrigation on larger scale (48.31% and 46.46%) respectively. Other sources of irrigation was also largely used by medium and marginal farm

households too (9.66% and 9.09%) respectively (table 3.4 (b)). In regard to distribution of unirrigated area, it is to be noted here that not only the marginal farm households, but the large and small farms also were highly disadvantaged in terms of owning larger unirrigated areas to their respected total areas (61.82%, 52.58% and 50.38%) respectively.

Table No. 3.4 (b): Percentage Distribution of Irrigated Area by Source

(In %)

	Irrigated					Unirrigated	Total
	Canal	Tubewell	Tank	Others	Total		
MARGINAL	---	29.09	---	9.09	38.18	61.82	100
SMALL	---	41.35	---	8.27	49.62	50.38	100
MEDIUM	---	48.31	---	9.66	57.97	42.03	100
LARGE	---	46.46	---	0.96	47.42	52.58	100
TOTAL	---	45.10	---	4.47	49.57	50.43	100

Primary source: Field level data.

3.5 Cropping Pattern (2008-09 to 2010-11)

In this section of this chapter, attempt has been made to find out cropping pattern of the surveyed areas overall seasons during the years 2008-09, 2009-10 and 2010-11. Crop wise area sown, number of months sown, percentages of irrigated areas under the crop, and crop duration index have been calculated and analyzed here.

3.5.1 Cropping Pattern (2008-09)

On having a glance on data in the table, It is revealed that during the year 2008-09, rice got dominant place in regard to area covered (5.96 ha), areas under wheat and maize were cent-per cent irrigated and crop duration index (CDI) being 42.95. As paddy is grown in the rainfed areas, so it had less area under irrigation (80.00%). Lentil, moong and gram are spread crops, so these were found to have been grown in less irrigated areas (20%, 20% and 30%) respectively (table 3.5). Paddy, wheat and lentil did take longer months of sowing (4.51, 3.99 and 3.80) respectively.

Table No. 3.5: Cropping Pattern-Over All Seasons: 2008-09

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
Paddy	5.96	4.51	80
Wheat	2.24	3.99	100
Maize	1.64	1.30	100
Lentil	1.09	3.80	20
Moong	1.09	2.7	20

Gram	0.55	4.15	30
"Total Area" from irrigation Details Table above (A)			
Crop Duration Index	**$[(\sum a_i d_i)/12A]*100$ = (47.31) 12 * 9.18* 100 = 42.95**		

Primary source: Field level data.

3.5.2 Cropping Pattern (2009-10)

Data in table generates the observation that during 2009-10, again maximum average area per farm was occupied by paddy (5.57 ha). While gram was ahead in duration (4.70 months), it was wheat grown in cent per cent irrigated area. Declined CDI (40.44%) over the year 2008-09, indicates lower utilization of land available for cultivation. The duration of sowing was also longer in case of paddy, wheat and lentil (4.25, 4 and 3.10 months) respectively (table 3.5 (a)). After paddy, wheat was the main cereal crop (2.19 ha), as there was scanty rain during 2009-10 in comparison to 2008-09, that might have led to decline in areas of wheat, maize and moong (2.19 ha, 1.20 ha and 0.98 ha) respectively. Gram and other rabi pulses, that do not necessarily required assured irrigation facility, witnessed either increase in area, or no significant decline in area as compared to previous year.

Table No. 3.5 (a): Cropping Pattern-Over All Seasons: 2009-10

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
Paddy	5.57	4.25	62
Wheat	2.19	4.00	100
Maize	1.20	1.30	89
Lentil	1.09	3.10	20
Moong	0.98	2.10	20
Gram	1.09	4.70	20
"Total Area" from irrigation Details Table above (A)			
Crop Duration Index		**$[(\sum a_i d_i)/12A]*100$ = 44.55/12* 9.18)* 100= 40.44%**	

Primary source: Field level data.

3.5.3 Cropping Pattern (2010-11)

Having looked about significant observations of the cropping pattern for the year 2010-11, more or less similar scenario like the year 2008-09 could be visible. Paddy occupied largest area sown and duration too (6.01 ha and 4.5 months) respectively. CDI was calculated at 42.75 per cent. The increase in crop duration index (CDI) during the year 1210-11, as compared to that of 2009-10 (from 40.44% to 42.75%) indicate better utilization of available land. It could be possible probably due to better rainfall in the year. The declined CDI of 40.44 in 2009-10 as compared to 42.95 per cent of 2008-09, indicates a fall in the utilization available land for farming. On leaf through of the (table 3.5 (b)), it is evident that among cereals, wheat and maize, and among pulse crops, lentil and gram occupied comparable areas (2.13 ha, 1.64 ha, and an equal of 1.09 ha) respectively. Paddy is grown in rainfed areas, so it had only 74.00 per cent of irrigated area under the crop. Wheat and maize were found to have

been grown in irrigated areas. As pulse crops do not require much assured irrigation, so lentil, moong and gram occupied 10, 10 and 20 per cent of irrigated areas under these crops respectively.

Table No. 3.5 (b): Cropping Pattern-Over All Seasons: 2010-11

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
Paddy	6.01	4.5	74
Wheat	2.13	4.00	100
Maize	1.64	1.20	100
Lentil	1.09	3.50	10
Moong	0.55	2.00	10
Gram	1.09	4.25	20
"Total Area" from irrigation Details Table above (A)			
Crop Duration Index		**$[(\sum a_i d_i)/12A]*100 = (47.09/12*9.18)* 100 = 42.75$**	

Primary source: Field level data.

Summary of the Chapter

It can be circumstantiated that surveyed farmers belonging to medium farm size class had higher average number of adult family members, whereas in regard to male members, small farmers' class was ahead. In regard to illiteracy, education levels up to primary and secondary and above sample marginal farm households were ahead. This could be due to their larger number in the sample. In percentage terms, on the parameter of education of the head of the family large sample households were at top having secondary and above qualification. On average (total) of educational front, medium farmers were ahead. As far percentage distribution of adult educated sample farmers is concerned, small farm size class was at top. Marginal size class had maximum number of SCs & OBCs households. There were no ST farm households in the sample. Percentage distribution of caste composition shows small farm households dominated by OBC, marginal by SC and large by the members of other castes. Higher average areas having irrigation facility were found in case of large and medium farms. In regard to unirrigated areas also, these two farm size classes were ahead. As far percentage distribution of irrigated area is concerned, in regard to total irrigated and total unirrigated areas medium & small and marginal & large respectively were ahead. No canal and tank irrigation was found in the area of study. There was a little fall in Crop Duration Index (CDI) in the year 2010-11 as compared to 2008-09. However, as a result of scanty rainfall in the year 2009-10, there was a clearly revealed decline in CDI. Paddy wheat and maize were the main cereals grown by the sample households, whereas under pulse crops, lentil, moong and gram got good shares of areas in cropping pattern during the three years.

CHAPTER - IV

COSTS OF MECHANIZATION

This chapter presents a facile interpretation of collected data and information related to (a) cost of mechanization vis-à-vis marketed surplus, (b) value of production etc., and; (c) cost of mechanization operation wise.

4.1 Input Costs

In this section of the chapter, eclectic analytical description of input costs (average of 2008-09, 2009-10 and 2010-11) has been presented. Input costs consist of costs incurred on the items/activities like: (i) seed, (ii) irrigation, (iii) organic manure, (iv) hired labour including bullock and manual, (v) hired machinery costs including (a) tractor, (b) harvest combine (in the study areas of this study, harvest combine cost for some crops are meant for/replaced by carriage cost, and; (vi) pesticides/weedicides. Percentage distribution of these input costs does also form the part of this section.

As far per hectare input costs incurred on seed and irrigation are concerned, wheat was at top (Rs. 3854 and Rs. 13,402) respectively. In regard to organic manure and fertilizer, maize was ahead (Rs. 4,100 and Rs. 4,980.33) respectively. Hired machinery costs, both on tractor and harvest combine/carriage costs were more in case of wheat again (Rs. 4053.33 and Rs. 5256) respectively (table 4.1 (a). Pesticides/weedicides cost was also found highest in case of wheat (Rs. 1,541/-. The total of hired machinery costs were found highest in case of wheat itself (Rs. 9309.33). In regard to hired labour (including bullock and manual), paddy was much ahead than wheat, maize and other pulse crops. Per hectare cost of hired labour in paddy was highest (at Rs. 12,043.04), while in regard to machinery cost, wheat was ahead (Rs. 9309.33). It suggests that level of mechanization in the forms of tractor and harvest combine/carriage cost was higher in wheat than paddy and other crops.

In percentage terms, distribution of input costs in regard to hired labour (bullock and manual taken together), and hired machinery costs (including tractor and harvest combine/carriage) paddy and wheat (42.72% and 22.20%) respectively were ahead. While maximum input cost on seed in gram (27.48%) was found, in case of irrigation, carriage (which has been mentioned as prominent component under harvest combine column) and pesticides/weedicides (31.96%, 12.53% and 3.67%)

respectively were found for wheat (table 4.1 (b). It is to be urgently mentioned here that the harvest combine machine was made available for service/use of the farmers in mechanized villages after the establishment of Farm Mechanization Bank in Mohanpur village of Shahkund Block in the year 2010. So, under the cost head of this item, we have basically considered expenditures incurred in carriage of large quantum of harvested grains by tractors.

4.2 Cost of Mechanization: Value of Output

In this section of the chapter, cost of mechanization vis-à-vis value of output (i.e., average of 2008-09 to 2010-11) have been examined and dealt. Analytical description of following aspects/components form the part of this section (i) value of output, (ii) hired machinery costs (total), (iii) marketed surplus, (iv) percentage of marketing costs to value of output, (v) percentage of machinery costs to marketed surplus, and; (vi) percentage of marketed surplus to value of output.

Having found out in the light of data, it could be noted that maximum and minimum percentages of machinery costs to value of output and machinery costs to marketed surplus were meant for wheat and gram (14.17, 3.22, 44.30 and 8.00) respectively. But, in regard to percentage of marketed surplus to value of output, paddy was at top (60.70%) and wheat was at the bottom (31.99%). It clearly suggests that retention in case of wheat was the maximum in this region of Bihar. It might be due to wheat being prominently used cereal crop in the state. Maize and lentil among cereal and pulse crops were found to have been prominently used for earning money by selling these commodities as the percentages of their marketed surplus to value of output were quite higher (56.80 and 42.17) respectively (table 4.2). Percentages of mechanization costs to value of output were also lower in case of lentil and paddy (6.75 and 9.07) respectively as compared to maize and wheat (10.01 and 14.17) respectively.

4.3 Costs of Mechanization: Operation wise

In this section, crisp data based analysis of operation wise costs of mechanization (both in (a) rupees/hectare and (b) percentage terms) has been given. Costs of mechanization include, (i) animal operated costs containing, (a) hire charges, (b)

input costs, and; (c) service and maintenance, (ii) manually operated containing (a), (b) and (c), (iii)power operated, (iv) tractor operated, (v) any other, and; (vi) total under each component i.e., (a), (b), and; (c) are included. It is to be noted here that hire charges have been calculated by multiplying number of hour per day with number of days and rate. All the above described heads of expenditure have been taken into consideration for showing percentage distribution of costs of mechanization operation wise.

Data in table helps us to bring out that in quantitative terms, the operation of ploughing (animal operated and tractor operated), cornered highest per hectare costs (Rs. 7650 and Rs. 4380) respectively. In context of manually and power operated costs of mechanization, sowing (including transplantation of paddy also) were ahead (Rs. 7413 and Rs. 4267.66) respectively. Animal operated ploughing (63.59%), manually operated weeding, plant protection and harvesting (100% each) were ahead. In case of power and tractor operated costs of mechanization, irrigation and 'transportation and marketing' (100% and 39.56%) respectively shared the maximum expenditures.

In quantitative term, on aggregate level, highest cost of mechanization was computed in the operation of ploughing (Rs. 12,030 per ha) followed by sowing, irrigation, harvesting and threshing (Rs. 9389/ha, Rs. 4267.66/ha, Rs. 3870/ha and Rs. 3724/ha) respectively (table 4.3 (a)). As far distribution of costs of mechanization is concerned, minimum percentage of it in animal operated operation was for threshing (8.43), sowing was meant for manually operated (78.95%) and power operated (21.05%), and it was lowest in case of ploughing (36.41%) by tractor operated machines (table 4.3 (b)).

