REPORT NO. 143

EFFECT OF MECHANIZATION ON AGRICULTURAL GROWTH AND COMPARATIVE ECONOMICS OF LABOUR AND MACHINERY - IN ODISHA

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Andhra University, Visakhapatnam

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Preface

Agricultural Mechanization has become a necessary change in the cultivation in India. Indian tractor industry is relatively young but now has become the largest market worldwide. Still agricultural mechanization has much space to become prevalent in the farming. Government of India has considered this problem and stared a mission to turn the fields with machine use to reduce drudgery and shifting of labour to other non-farm avenues. To meet this end and to bring sharp change in the structure of cultivation, it has been allocating funds in every budget. In this context, Government of India, Ministry of Agriculture & Farmers Welfare has been sanctioning the funds for agricultural mechanization in Odisha and consequently, Government of Odisha has been implementing the Agricultural Mechanization Programme in all districts. Therefore, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics, (A.E.R. Division) wants to evaluate the programme in Odisha and the study project is assigned to our centre.

As all the districts are under agricultural mechanization programme in Odisha, it is taken two districts-one is more mechanized district (Puri) and another one is less mechanized district (Khurdha) to evaluate the programme in Odisha. Agricultural mechanization has led to increase in production, as this study divulges. The cost of machine labour clearly shows to entire state at lower shares compared to the shares of human and bullock labour in operational costs and total costs and further, in the value of production. Hence, there is a lot of scope for agricultural mechanization in the cultivation in Odisha. Still the agricultural mechanization is at beginning in the operations of weeding and inter-culture, and plant protection (in both study districts) in Odisha, hence, it is required the suitable machines and awareness generation programme across state. The electric pump sets are to be substituted in lieu of diesel pump sets at the initiation and encouragement and support of governments. The ploughing, harvesting, threshing, and transportation and marketing are at priority in the whole operations of cultivation, but the machines of these operations are at the highest prices and much expensive, as the farmers viewed. It would be an urgent need of the hour to suit the scales of machines and prices suitable to lower farmer landholding sizes. It is better to arrange the literature of the uses and prices of the latest machines in the market along with subsidy and training available from government in the panchayat offices to disseminate information to the farmer.

I profusely thank Sri R. S. Gopalan, I.A.S., Director of Agriculture and Food Production, Government of Odisha, Bhubaneswar for giving permission to conduct the study in Puri and Khurdha districts. I owe much to Er. P.K. Paikray, Executive Engineer, Agricultural Engineering, Bhubaneswar, for guiding in the selection of study districts in the project. I am grateful to Smt. Rajeswari Dutta, Chief Statistician, Department of Agricultural Statistics, Government of Odisha, Bhubaneswar, for the services rendered in the collection of secondary data. I convey my gratitude to the Assistant Agricultural Engineers (Agricultural Engineering) of Puri and Khurdha districts.

I admire the efforts made by Dr. P. Ramu, Sr. Res. Investigator and Dr. K. Rambabu, Sr. Res. Investigator of the centre for conducting the field surveys. I appreciate Sri K. Ramesh for the computer typing of the draft of the project study.

Prof. G. Gangadhara Rao
Director

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CHAPTER – 1

INTRODUCTION, REVIEW OF LITERATURE, OBJECTIVES AND METHODOLOGY OF STUDY

1.1 Introduction:

Farm mechanization is the mainstay of modern agriculture and many developing countries have been following the same. These countries found congenial conditions for agriculture mechanization and India has found the requirement of mechanization in the cultivation. In the recent past, there has been alarming increase in the wages of agriculture labour and the prices of produce of cultivators have not shown that much hike. Moreover, the enhanced cropping intensity, irrigation and technology have a demand for the use of machines in agriculture across India and Odisha. Despite India is the major tractor producer in the world, India stands at nascent stage, which refers to lower level than that of Korea and Japan. Government of India aimed at 2.0 KW/ha by 2017.

The net sown area of cultivable land is constrained with extension in Odisha. Then, the additional production and yields would be made through the mechanization of agriculture. Where the high production is required, there the prudent application of inputs and technology is needed in an economic and scientific way. This might be accomplished by the mechanization. It leads to rise of yields through the improvement of water control, better soil preparation for planting, much efficient weeding, harvesting, storing and processing of all food and non-food crops. Ultimately, it reduces the human drudgery and the labour could be shifted and utilized to other activities, which may fetch higher incomes to them.

1.2 Scope of Mechanization:

Mechanization of agriculture has wide area across all the states, since it will give much benefit to the farming community. It increases the productivity of a farm. The in-time operations could be done in cultivation to obtain optimal yields from various crops. For example, certain operations like sowing, irrigation, harvesting, threshing and marketing, need to be performed at suitable time. Otherwise, yields, quality and prices of produce will be affected very badly. The quality and precision of the operations in the farms is much significant to realize higher yields. The duration of agricultural operations is performed in the farm and its

sequence of activities in the farm, is a basic determining factor for the successful and increased cropping intensity. Therefore, it is highly essential to ensure timely operations in the farm through mechanical devices and equipment. This will enable the extension of area under cultivation and rise in cropping intensity. Basically, the productivity of land and labour is enhanced in cultivation because of farm mechanization. The displaced labour could be absorbed in the non-farm activities. The increased production leads to commercialization of agriculture. Timely marketing is also made possible by mechanical devices application in cleaning, grading and handling and transporting.

1.3 Constraints in Mechanization:

There is certain criticism over the use of farm mechanization, though it has shown good improvement in production and living standards of farm community.

1. It replaces farm labour and it could not be directly substituted in mechanized works, since the semi-skill set is required.
2. Majority of Indian farmers may not meet cost of machinery.
3. The draft cattle population becomes surplus and do not find sufficient work in the farm and this cattle becomes burden to the farmer. Thus, it has led to certain extent of selling cattle to butchering and exporting of meat.
4. Many small and tiny land holdings are hardly suitable in the use of machines across India.
5. It is observed that lack of knowledge in the maintenance of machinery has burdened the farmers with higher costs of farm machinery.
6. Diesel and petrol are costly inputs to machines.
7. In reaching remote rural regions, farm equipment finds difficulty; Maintenance of this equipment has given much problem to peasants.
8. The seasonal nature of agriculture curtails to give yearlong work to machines of Indian farmers and
9. On the spot training to farmers and farm labour is not available and it gives problems to farmers and the concerned workers to run the machines successfully.

1.4 Review of Literature:

Ray. A.K. (1993) examined the agricultural mechanization in India during 1972-1987. Based on the secondary data sources, Ray tried to explore the present status of agricultural mechanization across states. He estimated the existing constraints in the mechanization process for all the states and these are: 1) Farm Size 2) Less Irrigation and 3) Lower level of cropping intensity.

Bina Agarwal (1984) analyzed the effects of tractors and tube wells in Punjab. This study took sample of 237 farms in wheat grown area in 20 Tehsils across state for the period 1971-1972. It was estimated that the cropping intensity was high in the farms where the tractor and tube-well were used for cultivation. Tube well irrigation led to higher cropping intensity rather than that of canal irrigation.

Joginder Singh (2005) reviewed the literature of farm mechanization in India and elaborated the scope, constraints, progress of farm mechanization and its impact on employment, economics of farm mechanization, inter-regional verifications, demand for mechanization and factors affecting the use of tractors in India during 1950-2001.

Gyanendra Singh (2006) analyzed the impact of mechanization on production and economic factors in Indian agriculture during 1971-1996. He developed a mechanization Index and further he used regression to know the impact of factors of production and found the strong influence of irrigation and farm power in the hike of yields across India. The analysis estimated the major part of labour cost in the cost of cultivation in the wheat crop. The mechanization Index varied from crop to crop and the wheat crop showed the highest of all principal crops in agriculture in India.

Komal Singh (2012) tried to estimate the impact of tractorisation in Indian agriculture during 1961-2003. By using "Unit root Test" and Augmented Engle Graner Test, it was found that the tractorisation increased the agriculture gross domestic product (GDP) both in short-run and long-run in India.

Debendra C. Baruah (2008) examined the good mechanization strategies for rice crop in Assom and he divided them into four to estimate the energy demand. The study found that the diesel demand increased to 200% against 80% and 100% for manpower and bullock power, respectively. In this study, "availability index" was developed. It was the ratio of available human workers to the actual demand for human workers in the cultivation of rice. This index displayed the insufficiency of required human workers in almost all agro-climatic zones in Assom justifying the need for mechanization. The prevailing rate of factors of production suggests the adoption of agricultural mechanization.

Nagaraj et.al (2013) conducted a survey to know the level of agriculture mechanization by collecting primary data in six villages with 120 respondents in Karnataka. The possession of knowledge of farmers was estimated at 55% of farmers with complete knowledge and the remaining farmers with medium level over the use of different machines for the cultivation. In the adoption of machines, only 42% belonged to medium level of adoption category. For the use of paddy transplanter, only15% of farmers knew the adoption of this device.

Tewari, V.K. et. al (2012) estimated the increase of production yields by farm mechanization in West Bengal. Further, a number of suitable mechanized tools for farmers were identified in the production of paddy and potato cultivation in this study. It was found that the cropping intensity was higher in West Bengal compared to India.The farmers were more interested in self-propelled paddy transplanter, conoweeder, vertical conveyer reaper and flow through paddy thresher in paddy crop and semiautomatic and automatic potato planter and potato digger in potato.

1.5 The Problem:

Based on above review of research work done over agricultural mechanization, it could be inferred that there is hardly good evaluation available either at all India or at Odisha for 'Mission of Agricultural Mechanization' in Odisha. It is felt that there is a dire need to know the impact and change in cultivation because of implementation of the 'Mission of Agricultural Mechanization' in Odisha. Therefore, Government of India, Ministry of Agriculture, Department of Agriculture and Co-operation assigned the study entitled "Evaluation and Impact of

Mechanization on Agricultural Growth: Comparative Economics of Labour and Machinery in Agriculture in Odisha" to Agro-Economic Research Centre, Visakhapatnam. It has been made an attempt to estimate the impact of agricultural mechanization in Odisha with the following objectives.

1.6 Objectives of the study:

The present study aims to find the effect of agricultural mechanization in Odisha with the following objectives:

1) To assess the impact of recent mechanization on agricultural growth in Odisha.
2) To estimate the pattern of mechanization at the crop level and effect on production and productivity and
3) To find the comparative economics of labour and machinery in agriculture in Odisha.

1.7 Methodology and Data Sources:

Both secondary and primary data will be used in this study. To estimate the trends in cost of cultivation, secondary data from the website of "DACNET" issued by calculating with semi log. The major data sources for this study are primary data surveys made in Odisha. The primary survey will be conducted with multi-stage sampling. Since all the 30 districts in Odisha are implemented mechanization, it is selected two districts with one more mechanized district – Puri and another one with less mechanized district-Khurdha. The similar sampling is followed in the selection of mandals/blocks and villages. In each block, one village is selected. From each village 50 beneficiaries are selected randomly from the given list by the Department of Agriculture. In selecting village, pre-tested survey is conducted. The selected beneficiaries are divided into Scheduled Castes (SCs), Scheduled Tribes (STs), and Other Backward Classes (OBCs) and 'Other Castes' (OCs). All the 50 farmers from each village are classified as marginal, small, medium and large based on the land holding size of the beneficiary. In this connection, leased-in land of the beneficiary is included to estimate farmer size group. Hence, the analysis in the study will take place with the comparison of two districts one for 'more mechanized-Puri district' and the other one for less mechanized district-Khurdha district. The primary data was collected during March 2014 as the reference year.

1.8 Chapterization:

Introduction, scope of mechanization, review of literature and the problem of the study are given in the first chapter, while second chapter estimates the trends of mechanization in Odisha. Third chapter explains the demographic profile and cropping pattern of sample villages of selected districts followed by the costs of mechanization of sample villages in fourth chapter. Pattern of Mechanization and farmers perception over the scheme of agricultural mechanization are given in the fifth and sixth chapters and the summary, conclusions and policy implications are taken place in the last chapter.

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CHAPTER – II

TRENDS IN AGRICULTURAL MECHANIZATION IN ODISHA

Introduction:

In this chapter, it is analyzed the trends of mechanization in Odisha during 2001-10 for principal crops. Primarily, machinery costs are examined in farming operations and it is estimated shares and value in total costs. Further, the growth of costs is calculated during 2001-10 for the entire state. It is given absolute figures and percentages to the relevant variables in this chapter regarding the share of machinery costs in operational costs so as to get a clear picture over the agricultural mechanization

2.1 Share of Machinery Costs in Operational Costs:

The share of machinery costs in operational costs is shown in Table 2.1. The important seven crops are examined for Odisha during 2001-10. In the operational costs, Jute crop reports the highest share out of all selected crops with 70% followed by sesamum with62% for human resource/labour, whereas moong and niger seed showed the lowest with 52%. Though paddy has the highest share in cropped area in Odisha, it does not indicate much share by human resource/labour. It is observed that the bullock labour is also the lowest one for jute crop against the highest use in niger seed (40%) followed by sesamum. Urad crop also shows the lower level use of bullock labour. Surprisingly, niger seed records zero level use of machine labour in the operational cost and arhar comes to next place. The highest machine labour is reported for moongcultivation and paddy occupies second place in the use of machine labour. Millets appear low use of machine labour than cereal crop paddy. The trend appears that there are higher shares for human labour and bullock labour rather than machine labour in operational costs during 2001-10.

Table 2.1 SHARE OF MACHINERY COSTS IN OPERATIONAL COSTS - 2001-10

(Average per ha cost)

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	7836.23	2281.24	542.95	13724.67	57.10	16.62	3.96
Urad	2650.57	813.80	115.07	4609.71	57.50	17.65	2.50
Moong	2499.99	1077.04	213.33	4771.50	52.39	22.57	4.47
Arhar	3187.50	1406.36	65.38	5228.60	60.96	26.90	1.25
Sesamum	3232.51	1468.02	85.05	5179.40	62.41	28.34	1.64
Niger seed	2199.62	1659.17	0.00	4187.94	52.52	39.62	0.00
Jute	11289.57	2058.75	500.15	16036.60	70.40	12.84	3.12

Source: http://eands.dacnet.nic.in/Cost of Cultivation.htm

2.2. Share of Machinery Costs in Total Costs in Odisha:

Table 2.2 presents share of machinery cost in total costs in Odisha during 2001-10. In the total costs, cost of human labour shows the highest for Jute crop (51%) followed by sesamum, while moong and urad reported lowest shares, respectively. Cost of bullock labour records at lowest to jute crop, whereas niger seed indicates the other side with 27% out of all selected crops in Odisha. Sesamum crop displays second place for higher cost of bullock costs in total costs. Moong crop reports biggest share of machine labour to total costs out of all crops referred and paddy comes next to moong crop. Costs of machine labour informs much less to arhar and sesamum, in that order. The machine labour in total costs ranges between 0.73% to 2.83% for different crops studied. It indicates that there is lot of scope for mechanization in agriculture in Odisha. In case of niger seed, it is zero level machine labour and it emphasizes that the tool design should be suitable to the crop in question to increase the mechanization in cultivation. When compared to other states like Punjab and Haryana, there is a great deal of requirement of machines in cultivation in Odisha. The dominance of human labour is there for all crops in total costs of cultivation and it could be further reduced for all selected crops in this study.