Table No. 4.1 (a): Input Costs (Average of 2008-09, 2009-10 and 2010-11)

(In Rs/ha)

Crop	Seed	Irrigation	Organic Manure	Fertilizer	Hired Labour			Hired Machinery costs				Pesticides/ Weedicides	Any other cost (specify)	Total (15=225+8 +12+13)
					Bullock	Manual	Total	Tractor	Harvest Combine	Any other (specify)	Total			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Paddy	989.21	3984.92	2500.00	2279.99	4150.91	7892.13	12043.04	2412.33	2964.00	---	5376.33	1020.09	---	28193.58
Wheat	3854.00	13402.80	2950.00	4794.33	1837.00	4250.00	6087.00	4053.33	5256.00	---	9309.33	1541.00	---	41938.46
Maize	1360.00	8800.00	4100.00	4980.33	1750.00	2980.00	4730.00	1300.86	2490.00	---	3790.86	599.22	---	28360.41
Gram	3375.00	1250.00	1350.00	1600.00	1150.86	1805.00	2955.86	1000.49	500.00	---	1500.49	250.00	---	12281.35
Lentil	1225.03	500.00	1150.00	980.00	900.00	1250.00	2150.00	1000.00	598.00	---	1598.00	152.10	---	7755.13

Primary source: Field level data.

Table No. 4.1 (b): Percentage Distribution of Input Costs

(In %)

Crop	Seed	Irrigation	Organic Manure	Fertilizer	Hired Labour			Hired Machinery costs				Pesticides/ Weedicides	Any other cost (specify)	Total
					Bullock	Manual	Total	Tractor	Harvest Combine	Any other (specify)	Total			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Paddy	3.51	14.13	8.87	8.09	14.72	28.00	42.72	8.56	10.51	---	19.07	3.61	---	100.00
Wheat	9.20	31.96	7.03	11.43	4.38	10.13	14.51	9.67	12.53	---	22.20	3.67	---	100.00
Maize	4.79	31.03	14.46	17.56	6.17	10.51	16.68	4.59	8.78	---	13.37	2.11	---	100.00
Gram	27.48	10.18	10.99	13.03	9.36	14.70	24.06	8.15	4.07	---	12.22	2.04	---	100.00
Lentil	15.79	6.45	14.83	12.64	11.61	16.12	27.73	12.89	7.71	---	20.60	1.96	---	100.00

Primary source: Field level data.

Table No. 4.2: Cost of Mechanization Vis-À-Vis Value of Output (average of 2008-09, 2009-10 and 2010-11)

(In 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)
Paddy	59304.00	5376.33	36000.00	9.07	14.93	60.70
Wheat	65700.00	9309.33	21015.00	14.17	44.30	31.99
Maize	37862.50	3790.86	21505.00	10.01	17.63	56.80
Gram	24885.00	800.49	10000.00	3.22	8.00	40.18
Lentil	14820.00	1000.00	6250.00	6.75	16.00	42.17

Primary source: Field level data.

Note: 1) Value of Output = (qty of main product × price of main product) + value of by-product
2) Marketed surplus = qty sold × price

Table No. 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	7650.00	---	---	7650.00	---	---	---	---	---	---	---	---
Sowing & transplantation	---	---	---	---	7413.00	---	---	7413.00	1976.00	---	---	1976.00
Irrigation	---	---	---	---	---	---	---	---	4267.66	---	---	4267.66
Weeding	---	---	---	---	1250.00	---	---	1250.00	---	---	---	---
Plant Protection	---	---	---	---	384.00	---	---	384.00	---	---	---	---
Harvesting	---	---	---	---	3870.00	---	---	3870.00	---	---	---	---
Threshing	314.00	---	---	314.00	3410.00	---	---	3410.00	---	---	---	---
Transportation and Marketing	600.25	---	---	600.25	---	---	---	---	---	---	---	---
Any other	---	---	---	---	---	---	---	---	---	---	---	---

Primary source: Field level data.

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	4380.00	---	---	4380.00	---	---	---	---	12030.00	---	---	12030.00
Sowing	---	---	---	---	---	---	---	---	9389.00	---	---	9389.00
Irrigation	---	---	---	---	---	---	---	---	4267.66	---	---	4267.66
Weeding	---	---	---	---	---	---	---	---	1250.00	---	---	1250.00
Plant Protection	---	---	---	---	---	---	---	---	384.00	---	---	384.00
Harvesting	---	---	---	---	---	---	---	---	3870.00	---	---	3870.00
Threshing	---	---	---	---	---	---	---	---	3724.00	---	---	372

												4.00
Transportation and Marketing	392.90	---	---	392.90	---	---	---	---	993.15	---	---	993.15
Any other	---	---	---	---	---	---	---	---	---	---	---	---

Hire charges = no of hrs. per day × no of days × rate

Primary source: Field level data.

Table No. 4.3 (b): Percentage Distribution of Costs of Mechanization - Operation wise

Operation	Animal Operated				Manually Operated				Power Operated			
	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost
Ploughing	63.59	---	---	63.59	---	---	---	---	---	---	---	---
Sowing	---	---	---	---	78.95	---	---	78.95	21.05	---	---	21.05
Irrigation	---	---	---	---	---	---	---	---	100.00	---	---	100.00
Weeding	---	---	---	---	100.00	---	---	100.00	---	---	---	---
Plant Protection	---	---	---	---	100.00	---	---	100.00	---	---	---	---
Harvesting	---	---	---	---	100.00	---	---	100.00	---	---	---	---
Threshing	8.43	---	---	8.43	91.57	---	---	91.57	---	---	---	---
Transportation and Marketing	60.44	---	---	60.44	---	---	---	---	---	---	---	---
Any other	---	---	---	---	---	---	---	---	---	---	---	---

Continued…

Operation	Tractor Operated				Any Other				Total			
	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost	Hire charges = no of hrs×rate	Input costs	Service & maintenance	Total cost

Ploughing	36.41	---	---	36.41	---	---	---	---	100%	0.0%	0.0%	100%
Sowing	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Irrigation	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Weeding	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Plant Protection	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Harvesting	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Threshing	---	---	---	---	---	---	---	---	100%	0.0%	0.0%	100%
Transportation and Marketing	39.56	---	---	39.56	---	---	---	---	100%	0.0%	0.0%	100%
Any other	---	---	---	---	---	---	---	---	0.0%	0.0%	0.0%	0.0%

Primary source: Field level data.

Summary of the Chapter

This chapter causes to lead the finding that wheat incurred maximum input costs on seed and irrigation. In regard to organic manure and fertilizer maize was ahead. Wheat also cornered maximum amount as cost on pesticides/weedicides. It is revealed that level of mechanization in the forms of tractor and harvest combine/carriage cost was higher in wheat than paddy and other crops. In percentage terms, distribution of input costs, in regard to hired labour (bullock and manual taken together), and hired machinery costs (including tractor and harvest combine) paddy and wheat respectively were ahead. As the harvest combine machine was made available for service/use of farmers in mechanized villages after the establishment of Farm Mechanization Bank in Mohanpur village of Shahkund block in the year 2010, so we have actually considered expenditures incurred on carriage of large quantum of harvested grains by tractors under the above noted head. Here it could be noted that maximum and minimum percentages of machinery costs to value of output and same to marketed surplus were meant for wheat and gram. But, in percentage terms of marketed surplus to value of output paddy was at top and wheat at the bottom suggesting that retention of wheat was higher in this region of the state. Percentages of mechanization costs to value of output were also lower in case of lentil and paddy as compared to maize and wheat. Data in tables demonstrate that in quantitative terms, the operation of ploughing cornered higher per hectare costs. In context of manually and power operated costs of mechanization, sowing were ahead. In case of power and tractor operated costs of mechanization irrigation and transportation and marketing shared maximum expenditures. In quantitative terms (on aggregate level) higher cost of mechanization was computed for the operation of ploughing and lower being for threshing. Minimum percentages of the costs of mechanization were found in animal operated activities for threshing, manually operated activities of sowing and the lower in case of ploughing by tractor operated machines.

CHAPTER - V

PATTERN OF MECHANIZATION

In this chapter, available empirical data in tabular form related to the following aspects have been gazed intently (a) Extent of machinery use, (b) number of farmers owning and using machinery, and; (c) time use of machinery overall and operation wise.

5.1 Extent of Farm machinery use

In this section of the chapter, data have been analyzed for core to the extent of farm machinery use (by type). It includes (i) manual, (ii) animal operated, (iii) power operated, (iv) tractor operated, and; (v) self propelled machines/implements. Analysis has been made to evince the following facts (a) number of farmers using the machinery, (b) number of farmers owning the machinery, (c) (i) as per cent of total number of farmers, (i.e., 100), and (ii) as percentage of total number of farmers (i.e., 100).

On having a glance on data in the table, it is envisaged that quite a large number of farmers used manual, tractor and power operated machineries (99%, 90% and 89%) respectively. However, few of the surveyed households (Hhs) owned power and tractor operated machineries (11% & 7 %) respectively. Most of the sample Hhs owned manual and animal operated machineries (28% & 21%) respectively.

Table No. 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)
Mannual	99	28	100	99.00	28.00
Animal operated	59	21	100	59.00	21.00
Power operated	89	11	100	89.00	11.00
Tractor operated	90	07	100	90.00	07.00
Self propelled	---	---	---	---	---

Primary source: Field level data.

5.2 Operation wise Farmers Owning Machinery

Operation wise farmers' number and their percentages distribution in regard to (a) animal operated, (b) manually operated, (c) power operated, (d) tractor operated, and; (e) other device operated have been presented in this section. By and large, agricultural operations like (i) ploughing, (ii) sowing, (iii) irrigation, (iv) weeding,

(v) plant protection, (vi) harvesting, (vii) threshing, (viii) transport and marketing, and; (ix) any other have been taken into consideration for analysis.

Data in the table enables us to emphasize that animal and manually operated machines used in ploughing, harvesting and threshing operations were prominently owned by the sample Hhs (21, 50 and 50) respectively. Ownership of machinery operation wise also revealed larger percentages of manually operated machines/tools in the activities like sowing, weeding, plant protection and harvesting (100% each). 07 farm households each were found to have owned and used tractor-operated ploughing and transportation and marketing related machines/equipments 05 farmers also owned animal operated devices for transportation (table 5.2 (a). While 75.00 per cent of the animal operated ploughing devices were owned by surveyed farmers, for transportation and marketing and ploughing operations tractor operated machinery/implements were also owned to a great and quarter extents (58.33% & 25.00%) respectively (table 5.2 (b). For irrigation operation, 100.00 per cent of the farms owned machinery driven with power (i.e., through diesel run machine).

Table No. 5.2 (a): NUMBER OF FARMERS OWNING MACHINERY – OPERATIONWISE

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other	Total
Ploughing	21	---	---	7	---	28
Sowing	---	28	---	---	---	28
Irrigation	---	---	11	---	---	11
Weeding	---	30	---	---	---	30
Plant Protection	---	42	---	---	---	42
Harvesting	---	50	---	---	---	50
Threshing	17	50	---	---	---	67
Transportation and Marketing	5	---	---	7	---	12
Any other	---	---	---	---	---	---

Primary source: Field level data.

Table No. 5.2 (b): PERCENTAGE DISTRIBUTION OF FARMERS OWNING MACHINERY – OPERATIONWISE

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other	Total
Ploughing	75.00	---	---	25.00	---	100
Sowing	---	100.00	---	---	---	100
Irrigation	---	---	100.00	---	---	100
Weeding	---	100.00	---	---	---	100
Plant Protection	---	100.00	---	---	---	100

Harvesting	---	100.00	---	---	---	100
Threshing	25.37	74.63	---	---	---	100
Transportation and Marketing	41.67	---	---	58.33	---	100
Any other	---	---	---	---	---	100

Primary source: Field level data.

5.3 Farmers using Machinery: Operation wise

This section of the chapter seeks to examine number and percentage distribution of farmers using machinery (operation wise). The operations from ploughing to transportation and marketing and any other have been taken into consideration for analysis like preceding section.

Data in the table draws attention towards the fact that most of the farmers using animal, manually operated, power operated and tractor operated machineries were meant for operations like (i) transportation and marketing, (ii) weeding, (iii) plant protection, (iv) harvesting, (v) threshing, (vi) irrigation, and; (vii) ploughing (21%, 100%, 68%, 100%, 83%, 100% and 90%) respectively. Manually operated sowing and plant protection machineries and power operated irrigation devices (diesel pump sets) were also prominently used by surveyed farmers (94, 68, and 100 number) respectively (table 5.3 (a)). As far operation wise distribution of farmers using machineries is concerned, while only 10.00 per cent and 6.00 per cent of the sample households used animal operated and power operated machineries for ploughing and sowing respectively, 79.00 per cent also used tractor operated implements in 'transportation and marketing' operations (table 5.3 (b)).

Table No. 5.3 (a): NUMBER OF FARMERS USING MACHINERY – OPERATIONWIS

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other	Total
Ploughing	10	---	---	90	---	100
Sowing	---	94	6	---	---	100
Irrigation	---	---	100	---	---	100
Weeding	---	100	---	---	---	100
Plant Protection	---	68	---	---	---	68
Harvesting	---	100	---	---	---	100
Threshing	17	83	---	---	---	100
Transportation and Marketing	21	---	---	79	---	100
Any other	---	---	---	---	---	---

Primary source: Field level data.

Table No. 5.3 (b): PERCENTAGE DISTRIBUTION OF FARMERS USING MACHINERY – OPERATIONWISE

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other	Total
Ploughing	10	---	---	90	---	100
Sowing	---	94	6	---	---	100
Irrigation	---	---	100	---	---	100
Weeding	---	100	---	---	---	100
Plant Protection	---	100	---	---	---	100
Harvesting	---	100	---	---	---	100
Threshing	17	83	---	---	---	100
Transportation and Marketing	21	---	---	79	---	100

Any other	---	---	---	---	---	100

Primary source: Field level data.

5.4 Time use of Machine

In this section of the chapter, attempt has been made to enumerate operation wise total number of hours of usage (both in quantitative and percentage terms). Operation wise hours of machine usages have been calculated in cases of (i) animal operated, (ii) manually operated, (iii) power operated, and; (iv) tractor operated activities and machines.

Data in the table clearly displays that in case of animal operated devices, ploughing took maximum time (35 hours/ha) and operation of harvesting was ahead in manually operated machines (125.20 hrs/ha). Irrigation and ploughing were the main operations that took quite larger hours/ha by power (means diesel) operated and tractor operated machines (32 and 7.10 hrs/ha) respectively. Threshing and sowing operations by animal operated and manually operated machines were also found to have taken longer hours/ha (16 hrs/ha, 110 hrs/ha and 74.20 hrs/ha) respectively (table 5.4 (a)).

In percentage terms, it is revealed that usage of machines in case of ploughing, weeding, plant protection and harvesting by animal operated and manually operated machines were maximum (83.14%, 100%, 100% and 100%) respectively. Irrigation and transportation and marketing showed highest distribution of power operated and tractor operated machine usages (100% and 31.03%) respectively. Other activities like (a) transportation and marketing, (b) sowing (by animal and manually operated machines), (c) sowing (by power operated source) and; (d) ploughing (by power and tractor operated machines) also got more hours of usages (68.97%, 95.24%, 4.76% and 16.86%) respectively (table 5.4 (b)). It will be desirable to note that here power operated means not necessarily electric power driven machines/implements, but it represents diesel energy driven tools/machines. In the year 2011-12, along with ploughing, seed spreading operation was also undertaken by such small diesel power driven implements to very small extent in mechanized cluster of villages.

Table No. 5.4 (a): TOTAL NUMBER OF HOURS OF USAGE – OPERATIONWISE

(Hrs/ha)

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other
Ploughing	35	---	---	7.10	---
Sowing	---	74.20	3.71	---	---
Irrigation	---	---	32.00	---	---
Weeding	---	32.00	---	---	---
Plant Protection	---	16.00	---	---	---
Harvesting	---	125.20	---	---	---
Threshing	16	110.00	---	---	---
Transportation and Marketing	10	---	---	4.5	---
Any other	---	---	---	---	---

Primary source: Field level data.

Note: Total Number of hours = Number of days × Number of hours a day

Table No. 5.4 (b): PERCENTAGE DISTRIBUTION OF NUMBER OF HOURS OF USAGE – OPERATIONWISE

Operation	Animal Operated	Manually Operated	Power Operated	Tractor Operated	Any Other	Total
Ploughing	83.14	---	---	16.86	---	100
Sowing	---	95.24	4.76	---	---	100
Irrigation	---	---	100	---	---	100
Weeding	---	100	---	---	---	100
Plant Protection	---	100	---	---	---	100
Harvesting	---	100	---	---	---	100
Threshing	12.70	87.30	---	---	---	100
Transportation and Marketing	68.97	---	---	31.03	---	100
Any other	---	---	---	---	---	100

Primary source: Field level data.

5.6 Farm Machinery usage: Ploughing and Seed-bed Preparation

In this section of the chapter, efforts have been made to grasp operation wise usage of farm machineries (both in absolute and percentage terms). Total numbers of hours and total cost (machine and source of power wise) have been calculated. Data related to (i) animal operated plough, disc harrow and cultivator, (b) power tiller operated rotavator, and; (c) tractor operated plough, disc harrow, cultivator and rotavator have been analyzed in this section.

Data in tables clearly denote higher number of hours and larger total costs (in absolute numbers and percentages) used and incurred in ploughing and seed-bed preparation by animal operated machines (35 hrs, Rs. 7,650 and 63.59%) respectively. In case of tractor operated plough, time required in the operation, as a result costs incurred, came down significantly both in absolute and percentage terms (7.10 hrs, Rs. 4146.40, 16.71% and 35.15%) respectively (table 5.5 (a) & 5.5 (b)). Percentages of total number of hours and total cost have been calculated from their respective totals. Total number of hours has been enumerated by multiplying number of hours per day with number of days in the crop season.

Table No. 5.5 (a) PLOUGHING AND SEEDBED PREPARATION *(absolute nos)*

(per hectare)

Source of Power	Machine	Total Number of hours	Total Cost
Animal operated			
	Plough	35	7650.00
	Disc Harrow	---	---
	Cultivator	---	---
Power tiller operated			
	Rotavator	---	---
Tractor operated			
	Plough	7.10	4146.40
	Disc Harrow	---	---
	Cultivator	---	---
	Rotavator	---	---
Total		42.5	11796.40

Primary source: Field level data.

Total No of hours = no of hrs per day × no of days in the crop season

Table No. 5.5 (b): PLOUGHING AND SEEDBED PREPARATION (In %)

Source of Power	Machine	Total Number of hours	Total Cost
Animal operated			
	Plough	82.35	63.59
	Disc Harrow	---	---
	Cultivator	---	---
Power tiller operated			---
	Rotavator	---	---
Tractor operated			
	Plough	16.71	35.15
	Disc Harrow	---	---
	Cultivator	---	---
	Rotavator	---	---
Total		100.00	100.00

Primary source: Field level data.

5.6.1 Sowing and Planting

In this section of the chapter, attempt has been made to evolve total number of hours and total costs (in absolute and percentage terms both) source of power wise for sowing and planting.

There is sufficient data to believe that adoption of mechanized practices in operations like sowing and planting is very low in case of surveyed farmers. Only 4.76 per cent of total number of hours and 21.05 per cent of total cost were devoted to seed drill used through power tiller/tractor operated. Manually operated seed drill shared 74.20 hrs/ha that costed Rs. 7,413 in total. On the other hand, power operated seed drill operation incurred the expenditure of Rs. 1,976 only i.e., 26.66 per cent of the manually operated machine (table 5.6 (a) & 5.6 (b). 95.24 per cent of the total number of hours was found to have been devoted in manually operated seed drill operation. It means levels of mechanization in sowing and planting activities were very low.

Table No. 5.6 (a): SOWING AND PLANTING (*absolute nos)*

Source of Power	Machine	Total Number of hours	Total Cost
Manually operated			
	Seed drill	74.20	7413.00
Animal operated			
	Seed drill	---	---
	Drill plough	---	---
	Mustard drill	---	---
	Row planter	---	---
	Sugarcane planter	---	---
	Potato planter	---	---
Power tiller/Tractor operated			
	Seed drill	3.71	1976.00
	Zero till drill	---	---
	Sugarcane planter	---	---
	Potato planter	---	---
	Cultivator	---	---
	Rotavator	---	---
Total		77.91	9389.00

Primary source: Field level data.

Table No. 5.6 (b): SOWING AND PLANTING *(In %)*

Source of Power	Machine	Total Number of hours	Total Cost
Manually operated			
	Seed drill	95.24	78.95
Animal operated			
	Seed drill	---	---
	Drill plough	---	---
	Mustard drill	---	---
	Row planter	---	---
	Sugarcane planter	---	---
	Potato planter	---	---
Power tiller/Tractor operated			
	Seed drill	4.76	21.05
	Zero till drill	---	---
	Sugarcane planter	---	---
	Potato planter	---	---
	Cultivator	---	---
	Rotavator		
Total		100.00	100.00

Primary source: Field level data.

5.6.2 Irrigation, Weeding and Inter-culture

In this section of the chapter, exercises have been undertaken to dig up source of power wise time consumed and total costs incurred in regard to farm machinery usages. Source of power includes (i) manually operated, (ii) animal operated, (iii) power tiller/tractor operated, and; (iv) self propelled. Calculations have been made both in absolute and percentage terms.

Flat out, it could be seen that cent per cent irrigation operation was done by diesel pump set. However, weeding and inter-culturing were undertaken by cent per cent manually operated devices. All in total 32 hours were required for irrigating 1 ha of cropped land that costed Rs. 4,267.66. No farm household was found to have used electric pump for irrigation (table 5.7 (a) & 5.7 (b). In weeding and inter-culturing operations also, 32 hours by manually operated exercises were needed. It costed Rs. 1,250/- only means only Rs. 39.06/hr was the remuneration of labourers for this purpose (table 5.8 (a) & 5.8 (b).

Table No. 5.7 (a): IRRIGATION

(Absolute nos)

Source of Power	Machine	Total Number of hours	Total Cost
	Diesel pump	32	4267.66
	Electric Pump	---	---
Total		32	4267.66

Table No. 5.7 (b): IRRIGATION *(In %)*

Source of Power	Machine	Total Number of hours	Total Cost
	Diesel pump	100	100
	Electric Pump	---	---
Total		100.00	100.00

Primary source: Field level data.

Table No. 5.8 (a): WEEDING AND INTERCULTURE (absolute nos)

Source of Power	Total Number of hours	Total Cost
Manually operated	32	1250
Animal operated	---	---
Power tiller/Tractor operated	---	---
Self-Propelled	---	---
Total	32	1250

Table No. 5.8 (b): WEEDING AND INTERCULTURE *(In %)*

Source of Power	Total Number of hours	Total Cost
Manually operated	100	100
Animal operated	---	---
Power tiller/Tractor operated	---	---
Self-Propelled	---	---
Total	100.00	100.00

Primary source: Field level data.

5.6.3 Plant Protection Equipment and Harvesting

This section of the chapter tries to attract attention towards machinery usages including time required and total costs related to agricultural operations, viz., (i) plant protection equipments, and; (ii) harvesting (both in absolute and percentage terms). As source of power for harvesting operation, questions related to the use of following tools/equipments were asked (i) manual sickle, (ii) animal operated gnut/potato digger, (iii) tractor operated reaper, and; (iv) self propelled reaper.