Table 2.2 SHARE OF MACHINERY COSTS IN TOTAL COSTS IN ODISHA- 2001-10

(Avg. per ha)

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	7836.23	2281.24	542.95	20346.05	38.51	11.21	2.67
Urad	2650.57	813.80	115.07	7645.47	34.67	10.64	1.51
Moong	2499.99	1077.04	213.33	7539.41	33.16	14.29	2.83
Arhar	3187.50	1406.36	65.38	8951.44	35.61	15.71	0.73
Sesamum	3232.51	1468.02	85.05	8095.32	39.93	18.13	1.05
Niger seed	2199.62	1659.17	0.00	6187.36	35.55	26.82	0.00
Jute	11289.57	2058.75	500.15	22111.27	51.06	9.31	2.26

Source: http://eands.dacnet.nic.in/Cost of Cultivation.htm

2.3. Share of Machinery Costs in Value of Production:

Share of machinery costs in the value of production is given in Table 2.3. It is observed that the share of value of machinery costs informs very lower level compared to its counterparts i.e., human labour and bullock labour. Further, it indicates the possibility of mechanization in agriculture in Odisha. As discussed earlier, jute crop shows the highest share of human labour, in the value of production, whereas sesamum crop reports second place. Urad, moong and arhar crops reported lower level of shares, in that order, in the total value of production. Cost of bullock labour reports the highest share of niger seed from all crops selected followed by sesamum crop. Urad and jute crops show the lowest shares, in that order. Cost of machine labour reports that paddy crop has the highest share of machine cost in value of production and moong crop occupies the second place. Arhar and sesamum reports the lowest shares for machine labour in value of production.

Table 2.3:SHARE OF MACHINERY COSTS IN VALUE OF PRODUCTION IN ODISHA - 2001-10

(Average per ha cost)

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	7836.23	2281.24	542.95	20260.55	38.68	11.26	2.68
Urad	2650.57	813.80	115.07	9107.64	29.10	8.94	1.26
Moong	2499.99	1077.04	213.33	8064.46	31.00	13.36	2.65
Arhar	3187.50	1406.36	65.38	8833.00	36.09	15.92	0.74
Sesamum	3232.51	1468.02	85.05	7764.52	41.63	18.91	1.10
Niger seed	2199.62	1659.17	0.00	5756.03	38.21	28.82	0.00
Jute	11289.57	2058.75	500.15	20988.06	53.79	9.81	2.38

Source: http://eands.dacnet.nic.in/Cost of Cultivation.htm

Cost of machine labour clearly shows the lower shares compared to the shares of human and bullock labour in operational costs and total costs and in the value of production. Still cost of bullock labour has its dominance in niger and sesamum crops.Paddy crop also records meager shares for machine labour against different cost heads. In future, there will be much possibilityfor machine labour for different crops selected in Odisha, as it is placed at low web. Though paddy crop is much popular for agricultural mechanization, it also divulges a lower stratum for the machine labour in the cost of cultivation. Hence, it could be inferred that there is ample scope for mechanization across the fields of Odisha, provided suitable devices adaptable to different crops in the cultivation.

Out of all cost heads, operational costs, total costs and the value of production and machine labour report meager values. For operational costs, machine labour ranges between 0.00% to 4% for different crops, whereas it is placed between 0.00% to 3% for total costs. Machine labour does not show much share for any crop in the value of production, as it covers upto 2.68% only for paddy crop, having other crops placed below to it.

2.4. Growth of Mechanization Costs:

Table 2.4 explains the rate of growth in mechanization costs during 1996-10 in Odisha. The trend of growth rate for cost of human labour displayed declining for all selected crops except sesamum and jute. For sesamum and jute crops, the increasing trend appeared and it is very high for sesamum. The declining trend is very high for moong crop (-3.19) followed by the rate of arhar. It indicates the contribution of human labour in declaration for the cultivation in Odisha. The growth rate of price of human labour shows increasing trend and this acceleration ranges between 0.04 to 0.11 for different selected crops in the study. The rate of increase is high for niger seed for all crops out of the selected crops for the price of human labour and the total cost shows higher level to the same crop followed by arhar and sesamum.

Table 2.4 GROWTH RATE OF COSTS IN MECHANIZATION IN ODISHA: 1996-2010

Crop	Cost of Human Labour			Cost of Bullock Labour			Cost of Machine Labour		
	Qty	Price	Total cost	Qty	Price	Total cost	Qty	Price	Total cost
Paddy	-0.54	0.08	0.10	-0.32	0.17	0.18	N.A	N.A	0.11
Urad	-0.49	0.05	0.09	-0.31	0.20	0.39	N.A	N.A	0.30
Moong	-3.19	0.06	0.07	-0.44	0.21	0.25	N.A	N.A	0.31
Arhar	-1.81	0.04	0.12	-0.43	0.10	0.17	N.A	N.A	0.44
Sesamum	7.14	0.05	0.11	1.00	0.10	0.09	N.A	N.A	0.41
Niger seed	-0.43	0.11	0.16	-0.26	0.10	0.14	N.A	N.A	0.00
Jute	2.61	0.08	0.10	-0.18	0.12	0.24	N.A	N.A	0.22

Source: http://eands.dacnet.nic.in/Cost of Cultivation.htm

The quantity of bullock labour shows rapid decrease for all crops except sesamum, while it was high for moong (-0.44) and arhar (-0.43). The least quantity of bullock labour was applied for jute crop from the selected crops. The growth of price of bullock labour increased for all crops and the price appeared the highest to moong crop and the second place went to urad. The growth of total cost of bullock labour reported much acceleration except for sesamum crop, which substituted much human labour. The growth of total cost of bullock labour was very high to urad (0.39) and jute (0.24) crops. Among the selected crops, though paddy reports a large area and high production in Odisha, it does not show much growth rate in the costs of human labour and bullock labour compared to other selected crops.

For cost of machine labour, growth rates of quantity and price are not available but total costs available. During the study period 1996-2010, growth of total cost for machine labour is tending to acceleration, while bullock labour shows lower level rates for different selected crops in Odisha. Interestingly, paddy has lower level of growth rate for cost of machine labour compared to bullock labour in Odisha. It is a fact that advocates the use of machines in paddy cultivation.

2.5. Growth Rate of Production and Mechanization Costs in Odisha:

Growth rates of production and mechanization costs in Odisha are given in Table 2.5. All the growth rates of yields and prices of selected crops are higher than the growth rates of costs of machine labour of selected crops in Odisha. The yield rates of urad, arhar and

sesamum are higher than that of other crops. The increase is there for different crops in price during 1996-2010 and the similar trend appears for value of production. When compared to yields, the growth rate is lowfor total cost of machine. In case of increase in price of produce of the farmer, the costs of machine labour show higher level against the rates of growth of prices. The analogous trend appears between the value of production and the cost of machines in the study period for all selected crops in Odisha.

Table 2.5

GROWTH RATE OF PRODUCTION VIS-A-VIS COSTS IN MECHANIZATION ODISHA: 1996-2010

Crop	Production			Cost of Machinery		
	Yield	Price (Value of Production/Yield)	Value of Production	Qty	Price	Total cost
Paddy	0.28	0.19	0.13	N.A	N.A	0.11
Urad	1.69	0.19	0.24	N.A	N.A	0.30
Moong	0.40	0.21	0.19	N.A	N.A	0.31
Arhar	3.02	0.22	0.26	N.A	N.A	0.44
Sesamum	0.56	0.14	0.17	N.A	N.A	0.41
Niger seed	-0.39	0.15	0.45	N.A	N.A	0.00
Jute	0.25	0.21	0.41	N.A	N.A	0.22

Source: http://eands.dacnet.nic.in/Cost of Cultivation.htm

2.6 Summary of Chapter:

The trend appears that there are higher shares for human labour and bullock labour rather than machine labour in operational costs during 2001-10 in Odisha. The machine labour ranges between 0.73% and 2.83% in total costs for different crops studied. It indicates that there is lot of scope for mechanization in agriculture in Odisha.The dominance of human labour is there for all crops in total costs of cultivation and it could be further reduced for all selected crops in this study. The growth rate displayed declining for all selected crops except sesamum and jute. The growth rate of price of human labour shows increasing trend and this acceleration ranges between 0.04 to 0.11 for different selected crops in the study.The quantity of bullock labour shows rapid decrease for all crops except sesamum. When compared to yields, the growth rate is lowfor total cost of machine. There is good scope for mechanization of agriculuture in Odisha.

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CHAPTER –III

DEMOGRAPHIC PROFILE AND CROPPING PATTERN OF THE STUDY REGION

It is highly needed the socio-economic conditions of the farmers to examine the change in the agricultural mechanization taken place in the study districts. Two study districts-more mechanised district (Puri district) and less mechanised district (Khurdha district) are selected under this project study. It is analysed the sample farmers of the selected villages of study districts and the socio-economic aspects are compared in between two sample villages, namely, the demographic profile, educational profile, caste composition, land endowment and cropping pattern (2008-11).

3.1 Demographic Profile:

The demographic profile is given in Table 3.1. For small and medium farmer size groups, males are higher than females, while marginal and large farmer groups are equivalent in the more mechanized district. In the less mechanized district, females appear in large number in marginal and small farmer groups, however, males report higher number across all groups. When compared the districts, more mechanized district displays more than two times high of children than in its counterpart and the similar picture appears for total number of persons.

Table3.1 Demographic Profile

(No. of Persons)

Categories	Adults			Children	Total
	Males	Females	Total		
	More Mechanized District (Puri)				
Marginal	2	2	4	4	8
Small	94	81	175	72	247
Medium	25	21	46	23	69
Large	15	15	30	14	44
Total	**136**	**119**	**255**	**113**	**368**
	Less Mechanized District (Khurdha)				
Marginal	53	56	109	11	120
Small	31	32	63	8	71
Medium	43	30	73	10	83
Large	4	4	8	5	13
Total	**131**	**122**	**253**	**34**	**287**

Source: Field Survey, 2014

3.2 Education of the Head:

Table 3.2(a) presents the education of head in absolute numbers. Small and medium farmer groups show higher number under illiteracy in more mechanized district rather than in less mechanized one. In both districts, many heads of households possess secondary education. The illiterates are in large number in more mechanized district. In more mechanized district, small farmer group reports the highest number of farmers with 'secondary and above education'. Comparatively, good education level appears in less mechanized district.

Table 3.2a: Education of the Head

(No. of hhs)

Categories	Illiterates	Primary	Secondary & Above	Total
	More Mechanized District (Puri)			
Marginal	**1**	**1**	**0**	**2**
Small	**4**	**5**	**25**	**34**
Medium	**2**	**2**	**5**	**9**
Large	**0**	**1**	**4**	**5**
Total	7	9	34	50
	Less Mechanized District (Khurdha)			
Marginal	**0**	**4**	**17**	**21**
Small	**0**	**1**	**11**	**12**
Medium	**1**	**1**	**13**	**15**
Large	**0**	**1**	**1**	**2**
Total	1	7	42	50

Source: Field Survey, 2014

Table 3.2(b) presents the percentage distribution of education of the Head of the households. The illiteracy prevails much among marginal farmer group rather than other groups in more mechanized district (Puri) and the similar trend appears for primary education and secondary education. In case of primary education, medium farmer size group shows the highest out of all groups, while large farmer size group displays the highest farmers from all the groups for 'secondary and above education' in Puri district.

Table 3.2b: Percentage Distribution of Education of the Head

(% of hhs)

Category	Illiterates	Primary	Secondary & Above	Total
	More Mechanized District (Puri)			
Marginal	50.00	50.00	0.00	100.00
Small	11.76	14.71	73.53	100.00
Medium	22.22	22.22	55.56	100.00
Large	0.00	20.00	80.00	100.00
Total	14.00	18.00	68.00	100.00
	Less Mechanized District (Khurdha)			
Marginal	0.00	19.05	80.95	100.00
Small	0.00	8.33	91.67	100.00
Medium	6.67	6.67	86.67	100.00
Large	0.00	50.00	50.00	100.00
Total	2.00	14.00	84.00	100.00

Source: Field Survey, 2014

In less mechanized district (Khurdha), marginal, small and large farmer groups do not report illiteracy among farmers, despite medium size farmer group shows 7% illiteracy. The illiteracy rate is high in more mechanized district rather than less mechanized one. Comparatively, the primary education is high in Puri district and 'secondary education and above' is high in Khurdha district. The education levels are high among farmer size groups in less mechanized district. More than 80% of farmers show secondary education for marginal, small and medium groups in less mechanized district.

3.3 Education Profile of Adult Population:

Education of adult population is given in table 3.3a and 3.3b in figures and percentages for the selected districts. The farmer group wise, the education level is examined in the sample villages. Illiteracy was much predominant among small farmers in Puri district, while it existed at higher level(62%) among large farmers in Khurdha district. It is higher than that of the average illiteracy in both selected districts. The marginal farmer size group shows much primary education among adults in the sample village of Puri district, while medium farmer size group shows the highest (23%) out of all groups in Khurdha district.

The secondary education is found very much in medium farmer size group in more mechanized district, nevertheless marginal farmer group informs the highest (72%) in Khurdha district. It indicates the greater level of adult education in Khurdha district. Much

illiteracy is in Puri district (44%) compared to Khurdha district (25%). The primary education is high in Puri district (16%), while it is 15% in Khurdha district and the secondary education appears high in Khurdha district and the opposite is there in Puri district.

Table 3.3 (a): Education of the Adult Population (Avg. No. of Persons)

Categories	Illiterates	Primary	Secondary & Above	Total
	More Mechanized District			
Marginal	2	2	2	6
Small	82	29	63	174
Medium	15	5	26	46
Large	13	5	11	29
Total	112	41	102	255
	Less Mechanized District			
Marginal	19	12	78	109
Small	15	8	40	63
Medium	25	16	32	73
Large	5	1	2	8
Total	64	37	152	253

Source: Field Survey, 2014

Table 3.3(b): Percentage Distribution of Adult Educated Population (%)

Categories	Illiterates	Primary	Secondary & Above	Total
	More Mechanized District			
Marginal	33.33	33.33	33.33	100.00
Small	47.13	16.67	36.21	100.00
Medium	32.61	10.87	56.52	100.00
Large	44.83	17.24	37.93	100.00
Total	43.92	16.08	40.00	100.00
	Less Mechanized District			
Marginal	17.43	11.01	71.56	100.00
Small	23.81	12.70	63.49	100.00
Medium	34.25	21.92	43.84	100.00
Large	62.50	12.50	25.00	100.00
Total	25.30	14.62	60.08	100.00

Source: Field Survey, 2014

3.4 Caste Composition:

Caste Composition, in absolute numbers, is given in Table 3.4(a) of both districts. SCs have good representation rather than all other groups in the sample village of more mechanized district followed by other castes. There are no STs in both districts of more and less mechanized ones. The SCs show less number of farmers in number. Total number of farmers is 50 in each district of Puri (more mechanized) and Khurdha (less mechanized

district). There is lower number of other backward castes (OBCs) in both sample villages of the selected districts.

Table 3.4(a): Caste Composition

(No. of hhs)

Categories	SC	ST	OBC	Others	Total
	More Mechanized District (Puri)				
Marginal	1	0	0	1	2
Small	16	0	5	13	34
Medium	3	0	3	3	9
Large	0	0	3	2	5
Total	20	0	11	19	50
	Less Mechanized District (Khurdha)				
Marginal	**2**	**0**	**5**	**14**	21
Small	**0**	**0**	**5**	**7**	12
Medium	**0**	**0**	**2**	**13**	15
Large	**0**	**0**	**0**	**2**	2
Total	2	0	12	36	50

Source: Field Survey, 2014

Table 3.4(b) gives percentage distribution of Caste Composition. The marginal farmer group of SCs display equal percent to 'other castes', while small farmer group of SCs report the highest out of all communal groups. Further, SCs are equivalent under medium size farmer group to OBCs and 'other castes' in more mechanized district (Puri) and there are no large farmers from the same community.

Table 3.4 (b): Percentage Distribution of Caste Composition

(%hhs)

Categories	SC	ST	OBC	Others	Total
	More Mechanized District (Puri)				
Marginal	50.00	0.00	0.00	50.00	100.00
Small	47.06	0.00	14.71	38.24	100.00
Medium	33.33	0.00	33.33	33.33	100.00
Large	0.00	0.00	60.00	40.00	100.00
Total	40.00	0.00	22.00	38.00	100.00
	Less Mechanized District (Khurdha)				
Marginal	9.52	0.00	23.81	66.67	100.00
Small	0.00	0.00	41.67	58.33	100.00
Medium	0.00	0.00	13.33	86.67	100.00
Large	0.00	0.00	0.00	100.00	100.00
Total	4.00	0.00	24.00	72.00	100.00

Source: Field Survey, 2014

In Khurdha district, 'other castes' report 72% of farmers out of the total farmers followed by OBCs with 24%. All the farmer size groups of 'other castes' report higher representation of farmers in less mechanized district (Khurdha). In case of large farmers, only 'other castes' report the farmers under this group than any other group. There are farmers under small, medium and large groups from SCs in the sample village of Khurdha district. More mechanized sample village shows SCs farmers in all farmer groups except large group, while the sample village of less mechanized district reports farmers under marginal group.

3.5 Land, Irrigation and Cropping Pattern:

The irrigation details are given in table 3.5 (a). In the sample village of Puri district, the irrigated area stands 159 ha and 12ha under irrigated and un-irrigated in that order. Out of all the sources of irrigation, tube well irrigation reports 135 ha. 'Tanks' and 'others' do not show any cropping. Under tube well and canal irrigation, large extent of area is cultivated by small farmer group. Under canal irrigation, medium and large farmers report equal share of cultivation, whereas for tube well irrigation, large farmers inform the large area compared to medium farmer size group in Puri district.

Table 3.5 (a): Irrigation Details

(Area in ha)

Categories	Irrigated					Un-irrigated	Total
	Canal	Tube well	Tank	Others	Total		
	More Mechanized District (Puri)						
Marginal	0	1.21	0	0	1.21	0	1.21
Small	6.46	51.33	0	0	57.8	5.66	63.47
Medium	4.05	39.72	0	0	43.77	0	43.77
Large	4.05	42.49	0	0	46.54	6.07	52.61
Total	14.56	134.75	0	0	149.32	11.73	161.06
	Less Mechanized District (Khurdha)						
Marginal	0	1.75	0	0	1.75	12.44	14.19
Small	0	3.64	9.31	0	12.95	6.46	19.41
Medium	0	46.13	33.87	0	80	11.02	91.02
Large	0	8.9	0.81	0	9.71	11.33	21.04
Total	0	60.42	43.99	0	104.41	41.25	145.66

Source: Field Survey, 2014

In Less mechanized district (Khurdha), there are no canal irrigation and 'others' source irrigation, but tank irrigation and tube well irrigation are existing at different farmer

groups. Medium farmer group is the dominant group out of all groups in the sample village of less mechanized district. Both under tube well and tank irrigation, medium farmers report major share of area than other groups. The large farmers do not report much area in either source of irrigation in the sample village of Khurdha district. Out of the two districts, the selected sample village from Puri district shows much area under irrigated.

Percentage distribution of irrigated area is shown in Table 3.5 (b). Under irrigated, small farmer group report highest share of canal irrigation out of all groups from Puri district followed by medium farmer size group and under canal irrigation, marginal farmer group has no share. In the tube well irrigation, medium farmer group shows higher share in Puri district. The Tank irrigation and the 'others' irrigation are not available in the sample village of Puri district.

Table 3.5 (b): Percentage Distribution of Irrigated Area by Source

(%hhs)

Categories	Irrigated					Un-irrigated	Total
	Canal	Tube well	Tank	Others	Total		
	More Mechanized District (Puri)						
Marginal	0.00	100.00	0.00	0.00	100.00	0.00	100.00
Small	10.18	80.89	0.00	0.00	91.07	8.93	100.00
Medium	9.25	90.75	0.00	0.00	100.00	0.00	100.00
Large	7.70	80.76	0.00	0.00	88.46	11.54	100.00
Total	9.04	83.66	0.00	0.00	92.71	7.29	100.00
	Less Mechanized District (Khurdha)						
Marginal	0.00	12.33	0.00	0.00	12.33	87.67	100.00
Small	0.00	18.75	47.96	0.00	66.72	33.28	100.00
Medium	0.00	50.68	37.21	0.00	87.89	12.11	100.00
Large	0.00	42.30	3.85	0.00	46.15	53.85	100.00
Total	0.00	41.48	30.20	0.00	71.68	28.32	100.00

Source: Field Survey, 2014

In Khurdha district, there is no canal irrigation in the sample village. Medium farmer group has the highest share of irrigation under tube well out of all groups in Khurdha district. The large farmer group occupies second place in tube well irrigation in the less mechanized district (Khurdha) for selected sample village. In Puri district, the irrigated area of the sample village is 93%, while it is 72% in Khurdha district. There is 30% tank irrigation in Khurdha district, while it is no irrigation under tanks in Puri district. Tank and canal irrigation are in large areas in Puri district compared to its counterpart.

3.6.1 Cropping Pattern (overall Season)- 2008-09:

Cropping pattern for overall season is given in Table 3.6 (a). There were three crops in the sample village of more mechanized village during khariff, rabi, and the third crop. The first two seasons were with paddy, while the third crop was moong. In less mechanized village, there was only one crop is khariff and second crop was moong. The Crop Duration Index shows 93% of cropping intensity in more mechanized district, while, it was 68% in less mechanized district. It indicates the possibility of further cropping in Khurdha district during 2008-09, provided irrigation.

Table 3.6 (a):Cropping Pattern Over- all-Season: 2008 -09

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
	More Mechanized District (Puri)		
Paddy (K)	2.83	5.00	92.81
Paddy (R)	3.30	4.04	100.00
Moong	1.34	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (31.50/12*2.83)*100 =92.76%		
	Less Mechanized District (Khurdha)		
Paddy	1.77	4.98	81.68
Moong	2.23	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (15.50/12*1.91)*100 =67.63%		

Source: Field Survey, 2014

3.6.2 Cropping Pattern overall Season 2009-10:

Table 3.6 (b) gives the cropping pattern of overall season for 2009-10. It is observed that the irrigated area under crops reported 96% for Khariff and 100% for rabi in the sample village of Puri district, while, the sample village showed 82% only for khariff in Khurdha district. Crop Duration Index clearly tells that the sample village from Puri district has better edge with 96%, while it is only 82%in Khurdha district. It informs that the more mechanized village shows much irrigation with good cropping intensity.

Table 3.6(b) Cropping Pattern Overall Season: 2009 -10

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
	More Mechanized District		
Paddy (K)	2.97	5.00	96.24
Paddy (R)	3.30	4.04	100.00
Moong	1.45	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (32.70/12*2.83)*100 = 96.29%		
	Less Mechanized District		
Paddy	1.77	4.98	81.68
Moong	2.23	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (15.50/12*1.91)*100 = 67.63%		

Source: Field Survey, 2014

3.6.3 Cropping Pattern overall Season-2010-11:

Cropping pattern of overall season for 2010-11 is given in the Table 3.6 (c). It shows a clear demarcation in between the two sample villages hailing from more mechanized and less mechanized districts, respectively. As discussed earlier, there is better irrigation in more mechanized sample village rather than in its counterpart. Further, crop duration index informs a great deal of cropping in Puri district than in Khurdha district as per the two village samples taken from the field study. The Crop Duration Index, for three-year period, will enable us to understand the level of cropping intensity in the sample village of more mechanised district. The cropping pattern shows the existence of three-crop-season in Puri district, while there were two seasons in Khurdha district.

Table 3.6 (c):Cropping Pattern Over all Seasons: 2010 -11

Crop	Area sown (a_i)	Number of months sown (d_i)	% of irrigated area under the crop
	More Mechanized District		
Paddy (K)	2.97	5.00	96.24
Paddy (R)	3.30	4.04	100.00
Moong	1.52	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (32.74/12*2.83)*100 = 96.41%		
	Less Mechanized District		
Paddy	1.77	4.98	84.62
Moong	2.23	3.00	-
Crop Duration Index	$\{(\sum a_i d_i)/12A\}$ *100 = (15.50/12*1.91)*100 = 67.63%		

Source: Field Survey, 2014

Summary:

More mechanized district displays more than two times high of children than in its counterpart and the similar picture appears for total number of persons. The illiteracy prevails much among marginal farmer group rather than in other farmer groups in more mechanized district (Puri) and similar trend appears for primary education and secondary education. The illiteracy rate is high in more mechanized district rather than in less mechanized one. In the less mechanized district, females appear in large number in marginal and small farmer groups, however, males report in higher number across all groups.

Comparatively, good education level appears in less mechanized district. More than 80% of farmers show secondary education for marginal, small and medium groups in less mechanized district. There are no schedule tribes in both districts. Out of the two districts, the selected sample village from Puri district shows much area under irrigated. In Khurdha district, there is no canal irrigation in the sample village. In Puri district, the irrigated area of the sample village is 93%, while it is 72% in Khurdha district. The Crop Duration Index, for three-year period, will enable us to understand the level of cropping intensity in the sample village of more mechanised district in 2008-11. The cropping pattern shows the existence of three-crop-season in Puri district, while there were two seasons in Khurdha district during 2008-11.

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CHAPTER – IV

COSTS OF MECHANIZATION

In this chapter, it is examined the aspects of mechanization, with primary data collected from the sample villages of more mechanised and less mechanised districts. The variables are analysed viz. input costs, cost of mechanization vis-a-vis value of output, pattern of mechanization, extent of farm machinery use, ownership of machinery operated, operation wise number of farmers using machinery, operation wise time use of machinery and costs of mechanization-operation wise. The data was collected from 50 farmers from each village of study districts and it is tabulated and analysed the same here to estimate the relative costs of mechanization of the selected districts-Puri and Khurdha.

4.1 Input Costs:

The input costs of selected sample villages are presented in Table 4.1(a) and 4.1(b) in absolute figures and percentages, respectively in between more mechanized district (Puri) and low mechanized district (Khurdha) during 2008-11. Out of all the costs, hired machinery costs stood at the highest by 38% followed by hired labour costs for paddy. Among other costs, fertilizer costs reported 15% and it was higher than any other input cost of paddy crop. The lowest cost appeared for pesticides/weedicides with 3%. Moong crop did not show much input costs compared to paddy. In the cultivation of moong, hired labour reported the maximum cost out of all input costs in the more mechanized district (Puri). The less mechanized district (LMD) showed opposite picture compared to more mechanized district (MMD), as it reported much costs under hired labour (62%) and less costs under hired labour (18%). This appears that all the costs have much variation in between the two districts regarding input costs, as the costs in MMD (Puri) are high for all inputs compared to LMD (Khurdha). However, this is not replicated for moong crop and it refers to higher input costs in LMD than in MMD. Thus, the cost of cultivation is higher in LMD for moong crop than in MMD.

Table 4.1 (a) Input Costs (Average of 2008-09,2009-10 and 2010-11)

(Rs/ha)

Crop	Seed	Irrigation	Organic Manure	Fertilizer	Hired labour			Hired machinery costs			Pesticides/ Weedicides	Total
					Bullock	Manual	Total	Tractor	Harvest Combine	Total		
MORE MECHANIZED DISTRICT (PURI)												
Paddy	1395.04	1729.06	2358.42	6380.54	896.15	11740	12636.15	13087.6	2576.36	15663.96	1178.93	41342.1
Moong	1820	0	410	1150	576	2350	2926	1480	0	1480	324	8110
LESS MECHANIZED DISTRICT(Khurdha)												
Paddy	1143.4	579.9	1625.05	3109.61	1476.28	21080	22556.28	5380.31	1239.64	6619.95	966.49	36600.68
Moong	1695	0	382	850	1075	3850	4925	820	0	820	150	8822

Source: Field Survey, 2014

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

Crop	Seed	Irrigation	Organic Manure	Fertilizer	Hired labour			Hired machinery costs			Pesticides/ Weedicides	Total
					Bullock	Manual	Total	Tractor	Harvest Combine	Total		
MORE MECHANIZED DISTRICT												
Paddy	3.37	4.18	5.70	15.43	2.17	28.40	30.56	31.66	6.23	37.89	2.85	100.00
Moong	22.44	0.00	5.06	14.18	7.10	28.98	36.08	18.25	0.00	18.25	4.00	100.00
LESS MECHANIZED DISTRICT												
Paddy	3.12	1.58	4.44	8.50	4.03	57.59	61.63	14.70	3.39	18.09	2.64	100.00
Moong	19.21	0.00	4.33	9.64	12.19	43.64	55.83	9.29	0.00	9.29	1.70	100.00

Source: Field Survey, 2014

4.2 Cost of Mechanization Vs Value of Output:

Cost of mechanization and value of output is presented in the Table 4.2. Two crops are analysed in the sample villages selected from the study area. Between paddy and moong, paddy has higher value of output per ha in both selected districts (it is known fact). The percentage of machinery costs to value of output is high in MMD than in its counterpart, as the high mechanization in the study area may be causative factor compared to LMD. The similar trend appears for marketed surplus.

Table 4.2 Cost of Mechanization Vis –a-Vis Value of Output (Rs/ha)

Crop	Value of Output	Hired Machinery Costs	Marketed Surplus	% of Machinery Costs to Value of Output	% of Machinery Costs of Marketed Surplus	% of Marketed Surplus to Value of Output
MORE MECHANIZED DISTRICT						
Paddy	56275	15663.96	53885.34	27.83	28.92	95.75
Moong	14500	1480	13842.00	10.21	10.63	95.46
LESS MECHANIZED DISTRICT						
Paddy	38565	6619.95	36120.48	17.17	18.33	93.66
Moong	12822.00	820	11500.63	6.39	7.13	89.68

Source: Field Survey, 2014

Nearly 29% of machinery costs are covered in the marketed surplus for paddy crop in Puri district, while it is 18% in Khurdha district. Moong has also higher share of machinery costs (11%) in Puri district, whereas in Khurdha district, it is low with 7% of machinery cost in marketed surplus. In the value of output, both crops paddy and moong have higher share of marketed surplus 96% and 95%, respectively in Puri district, however, Khurdha district reports lower level of marketed surplus to the value of output for both crops – paddy and moong.