Having scrutinized the collected data, it is revealed that plant protection equipments are cent per cent manually operated. Harvesting operation, particularly for paddy, was found to have been totally performed by manual sickle. Manually operated plant protection equipments did take 16 hours of time that costed Rs. 384/-. No other source of power was used for plant protection equipment (table 5.9 (a) & 5.9 (b). As far harvesting operation is concerned, only manual sickle was found to have been used. It took nearly 125.20 hrs and costed Rs. 3870/- (table 5.10 (a) & 5.10 (b). It is to be noted that the harvester and reaper machine etc., were made available in the surveyed areas through Farm Machinery Bank in the late 2011-12, and the primary data collected was confined to the last crop season, i.e., paddy. It might be due to this that no machinery was found to have been used in harvesting operation. Longer time usage in harvesting by manual sickle clearly reveals low level of mechanization in the area/region.

Table No. 5.9 (a): PLANT PROTECTION EQUIPMENT (absolute nos)

Source of Power	Total Number of hours	Total Cost
Manually operated	16	384.00
Animal operated	---	---
Power tiller/Tractor operated	---	---
Self-Propelled	---	---
Total	16	384.00

Table No. 5.9 (b): PLANT PROTECTION EQUIPMENT (In %)

Source of Power	Total Number of hours	Total Cost
Manually operated	**100**	**100**
Animal operated	---	---
Power tiller/Tractor operated	---	---
Self-Propelled	---	---
Total	100.00	100.00

Primary source: Field level data.

Table No. 5.10 (a): HARVESTING (absolute nos)

Source of Power	Total Number of hours	Total Cost
Manual Sickle	125.20	3870.00
Animal operated gnut/potato digger	---	---
Tractor operated reaper	---	---
Self-Propelled reaper	---	---
Total	125.20	3870.00

Table No. 5.10 (b) HARVESTING

(In %)

Source of Power	Total Number of hours	Total Cost

Manual Sickle	100	100
Animal operated gnut/potato digger	---	---
Tractor operated reaper	---	---
Self-Propelled reaper	---	---
Total	100.00	100.00

Primary source: Field level data.

5.6.4 Threshing

In this section of the chapter, attempt has been made to figure out source of power wise time taken and total costs (both in absolute and percentage terms). Information related to (i) power operated thresher, (ii) tractor operated thresher, (iii) paddy thresher, (iv) maize thresher, (v) ground thresher, and; (vi) any other (specific) were duly obtained to arrive at a conclusion.

Having a glance on data in the table, it can be inscribed that cent per cent threshing operation in case of paddy was done by paddy thresher, which required 126 hours in threshing full quantum of grain grown/hectare of land. Out of the total grain threshed, 91.57 per cent was done manually, whereas 8.43 per cent of threshing operation was undertaken by animal power. All in total, it costed Rs. 3724/- only (table 5.11 (a) & 5.11 (b). It is to be again noted here that in this section, information and data of the crops grown in the last crop season only (means paddy), have been obtained and analyzed. It is, therefore, the use of thresher only could be observed in this case. Though, machines like combine harvester and thresher were available in the recently established Farm Mechanization Bank. However, as a result of non-familiarity of the farmers with the use of these machines, and in absence of a **full time trained mechanical operator** of these machines, their usage was limited.

Table No. 5.11 (a): THRESHING (absolute nos)

Source of Power	Total Number of hours	Total Cost
Power operated thresher	---	---
Tractor operated thresher	---	---
Paddy thresher	126.00	3724.00
Maize thresher	---	---
Groundnut thresher	---	---
Any other (specify)	---	---
Total	126.00	3724.00

Table No. 5.11 (b): THRESHING (In %)

Source of Power	Total Number of hours	Total Cost
Power operated thresher	---	---
Tractor operated thresher	---	---

Paddy thresher	100	100
Maize thresher	---	---
Groundnut thresher	---	---
Any other (specify)	---	---
Total	100.00	100.00

Primary source: Field level data.

5.6.5 Transportation and Marketing

In this section of the chapter, efforts have been made to dig out source of power wise usage of devices/machines meant for transportation and marketing (both in absolute and percentage terms). Animal operated and 'tractor trolley driven' means of transportation have been taken into consideration for analysis.

Data help us to show the general idea that more time was devoted (10 hours) means 68.97 per cent of the total usage in transporting the agricultural produces for marketing by animal operated device. Total cost incurred in animal operated transport device stood at Rs. 600.25/- per ha, i.e., Rs. 60.02/- per hour. Tractor operated trolley was used only for 4.5 hours that costed Rs. 392.90. It means per hour cost incurred in machine driven device (Rs. 87.31) is higher than animal operated device. In percentage terms, the share of costs incurred in animal operated and tractor trolley were 60.44 and 39.56 respectively (table 5.12 (a) & 5.12 (b). Percentages of total hours devoted for these two modes of transportation and marketing were calculated at 68.97 and 31.03 respectively.

Table No. 5.12 (a): TRANSPORTATION AND MARKETING

(absolute nos)

Source of Power	Total Number of hours	Total Cost
Animal Operated	10.00	600.25
Tractor trolley	4.50	392.90
Total	14.50	993.15

Table No. 5.12 (b): TRANSPORTATION AND MARKETING

(In %)

Source of Power	Total Number of hours	Total Cost
Animal Operated	68.97	60.44
Tractor trolley	31.03	39.56
Total	100.00	100.00

Primary source: Field level data.

Conclusively, it can be congenitally mentioned that if general conditions of roads in remote rural areas are improved and larger use of tractor trolleys are preferred, then costs of transportation and marketing will be certainly lower.

Summary of the Chapter

Before jumping to conclusions it is envisaged that most of the sample households owned manual and animal operated machines. Ownership of machinery operation wise also revealed larger percentages of manually operated machines/tools used in the activities like: sowing weeding, plant protection and harvesting. For irrigation, cen-per-cent of the farm households used pump sets mostly diesel run, either owned by them or on custom hiring basis. Animal and manually operated machines/devices were used by most of the farmers for (i) threshing, (ii) weeding, and; (iii) harvesting respectively, whereas tractor was operated prominently for ploughing purposes. While ploughing and harvesting were the main operations, where animal and manually operated machines were employed for larger hours of time usage, there, on the other hand, irrigation and ploughing were ahead by power and tractor operated machines respectively. In percentage terms, operations like: (i) weeding, (ii) plant protection, and; (iii) harvesting shared longer hours of usage by manually operated devices. Longer time and larger total costs (in absolute number and percentage both) could be seen in ploughing and seed-bed preparation by animal operated machines. There is sufficient data to believe that adoption of mechanized practices in operations like sowing and planting were very low in case of surveyed farmers. It was seen that cent-per-cent irrigation operation was performed by diesel pump sets. However, weeding and inter-culturing activities were undertaken cent-per-cent by manually operated devices. Both of these operations took equally large hours of time usages. Cent-per-cent of the plant protection equipments were used, which were manually operated and it took (all in total) 16 hours of time per hectare of cropped area. Operation of harvesting needed quite longer hours of time than plant protection, irrigation, sowing and planting and ploughing & seed-bed preparation. It was wholly performed by manual sickle. Even having used paddy thresher by cent-per-cent-per-cent of the sample households, it had to be given maximum number of hours. General observation is also revealed here that more time was devoted containing quite higher percentage of the total usage in transporting the agricultural produces for marketing by animal operated means of conveyance. Per hour cost incurred in machine driven device was higher than that of animal operated device.

CHAPTER - VI

FARMERS' PERCEPTIONS

This chapter contains farmers' perception in regard to various aspects of Mechanized practices in the field of agriculture as reported by surveyed farmers of non-

mechanized and comparatively mechanized villages. Attempt has been made to analytically illuminate the following perception aspects (i) reasons for using machinery, (ii) operations for which machines were used, (iii) appropriate machines for various operations, (iv) major problems with the machinery, (v) usefulness of machinery, (vi) awareness assistance received from and usefulness of government mechanization programs, and; (vii) increase in area and production (if any) after using machines.

6.1 Reasons for using Machinery

In this section, ranks have been provided to different factors responsible for using machineries. The analysis has been made in absolute and percentage terms. Some of the reasons included for knowing the perception of sample farmers were (i) higher yield, (ii) economical, (iii) quicker operations, (iv) reduces drudgery, and; (v) any other.

Quicker operations, economical and quicker operations again (for rank – III) were the main reasons, provided top rating under rank – I, rank – 2 and rank – 3 (59%, 50% and 49%) respectively by the sample farmers for using machinery. Economical and quicker operations and economical again were the other important factors widely perceived by the sample households being the reasons for using farm machineries (35%, 40% and 40%) respectively (tale 6.1(a) & 6.1 (b)).

Table No. 6.1 (a): REASONS FOR USING MACHINERY **(absolute nos)**

Reason	Rank 1	Rank 2	Rank 3
Higher Yield	06	06	09
Economical	35	50	40
Quicker operations	59	40	49
Reduces drudgery	0	04	02
Any other	0	0	0
Total	100	100	100

Table No. 6.1 (b): REASONS FOR USING MACHINERY **(In %)**

Reason	Rank 1	Rank 2	Rank 3
Higher Yield	06	06	09
Economical	35	50	40
Quicker operations	59	40	49
Reduces drudgery	0	04	02
Any other	0	0	0
Total	100%	100%	100%

Primary source: Field level data.

6.2 Operations for which Machines used

Farmers' perception in regard to ranking for different operations have been obtained and emphasized in this section. Ploughing, sowing, irrigation, weeding, plant protection, harvesting threshing and transportation and marketing were the operations regarding which questions were asked. Data showing operation of irrigation having achieved highest rating under ranks - 1, 2 & 3 thrust on self forward (50%, 45% and 50%) respectively. After irrigation, the other operation for which machineries were predominantly used and which were provided rank – 1, rank-2 and rank -3 was ploughing (47%, 41% and 40%) respectively (table 6.2 (a) & 6.2 (b)). Other operations got poor ratings under the three categories of ranks. It means mechanization levels in other operations were very low. The low percentages of surveyed farm households in regard to farmers' perception for using transportation and marketing related devices (either by animal operated or tractor operated), were the only opinions in terms of rank rating. It could be possibly due to the fact that most of the farmers preferred to sell their surplus agricultural produces within villages. If some of them sold their surplus agricultural commodities in the distant district or sub-divisional markets or arhats, they did so through commission agents/middlemen/itinerant traders. In such situation, they had not much direct experiences in regard to transportation and marketing means or machineries. So, the percentages were found low at 3,4 & 2 (for rank I,II & III) respectively.

Table No. 6.2 (a): Operations for which the machines are used (absolute nos)

Operation	Rank 1	Rank 2	Rank 3
Ploughing	47	41	40
Sowing	0	0	0
Irrigation	50	45	50
Weeding	0	0	0
Plant Protection	0	0	0
Harvesting	0	0	0
Threshing	0	10	08
Transportation and Marketing	03	04	02
Any other	0	0	0
Total	100	100	100

Table No. 6.2 (b): Operations for which the machines are used (In %)

Operation	Rank 1	Rank 2	Rank 3
Ploughing	47	41	40
Sowing	0	0	0
Irrigation	50	45	50
Weeding	0	0	0
Plant Protection	0	0	0
Harvesting	0	0	0
Threshing	0	10	08
Transportation and Marketing	03	04	02
Any other	0	0	0

Total	100%	100%	100%

Primary source: Field level data.

6.3 Appropriate Machines for Different Operations: Ploughing

Attempt has been made in this section of the chapter to divulge sample farmers perception towards their preference for appropriate machine Their number and percentage were drawn in regard to (i) animal operated, (ii) power tiller operated, and; (iii) tractor operated ploughing machine.

It is observed that in the study area, tractor operated plough (60%) and animal operated ploughing (15%) were considered to be the most appropriate machines/devices for ploughing. Disc harrow (10%) power tiller operated rotavator (9%) and tractor operated disc harrow (6%) could also be appropriate machines for ploughing (table 6.3). Having come across about the use of these machines through demonstration, the surveyed farmers opined that these might be the appropriate tools for ploughing.

Table No. 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	15	100	15
	Disc Harrow	10	100	10
	Cultivator	00	00	00
Power tiller operated				
	Rotavator	09	100	09
Tractor operated				
	Plough	60	100	60
	Disc Harrow	06	100	06
	Cultivator	00	00	00
	Rotavator	00	00	00

Primary source: Field level data.

6.4 Sowing and Planting

In this section, appropriate machines for sowing and planting have been examined. (i) manually operated, (ii) animal operated, and; (iii) power tiller/tractor operated seed drill, drill plough, mustard drill, row planter, sugarcane planter, potato planter, zero till drill, cultivator and rotavator have been taken into consideration to obtain perception of sample farms for ascertaining their views regarding appropriate machines for sowing and planting.

Having scrutinized data in table, it can be noted that manually and animal operated seed drill were considered as the most appropriate sowing and planting machines (65% & 17%) respectively by the sample households. However, in very small number of cases (8% and 10%) power tiller/tractor operated seed drill and zero till drill were also found to be appropriate machines for these purposes (table 6.4). 94 sample farmers (as per table 5.3(a) were found to have used sowing related manually operated machines. It is being reflected here also through the analysis of table 6.4.

Table No. 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	65	100	65
Animal operated				
	Seed drill	17	100	17
	Drill plough	00	100	00
	Mustard drill	00	00	00
	Row planter	00	00	00
	Sugarcane planter	00	00	00
	Potato planter	00	00	00
Power tiller/Tractor operated				
	Seed drill	08	100	08
	Zero till drill	10	100	10
	Sugarcane planter	00	00	00
	Potato planter	00	00	00
	Cultivator	00	00	00
	Rotavator	00	00	00

Primary source: Field level data.

6.5 Irrigation

There is no data based evidence to contradict that cent-per-cent surveyed farm households pronounced diesel pump to be the most appropriate machine for irrigation (table 6.5). It is also corroborated by table 5.3(a), which reveals that all of the surveyed farmers used diesel power operated machines for irrigation.

Table No. 6.5: Irrigation

Most Appropriate Machine (1)	Number of farmers (2)	Total no of farmers (3)	% of farmers (2 as % of 3)
Diesel Pump	100	100	100
Electric Pump	00	00	00

Primary source: Field level data.

6.6 Weeding and Inter-culture

In this section, farmers perception related to most appropriate machines for weeding and inter culture has been examined (i) manually operated, (ii) animal operated, (iii)

power tiller/tractor operated, and; (iv) self-propelled machines have been juxtaposed for capturing data/information in this section.

Manually operated weeding and inter-culture machines were confirmed as most appropriate ones (89%) by the sample households. However, quite a few of them described self propelled machine (9%) to be the most appropriate for weeding and inter-culture (table 6.6). Farmers' perception towards manually operated weeding and inter-culture machines to be highly suitable and one of the prominent ones, is in consonant with the data in the table sowing number of farmers using machinery.

As through data contained in table 6.6, farmers' perception in regard to various aspects of mechanized practices has been captured, so some of them did not clearly say about manually operated self propelled weeding and inter-culture devices/equipments. Due to ignorance, some of the marginal and small sample households did not give a definite in regard to most appropriate machine.

Table No. 6.6: Weeding and Inter-culture

Most Appropriate Machine (1)	Number of farmers (2)	Total no of farmers (3)	% of farmers (2 as % of 3)
Manually operated	89	100	89
Animal operated	00	00	00
Power tiller/Tractor operated	00	00	00
Self-Propelled	09	100	09

Primary source: Field level data.

6.7 Plant Protection Equipment

Among plant protection equipments, manually operated machine was exalted as appropriate one by larger proportion of farmers (75%). However, self propelled machine was also held appropriate by 25.00 per cent of sample households (table 6.7). There is sufficient ground to deem the appropriateness of manually operated machines for plant protection as quite large number of sample households (68) were also found to have used such machines for this operation.

Table No. 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	75	100	75
Animal operated	00	00	00
Power tiller/Tractor operated	00	00	00

Self-Propelled	25	100	25

Primary source: Field level data.

6.8 Harvesting

As noted earlier, sample households had definite feeling/experience that manual sickle was the most appropriate machine 61.00 per cent for harvesting. No other machine except self propelled reaper (12%) was described as appropriate as sickle by the farmers of the study area (table 6.8). If animal operated gnut/potato digger and tractor operated reaper are popularized through demonstration, then these can be widely used, as this is potential area for potato. The above scenario, to a great degree, supports the earlier response of the sample farmers, where highest number of them had told about the use of manually operated harvesting machines. The surveyed farm households (particularly belonging to marginal and small classes), though were not much familiarized about technical harvesting devices or other similar purpose machines. However, such farmers and some other households belonging to medium and large size classes were also of the view that tractor operated reaper could have been most appropriate machines for them. Number of farmers having this perception was 27 (table 6.8).

Table No. 6.8: Harvesting

Most Appropriate Machine (1)	Number of farmers (2)	Total no of farmers (3)	% of farmers (2 as % of 3)
Manual Sickle	61	100	61
Animal operated gnut/potato digger	00	00	00
Tractor operated reaper	00	00	00
Self-Propelled reaper	12	100	12

Primary source: Field level data.

6.9 Threshing

In threshing, power operated thresher was told as most appropriate machine (50%) by sample households. Paddy thresher and maize thresher (25%) each was also accepted as appropriate machines by them (table 6.9). Though in regard to using machinery for threshing, quite high number of small households used manual and animal operated devices (83 & 17 respectively) table (5.3(a)). However, as far their

perception/willingness is concerned, they would like to use or hire the services of power operated thresher.

Table No. 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	50	100	50
Tractor operated thresher	00	00	00
Paddy thresher	25	100	25
Maize thresher	25	100	25
Groundnut thresher	00	00	00
Any other (specify)	00	00	00

Primary source: Field level data.

6.10 Marketing and Transportation

A glance on data collected causes to do believe that tractor trolley like device/machine was the most appropriate means for marketing and transportation (80%). However, animal operated means of transportation was also, used for this purpose to some extent in less mechanized villages/areas 20.00 per cent (table 6.10). These data spell and help to draw the inference that number of farmers, who have used animal and tractor operated devices of transportation and marketing (as discussed in section 5.3), is very much similar to this scenario.

Table No. 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	20	100	20
Tractor trolley	80	100	80

Primary source: Field level data.

6.11 Major Problems with Machinery used

6.11.1 Ploughing

This section of the chapter seeks to examine major problems with machinery used for ploughing (as percentage of farmers reporting as rank – 1). Power source wise information containing (i) animal operated, (ii) power tiller, (iii) tractor, (iv) Manual, and; (v) animal driven machines have been taken into consideration. Crisp opinion perceptions have been obtained from the sample farmers in connection with the following questions (a) expensive to purchase, (b) hire facility not available, (c) expensive to hire, (d) high maintenance cost, (e) repair facilities unavailable, (f) repair and service facilities expensive, (g) yield not as expected, (h) not easy to use (i) no government support, (j) any other, and; (k) percentage of farmers not reporting

any reason. Some set of questions/information were entailed in regard to machineries used for (i) sowing and planting, (ii) irrigation, weeding and plant protection, and; (iii) harvesting, threshing and marketing.

Main revealed problem in case of animal operated plough and tractor plough were expensive to hire and expensive to purchase (31% & 37%) respectively. Hire facility not available, expensive to hire and repair facilities unavailable were also reported as some of the problems in regard to tractor plough, power tiller rotavator, manual seed drill and animal seed-cum-fertilizer drill (10%, 8%, 9%, 11%, 7% and 7%) respectively (table 6.11.1).

6.11.2 Sowing and Planting

Hire facility not available and expensive to hire in case of tractor driven seed-cum-fertilizer drill and manual seed drill (17%, 12% & 10%) respectively were noted as major problems by the surveyed farmers. Expensive to purchase and high maintenance cost were also evinced as low ranking major problems in regard to tractor driven seed-cum-fertilizer drill, zero till drill and hire facility not available for animal driven row planter (2%, 1%, 2% & 2%) respectively (table 6.11.2).

6.11.3 Irrigation, Weeding and Plant Protection

In this section of the chapter, attempt has been made to knock major problems with machineries used for irrigation, weeding and plant protection off surveyed farmers pedestal (as reported by them in percentage terms). It is a matter to be dwelt upon that expensive to hire and hire facility not available in case of manually operated weeding and interculture machines (25% & 10%) respectively were the major problems). Further, expensive to purchase, expensive to hire, repair and service facilities expensive, and high maintenance cost were also experienced as low and middle ranking major problems in case of diesel pump operated irrigation machine (8%, 10%, 10% & 7%) respectively (table 6.11.3). In regard to plant protection machineries used, major problems reported by sample households were related to hire facility not available and expensive to hire manually operated machines (5% & 7%) respectively.

6.11.4 Harvesting, Threshing and Marketing

Major problems, as reported by surveyed farmers in regard to use of machineries for harvesting, threshing and marketing have been recognized and analysed in this section. Hiring facility not available in case of manual sickle, particularly when labourers were not available in desired number, paddy thresher for undertaking the operation of threshing and expensive to hire bullock driven marketing means of conveyance (20%, 50% & 12%) have been reported as major problems. The bullock driven marketing means suffered with disadvantages of expensive to hire in those villages, roads and streets of which were very narrow and in a dilapidated condition. Not easy to use was informed as third ranking major problem (11%) in case of manual sickle, as some wastage of grains also occurred in the process. Under this colum of operation by manual sickle, 64.00 per cent of the respondents did not report any reason in regard to the use of it. Hiring facility not available (in case of maize thresher) and expensive to purchase tractor trolley for marketing (25% & 8%) respectively, were the constraints reported as some of the second ranking problems (table 6.11.4).

Table No. 6.11.1: 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	--	05	31	--	--	--	--	--	--	--	64	100%
	Disc Harrow	--	--	--	--	--	--	--	--	--	--	100	100%
	Cultivator	--	--	--	--	--	--	--	--	--	--	100	100%
Power Tiller	Rotavator	--	09	--	--	--	--	--	02	--	--	89	100%
Tractor	Plough	37	10	08	03	--	--	--	--	--	--	42	100%
	Disc Harrow	--	03	--	--	--	--	--	--	--	--	97	100%
	Cultivator	--	02	--	--	--	--	--	--	--	--	98	100%
	Rotavator	--	02	--	--	--	--	--	--	--	--	98	100%
Manual	Seed drill	--	11	--	--	--	--	--	--	--	--	89	100%
Animal	Seed cum fertilizer drill	--	07	--	--	07	--	--	--	--	--	86	100%
	Drill Plough	--	--	--	--	--	--	--	--	--	--	100	100%
	Mustard drill	--	--	--	--	--	--	--	--	--	--	100	100%
	Row planter	--	04	--	--	--	--	--	--	--	--	96	100%
	Sugarcane planter	--	--	--	--	--	--	--	--	--	--	100	100%
	Potato planter	--	--	--	--	--	--	--	--	--	--	100	100%

Primary source: Field level data.

Table No. 6.11.2: 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	--	05	10	--	--	--	--	--	--	--	85	100%
Animal	Seed cum fertilizer drill	--	--	--	--	--	--	--	--	--	--	100	100%
	Drill Plough	--	--	--	--	--	--	--	--	--	--	100	100%
	Mustard drill	--	--	--	--	--	--	--	--	--	--	100	100%
	Row planter	--	02	--	--	--	--	--	--	--	--	98	100%
	Sugarcane planter	--	--	--	--	--	--	--	--	--	--	100	100%
	Potato planter	--	--	--	--	--	--	--	--	--	--	100	100%
Tractor	Seed cum fertilizer drill	02	17	12	02	--	--	--	--	--	--	67	100%
	Zero till drill	01	02	--	--	--	--	--	--	--	--	97	100%
	Sugarcane planter	--	--	--	--	--	--	--	--	--	--	100	100%
	Potato planter	--	--	--	--	--	--	--	--	--	--	100	100%

Primary source: Field level data.

Table No. 6.11.3: 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	08	05	10	07	--	10	--	--	--	--	60	100%
	Electric pump	--	---	---	--	--	--	--	--	--	--	100	100%
Weeding and intercultue	Manually operated	--	10	25	--	--	--	--	--	--	--	65	100%
	Animal operated	--	---	---	--	--	--	--	--	--	--	100	100%
	Tractor/ power tiller operated	--	---	---	--	--	--	--	--	--	--	100	100%
	Self-propelled	--	10	---	--	--	--	--	--	--	--	90	100%
Plant protection	Manually operated	--	05	07	--	--	--	--	--	--	--	88	100%
	Power tiller operated	--	---	--	--	--	--	--	--	--	--	100	100%
	Tractor operated	--	---	--	--	--	--	--	--	--	--	100	100%
	Self-propelled	03	03	--	--	--	--	--	--	--	--	94	100%

Primary source: Field level data.