4.3 Pattern of Mechanization:

It is examined the pattern and level of mechanization through: i) the extensive use of farm machinery and ii) owning of farm machinery by farmers in the selected districts of Odisha.

4.3.1 Extent of Farm Machinery Use:

The extent of farm machinery use is given in Table 4.3. In the MMD (Puri), animal operation for the usage of machinery, stood at 4%, while it was 34% in Khurdha district. The power operated and the tractor operated are 100% covered in the sample village of

Puri district, though in Khurdha district, it remained as 58% and 66% in that order. In case of owning the machinery, Puri district displayed the higher level of ownership in power operated (84%) and tractor operated (28%). It is observed that the ownership of power operated and tractor operated took place at lower level in Khurdha district.

Table 4.3 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)
MORE MECHANIZED DISTRICT					
Manual	50	-	50	100.00	0.00
Animal Operated	2	2	50	4.00	4.00
Power Operated	50	42	50	100.00	84.00
Tractor Operated	50	14	50	100.00	28.00
Self Propelled	-	-	50	0.00	0.00
LESS MECHANIZED DISTRICT					
Manual	50	-	50	100.00	0.00
Animal Operated	17	17	50	34.00	34.00
Power Operated	29	22	50	58.00	44.00
Tractor Operated	33	4	50	66.00	8.00
Self Propelled	-	-	50	0.00	0.00

Source: Field Survey, 2014

4.3.2 Number and Percentage of farmers with ownership of Machinery-Operation wise:

It is presented the figures and percentages of farmers with ownership of machinery operation wise in Table 4.4(a) and 4.4(b). The mechanization shows a lot of difference between the two selected districts. In Puri district, a better picture appears for the owning of machinery for cultivation than in Khurdha district. Animal operation for ploughing is at low (12%) in Puri district compared to 81% in Khurdha district. In case of irrigation, it is not found any difference in the use of machinery for power operation in both selected districts. In tractor operation, the use of tractor for various operations differs in study districts. For harvesting, it is observed the analogous trend in the use of tractor in the operation of threshing and transportation and marketing in Puri and Khurdha districts, whereas we will find a distinct variation in between more mechanized and less mechanized districts for ploughing and sowing. In Puri district, tractor use is very much high with 87% and 100% in ploughing and sowing, in that order, though it is not found in Khurdha district (except for ploughing).In case of weeding, farmers are much motivated in manual operation for weeding in Puri district in the cultivation.

4.4 (a) Number of Farmers Owning Machinery – Operation wise

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	2	0	0	14	0	16
Sowing	0	0	0	3	0	3
Irrigation	0	0	42	0	0	42
Weeding	0	6	0	0	0	6
Plant Protection	0	0	0	0	0	0
Harvesting	0	0	0	5	0	5
Threshing	0	0	0	14	0	14
Transportation and Marketing	0	0	0	9	0	9
Any other	0	0	0	0	0	0
	LESS MECHANIZED DISTRICT					
Ploughing	17	0	0	4	0	21
Sowing	0	0	0	0	0	0
Irrigation	0	0	22	0	0	22
Weeding	0	0	0	0	0	0
Plant Protection	0	0	0	0	0	0
Harvesting	0	0	0	1	0	1
Threshing	0	0	0	4	0	4
Transportation and Marketing	0	0	0	4	0	4
Any other	0	0	0	0	0	0

Source: Field Survey, 2014

4.4 (b) Percentage Distribution of Farmers Owning Machinery–Operation wise

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	12.50	0.00	0.00	87.50	0.00	100.00
Sowing	0.00	0.00	0.00	100.00	0.00	100.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	100.00	0.00	0.00	0.00	100.00
Plant Protection	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting	0.00	0.00	0.00	100.00	0.00	100.00
Threshing	0.00	0.00	0.00	100.00	0.00	100.00
Transportation and Marketing	0.00	0.00	0.00	100.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00
	LESS MECHANIZED DISTRICT					
Ploughing	80.95	0.00	0.00	19.05	0.00	100.00
Sowing	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	0.00	0.00	0.00	0.00	0.00
Plant Protection	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting	0.00	0.00	0.00	100.00	0.00	100.00
Threshing	0.00	0.00	0.00	100.00	0.00	100.00
Transportation and Marketing	0.00	0.00	0.00	100.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00

Source: Field Survey, 2014

4.4 Farmer Usage of Machinery–Operation-wise:

The absolute numbers and percentages of farmers in using machinery operation-wise is given in Table 4.5(a) and 4.5(b).Still in both study districts, the agricultural mechanization is to be taken place in weeding and plant protection, as these districts report 100% manual operation in weeding and plant protection. The mechanization achieved 100% in irrigation, harvesting, threshing and transportation and marketing in Puri district, though Khurdha district lags in achieving 100% in threshing and transportation. In the ploughing operation, Khurdha district shows 34% of animal operation in ploughing and transportation and marketing.

4.5 (a) Number of Farmers Using Machinery – Operation wise

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	2	0	0	48	0	50
Sowing	0	0	0	16	0	16
Irrigation	0	0	50	0	0	50
Weeding	0	27	0	0	0	27
Plant Protection	0	48	0	0	0	48
Harvesting	0	0	0	45	0	45
Threshing	0	0	0	50	0	50
Transportation and Marketing	0	0	0	50	0	50
Any other	0	0	0	0	0	0
	LESS MECHANIZED DISTRICT					
Ploughing	17	0	0	33	0	50
Sowing	0	0	0	0	0	0
Irrigation	0	0	29	0	0	29
Weeding	0	12	0	0	0	12
Plant Protection	0	26	0	0	0	26
Harvesting	0	0	0	2	0	2
Threshing	5	0	0	45	0	50
Transportation and Marketing	17	0	0	33	0	50
Any other	0	0	0	0	0	0

Source: Field Survey, 2014

4.5 (b) Percentage Distribution of Farmers Using Machinery – Operation wise

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	4.00	0.00	0.00	96.00	0.00	100.00
Sowing	0.00	0.00	0.00	100.00	0.00	100.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	100.00	0.00	0.00	0.00	100.00
Plant Protection	0.00	100.00	0.00	0.00	0.00	100.00
Harvesting	0.00	0.00	0.00	100.00	0.00	100.00
Threshing	0.00	0.00	0.00	100.00	0.00	100.00
Transportation and Marketing	0.00	0.00	0.00	100.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00
	LESS MECHANIZED DISTRICT					
Ploughing	34.00	0.00	0.00	66.00	0.00	100.00
Sowing	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	100.00	0.00	0.00	0.00	100.00
Plant Protection	0.00	100.00	0.00	0.00	0.00	100.00
Harvesting	0.00	0.00	0.00	100.00	0.00	100.00
Threshing	10.00	0.00	0.00	90.00	0.00	100.00
Transportation and Marketing	34.00	0.00	0.00	66.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00

Source: Field Survey, 2013

4.5 Time Use of Machines-Operation-wise:

The number of hours and percentage of hours-operation wise is presented in 4.6(a) 4.6(b) tables. In absolute numbers, less mechanized district (Khurdha) shows higher number of hours for every operation in the cultivation compared to more mechanized district. In the ploughing, animal operation is 21 hours in Puri district, while it is 25 hours in Khurdha district. In the weeding, manual operation is more than seven times less in the sample villages of Puri district compared to its counterpart and plant protection shows less manual operation in Puri district. Harvesting, threshing, and transportation and marketing completed through machine operation and these report 4 hours, 2.5 hours and 4 hours, respectively, in more mechanised district, whereas threshing refers to animal and manual operation in Khurdha district. There is no machine operation for threshing in less mechanized district. Manual operation reports 21 hours for harvesting in Khurdha district from sample villages. It is very high for threshing with 36 hours for manual operation and 36 hours for animal operation and it is very high in the cost aspect of the labour. In case of transport and marketing, there is very substantial difference in between two study districts, as the sample villages report seven times more time use from Khurdha district.

In the total number of hours, the usage of time appears at low in more mechanized district for different cultivation activities. For ploughing, the time usage shows 30 hours in Khurdha district, while it is 25 hours in Puri district. The significant difference in time usage reports for the operation of irrigation with 1100 hours in Puri district and 1255 hours in Khurdha district per ha. For weeding operation, there is vast variation between two districts by nearly eight times of higher time use in the sample villages of Khurdha district. A huge time usage appears in threshing in Khurdha district compared to Puri district, as the latter has 30 times lower time use. The transportation and marketing operation informs more than eight times higher use of time in the sample villages of Khurdha district.

Table 4.6(a) Total number of Hours of Usage – Operation wise (hrs./ha)

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	21.40			3.86		25.26
Sowing				1.30		1.3
Irrigation			1100			1100
Weeding		7.30				7.3
Plant Protection		9.50				9.5
Harvesting				3.80		3.8
Threshing				2.50		2.5
Transportation and Marketing				3.84		3.84
Any other						0.00
	LESS MECHANIZED DISTRICT					
Ploughing	25.30			4.50		29.8
Sowing						0
Irrigation			1255			1255
Weeding		56.50				56.5
Plant Protection		16.30				16.3
Harvesting		21.00		4.20		25.2
Threshing	36.30	36.30		3.10		75.7
Transportation and Marketing	28.45			4.62		33.07
Any other						0.00

Source: Field Survey, 2014

Table 4.6 (b) Percentage Distribution of Number of Hours of Usage – Operation wise (hrs./ha)

Operation	Animal Operated	Manually Operated	Power operated	Tractor operated	Any other	Total
	MORE MECHANIZED DISTRICT					
Ploughing	84.72	0.00	0.00	15.28	0.00	100.00
Sowing	0.00	0.00	0.00	100.00	0.00	100.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	100.00	0.00	0.00	0.00	100.00
Plant Protection	0.00	100.00	0.00	0.00	0.00	100.00
Harvesting	0.00	0.00	0.00	100.00	0.00	100.00
Threshing	0.00	0.00	0.00	100.00	0.00	100.00
Transportation and Marketing	0.00	0.00	0.00	100.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00
	LESS MECHANIZED DISTRICT					
Ploughing	84.90	0.00	0.00	15.10	0.00	100.00
Sowing	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	100.00	0.00	0.00	100.00
Weeding	0.00	100.00	0.00	0.00	0.00	100.00
Plant Protection	0.00	100.00	0.00	0.00	0.00	100.00
Harvesting	0.00	83.33	0.00	16.67	0.00	100.00
Threshing	47.95	47.95	0.00	4.10	0.00	100.00
Transportation and Marketing	86.03	0.00	0.00	13.97	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00

Source: Field Survey, 2014

The non-mechanized operation reports 86% to transportation and marketing in the cultivation from the sample village of Khurdha district and it indicates the highest time spared under different operations in the sample villages of Khurdha district.

4.6 Costs of Mechanization–Operation-wise:

Cost of Mechanization–Operation wise is given in Tables 4.7 (a) and 4.7(b) with costs in figures and percentages, respectively. Cost of cultivation per ha is high in less mechanized district rather than in its counter-part. Hiring charges are very low in Puri district compared to Khurdha district and the other charges are low in Khurdha district in absolute figures viz. ,input costs and service maintenance charges. The sample villages from Khurdha district are facing higher charges in ploughing, in addition to the charges under threshing and transportation and marketing for animal operation and the similar trend appears for manual and power operations for Khurdha district compared to Puri district. The harvesting costs under manual operations have much burdened the farmer in sample villages of Khurdha district. Under power operation also, the irrigation costs are high to the farmer in less mechanized district. The intensive use and extensive demand for tractors in the sample villages of Puri district has led to higher charges under tractor operation, which is higher than in the sample villages of Khurdha district. When we observe the head wise costs of

cultivation, Puri district has lower costs under all heads compared to Khurdha district except in tractor operation and harvesting. In case of harvesting, both sample villages show nearly similar costs. In the more mechanized district (Puri), the lowest costs appear in irrigation and threshing operations and these costs have led to total difference in total costs of cultivation.

In percentage terms, the time use difference is examined between two study districts in various operations. Animal operation stands at 25% out of all operations in more mechanised district, while it is 117% in less mechanised district.

4.7 (a) Costs of Mechanization – Operation wise

Operation	Animal operated				Manually operated				Power operated			
	Hire charges	Input costs	Service& maintenance	Total cost	Hire charges	Input costs	Service& maintenance	Total cost	Hire charges	Input costs	Service& maintenance	Total cost
MORE MECHANIZED DISTRICT												
Ploughing	1850	0	0	1850	0	0	0	0	0	0	0	0
Sowing	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0	.	1750	857	480.25	3087.25
Weeding	0	0	0	0	402.50	0	0	402.50	0	0	0	0
Plant Protection	0	0	0	0	356.25	0	0	356.25	0	0	0	0
Harvesting	0	0	0	0	0	0	0	0	0	0	0	0
Threshing	0	0	0	0	0	0	0	0	0	0	0	0
Transportation and Marketing	0	0	0	0	0	0	0	0	0	0	0	0
Any other	0	0	0	0	0	0	0	0	0	0	0	0
Total	1850	0	0	1850	758.75	0	0	758.75	1750	857	480.25	3087.25
LESS MECHANIZED DISTRICT												
Ploughing	2950	0	0	2950	0	0	0	0	0	0	0	0
Sowing	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0	0	3500	1275.20	528.50	5303.7
Weeding	0	0	0	0	328.40	0	0	328.40	0	0	0	0
Plant Protection	0	0	0	0	245.50	0	0	245.50	0	0	0	0
Harvesting	0	0	0	0	2156.68	0	0	2156.68	0	0	0	0
Threshing	1314.00	0	0	1314.00	0	0	0	0	0	0	0	0
Transportation and Marketing	520.90	0	0	520.90	0	0	0	0	0	0	0	0
Any other	0	0	0	0	0	0	0	0	0	0	0	0
Total	4784.00		0	4784.00	2730.58	0	0	2730.58	3500	1275.20	528.50	5303.7

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
MORE MECHANIZED DISTRICT												
Ploughing	5635	750.25	180.10	6565.35	0	0	0	0	7485	750.25	180.1	8415.35
Sowing	1000	240.36	86.50	1326.86	0	0	0	0	1000	240.36	86.5	1326.86
Irrigation	0	0	0	0	0	0	0	0	1750	857	480.25	3087.25
Weeding	0	0	0	0	0	0	0	0	402.5	0	0	402.5
Plant Protection	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting	1260	394.15	94.50	1748.65	0	0	0	0	1260	394.15	94.5	1748.65
Threshing	1440	558.50	120.31	2118.81	0	0	0	0	1440	558.5	120.31	2118.81
Transportation and Marketing	900	187.44	0	1087.44	0	0	0	0	900	187.44	0	1087.44
Any other	0	0	0	0	0	0	0	0	0	0	0	0
Total:	10235	2130.70	481.41	12847.11	0	0	0	0	14237.5	2987.70	961.66	18186.66
LESS MECHANIZED DISTRICT												
Ploughing	4940	600.50	150.86	5691.36	0	0	0	0	7890	600.5	150.86	8641.36
Sowing	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0	0	3500	1275.2	528.5	5303.7
Weeding	0	0	0	0	0	0	0	0	0	0	0	0
Plant Protection	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting	856.40	0	0	856.40	0	0	0	0	1756.68	0	0	1756.68
Threshing	2036.83	0	0	2036.83	0	0	0	0	3350.83	0	0	3350.83
Transportation and Marketing	780	0	0	780	0	0	0	0	1300.9	0	0	1300.9
Any other	0	0	0	0	0	0	0	0	0	0	0	0
Total:	8613.23	600.50	150.86	9364.59	0	0	0	0	17798.41	1875.7	679.36	20353.47

Source: Field Survey, 2014

4.7 (b) Percentage Distribution of costs of Mechanization – Operation wise

Operation	Animal operated				Manually operated				Power operated			
	Hire charges	Input costs	Service& maintenance	Total cost	Hire charges	Input costs	Service& maintenance	Total cost	Hire charges	Input costs	Service& maintenance	Total cost
MORE MECHANIZED DISTRICT												
Ploughing	24.72	0.00	0.00	21.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sowing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00
Weeding	0.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
Plant Protection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Threshing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation and Marketing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	24.72	0.00	0.00	21.98	100.00	0.00	0.00	100.00	100.00	100.00	100.00	100.00
LESS MECHANIZED DISTRICT												
Ploughing	37.39	0.00	0.00	34.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sowing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00
Weeding	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plant Protection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Threshing	39.21	0.00	0.00	39.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transportation and Marketing	40.04	0.00	0.00	40.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	116.64	0.00	0.00	113.39	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00

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
MORE MECHANIZED DISTRICT												
Ploughing	75.28	100.00	100.00	78.02	0	0	0	0	100.00	100.00	100.00	100.00
Sowing	100.00	100.00	100.00	100.00	0	0	0	0	100.00	100.00	100.00	100.00
Irrigation	0.00	0.00	0.00	0.00	0	0	0	0	100.00	100.00	100.00	100.00
Weeding	0.00	0.00	0.00	0.00	0	0	0	0	100.00	0.00	0.00	100.00
Plant Protection	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
Harvesting	100.00	100.00	100.00	100.00	0	0	0	0	100.00	100.00	100.00	100.00
Threshing	100.00	100.00	100.00	100.00	0	0	0	0	100.00	100.00	100.00	100.00
Transportation and Marketing	100.00	100.00	0.00	100.00	0	0	0	0	100.00	100.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	475.28	500.00	400.00	478.02	0.00	0.00	0.00	0.00	700.00	600.00	500.00	700.00
LESS MECHANIZED DISTRICT												
Ploughing	62.61	100.00	100.00	65.86	0	0	0	0	100.00	100.00	100.00	100.00
Sowing	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
Irrigation	0.00	0.00	0.00	0.00	0	0	0	0	100.00	100.00	100.00	100.00
Weeding	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
Plant Protection	0.00	0.00	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00
Harvesting	100.00	0.00	0.00	100.00	0	0	0	0	100.00	0.00	0.00	100.00
Threshing	60.79	0.00	0.00	60.79	0	0	0	0	100.00	0.00	0.00	100.00
Transportation and Marketing	59.96	0.00	0.00	59.96	0	0	0	0	100.00	0.00	0.00	100.00
Any other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	283.36	100.00	100.00	286.61	0.00	0.00	0.00	0.00	500.00	200.00	200.00	500.00

Source: Field Survey, 2014

Summary:

Out of all the costs, hired machinery costs stood at the highest by 38% followed by hired labour costs for paddy. Among other costs, fertilizer costs reported 15% and it was higher than any other input cost of paddy crop. The percentage of machinery costs to value of output is high in more mechanized district (Puri) than in its counterpart (Khurdha). The power operated and the tractor operated are 100% covered in the sample village of Puri district, though it remained as 58% and 66% in that order in Khurdha district. Hired machinery costs and hired labour costs are the major costs in the cost of cultivation of paddy. The mechanised costs are high in more mechanised district. The marketed surplus is high in more mechanised district and the similar trend is found with the value of output. The high mechanization reflects in the use of operation wise use of machinery and its use in the cultivation. A great deal of 'Time use' appears for agricultural machinery in Puri district compared to Khurdha district. Cost of cultivation per ha is high in less mechanized district (Khurdha) rather than in another study district.

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CHAPTER – V

PATTERN OF MECHANIZATION IN SELECTED DISTRICTS OF ODISHA

All the farm machinery operations are estimated to know the relative pattern of mechanization of the selected districts of Odisha. This chapter estimates the importance of time use and costsin the mechanization of cultivation in a detailed way. To this end, it is tried to examine the various operations with reference to the primary data. It is analysed the operations of:ploughing and seedbed preparation,sowing and planting, irrigation**,** weedingand inter-culture**,** plant protection equipment, harvesting,threshing and transportation and marketing. It is estimated the pattern of mechanization in selected districts of Odisha.

5.1 Ploughing and Seedbed Preparation:

Number of hours and costs of ploughing and seedbed preparation operation are shown in Table 5.1(a) and 5.1(b). It is found that the number of hours and toiling is high in less mechanized district and vice versa. The cost and times of ploughing through animal operation are Rs. 1,850 and 21 hours, in that order in the sample villages of Puri district, while these are Rs. 2,950 and 25 hours respectively, in Khurdha district. The analogous trend appears for tractor operation in the study districts. For ploughing, tractor operation takes place with 4 hours time and Rs. 66 hundreds in cost Puri district, while it is 4.5 hours time with Rs. 5,700 cost in Khurdha district. The total cost is high for ploughing and seedbed preparation in Khurdha district (Rs. 8,641) compared to Puri district (Rs. 8,415).

Table 5.1 (a) Ploughing and Seedbed Preparation

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
Animal operated	Plough	21.40	1850
	Disc harrow		
	Cultivator		
Power tiller operated	Rotavator		
Tractor operated	Plough	3.86	6565.35
	Disc harrow		
	Cultivator		
	Rotavator		
Total		25.26	8415.35
	LESS MECHANIZED DISTRICT		
Animal operated	Plough	25.30	**2950**
	Disc harrow		
	Cultivator		
Power tiller operated	Rotavator		
Tractor operated	Plough	4.50	5691.36
	Disc harrow		
	Cultivator		
	Rotavator		
Total		29.8	8641.36

Note: Total No of hours = no of hrs per day x no of days in the crop season, Source: Field Survey, 2014

The percentage coverage of costs is 22% and 78% for animal ploughing and tractor ploughing,respectively in more mechanized district, whereas the less mechanized district reports 34% and 66% in that order. For the number of hours, it is observed that the similar trend is traced in both study districts. In Puri and Khurdha districts, the animal operation and tractor operation are synced up in the number of hours toiled for ploughing and seedbed preparation.

Table 5.1 (b) Ploughing and Seedbed Preparation

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
Animal operated	Plough	84.72	21.98
	Disc harrow		
	Cultivator		
Power tiller operated	Rotavator		
Tractor operated	Plough	15.28	78.02
	Disc harrow		
	Cultivator		
	Rotavator		
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
Animal operated	Plough	84.90	34.14
	Disc harrow		
	Cultivator		
Power tiller operated	Rotavator		
Tractor operated	Plough	15.10	65.86
	Disc harrow		
	Cultivator		
	Rotavator		
Total		100.00	100.00

Source: Field Survey, 2014.

5.2 Sowing and Planting:

Sowing and Planting is given in Tables 5.2(a) and 5.2(b) for absolute numbers and percentages, respectively. In more mechanized district, there is no animal operation for sowing and planting and the planting operation by tractor is found for sowing and planting, however, itis found complete manual and animal operation in Khurdha district, and therefore, we will not find any information under this variable-farm machinery. Hence, Puri district shows 100% Mechanization for sowing and planting. This is absent in another study district.

5.2 (a) Sowing and Planting

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
Manually operated	Seed drill	0	0
Animal operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
Tractor operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
	Planting machine	1.30	1326.86
Total		1.30	1326.86
	LESS MECHANIZED DISTRICT		
Manually operated	Seed drill	0	0
Animal operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
Tractor operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
	Planting machine	0	0
Total		0	0

Source: Field Survey, 2014.

5.2 (b) Sowing and Planting

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
Manually operated	Seed drill	0	0
Animal operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
Tractor operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
	Planting machine	100.00	100.00
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
Manually operated	Seed drill	0	0
Animal operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
Tractor operated	Seed drill	0	0
	Drill plough	0	0
	Row planter	0	0
	Planting machine	0	0
Total		0	0

Source: Field Survey, 2014.

5.3 Irrigation:

Tables 5.3(a) and 5.3(b) present the irrigation information in absolute numbers and percentages, respectively. The irrigation costs per ha appear high in Khurdha district for both diesel and electric pumps. The total cost of pump sets is Rs. 3,087 in Puri district, while it is Rs. 5,300/- in Khurdha district. In both sample villages, diesel pumps report

higher costs compared to electric pumps. The number of hours of pumps working is higher in Puri district compared to Khurdha district.

5.3 (a) Irrigation

(infigures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Diesel Pump	620	2050.00
	Electric Pump	480	1037.25
Total		1100	3087.25
	LESS MECHANIZED DISTRICT		
	Diesel Pump	720	3500.00
	Electric Pump	535	1803.70
Total		1255	5303.7

Source: Field Survey, 2014.

5.3 (b) Irrigation

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Diesel Pump	56.36	66.40
	Electric Pump	43.64	33.60
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Diesel Pump	57.37	65.99
	Electric Pump	42.63	34.01
Total		100.00	100.00

Source: Field Survey, 2014.

In percentages, the share of costsdoes not report significant variation in between two study districts.It is observed that there is no big variation in number of hours or costs.The diesel pump refers to 56% in Puri district, whereas in Khurdha district, it is 57% only. In case of total costs also, we will find that there is little variation with 66.40% and 66% in Puriand Khurdha districts, respectively, for costs sharing of diesel pump. In both sample villages, the costs of electric pumps are lower than the costs of diesel pumps.

5.4 Weeding and Inter-culture:

The information of number of hours and total cost for the use of machines is given in Tables5.4(a) and 5.4(b). The number of hours are 7 and 56 for both more mechanised and less mechanised districts, respectively for weeding and inter-culture, whereas the cost differs widely with Rs. 402/- in Puri district and Rs. 328 in Khurdha district per ha of sample villages. There is much significance for the weeding and inter-culture operation with very low number of hours per ha in Puri district. There should be some difference in usage of machines by hours during weeding, because there is a lot of variation in the two sample villages. The manual operation is the single operation in both villages for weeding and therefore, the manual operation becomes 100% usage in weeding and inter-culture in the study districts. No other operation appears in the sample villages for weeding.

5.4 (a) Weeding and Inter-culture

(infigures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manually operated	7.30	402.50
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		7.30	402.50
	LESS MECHANIZED DISTRICT		
	Manually operated	56.50	328.40
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		56.50	328.40

Source: Field Survey, 2014.

5.4 (b) Weeding and Inter-culture

(in %)

Source of Power	**Machine**	**Total number of hours**	**Total cost**
	MORE MECHANIZED DISTRICT		
	Manually operated	100.00	100.00
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Manually operated	100.00	100.00
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		100.00	100.00

Source: Field Survey, 2014.

5.5 Plant Protection Equipment:

The total number of hours and total cost for plant protection equipment for both study districts is given in Tables 5.5(a) and 5.5(b), respectively. In more mechanized district, the number of hours are 9.50 per ha for manual operation of plant protection equipment, whereas it is 16.30 hours per ha in less mechanized district. It indicates lower level of use of machinery equipment. In case of costs, Puri district has high costs with Rs. 356/-, while it is only Rs. 245/-in Khurdha district. Though number of hours is high per ha in Khurdha district, the costs stand at lower level. This may be because of low labour costs and less demand for manual operating equipment in Khurdha district. The costs are 100% under manual operation for plant protection. No other alternative method of device is adapted.

5.5 (a) Plant Protection Equipment

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manually operated	9.50	356.25
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		9.50	356.25
	LESS MECHANIZED DISTRICT		
	Manually operated	16.30	245.50
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		16.30	245.50

Source: Field Survey, 2014.

5.5 (b) Plant Protection Equipment

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manually operated	100.00	100.00
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Manually operated	100.00	100.00
	Animal operated		
	Power tiller/tractor operated		
	Self –Propelled		
Total		100.00	100.00

Source: Field Survey, 2014.

5.6 Harvesting:

Harvesting information for the study districts is shown in Tables 5.6(a) and 5.6(b) in absolute figures and percentages, in that order. It is found that the number of hours for harvesting is 3.8 hours per ha in Puri district, while it is21 hours per ha in Khurdha district. However, if it is seen costs, Puri district shows Rs. 1748/- per ha and Khurdha district reports Rs. 2157/- for manual operation through sickle. For tractor operation in harvesting, Khurdha district informs Rs 856/- per ha for 4 hours duration of work. As a whole, more mechanized district reports very low level of harvesting costs through tractor operation per ha and it is traced the opposite picturein less mechanized district.

5.6 (a) Harvesting

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manual sickle		
	Animal operated		
	Power tiller/tractor operated	3.8	1748.65
	Self –Propelled		
Total		3.8	1748.65
	LESS MECHANIZED DISTRICT		
	Manual sickle	21.00	2156.68
	Animal operated		
	Power tiller/tractor operated	4.20	856.40
	Self –Propelled		
Total		25.2	3013.08

Source: Field Survey, 2014.

5.6 (b) Harvesting

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manual sickle		
	Animal operated		
	Power tiller/tractor operated	100.00	100.00
	Self –Propelled		
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Manual sickle	83.33	71.58
	Animal operated		
	Power tiller/tractor operated	16.67	28.42
	Self –Propelled		
Total		100.00	100.00

Source: Field Survey, 2014.

Puri district uses 100% machines for harvesting and got low level of harvesting costs (Rs. 1748), whereas, in case of Khurdha district, there is sharing in between manual operation (83%) and tractor operation (17%) to complete harvesting activity. Thus, it is found much dependence on manual operation for harvesting in Khurdha district. However, in Puri district, it is 100% mechanization of harvesting activity, which has led to lower level of costs for harvesting.

5.7 Threshing:

Absolute numbers and percentages are given for threshing activity of two study districts in Tables 5.7(a) and 5.7(b) in that order. 'Threshing' shows completely under tractor operation in Puri district and no other operation is engaged for it. In Khurdha district, there is sharing of 'threshing' operation in between animal operation and tractor operation and the animal operation shows 36 hours per ha and tractor operation shows 3

hours. When we see costs, the costs per ha for 'threshing' is lower in Puri district (Rs. 2118) than in Khurdha (Rs. 3350/-).