Table No. 6.11.4: 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	--	20	05	--	--	--	--	11	--	--	64	100%
	Animal operated groundnut-cum-potato digger	--	---	--	--	--	--	--	--	--	--	100	100%
	Tractor operated reaper	--	---	--	--	--	--	--	--	--	--	100	100%
	Self-propelled reaper	--	09	--	--	--	--	--	--	--	--	91	100%
Threshing	Power operated thresher	--	---	--	--	--	--	--	--	--	--	100	100%
	Tractor operated thresher	--	---	--	--	--	--	--	--	--	--	100	100%
	Paddy thresher	10	50	--	--	--	--	--	--	--	--	40	100%
	Maize thresher	--	25	--	--	--	--	--	--	--	--	75	100%
	Groundnut thresher	--	---	--	--	--	--	--	--	--	--	100	100%
	Any other (specify)……..	--	---	--	--	--	--	--	--	--	--	100	100%
Marketing	Bullock	02	02	12	--	--	--	--	--	04	--	80	100%
	Camel	--	--	--	--	--	--	--	--	--	--	100	100%
	Horse	--	--	--	--	--	--	--	--	--	--	100	100%
	Donkey	--	--	--	--	--	--	--	--	--	--	100	100%
	Any other animal	--	--	--	--	--	--	--	--	--	--	100	100%
	Tractor trolley	08	--	02	--	--	--	--	--	--	--	90	100%

Primary source: Field level data.

6.12 Usefulness of the Machinery

In this section of the chapter, farmers' views in regard to usefulness of the machineries used have been sat up and taken type of use wise. Type of use regarding which perceptions were obtained is contained in (i) higher yield, (ii) better land utilization, (iii) more number of crops, (iv) reduced drudgery, (v) higher social esteem, (vi) higher income, and; (vii) any other.

Better land utilization and reduced drudgery were the two prominently reported answers of usefulness of machineries (29% & 27%) respectively. However, higher yield and more number of crops were also felt as usefulness of machineries by some of the respondents (11% & 5%) respectively (table 6.12). Higher social esteem, higher income and other factors were also reported by the farm households (10%, 12% & 6%) respectively as the instrumental factors for being the machineries useful.

Table No. 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	11	11
	Better land utilization	29	29
	More number of crops	05	05
	Reduced drudgery	27	27
	Higher social esteem	10	10
	Higher income	12	12
	Any other	6	6

Primary source: Field level data.

6.13 Awareness and Assistance under Government Programme

This section of the chapter contains analytical discussion related to (i) farmers' awareness related to governments programmes, (ii) farmers received assistance under the programme, and; (iii) type of assistance received. The (iii) number further includes number of farmers by type of assistance as mentioned below: (a) subsidy on purchase of machine, (b) subsidy on consumables, (c) Demonstration of best practices, (d) training to use machines, (e) cash incentives to use machines, (f) complementary input provision, and; (g) any other. While information/data related to (i) to (iii) are in number and percentage to the total number of farmers, data in the table meant for (a) to (g) have been collected in multiple response.

Having a glance on data, it is interesting to note that majority of the total farmers surveyed (60%) were though aware of the government programmes and types of assistance provided under those schemes/programmes. However, only 18.00 per cent of the sample farm households were found to have received assistance of one kind or the other under government run programmes/schemes (table 6.13). Subsidy on consumables' was received by 8 farmers out of 18 and training to use machines by 2 only. The low level of awareness about the programmes and assistance received, thus, need to be removed by expanding and gearing up extension services and machineries of the state and central governments.

Table No. 6.13: Awareness and Assistance received under government programmes

Awareness/Assistance	Type	No of farmers	% of farmers to total number of farmers
Farmers aware of the programs		60	40
Farmers not aware of the programs		40	60
Farmers who received assistance under the programs		18	18
Type of assistance received	Subsidy on purchase of machine	04	---
	Subsidy on consumables	08	---
	Demonstration of best practices	04	---
	Training to use machines	02	---
	Cash incentives to use machines	---	---
	Complementary input provision	---	---
	Any other	---	---

Primary source: Field level data.

6.14 Usefulness of the Programmes

It is interesting to note that 20.00 per cent of the total farmers surveyed did not find the programmes useful, as they were not even aware about most of the farm mechanization initiatives. However, 40.00 per cent of the farm households found the programmes useful (table 6.14). Out of the total sample farmers, who found the programmes useful, 28 told about learning new techniques of mechanization, whereas 12 accepted to have got cash/subsidy for machines or other consumables.

Table No. 6.14: Usefulness of the Programs

Usefulness/type of use	**Type**	**No of farmers**	**% of farmers to total number of farmers**
Farmers who found the programs useful		40	40
Farmers who haven't found the programs useful		20	20
Type of use	Learnt new techniques of mechnization	28	---
	Got cash/subsidy for machines	12	---
	Any other	---	---

Primary source: Field level data.

Quite good proportion of surveyed farmers denying use fullness of the programmes related to agricultural mechanization could be due to the fact that the farm mechanization bank was installed in the study region in the recent past. So most of the farmers could not learn the technical process of their operations and couldn't grasp their utility/advantages also.

6.15 Increases in Area after Mechanization

It is clearly revealed that whatever increases in production were observed in cases of paddy, wheat and gram had caused as a result of mechanization (2.15%, 1.90% & 1.50%) respectively. The increases in percentage of production of these crops were seen after 0.92 per cent and 5.00 per cent increases in areas under paddy and gram respectively (table 6.15). Surveyed farmers, in aggregate sense, perceived such increases in quantum of production to have caused by mechanized practices and use of machineries (manually, animal, tractor, power tiller operated and self-propelled too) to a great extent. Conclusively, positive effects of mechanization on agricultural growth and comparative economics of labour and machinery are there. Its adjacency to real contribution needs to be assessed.

Table No. 6.15: Increase in area after mechanization

Crop	% of area increase	% of production increase	% of production increase reported to be due to machines
Paddy	0.92	2.15	2.15
Wheat	---	1.90	1.90
Maize	---	---	---
Lentil	---	---	---
Gram	05.00	1.50	1.50

Primary source: Field level data.

Summary of the Chapter

The analysis related to farmers' perceptions has been made in absolute and percentage terms. The factors for which farmers' perception have been obtained contained: (i) economical, (ii) quicker operations, (iii) reduction in drudgery, and; (iv) any other. For measuring the intensity of perception, ranking (viz., Rank – I, Rank-II and Rank – III) has been taken into consideration. Quicker operation, economical and quicker operations again were considered main reasons by the farmers for the use of machinery revealed in the form of getting Rank – I, II & III respectively. In percentage terms also, the scenario was similar. Irrigation and ploughing related operations were the main for which machines were widely used. For all the three ranks, these operations were prominent. In the study area, tractor operated plough and then animal operated plough were reported as most appropriate machines/devices for this purpose. It was observed that manually and animal operated seed drills were the most appropriate sowing and planting machines by the sample households. Cent-per-cent surveyed farm households pronounced diesel pump set to be the most appropriate machine for irrigation. Farmers' perception towards manually operated weeding and inter-culture machines to be highly suitable was in consonant with earlier data showing number of farmers using machineries. Among plant protection equipments, manually operated machine was considered as appropriate one by larger proportion of farmers. No other machine except self propelled reaper was described as appropriate as sickle for harvesting by the sample farmers.

Power operated thresher was perceived as most appropriate machine for threshing. Though quite large number of sample households used manual and animal operated devices for this purpose. For marketing and transportation tractor trolley like: device/machine was perceived as the most appropriate means. Main revealed problem in cfase of animal operated plough and tractor plough were expensive to hire and expensive to purchase respectively. Hire facility not available and expensive to hire in case of tractor driven seed-cum-fertilizer drill respectively were noted as major problems by surveyed farmers. While expensive to hire and hire facility not available in case of manually operated weeding and inter-culture machines respectively were the major problems as perceived by the farmers. In regard to irrigation related problems; (i) expensive to purchase, (ii) expensive to hire, (iii) repair and service facilities expensive, and; (iv) high maintenance cost were experienced as low and middle ranking major problems. In case of plant protection machineries used problems of hiring facility not available and expensive to hire were major but low ranking problems. Hire facility not available (in case of manual sickle), particularly when labourers were not available in desired number, non-availability of paddy thresher on time and expensive to hire bullock driven cart marketing means of transportation have been reported as major problems. Better land utilization and reduced drudgery were the two prominently reported answers in response to usefulness of machineries. It was interesting to note that majority of the total farmers surveyed were though not aware of all the government programmes and types of assistance being provided, however, some of them did receive assistance of one kind or the other under some of programmes/schemes. Quite lower

percentage of total farmers surveyed didn't find the programme useful, as they were not even aware about most of the farm mechanization initiatives. However, a little less than half of the total farm households surveyed found the programmes/schemes useful. It is clearly revealed that whatever increases in production were observed in regard to paddy, wheat and gram had caused as a result of mechanization. Conclusively, positive effects of mechanization on agricultural growth, and comparative economics of labour and machinery are there. Its adjacency to actual contribution needs to be examined separately.

CHAPTER – VII

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

7.1 Introduction

Traditionally, Indian farmers relied on equipments, which were simple and could be easily fabricated by village craftsmen. Since introduction of mechanical power, agricultural engineering started gaining importance and thus; organized professional activities started. Though farm mechanization is increasing in India, it is mostly region specific. Besides the region specificity, the growth of agricultural mechanization is mainly hindered by the impediment of decreasing trend in operational land holdings. One of the major factors for poor response of farmers towards mechanization may be that mechanization of small and contiguous groups of land is found to be against economics of scale. Having understood the conformity of farm mechanization with increased production level at lower costs of production; in course of time policy efforts have been made by the Government of India. In addition to two Central Sector Schemes (namely; (i) Promotion and Strengthening of Agricultural Mechanization through Training, Testing and Demonstration, and; (ii) Post-harvest Technology and Management during the 11th Plan Period programmes like; MMA, RKVY, NHM and NFSM are also being implemented for promotion of mechanization. In the above backdrop and based on the primary survey of 100 farmers randomly chosen (50 each from high and low mechanized villages/strata), this study seeks to study the effects of mechanization on agricultural growth and comparative economics of labour and machinery in Bihar.

While the secondary data sources and information provide the breadth of effects of mechanization in agricultural sector as a whole, the primary data based inputs provide the depth. We are sure that the Policy Makers; Agricultural Scientists,

scholars, practitioners and officers of Agriculture and allied departments will find this study useful for their purposes.

Reference Period

Reference period of secondary data used in this study is 2001-02 to 2009-10. For primary data, it was 2008-09 to 2010-11.

7.2 Mechanization Programmes and Trends of Mechanization in Bihar

In Bihar, agricultural sector is faced with mainly four key challenges: (i) nano size of land holdings, (ii) low yields and high risks, (iii) biotic and abiotic constraints in raising crop yields, and; (iv) weak institutions accompanied by poor infrastructure. As far as efforts of the Government to promote and strengthen mechanization in agricultural sector are concerned since the year 2009-10 during the 11th Five Year Plan, i.e., agricultural machines, tools and equipments are being made available to farmers on subsidy basis mainly under the six schemes/programmes, viz., (i) MMA, (ii) ISOPOM, (iii) Jute Technology Mini Mission – II, (iv) NFSM, (v) RKVY, and; (vi) State Plan on Power Tiller Promotion Scheme. Range of subsidy on agricultural machineries/implements being very wide (from Rs. 3,000/- only on conoweeder to Rs. 30,000/- only meant for rotavator). As small implements were distributed largely, which had led in exceeding of physical targets in some years, so big machines could be distributed in less than targeted numbers.

Share of cost of human labour as percentage of operational cost was found higher in case of paddy. Cost of bullock labour as percentage of operational cost and machine labour as percentage of the same were found higher in cases of lentil and wheat respectively.

Further, higher shares of the cost of human labour and cost of bullock labour to total cost were found for paddy respectively. Cost of machine labour to total cost could be seen the higher in case of wheat and lower for paddy.

It is interesting to have the determinate observation that the share of machinery cost in regard to value of production was higher in case of paddy for human labour, the same for bullock labour and machine labour in case of wheat. Data reveals higher share of cost of human labour for maize, cost of bullock labour for lentil and cost of

machine labour for paddy' as percentage of value of production. The most interesting and substantial facts revealed here, are that shares of cost of (i) human, (ii) bullock, and; (iii) machine labour as percentage of value of production were minimum or the lowest for pulse crops only.

As far growth of costs in human labour, bullock labour and machine labour in the year 2008-09 as compared to 1996-97 is concerned maximum increase in human labour was observed in case of wheat, higher decline in bullock labour was seen in case of gram and higher increase in machine labour was found in paddy. The growth of production during the period (in percentage terms) was quite higher in value of production terms for wheat. Like the growth of costs scenario quite higher increase in machinery cost was observed in case of paddy again.

7.3 Demographic Profile and Cropping Pattern

It can be circumstantiated that surveyed farmers belonging to medium farm size class had higher average number of adult family members, whereas in regard to male members, small farmers' class was ahead. In regard to illiteracy, education levels up to primary and secondary and above sample marginal farm households were ahead. This could be due to their larger number in the sample. In percentage terms, on the parameter of education of the head of the family large sample households were at top having secondary and above qualification. On average (total) of educational front, medium farmers were ahead. As far percentage distribution of adult educated sample farmers is concerned, small farm size class was at top. Marginal size class had maximum number of SCs & OBCs households. There were no ST farm households in the sample. Percentage distribution of caste composition shows small farm households dominated by OBC, marginal by SC and large by the members of other castes. Higher average areas having irrigation facility were found in case of large and medium farms. In regard to unirrigated areas also, these two farm size classes were ahead. As far percentage distribution of irrigated area is concerned, in regard to total irrigated and total unirrigated areas medium & small and marginal & large respectively were ahead. No canal and tank irrigation was found in the area of study. There was a little fall in Crop Duration Index (CDI) in the year 2010-11 as compared to 2008-09. However, as a result of scanty rainfall in

the year 2009-10, there was a clearly revealed decline in CDI. Paddy wheat and maize were the main cereals grown by the sample households, whereas under pulse crops, lentil, moong and gram got good shares of areas in cropping pattern during the three years.

7.4 Costs of Mechanization

The analysis causes to lead the finding that wheat incurred maximum input costs on seed and irrigation. In regard to organic manure and fertilizer maize was ahead. Wheat also cornered maximum amount as cost on pesticides/weedicides. It is revealed that level of mechanization in the forms of tractor and harvest combine/carriage cost was higher in wheat than paddy and other crops. In percentage terms, distribution of input costs, in regard to hired labour (bullock and manual taken together), and hired machinery costs (including tractor and harvest combine) paddy and wheat respectively were ahead. As the harvest combine machine was made available for service/use of farmers in mechanized villages after the establishment of Farm Mechanization Bank in Mohanpur village of Shahkund block in the year 2010, so we have actually considered expenditures incurred on carriage of large quantum of harvested grains by tractors under the above noted head.

Here it could be noted that maximum and minimum percentages of machinery costs to value of output and same to marketed surplus were meant for wheat and gram. But, in percentage terms of marketed surplus to value of output paddy was at top and wheat at the bottom suggesting that retention of wheat was higher in this region of the state. Percentages of mechanization costs to value of output were also lower in case of lentil and paddy as compared to maize and wheat.

Data in tables demonstrate that in quantitative terms, the operation of ploughing cornered higher per hectare costs. In context of manually and power operated costs of mechanization, sowing were ahead. In case of power and tractor operated costs of mechanization irrigation and transportation and marketing shared maximum expenditures.

In quantitative terms (on aggregate level) higher cost of mechanization was computed for the operation of ploughing and lower being for threshing. Minimum percentages of the costs of mechanization were found in animal operated activities for threshing, manually operated activities of sowing and the lower in case of ploughing by tractor operated machines.

7.5 Pattern of Mechanization

Before jumping to conclusions it is envisaged that most of the sample households owned manual and animal operated machines. Ownership of machinery operation wise also revealed larger percentages of manually operated machines/tools used in the activities like: sowing weeding, plant protection and harvesting. For irrigation, cen-per-cent of the farm households used pump sets mostly diesel run, either owned by them or on custom hiring basis. Animal and manually operated machines/devices were used by most of the farmers for (i) threshing, (ii) weeding, and; (iii) harvesting respectively, whereas tractor was operated prominently for ploughing purposes. While ploughing and harvesting were the main operations, where animal and manually operated machines were employed for larger hours of time usage, there, on the other hand, irrigation and ploughing were ahead by power and tractor operated machines respectively. In percentage terms, operations like: (i) weeding, (ii) plant protection, and; (iii) harvesting shared longer hours of usage by manually operated devices. Longer time and larger total costs (in absolute number and percentage both) could be seen in ploughing and seed-bed preparation by animal operated machines. There is sufficient data to believe that adoption of mechanized practices in operations like sowing and planting were very low in case of surveyed farmers. It was seen that cent-per-cent irrigation operation was performed by diesel pump sets. However, weeding and inter-culturing activities were undertaken cent-per-cent by manually operated devices. Both of these operations took equally large hours of time usages. Cent-per-cent of the plant protection equipments were used, which were manually operated and it took (all in total) 16 hours of time per hectare of cropped area. Operation of harvesting needed quite longer hours of time than plant protection, irrigation, sowing and planting and ploughing & seed-bed preparation. It was wholly performed by manual sickle.

Even having used paddy thresher by cent-per-cent-per-cent of the sample households, it had to be given maximum number of hours. General observation is also revealed here that more time was devoted containing quite higher percentage of the total usage in transporting the agricultural produces for marketing by animal operated means of conveyance. Per hour cost incurred in machine driven device was higher than that of animal operated device.

7.6 Farmers' Perceptions

The analysis related to farmers' perceptions has been made in absolute and percentage terms. The factors for which farmers' perception have been obtained contained: (i) economical, (ii) quicker operations, (iii) reduction in drudgery, and; (iv) any other. For measuring the intensity of perception, ranking (viz., Rank – I, Rank-II and Rank – III) has been taken into consideration.

Quicker operation, economical and quicker operations again were considered main reasons by the farmers for the use of machinery revealed in the form of getting Rank – I, II & III respectively. In percentage terms also, the scenario was similar. Irrigation and ploughing related operations were the main for which machines were widely used. For all the three ranks, these operations were prominent. In the study area, tractor operated plough and then animal operated plough were reported as most appropriate machines/devices for this purpose. It was observed that manually and animal operated seed drills were the most appropriate sowing and planting machines by the sample households. Cent-per-cent surveyed farm households pronounced diesel pump set to be the most appropriate machine for irrigation. Farmers' perception towards manually operated weeding and inter-culture machines to be highly suitable was in consonant with earlier data showing number of farmers using machineries. Among plant protection equipments, manually operated machine was considered as appropriate one by larger proportion of farmers. No other machine except self propelled reaper was described as appropriate as sickle for harvesting by the sample farmers.

Power operated thresher was perceived as most appropriate machine for threshing. Though quite large number of sample households used manual and animal operated devices for this purpose. For marketing and transportation tractor trolley like:

device/machine was perceived as the most appropriate means. Main revealed problem in case of animal operated plough and tractor plough were expensive to hire and expensive to purchase respectively. Hire facility not available and expensive to hire in case of tractor driven seed-cum-fertilizer drill respectively were noted as major problems by surveyed farmers. While expensive to hire and hire facility not available in case of manually operated weeding and inter-culture machines respectively were the major problems as perceived by the farmers. In regard to irrigation related problems; (i) expensive to purchase, (ii) expensive to hire, (iii) repair and service facilities expensive, and; (iv) high maintenance cost were experienced as low and middle ranking major problems. In case of plant protection machineries used problems of hiring facility not available and expensive to hire were major but low ranking problems. Hire facility not available (in case of manual sickle), particularly when labourers were not available in desired number, non-availability of paddy thresher on time and expensive to hire bullock driven cart marketing means of transportation have been reported as major problems. Better land utilization and reduced drudgery were the two prominently reported answers in response to usefulness of machineries. It was interesting to note that majority of the total farmers surveyed were though not aware of all the government programmes and types of assistance being provided, however, some of them did receive assistance of one kind or the other under some of programmes/schemes. Quite lower percentage of total farmers surveyed didn't find the programme useful, as they were not even aware about most of the farm mechanization initiatives. However, a little less than half of the total farm households surveyed found the programmes/schemes useful. It is clearly revealed that whatever increases in production were observed in regard to paddy, wheat and gram had caused as a result of mechanization. Conclusively, positive effects of mechanization on agricultural growth, and comparative economics of labour and machinery are there. Its adjacency to actual contribution needs to be examined separately.

7.7 Action Points

On the basis of analytical discussions, and secondary and primary data based observations made through the preceding six chapters, the following Action Points can be appropriately suggested:

1. Higher costs of mechanized farming, particularly in wheat, are due to good number of irrigation and threshing operations. It could be reduced to some extent by exploring and developing low cost irrigation infrastructure. *(Attn: Department of Water Resources, Government of Bihar, Director-Cum-Dean, Research, "Bihar Agricultural University, Sabour, (Bhagalpur)" RAU, PUSA (Samastipur) and WALMI (Patna).*
2. Zero tillage (particularly in wheat), saves about 1 and half hour of time required for preparing one hectare of land. It also helps in reducing the consumption of diesel by about 20 litres required in sowing wheat/hectare of land. So, 'zero tillage method' needs to be popularized and promoted. *(Attn: Directorate of Agricultural Extension, Government of Bihar).*
3. In the areas/regions of low agricultural mechanization, emphasis should be given on establishing Farm Machinery Banks on district/commissionery level. *(Attn: Ministry of Agriculture, Government of India & Department of Agriculture, Government of Bihar).*
4. In view of increasing number of farmers willing to adopt mechanization in their agricultural operations, the areas/regions where 'Farm Mechanization Banks' are already in existence, the number of particular type of machines/implements should be increased. *(Attn: Director, Agriculture, Government of Bihar & Ministry of Agriculture, Government of India).*
5. As 'Power tillers or 2WTs (two-wheel tractors)' perform the same tasks as' '4WTs,' and these are more effective and desirable for marginal and small holdings, so use of 'Power Tillers (PTs)' needs to be assisted and promoted. *(Attn: Department of Agricultural Extension, Directorate of Agriculture, Government of Bihar, NABARD & Other Public Sector Banks).*
6. Even farmers with small holdings wish to use selected improved farm equipments through custom hiring to increase productivity and to reduce 'cost of production.' So, demonstration and on the field training should be

given/arranged on regular intervals in regard to uses of machine and animal drawn steel plough, disc harrow/cultivators, seed drill, row planter, etc. *(Attn: Directorate of Extension, Government of Bihar).*

7. With a view to overcome the problems of scarcity of capital and/resource to hire machines/tools, Users group or Farmers Co-operative Societies should be formed under mechanization schemes. Further, it should be linked with banks through Micro finance lending. *(Attn: Ministry of Agriculture, Government of India, NABARD, Department of Institutional Finance, Government of Bihar).*
8. In comparatively low mechanized villages/areas, some of the prominent impediments were non-availability of assured sources of irrigation and very poor power supply position, particularly for agricultural operations. To remove these constraints, separate electricity feeders for rural areas be given on priority basis. *(Attn: Department of Water Resources, Government of Bihar, and Bihar State Power Holding Company Ltd. (BSPHCL), Patna.*
9. Mechanized practices in agricultural operations (particularly sowing, planting, etc.) have crept in. But, its level is very low. So, there is need to make farmers more responsive towards mechanization of agriculture by suitably explaining and properly training them about the comparative advantages and usage of agricultural tools, machineries and equipments. *(Attn: Directorate of Agriculture Extension, Government of Bihar).*
10. No use or limited uses of Harvester combine, thresher and other machines/ implements were the result of non-familiarity of farmers with these machines and lack of technical knowledge about how to operate them. So, on regular intervals, trainings to operate those machines/implements need to be urgently given. *(Attn: Directorate of Agricultural Extension, Government of Bihar).*
11. To expand the purview of Agricultural mechanization, "Rice-rubber Houlier Sail-arm Machine and facility of laser leveler (on hiring basis) should be made available. *(Attn: Directorate/Division of Extension, Agricultural Engineering, Directorate of Agriculture, Government of Bihar).*