It indicates the benefits derived by the farmers of sample villages of Puri district through more mechanization of cultivation. If it is observed in the percentage share and distribution of threshing activity among different operations, the machine operation or tractor operation is 100% for 'threshing' activity and the farmers of the sample villages of Puri district engage no other operation. For Khurdha district, still farmers engaged 92% threshing through animal operation and 8% through tractor operation. However, the costs are high for tractor operation with 61% and the costs of animal operation are low with 39%. Though the number of hours of animal operation is 92%, the costs go only by 39% in the form of costs in 'threshing'activity in Khurdha district.

5.7 (a) Threshing

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manually operated		
	Animal operated		
	Power tiller/tractor operated	2.5	2118.81
	Self –Propelled		
Total		2.5	2118.81
	LESS MECHANIZED DISTRICT		
	Manually operated		
	Animal operated	36.30	1314.00
	Power tiller/tractor operated	3.10	2036.83
	Self –Propelled		
Total		39.4	3350.83

Source: Field Survey, 2014.

5.7 (b) Threshing

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Manually operated		
	Animal operated		
	Power tiller/tractor operated	100.00	100.00
	Self –Propelled		
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Manually operated		
	Animal operated	92.13	39.21
	Power tiller/tractor operated	7.87	60.79
	Self –Propelled		
Total		100.00	100.00

Source: Field Survey, 2014.

5.8 Transportation and Marketing:

Absolute numbers and percentages of study districts for transportation and marketing are displayed in Tables5.8(a) and 5.8(b), respectively. The whole transportation and marketing is fully mechanized in Puri district through tractor trolley operation with 3.84 hours per ha withcosts Rs. 1087. There is no animal operation in Puri district. The picture of Khurdha district differs completely from Puri district. Still animal operation is there for transportation and marketing with 28 hours per ha, while it is low for tractor operation with 5 hours per hain Khurdha district. The costs also vary widely between two operationsas animal operation charges Rs. 521, while tractor trolley charges Rs. 780/-.

5.8 (a) Transportation and Marketing

(in figures)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Animal operated		**-**
	Tractor trolley	3.84	1087.44
Total		3.84	1087.44
	LESS MECHANIZED DISTRICT		
	Animal operated	28.45	520.90
	Tractor trolley	4.62	780.00
Total		33.07	1300.9

Source: Field Survey, 2014.

5.8 (b) Transportation and Marketing

(in %)

Source of Power	Machine	Total number of hours	Total cost
	MORE MECHANIZED DISTRICT		
	Animal operated	**-**	
	Tractor trolley	100.00	100.00
Total		100.00	100.00
	LESS MECHANIZED DISTRICT		
	Animal operated	86.03	40.04
	Tractor trolley	13.97	59.96
Total		100.00	100.00

Source: Field Survey, 2014.

It is found that the transportation and marketing is 100% mechanized in Puri district, whereas it is 86% animal operation and 14% tractor trolley operation in Khurdha district. The costs are lowfor animal operation with 40%, while tractor trolley operation demands high charges with 60%. It is found that the less mechanized district shows good dependence on animal operation for the transport of produce from farm gate to market yard and the more mechanised district informs the opposite.

Summary:

It is found that the number of hours and toiling is high in less mechanized district and vice versa for various operations of cultivation. In Puriand Khurdha districts, the animal operation and tractor operation is synced up in the number of hours toiled for ploughing and seedbed preparation. In more mechanized district, there is no animal operation for sowing and planting. The planting operation by tractor is found 100% for sowing and planting in Puri district.However, it is found complete manual and animal operation in Khurdha district, and therefore, we will not find any information under this variable-farm machinery. The irrigation costs per ha appear high in Khurdha district for both diesel and electric pumps. In both sample villages, the costs of electric pumps are lower than the costs of diesel pumps. The manual operation is the single operation in both villages for weeding and therefore, the manual operation becomes 100% in use in weeding and inter-culture in the study area.The costs for plant protection are 100% under manual operation and no other alternative method of device is adapted in study districts.The more mechanized district reports very low level of harvesting costs per ha through tractor operation and it is traced the opposite picture in Khurdha district. The machine operation or tractor operation is 100% for 'threshing' activity and the farmers of the sample villages of Puri district engage no other operation. For Khurdha district, still farmers engaged 92% threshing through animal operation and 8% through tractor operation. It is found that the transportation and marketing is 100% mechanized in Puri district, whereas it is 86% animal operation and 14% tractor trolley operation in Khurdha district.

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CHAPTER – VI

FARMERS' OPINION SURVEY AND THEIR MAJOR PROBLEMS WITH MACHINERY USED

Introduction:

This chapter consists two parts as part A and part B. First part gives opinion of the farmers in the preference of machine-use in the cultivation, based on the field data collected from sample villages of study districts. This part gives in detail over: i) reasons for using machinery, ii) operations for which machines used, iii) appropriate machine use for different operations, iv) appropriate machines for sowing and planting, v) appropriate machine use in irrigation, vi) weeding and inter-culture: vii) appropriate plant protection equipment, viii) appropriate harvesting machine, ix) appropriate machine use in threshing and x) appropriate machine use for marketing & transportation.

The second part gives the problems faced by the farmers in the use of machinery in ploughing, sowing and planting, irrigation, weeding and plant protection, harvesting, threshing and transporting. Further, through the field study in the sample villages, it is examined the usefulness of machinery, awareness and assistance received from government programmes, usefulness of programme and increase in area and production after mechanization. The success of the agricultural mechanization programmes is analysed through the opinion of farmers from the selected districts in Odisha.

Part – A

Farmers' Opinion Survey

6.A.1 Reasons for Using Machinery:

The opinion of the farmers for using machinery is given Table 6.A. 1(a). There are five reasons in the table for both sample villages in more and less mechanized districts. These five reasons are taken in the ranking order and there are three ranks. All the farmers (50) from the sample expressed first rank to different categories as ' to quick operation' by 39 farmers, 'to economical' by seven farmers and 'for higher yield ' four farmers. It is observed that the option 'quick operations' is followed by higher yield with 22 choices with 2nd rank and the third choice shows equal importance to economical and higher yield. Thus, in Puri district, farmers gave much priority to quick operations followed by higher yield and it

might be because of climatic changes, storms, rains etc. The 'economical option' reports third position by the choice given by farmers in more mechanized district.

Table:6. A.1 (a) Reasons for Using Machinery

(in figures)

Reason	Rank 1	Rank 2	Rank 3
	More Mechanized District		
Higher Yield	4	22	24
Economical	7	19	24
Quicker Operations	39	9	2
Reduces drudgery	0	0	0
Any other	0	0	0
Total	50	50	50
	Less Mechanized District		
Higher Yield	4	23	23
Economical	4	4	9
Quicker Operations	42	5	3
Reduces drudgery	0	18	15
Any other	0	0	0
Total	50	50	50

Source: Field Survey, 2014

In Khurdha district (less mechanized district), farmers gave first rank to quick operations, second rank to higher yield and third rank to higher yield and economical. The farmers have given priority to reducing drudgery. In both sample villages, early completion of cultivation activities is shown much weight followed by higher yield.

Reasons for using machinery in percentages are given Table 6. A.1(b). In more mechanized district, quicker operations are given first rank by the farmers with 78%. In the second priority, higher yield gets 44% followed economical with 38%. In the third priority, farmers show equivalent weight to higher yield and economical. Farmers did not refer to drudgery and other reasons and they gave much weight to the period of operations and higher yield and economical in Puri district, whereas it differs in Khurdha district. The farmers of sample village of Khurdha district express that they gave first and second ranks to quicker operations and higher yield, respectively along with the consideration of drudgery. In less mechanized district, drudgery is also given certain importance in the consideration of machine use in cultivation.

Table:6. A.1 (b)Reasons for Using Machinery

(%)

Reason	Rank 1	Rank 2	Rank 3
	More Mechanized District		
Higher Yield	8.00	44.00	48.00
Economical	14.00	38.00	48.00
Quicker Operations	78.00	18.00	4.00
Reduces drudgery	0.00	0.00	0.00
Any other	0.00	0.00	0.00
Total	100.00	100.00	100.00
	Less Mechanized District		
Higher Yield	8.00	46.00	46.00
Economical	8.00	8.00	18.00
Quicker Operations	84.00	10.00	6.00
Reduces drudgery	0.00	36.00	30.00
Any other	0.00	0.00	0.00
Total	100.00	100.00	100.00

Source: Field Survey, 2014

6. A.2 Operations for Which Machines Used:

Operations for which machines used are given in Table 6. A. 2(a). In both districts, ploughing is given first rank followed by the irrigation and the threshing. In the second rank also, farmers expressed similar priority to irrigation and threshing. In the agricultural operations, the machines are preferred much for ploughing, irrigation, threshing and transportation in both sample villages. In more mechanized cultivation, it is found threshing and harvesting operations showing much weight compared to less mechanized one. Sowing and weeding found some place in mechanized village rather than in its counterpart. The plant protection does not show any use of machinery in either selected district in the cultivation of the concerned sample villages.

Table: 6. A. 2 (a)Operations for Which the Machines Used

(in figures)

Reason	Rank 1	Rank 2	Rank 3
	More Mechanized District		
Ploughing	42	6	0
Sowing	0	2	1
Irrigation	7	23	18
Weeding	0	0	1
Plant protection	0	0	0
Harvesting	0	5	5
Threshing	1	14	24
Transportation & Marketing	0	0	1
Any other	0	0	0
Total	50	50	50
	Less Mechanized District		
Ploughing	30	16	4
Sowing	0	0	0
Irrigation	7	19	16
Weeding	0	0	0
Plant protection	0	0	0
Harvesting	0	0	0
Threshing	13	15	21
Transportation & Marketing	0	0	9
Any other	0	0	0
Total	50	50	50

Source: Field Survey, 2014

In Puri district, farmers are much accustomed to machines rather than in Khurdha district for different farming activities. In Khurdha district, farmers do not use machines in sowing, plant protection and harvesting, while it is opposite for Puri district. Therefore, it could be inferred that the sample village of Puri district is much mechanized than in its counterpart.

Percentage of operations for which the machines used is given in Table 6.A. 2(b). Farmers of more mechanized district exhibit first rank to ploughing by giving 84% and they expressed their priority to irrigation with 46% under second rank and with 48% to threshing under third rank. It could be inferred that the farmers have concentrated particular farming activities viz., Ploughing, Irrigation and Threshing that reduce the time and labour cost. For less mechanized district, the same trend of Puri district appears and the machines used in the operations do resemble as in case of the farmers of more mechanized district. The priorities of the farmers in the use of machines indicate same level of preference of activities. However, in Puri district, farmers have gone ahead at a small extent in the farming activities of sowing, weeding and harvesting and this does not appear in less mechanized district Khurdha.

Table:6. A. 2 (b) Operations for Which the Machines Used

(in%)

Reason	Rank 1	Rank 2	Rank 3
	More Mechanized District		
Ploughing	84.00	12.00	0.00
Sowing	0.00	4.00	2.00
Irrigation	14.00	46.00	36.00
Weeding	0.00	0.00	2.00
Plant protection	0.00	0.00	0.00
Harvesting	0.00	10.00	10.00
Threshing	2.00	28.00	48.00
Transportation & Marketing	0.00	0.00	2.00
Any other	0.00	0.00	0.00
Total	100.00	100.00	100.00
	Less Mechanized District		
Ploughing	60.00	32.00	8.00
Sowing	0.00	0.00	0.00
Irrigation	14.00	38.00	32.00
Weeding	0.00	0.00	0.00
Plant protection	0.00	0.00	0.00
Harvesting	0.00	0.00	0.00
Threshing	26.00	30.00	42.00
Transportation & Marketing	0.00	0.00	18.00
Any other	0.00	0.00	0.00
Total	100.00	100.00	100.00

Source: Field Survey, 2014

6. A. 3 Appropriate Machine Use for Different Operations:

Table 6. A. 3 presents the appropriate machine use for ploughing in the two districts. It is observed that the animal operation of plough, disc harrow and cultivator are not there in Puri district, while it is found 34% in Khurdha district for ploughing by animal operation. The tractor operation is 88% for ploughing in Puri district, whereas it is only 66% in Khurdha district. For the ploughing, farmers are much dependent on machine-tractor in both sample villages with little variation. The appropriate machine for the ploughing is much considered as tractor among the farmers, however, the level of use is much high in Puri district.

Table:6. A.3. Ploughing

	Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District			
Animal operated	Plough	0	50	0.00
	Disc harrow	0	50	0.00
	Cultivator	0	50	0.00
Power tiller operated	Rotavator	6	50	12.00
Tractor operated	Plough	44	50	88.00
	Disc harrow	0	50	0.00
	Cultivator	0	50	0.00
	Rotavator	0	50	0.00
	Less Mechanized District			
Animal operated	Plough	17	50	34.00
	Disc harrow	0	50	0.00
	Cultivator	0	50	0.00
Power tiller operated	Rotavator	0	50	0.00
Tractor operated	Plough	33	50	66.00
	Disc harrow	0	50	0.00
	Cultivator	0	50	0.00
	Rotavator	0	50	0.00

Source: Field Survey, 2014

6. A. 4 Appropriate Machines for Sowing and Planting:

Appropriate machine for sowing and planting is given Table 6. A. 4. Still in Odisha, farmers are in the habit of manual sowing in either area of the selected districts. In Puri district only 15 farmers of the sample used the machine for sowing and planting, while in Khurdha district, all the 50 farmers of the sample use manual operation for sowing and planting. It could be understood that the machine is to reach the farmer; otherwise, the appropriate machine is to be designed to be much useful in sowing and planting activity. Animal operation of sowing and planting is 60% of the farmers in more mechanized district, while there is no animal operation in less mechanized district (it is complete manual). Therefore, there is need of inventing good device, which is suitable to the area in question.

Table:6. A. 4 Sowing and Planting

	Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District			
Manually operated	Manual	5	50	10.00
	Seed drill	0	50	0.00
Animal operated	Seed drill	0	50	0.00
	Drill Plough	0	50	0.00
	Mustard drill	0	50	0.00
	Row planter	30	50	60.00
Power tiller operated/ Tractor operated	Seed drill	15	50	30.00
	Zero till Drill	0	50	0.00
	Cultivator	0	50	0.00
	Rotavator	0	50	0.00
	Less Mechanized District			
Manually operated	Manual	50	50	100.00
	Seed drill	0	50	0.00
Animal operated	Seed drill	0	50	0.00
	Drill Plough	0	50	0.00
	Mustard drill	0	50	0.00
	Row planter	0	50	0.00
Power tiller operated/ Tractor operated	Seed drill	0	50	0.00
	Zero till Drill	0	50	0.00
	Cultivator	0	50	0.00
	Rotavator	0	50	0.00

Source: Field Survey, 2014

6. A. 5 Appropriate Machine Use in Irrigation:

Table 6.A. 5 gives information regarding the appropriate machine use in irrigation. All the sample farmers of more mechanized use the machine for irrigation in the cultivation, while less mechanized district reports only 58% of farmers use machine for irrigation in the cultivation. It is observed that the farmers of both sample villages are in much use of electric pump sets rather than diesel pumps. To run the diesel pump set, farmer was to bear much fuel expenses and it is not much efficient compared to electric pump set. Therefore, the farmers of more mechanized report 90% and 18% use of electric pumps and diesel pumps, in that order. It indicates the non-suitability of diesel pump set keeping in view the running costs of the machine.

Table: 6.A. 5 Irrigation

Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District		
Diesel Pump	9	50	18.00
Electric Pump	45	50	90.00
	Less Mechanized District		
Diesel Pump	7	50	14.00
Electric Pump	22	50	44.00

Source: Field Survey, 2014

6. A. 6. Weeding and Inter-culture:

Table 6.6 presents the weeding and inter-culture in the sample villages from selected districts. It is observed that all the farmers (100) in the sample villages were with manual operation of weeding and inter-culture and therefore, the opinion could not be obtained for the particular device/machine in the weeding and inter-culture of the cultivation. The same picture appears for both study districts of Puri and Khurdha. All the farmers are with 100% in manual operation in the study districts.

Table: 6.A. 6 Weeding and Intercultural

Most Appropriate Machine (1)	Number of farmers (2)	Total no of farmers (3)	% of farmers (2 as % of 3)
	MORE MECHANIZED DISTRICT		
Manually operated	50	50	100.00
Animal operated	0	0	0.00
Power/Tractor operated	0	0	0.00
Self – Propelled	0	0	0.00
	LESS MECHANIZED DISTRICT		
Manually operated	50	50	100.00
Animal operated	0	0	0.00
Power/Tractor operated	0	0	0.00
Self – Propelled	0	0	0.00

Source: Field Survey 2014

6. A. 7.Appropriate Plant Protection Equipment:

Table 6.A. 7 gives the data over appropriate plant protection equipment. It is found that both more and less mechanized districts display similar picture. All the farmers are 100% dependent on manual operated devices for plant protection. They are not using animal operated or power tiller or tractor operated in the fields to protect the plants. This is because of cost of device or required skill set or its large-scale machine size. It could be considered the smaller machine instrument, which suits much the farmers across the region under study. The prices of machines and the subsidies of government will also play a crucial role in the use of this type of machines in the agricultural fields.

Table: 6.A. 7Plant Protection Equipment

Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District		
Manually operated	50	50	100.00
Animal operated	0	50	0.00
Power tiller/ Tractor Operated	0	50	0.00
Self- propelled	0	50	0.00
	Less Mechanized District		
Manually operated	50	50	100.00
Animal operated	0	50	0.00
Power tiller/ Tractor Operated	0	50	0.00
Self- propelled	0	50	0.00

Source: Field Survey, 2014

6. A. 8 Appropriate Harvesting Machine:

Appropriate Harvesting machine is shown Table6.A.8. There are four types of harvesting operations possible. Out of these, power tiller-tractor operated (continued harvester) reports the use of 45 farmers from the sample village of Puri district and manually through sickle, the harvesting is done by five farmers. It shows that the harvesting is done 90% through machine-combined harvester. In Khurdha district, still the farmers harvest the crop by using manual sickle at the rate of 96% out of the sample 50 farmers. Only two farmers used the combined harvester to the harvesting in the fields of Khurdha district. There is large variation in between the two districts in harvesting of the crop.

Table: 6.A. 8 Harvesting

Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District		
Manually Sickle	5	50	10.00
Animal operated	0	50	0.00
Power tiller/ Tractor Operated (Combined Harvester)	45	50	90.00
Self- propelled	0	50	0.00
	Less Mechanized District		
Manually Sickle	48	50	96.00
Animal operated	0	50	0.00
Power tiller/ Tractor Operated (Combined Harvester)	2	50	4.00
Self- propelled	0	50	0.00

Source: Field Survey, 2014

6. A. 9 Appropriate Machine Use in Threshing:

Appropriate machine in Threshing is presented in Table 6.A. 9. In Puri district 96% farmers are in the use of combined harvester for threshing and only 4% farmers are using power-operated thresher. The farmers prefer to use combined harvester, rather than paddy thresher. The similar trend appears in less mechanised district-Khurdha. Still 10% farmers are using animal operated in Khurdha district, whereas this is completely absent in Puri district.

Table: 6.A. 9 Threshing

Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District		
Animal operated	0	50	0.00
Power Operated Thresher	2	50	4.00
Power tiller/ Tractor Operated (Combined Harvester)	48	50	96.00
Paddy Thresher	0	50	0.00
	Less Mechanized District		
Animal operated	5	50	10.00
Power Operated Thresher	0	50	0.00
Power tiller/ Tractor Operated	45	50	90.00
Paddy Thresher	0	50	0.00

Source: Field Survey, 2014

6. A. 10 Appropriate Machine Use for Marketing & Transportation:

Table 6.A. 10 gives the appropriate machine use for marketing and transportation. All the farmers (100%) have used the tractor trolley to transport the produce from farm gate to market in Puri district, contrary to it, the farmers of Khurdha district show 66% use of tractor trolley. The farmers of less mechanized district are still dependent on animal operation (34%) in transport for marketing the produce.

Table: 6. A. 10 Marketing and Transportation

Most Appropriate Machine (1)	Number of farmers (2)	Total No of farmers (3)	% of farmers (2 as % of 3)
	More Mechanized District		
Animal operated	0	50	0.00
Tractor trolley	50	50	100.00
	Less Mechanized District		
Animal operated	17	50	34.00
Tractor trolley	33	50	66.00

Source: Field Survey, 2014

Part-B

Farmers' Major Problems with Machinery Used

6. B.1 Ploughing:

Table 6.B.1 gives the problems of the farmers in the study districts based on the opinion expressed by farmers during the field survey. In the ploughing, farmers (4%) informed that there was a problem to hire animal operation for ploughing in Puri district, while this view was not found in Khurdha district. In the tractor ploughing, the cultivators (24%) view that they think higher price of tractor to purchase in Puri district. In less mechanized district (Khurdha), the farmers (34%) expressed high expensive of the tractor, as it takes much investment by the farmer. They (6%) express that tractors are not available for hiring during the sowing season for right time ploughing. They (42%) informed the existence of much expensive hiring of tractors for ploughing in Khurdha district. Lastly, farmers (2%) viewed the existence of good maintenance cost to tractors even for hired tractors during ploughing season across fields.

6. B.2 Sowing and Planting:

The problems faced in the sowing and planting machinery is presented in Table 6.B. 2. In the study districts, the farmers have the only one option. It is the machinery of 'tractor planter' in sowing and planting in both Puri and Khurdha districts in Odisha. The remaining machines are not useful under 'manual' and 'animal' and hence, cultivators are not in the use of other machinery. The farmers of Puri district expressed that the cost of 'tractor planter' was expensive to purchase. The respondents informed at 18% in more mechanized district. In khurdha district, farmers (60%) opined the expensiveness in purchasing a 'tractor planter' to have it in cultivation. The other problems were not found with cultivators. The cultivators from the study are very particular regarding the price of 'tractor operated planter'.

6. B.3 Irrigation, Weeding and Plant protection:

Table 6.B. 3 presents the problems expressed by farmers over irrigation, weeding and plant protection in the study area. In Puri district, farmer did not show any problem over the machinery of irrigation, weeding and plant protection and it informs the good adaption of machinery in these lines of activities in cultivation. In Khurdha district, farmers expressed some problem over irrigation machinery. They expressed that the diesel pump

and electric pump were expensive and the cultivators opined 26% and 12% for diesel and electric pumps, respectively. It shows some problem faced by farmers in Khurdha district in the irrigation over the machinery, but it is absent in Puri district. As per the opinion expressed in sample villages, the farmers are not faced with any problem over machinery of irrigation, weeding and plant protection in Puri district.

6. B.4 Harvesting, Threshing and Marketing:

Table 6.B. 4 presents the picture of problems faced by the farmers in the use of machinery in harvesting, threshing and marketing in Puri and Khurdha districts through the field survey. In harvesting of paddy, the farmers (16%) informed the problem in receiving yield at expected level in use of manual sickle for harvesting in Puri district and the farmers (24%) expressed the problem of high cost of 'tractor harvesting machine' in the same district. The different picture appears in Khurdha district for harvesting. The cultivators (28% from sample village) viewed that it was much problem to hire the labour for cutting the paddy through 'manual sickle' and further they (6%) expressed the problem of higher labour wages (expensive to hire). In case of tractor use, these farmers (72%) were very particular about the price of tractor (expensive to purchase).

In Threshing, we find different picture in between two study districts. Farmers (18%) expressed the high cost of price of the tractor for threshing purpose in the cultivation in Puri district. In Khurdha district, farmers have shown three problems in the use of tractor in threshing. First, they (50%) informed the problem of the high price of tractor and at the same time, they are particular over the hiring situation in the village. The farmers (10%) expressed the problem of non-availability of tractor for threshing on hire basis and further, they (4%) informed the higher cost of hire basis in getting a tractor for threshing during the harvesting season. Therefore, it would be better to arrange number of machines to the farmers for hire basis from agriculture department.

In the Marketing of produce, farmers employ tractor trolley for the transport of the produce in both study districts. In Puri district, farmers (10%) viewed the expensive price of a tractor trolley to purchase, while the farmers (24%) expressed the same opinion in Khurdha district. The farmers are much concerned with the price of tractor and its trolley and hence, it would be better either to increase the amount of subsidy or to reduce the price of tractor and its trolley by the producers of the tractors.

Table: 6. B. 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 farmer not reporting any reason	Total
MORE MECHANIZED DISTRICT													
Animal operated	Plough	0	4.00	0	1.00	0	0	0	0	0	0	96.00	100
	Disc arrow	0	0	0	0	0	0	0	0	0	0	100	100
	Cultivator	0	0	0	0	0	0	0	0	0	0	100	100
Power tiller	Rotavator	0	0	0	0	0	0	0	0	0	0	100	100
Tractor	Plough	24.00	0	0	0	0	0	0	0	0	0	76.00	100
	Disc arrow	0	0	0	0	0	0	0	0	0	0	100	100
	Cultivator	0	0	0	0	0	0	0	0	0	0	100	100
	Rotavator	0	0	0	0	0	0	0	0	0	0	100	100
Manual	Seed drill	0	0	0	0	0	0	0	0	0	0	100	100
LESS MECHANIZED DISTRICT													
Animal operated	Plough	0	0	0	0	0	0	0	0	0	0	100	100
	Disc arrow	0	0	0	0	0	0	0	0	0	0	100	100
	Cultivator	0	0	0	0	0	0	0	0	0	0	100	100
Power tiller	Rotavator	0	0	0	0	0	0	0	0	0	0	100	100
Tractor	Plough	34.00	6.00	42.00	2.00	0	0	0	0	0	0	16.00	100
	Disc arrow	0	0	0	0	0	0	0	0	0	0	100	100
	Cultivator	0	0	0	0	0	0	0	0	0	0	100	100
	Rotavator	0	0	0	0	0	0	0	0	0	0	100	100
Manual	Seed drill	0	0	0	0	0	0	0	0	0	0	100	100

Source: Field Survey, 2014

Table: 6.B. 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 farmer not reporting any reason	Total
MORE MECHANIZED DISTRICT													
Manual	Seed drill	0	0	0	0	0	0	0	0	0	0	100	100
Animal	Seed cum fertilizer drill	0	0	0	0	0	0	0	0	0	0	100	100
	Drill plough	0	0	0	0	0	0	0	0	0	0	100	100
	Mustard drill	0	0	0	0	0	0	0	0	0	0	100	100
	Row planter	0	0	0	0	0	0	0	0	0	0	100	100
Tractor	Seed cum fertilizer drill	0	0	0	0	0	0	0	0	0	0	100	100
	Zero till drill	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor planter	18.00	0	0	0	0	0	0	0	0	0	82.00	100
LESS MECHANIZED DISTRICT													
Manual	Seed drill	0	0	0	0	0	0	0	0	0	0	100	100
Animal	Seed cum fertilizer drill	0	0	0	0	0	0	0	0	0	0	100	100
	Drill plough	0	0	0	0	0	0	0	0	0	0	100	100
	Mustard drill	0	0	0	0	0	0	0	0	0	0	100	100
	Row planter	0	0	0	0	0	0	0	0	0	0	100	100
Tractor	Seed cum fertilizer drill	0	0	0	0	0	0	0	0	0	0	100	100
	Zero till drill	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor planter	60.00	24.00	0	0	0	0	0	0	0	0	16.00	100

Source: Field Survey, 2014

Table: 6.B. 3 Irrigation, Weeding and Plant Protection

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 farmer not reporting any reason	Total
MORE MECHANIZED DISTRICT													
Irrigation	Diesel Pump	0	0	0	0	0	0	0	0	0	0	100	100
	Electric pump	0	0	0	0	0	0	0	0	0	0	100	100
Weeding, etc.	Manually operated	0	0	0	0	0	0	0	0	0	0	100	100
	Animal	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor/power	0	0	0	0	0	0	0	0	0	0	100	100
	Self-propelled	0	0	0	0	0	0	0	0	0	0	100	100
Plant protection	Manually operated	0	0	0	0	0	0	0	0	0	0	100	100
	Power operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	0	0	0	0	0	0	0	0	0	0	100	100
	Self-propelled	0	0	0	0	0	0	0	0	0	0	100	100
LESS MECHANIZED DISTRICT													
Irrigation	Diesel Pump	26.00	0	0	0	0	0	0	0	0	0	74.00	100
	Electric pump	12.00	0	3	0	0	0	0	0	0	0	88.00	100
Weeding, etc.	Manually operated	0	0	0	0	0	0	0	0	0	0	100	100
	Animal	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor/power	0	0	0	0	0	0	0	0	0	0	100	100
	Self-propelled	0	0	0	0	0	0	0	0	0	0	100	100
Plant protection	Manually operated	0	0	0	0	0	0	0	0	0	0	100	100
	Power operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	0	0	0	0	0	0	0	0	0	0	100	100
	Self-propelled	0	0	0	0	0	0	0	0	0	0	100	100

Source: Field Survey, 2014

Table: 6.B. 4 Harvesting, Threshing and Marketing

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 farmer not reporting any reason	Total
MORE MECHANIZED DISTRICT													
Harvesting	Manual sickle	0	0	0	0	0	0	16.00	0	0	0	84.00	100
	Animal operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	24.00	0	0	0	0	0	0	0	0	0	76.00	100
Threshing	Power operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	18.00	0	0	0	0	0	0	0	0	0	82.00	100
	Paddy thresher	0	0	0	0	0	0	0	0	0	0	100	100
Marketing	Bullock	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor Trolley	10.00	0	0	0	0	0	0	0	0	0	90.00	100
LESS MECHANIZED DISTRICT													
Harvesting	Manual sickle	0	28.00	6.00	0	0	0	0	0	0	0	76.00	100
	Animal operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	72.00	0	0	0	0	0	0	0	0	0	28.00	100
Threshing	Power operated	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor operated	50.00	10.00	4.00	0	0	0	0	0	0	0	36.00	100
	Paddy thresher	0	0	0	0	0	0	0	0	0	0	100	100
Marketing	Bullock	0	0	0	0	0	0	0	0	0	0	100	100
	Tractor Trolley	24.00	0	0	0	0	0	0	0	0	0	76.00	100

Source: Field Survey, 2014

6. B. 5.Usefulness of Machinery:

Usefulness of machinery is given in Table 6.B.5. Farmers (60%) expressed the use of machine to receive higher yield from the cultivation from Puri district, whereas it is 54% in Khurdha district. The farmers (24%) display usefulness of machinery to derive reduced drudgery from more mechanized district, though the farmers (34%) inform in higher extent for better reduction of drudgery in Khurdha district. Only 10% of farmers from Puri district express the usefulness of machinery for higher income, but it is absent in the other study district. The major segment of farmers express the usefulness of machinery for higher yield and it indirectly indicates the increase of income of the farmer.