12. Tractor for "Farm Machineries Bank" should be made available on permanent basis. *(Attn: Directorate of Agriculture, Government of Bihar.*
13. With a view to promote mechanization in agriculture in less mechanized areas of Bhagalpur, Banka and Munger districts, unchecked excavation of sand, particularly from the bed of river Chandan and construction of check dams at some points in this river, need to be strictly stopped and constructed respectively, so that adequate irrigation is ensured during all seasons. *(Attn: Departments of Mines & Water Resources, Government of Bihar).*
14. In view of the lower share of machine labour costs of incurred in pulse crops as percentage of values of their production, greater emphasis needs to be given for promoting mechanized practices in cultivation of pulses. (Attn: *Ministry of Agriculture, Government of India, Department of Agriculture, Government of Bihar).*

Notes & References

1. "*Agricultural Road Map (Implementation Guidelines),"* Agriculture Mechanization (2009-10), Department of Agriculture, Government of Bihar.
2. Singh, Gyanendra (1997), "*Data Book on Mechanization and Agro-Processing since Independence,"* Central Institute of Agricultural Engineering Nabibagh, Berasia Road, Bhopal.
3. "*State of Indian Agriculture (2012-13),"* DAC, MoA, Government of India, p-16-17.
4. "*Adhunik Kisan Diary (2010),"* RAU, PUSA, Samastipur (Bihar).
5. Biggs, Stephen Justice, Scott and Lewis, Davis (2011) "*Patterns of Rural Mechanization, Energy and Employment in South Asia: Reopening the Debate,"* Economic & Political Weekly, Vol.-XLVI, No. 9, February 26 –March 4, 2011, p. 78-82.

Annexure-I

Comments on the draft report

EFFECT OF FARM MECHANIZATION ON AGRICULTURAL GROWTH AND COMPARATIVE ECONOMICS OF LABOUR AND MACHINERY

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22 August 2013

The draft report is in general well-written and the tabulation and chapter schemes suggested by the coordinating institute (IEG) have been broadly followed. The general and chapter-wise comments are given below

General Comments

1. Please provide a one-paragraph summary of each chapter at the end of the chapter bringing out the important inferences of the chapter. Do not give figures in this summary.
2. Please mention data source clearly below each table in the report. If the table is based on author's own calculations based on survey data, mention the same in the source.
3. Please avoid unusual and difficult (and unnecessary) words such as cognised, espouses, enucleate, reverberate, careered etc. Please use simple and easy terms for ease of understanding.

Chapter-wise Comments

Chapter 1

1. Indicate the sources of secondary data clearly

Chapter 2

1. Page 8, section 2.2, paragraph 1 – "The same for Bihar was 1.00 Kilowatt/hectare". Please give the time period to which this refers.

2. Page 9, para iii – "The membership of the committee will comprise of ……testing Report of the Committee". This part does not add much value to this section and may be deleted

3. Page 10, section 2.3 – What could be the possible reasons for financial achievements of farm mechanization programs falling way below 100% of the targets, while the physical achievements are way above 100% of targets? Please give some plausible reasons.

4. Page no 12, Table 2.2 – What is the exact source for this table? Has Jharkhand been excluded? This is important because our own calculations of the costs, excluding Jharkhand, are slightly different from what is given in tables here. Also, please check the data availability for all the years as data for some recent years is available online from the CACP website

5. Table No. 2.3, Page No. 12, Calculation mistake - % of Cost of Machine Labour in Total cost for Lentil, % should be 9.85, (not 0.99%) and change the write-up accordingly *(Last line, Page No. 11 and first paragraph, Page No. 12)*.

6. Table No. 2.4, Page No. 12, Calculation mistake - % of Cost of Human Labour in Value of Production for Maize, % should be 20.13, (not 15.98%) and change the write-up accordingly *(Second paragraph, Page No. 12)*.

7. Page 12, Section 2.4 – Two tables on growth rates of costs of mechanization, in the tabulation scheme by IEG, are not given. These are important tables that give the trends in cost of mechanization vis-à-vis value of production. Kindly include these tables in the final report.

Chapter 3

1) *Page No. 18, Table 3.4 (a)* - The total of all the farm size classes should the total of all the classes. The mistake is that you have calculated 'average area' whereas the correct procedure is to give the total area.

2) Page no 19, Section 3.5, Tables 3.5, 3.5(a), 3.5(b) - 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 3.4(a). However table 3.4(a) also appears incorrect. The irrigated area under tubewell for all farm size-groups does not add up to total irrigated area. This is because you have computed 'average area' for each size group whereas what was required was the 'total area' in each size-group. Similarly for other sources. Kindly correct this table first. The total of irrigated and unirrigated area i.e. the last row, last column entry in this corrected table constitutes "A". Accordingly recalculate tables 3.5, 3.5(a) and 3.5(b). **These are important tables and kindly carry out the corrections carefully.** (kindly call if you need some clarification). Rewrite the text accordingly

Chapter 4

1) *Page No. 25, Tables No. 4.1 (a) and Table No. 4.1 (b)* - The sum is not adding up in 1st table. So in 2nd table, how is the % distribution is calculated? It is not adding up to 100 % but it is indicated in the table. Please correct the table and change the write-up accordingly.

Chapter 5

1) There is a mismatch between tables 5.2(a), 5.3 (a) and 5.4(a). In 5.2(a), 17 households are shown as owning 'animal operated machinery' for 'threshing' whereas as in 5.3(b) no household appears to be using such machinery for threshing. Since the number of households 'owning' the machinery can only be less than or (at most) equal to the number of households 'using' the machinery, one of the tables needs correction. It appears that 5.3(b) is the one that needs correcting because in table 5.4(a) also, the time use for this machinery and operation is recorded as 16 hrs/ha. Therefore, it appears that 5.3(a) (and also 5.3(b)) need correction. Also rewrite the corresponding text accordingly.

2) Page 32 & 33, Tables 5.4 (a) and 5.5(a) - There is a mismatch between tables 5.4(a) and 5.5(a). The hours of usage for 'tractor operated machinery' for 'ploughing' is 7.1 in table 5.4(a) while it is given as 7.5 in 5.5(a). Please correct.

Chapter 6

1) Page no 41, Table 6.3(a) – Please compare table 6.3(a) with 5.3(a) for consistency. For example, the percentage of farmers showing preference for machines for transportation & marketing in table 6.3(a) is only 3% whereas the number of farmers actually using machines is much higher (table 5.3(a)). These differences need to be explained.

2) Pages 43-44, Tables 6.4-6.10 - These tables give perceptions of farmers about the appropriate machinery for different operations while table 5.3(a) gives the actual current usage. Please compare these tables with table 5.3(a) and draw some inferences about the gap between the actual and the desired machinery.

3) *Table No. 6.6, Page No. 44* - Total no of farmers who reported for most appropriate machine for weeding and interculture is not adding up to 100. Please specify if they are non respondents or prefer any other machine for that operation. Similar explanations are required in Table No. 6.8 for harvesting operations and Table No. 6.12 for Usefulness of machinery.

4) Page 52, Tables 6.13 and 6.14 – The total number of farmers finding programs useful+not useful is 60 in table 6.14 whereas the total number of farmers aware of the program are 40. Please check and correct.

Chapter 7

Please organize the summary chapter as suggested in the Chapter Scheme. Please try to provide information on the following but avoid giving statistics in this chapter.

1) Trends in costs of machinery vis-à-vis total costs and value of production
2) For which operations are machines mostly used and which operations are carried out manually?
3) Which type machines (animal, manual, tractor etc) are used for different operations?
4) What is the time use for different machines and operations?
5) What are benefits of machinery as perceived by farmers?

6) What are common difficulties faced by farmers in using machinery?
7) What is the effect of machinery use on production in the perception of the farmers?

Based on these, please provide relevant policy suggestions which should be useful to the policy makers (and Ministries)

Common formatting mistakes

1) *Table No. 2.2, Page No. 11*, Data entry mistake - Operational cost for Lentil, figure should be 5400.90, (not 5400..90).

2) *Page No. 14, 15 17 18 and 20,* end bracket in not placed after table numbering. It should be like (table 3.2(a)), please correct at all the places.

3) *Page No. 17, first line,* Number of OBC households in marginal farms class is 32 (not 23) and head note for table no. 3.3 (b) should be % of Households (Not No. of Households).

4) *Section 3.5, Page No. 19 onwards,* please make single notation for crop names (in tables). In tables it is Masur and in write-up it is Lentil. Please correct at all places.

5) *Page No. 23, Paragraph 3rd,* percentages of machinery costs to marketed surplus for wheat is 44.30 (not 40.30). Please correct based on Table No. 4.2, Page No. 25.
6) *Page No. 31, third last line, (c) sowing for 4.76 % hour is by power operated source.*

7) *Table No. 5.5 (a), Page No. 33,* total no of hours for tractor operated plough should be 7.10 (not 7.5), as reported in Table No. 5.4 (a). Please change the cost and % distribution accordingly.

8) *Page No,40, last paragraph,* Reasons for using machinery are repeating and the % given are 35%, 50%, and 40% (not 35%, 40% and 40%) for ranking for reason-economical. please correct the write-up.

9) *Page No. 45,* Place "," in the last line.

10) *Page No. 47,* write-up based on *Table No. 6.11.4,* 11% farmers reported problem in case of manual sickle is " Not easy to use" (Not the "Yield not as expected")

Annexure – II

Action Taken Report

1. Title of the Study : **EFFECT OF MECHANIZATION ON AGRICULTURAL GROWTH AND COMPARATIVE ECONOMICS OF LABOUR AND MACHINERY IN BIHAR**
2. Date of Receipt of the Comments on Draft Report : 23/08/2013
3. Date of dispatch of the Final Report : 26/09/2013
4. Section wise action taken are as below :

A. **General Comments**

1. Summary of each chapter provided at the end of respective chapters.
2. Data sources mentioned in each table.
3. Corrections made.

B. Chapter wise Comments

Chapter – I : Sources of secondary data indicated clearly at appropriate places.

Chapter – II :

1. Time period mentioned accordingly.
2. The indicated part deleted.
3. Plausible reason has been given at the end of section 2.3 (i.e., in third para).
4. The source of table (2.2) is "Reports of the Commission, for Agricultural Costs and Prices (2002-03 to 2008-09). As the state of Jharkhand came into existence in November 2000, the data have been taken from 2001-02, so, all the data in tables are meant for Bihar only.
5. Calculation mistake and write-up corrected at appropriate places.
6. Calculation mistake and write-up corrected accordingly.

7. Due to lack of statistician in the Centre, we could not make any statistical interpretation of the data. Lack of availability of data for all the crops and for the years in reference could enable us to analyze the growth in simple percentage term for the years (2008-09 over 1996-97).

Chapter – III : 1. Correction made accordingly in table 3.4 (a) and write-up also.

2. Corrections in table Nos. 3.5, 3.5 (a) & 3.5 (b) made. Texts also rewritten accordingly in relevant sections.

Chapter – IV : 1. Rechecked and found correct.

Chapter – V : 1. Corrections made in table Nos. 5.3 (a) & 5.3 (b). Corresponding texts rewritten accordingly.

2. Correction made.

Chapter- VI : 1. Differences elaborately explained.

2. Comparisons of suggested tables made and inferences drawn.

3. Specified the reason. Required explanation given for table No. 6.8. Correction made in table No. 6.12.

4. Checked and corrected.

Chapter –VII: Organized the Summary chapter as per the suggestions.

C. **Common Formatting Mistakes**

1. Corrected
2. Corrected
3. Corrected
4. Corrected
5. Corrected
6. Corrected
7. Corrected
8. Corrected
9. Corrected
10. Corrected

Rajiv Kumar Sinha
Rosline Kusum Marandi

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