Table:6. B. 5 Usefulness of the Machinery

	Type of use	No of farmers	% of farmers to total number of farmers
	MORE MECHANIZED DISTRICT		
Farmers finding the machinery useful			
Type of use	Higher yield	30	60.00
	Better land utilization	3	6.00
	More number of crops	0	0.00
	Reduced drudgery	12	24.00
	Higher social esteem	0	0.00
	Higher income	5	10.00
	Any other	0	0.00
	LESS MECHANIZED DISTRICT		
Type of use	Higher yield	27	54.00
	Better land utilization	6	12.00
	More number of crops	0	0.00
	Reduced drudgery	17	34.00
	Higher social esteem	0	0.00
	Higher income	0	0.00
	Any other	0	0.00

Source: Field Survey 2014

More farmers (12%) express the use of machine for the better land utilization in Khurdha district, while it is only 6% in Puri district. By and large, farmers from both districts have recognized the usefulness of machines in the cultivation. They understood clearly the use of machines for good cultivation in fields and for better incomes.

6.B.6 Awareness and Assistance received from Government Programmes:

Table 6.B.6 presents awareness and assistance received from government programmes. In Puri district, farmers are much aware of government programmes than in Khurdha district, as the farmers express with 42% and 14% in Puri and Khurdha districts, respectively. Farmers (42%) express that they know much of demonstration of best

practices (by 42% farmers). Moreover, the farmers from less mechanized district express the awareness of best practices by 18% farmers.

Table:6.B. 6 Awareness and Assistance Received under Government Programmes

Awareness and Assistance	Type of use	No of farmers	% of farmers to total number of farmers
	MORE MECHANIZED DISTRICT		
Farmers aware of the programme	Line plantation, training to use machines	21	42.00
Farmers not aware of the programme		29	58.00
Farmers who received assistance under the programs			
Type of assistance received	Subsidy on purchase of machine	14	28.00
	Demonstration of best practices	21	42.00
	Training to use machines	14	28.00
	Cash incentives to use machines	0	0.00
	Complementary input provision	0	0.00
	Any other	0	0.00
	LESS MECHANIZED DISTRICT		
Farmers aware of the programme	Line plantation, training to use machines	7	14.00
Farmers not aware of the programme		43	86.00
Farmers who received assistance under the programs			
Type of assistance received	Subsidy on purchase of machine	6	12.00
	Demonstration of best practices	9	18.00
	Training to use machines	6	12.00
	Cash incentives to use machines	0	0.00
	Complementary input provision	0	0.00
	Any other	0	0.00

Source: Field Survey 2014

The subsidy on purchase of machine is known much in Puri district among farmers (28%) than that of the farmers (12%) in Khurdha district. In case of demonstration of best practices, cultivators have much exposure in more mechanised district compared to its counterpart. Much 'training' is there in the sample village of Puri district rather than in sample village of Khurdha district. The other factors viz., cash incentives, input provision and 'any other' are not in the awareness of both farmers of the two sample villages of the selected districts. The farmers are much interested in subsidy, best practices of the machine and the training to use the machine.

6.B.7. Usefulness of Programmes:

Table 6.B.7 presents the usefulness of the programme. The awareness of the farmers differs in between two sample villages of the study districts. More mechanised village shows 42% of farmers in favour of the mechanization programme, while the farmers of less mechanized village express by 18% for the usefulness of the programme. Farmers (82%) of Khurdha district inform the non-usefulness of programme in Khurdha district, whereas, it is found only 58% in Puri district. In the learning techniques of mechanisation, the farmers (42%) are in advance in Puri district, while it is found with 18% in Khurdha district. In the more mechanized area, farmers (28%) got cash subsidy for machines, while it was 12% only from less mechanized village from Khurdha district. Farmers did not make any negative remark, as there was no any reference under 'any other'. It shows that farmers are well aware of the usefulness of government programme, however, there is variation among the study districts.

Table:6.B. 7 Usefulness of the Programmes

Usefulness/Type of Use	Type of use	No of farmers	% of farmers to total number of farmers
	MORE MECHANIZED DISTRICT		
Farmers who found the programs useful		21	42.00
Farmers who haven't found the programs useful		29	58.00
Type of use	Learnt new techniques of mechanization	21	42.00
	Got cash subsidy for machines	14	28.00
	Any other	0	0.00
	LESS MECHANIZED DISTRICT		
Farmers who found the programs useful		9	18.00
Farmers who haven't found the programs useful		41	82.00
Type of use	Learnt new techniques of mechanization	9	18.00
	Got cash subsidy for machines	6	12.00
	Any other	0	0.00

Source: Field Survey, 2014

6.B. 8 Increase in Area and Production after Mechanization:

Increase in area and production after mechanization is given in Table 6.B. 8. There is hardly increase in area in both selected districts. The two sample villages have shown in the rise of production at 6.80% and 1.02% in Puri and Khurdha districts, respectively. Much

mechanisation effect could be traced in Puri district rather than in Khurdha district. Therefore, the mechanisation programme is still to knock the doors of the farmer in Khurdha district.

Table:6. B.8 Increase in Area and Production after Mechanization

Crop	% of area increase	% of production increase	% of production increase reported to be due to machines
	MORE MECHANIZED DISTRICT		
Paddy	0	6.80	6.80
	LESS MECHANIZED DISTRICT		
Paddy	0	1.02	1.02

Source: Field Survey, 2014.

Summary

Part-A:

In the use of machinery, the farmers express much for the 'quick operation' of cultivation activities. In the priority of operations in both districts, ploughing is given first rank followed by the irrigation and the threshing. In the second rank also, farmers expressed similar priority to irrigation and threshing. In the agricultural operations, the machines are preferred much for ploughing, irrigation, threshing and transportation in both sample villages. In Puri district, farmers are much accustomed to machines rather than in Khurdha district for different farming activities. The priorities of the farmers in the use of machines indicate same level of preference of activities in study districts. It is observed that the animal operation of plough, disc harrow and cultivator are not there in Puri district, while it is found 34% in Khurdha district for ploughing by animal operation.

Still in Odisha, farmers are in the habit of manual sowing in either area of the selected districts. It is observed that the farmers of both sample villages are in much use of electric pump sets rather than diesel pumps. All the farmers from both study districts are 100% dependent on manual operated devices for plant protection. It could be considered the smaller machine instrument, which suits much the farmers across the region under study. The farmers prefer to use combined harvester, rather than paddy thresher in study districts. All the farmers (100%) have used tractor trolley to transport the produce from farm gate to market in Puri district, while it is low in another study district.

Part – B:

In the tractor ploughing, the cultivators (24%) view that they are particular over higher price of tractor to purchase in Puri district. In less mechanized district (Khurdha), the farmers (34%) expressed high price of the tractor, as it takes much investment by the farmer. It is the machinery of 'tractor planter' in sowing and planting in both Puri and Khurdha districts in Odisha. The remaining machines are not useful under 'manual' and 'animal' and hence, cultivators are not in the use of other machinery. The cultivators from the study are very particular regarding the price of 'tractor operated planter'. In Puri district, farmer did not show any problem over the machinery of irrigation, weeding and plant protection and it informs the good adaption of machinery in these lines of activities in cultivation. In Khurdha district, farmers expressed some problem over irrigation machinery. In harvesting of paddy, the farmers (16%) informed the problem in receiving yield at expected level in use of manual sickle for harvesting in Puri district and the farmers (24%) expressed the problem of high cost of 'tractor harvesting machine' in the same district. The different picture appears in Khurdha district for harvesting.

Farmers (18%) expressed the high cost of price of the tractor for threshing purpose in the cultivation in both districts. The farmers are much concerned with the price of tractor and its trolley and hence, it would be better either to increase the amount of subsidy or to reduce the price of tractor and its trolley by the producers of the tractors. By and large, farmers from both districts have recognized the usefulness of machines in the cultivation. They understood clearly the use of machines for good cultivation in fields and for better incomes. The farmers are much interested in subsidy, best practices of the machine and the training to use the machine. It shows that farmers are well aware of the usefulness of government programme; however, there is variation among the study districts. Much mechanization effect could be estimated in Puri district rather than in Khurdha district. Therefore, the mechanisation programme is still to knock the doors of the farmer in Khurdha district.

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CHAPTER- VII

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

7. 1.1Background:

Farm mechanization is the mainstay of modern agriculture and many developing countries have been following the same. The scope of farm mechanization is wide. Mechanization of agriculture has wide area across all the states, since it will give much benefit to the farming community. It increases the productivity of a farm. The in-time operations could be done in cultivation to obtain optimal yields from various crops. Constraints in Mechanization are there in India. It replaces farm labour and it could not be directly substituted in mechanized works, since the semi-skill set is required. Majority of Indian farmers may not meet cost of machinery and, thus, there are number of impediments to agricultural mechanization in India.

7. 1.2 Review of Literature:

Ray. A.K. (1993) examined the agricultural mechanization in India during 1972-1987. He estimated the existing constraints in the mechanization process for all the states and these are: 1) Farm Size 2) Less Irrigation and 3) Lower level of cropping intensity. Bina Agarwal (1984) analyzed the effects of tractors and tube wells in Punjab. Joginder Singh (2005) reviewed the literature of farm mechanization in India during 1950-2001. Gyanendra Singh (2006) analyzed the impact of mechanization on production and economic factors in Indian agriculture during 1971-1996. Komal Singh (2012) tried to estimate the impact of tractorisation in Indian agriculture during 1961-2003. Debendra C. Baruah (2008) examined the good mechanization strategies for rice crop in Assom and he divided them into four to estimate the energy demand. Nagaraj et.al (2013) conducted a survey to know the level of agriculture mechanization by collecting primary data in six villages with 120 respondents in Karnataka. Tewari, V.K. et. al (2012) estimated the increase of production yields by farm mechanization in West Bengal.

7.1.3The Problem:

Based on above review of research work done over agricultural mechanization, it could be inferred that there is hardly good evaluation available either at all India or at Odisha for 'Mission of Agricultural Mechanization' in Odisha. It is felt that there is a dire

need to know the impact and change in cultivation because of implementation of the 'Mission of Agricultural Mechanization' in Odisha. Therefore, Government of India, Ministry of Agriculture, Department of Agriculture and Co-operation assigned the study entitled "Evaluation and Impact of Mechanization on Agricultural Growth: Comparative Economics of Labour and Machinery in Agriculture in Odisha" to Agro-Economic Research Centre, Visakhapatnam. It has been made an attempt to estimate the impact of agricultural mechanization in Odisha with the following objectives.

7.1.4Objectives of the study:

1). To assess the impact of recent mechanization on agricultural growth in Odisha,
2) To estimate the pattern of mechanization at the crop level and effect on production and productivity and
3) To find the comparative economics of labour and machinery in agriculture in Odisha.

7.1.5Methodology and Data Sources:

Both secondary and primary data will be used in this study. To estimate the trends in cost of cultivation, secondary data from the website of "DACNET" is used by calculating with semi log. The major data sources for this study are primary data surveys made in Odisha. The primary survey will be conducted with multi-stage sampling. Since all the 30 districts in Odisha are implemented mechanization, it is selected two districts with one more mechanized district –Puri and another one with less mechanized district-Khurdha. The similar sampling is followed in the selection of mandals/blocks and villages. In each block, one village is selected. From each village 50 beneficiaries are selected randomly from the given list by the Department of Agriculture. In selecting village, pre-tested survey is conducted. The selected beneficiaries are divided into Scheduled Castes (SCs), Scheduled Tribes (Sts), and Other Backward Classes (OBCs) and 'Other Castes' (OCs). All the 50 farmers from each village are classified as marginal, small, medium and large based on the land holding size of the beneficiary. In this connection, leased-in land of the beneficiary is included to estimate farmer size group. Hence, the analysis in the study will take place with the comparison of two districts one for 'more mechanized-Puri district' and the other one for less mechanized district-Khurdha district. The primary data was collected during March 2014 as the reference year.

7.2 Trends in Agricultural Mechanization in Odisha:

The trend appears that there are higher shares for human labour and bullock labour rather than machine labour in operational costs during 2001-10 in Odisha. The machine labour ranges between 0.73% and 2.83% in total costs for different crops studied. It indicates that there is lot of scope for mechanization in agriculture in Odisha. The dominance of human labour is there for all crops in total costs of cultivation and it could be further reduced for all selected crops in this study. The growth rate displayed declining for all selected crops except sesamum and jute. The growth rate of price of human labour shows increasing trend and this acceleration ranges between 0.04 and 0.11 for different selected crops in the study. The quantity of bullock labour shows rapid decrease for all crops except sesamum. When compared to yields, the growth rate is low for total cost of machine. There is good scope for mechanization of agriculture in Odisha.

7.3 Demographic Profile and Cropping Pattern of the Study Region:

More mechanized district displays more than two times high of children than in its counterpart and the similar picture appears for total number of persons. The illiteracy prevails much among marginal farmer group rather than in other farmer groups in more mechanized district (Puri) and similar trend appears for primary education and secondary education. The illiteracy rate is high in more mechanized district rather than in less mechanized one. In the less mechanized district, females appear in large number in marginal and small farmer groups, however, males report in higher number across all groups.

Comparatively, good education level appears in less mechanized district. More than 80% of farmers show secondary education for marginal, small and medium groups in less mechanized district. There are no schedule tribes in both districts. Out of the two districts, the selected sample village from Puri district shows much area under irrigated. In Khurdha district, there is no canal irrigation in the sample village. In Puri district, the irrigated area of the sample village is 93%, while it is 72% in Khurdha district. The Crop Duration Index, for three-year period, will enable us to understand the level of cropping intensity in the sample village of more mechanised district in 2008-11. The cropping pattern shows the existence of three-crop-season in Puri district, while there were two seasons in Khurdha district during 2008-11.

7.4 Costs of Mechanization of the Sample Villages in the Selected Districts:

Out of all the costs, hired machinery costs stood at the highest by 38% followed by hired labour costs for paddy. Among other costs, fertilizer costs reported 15% and it was higher than any other input cost of paddy crop. The percentage of machinery costs to value of output is high in more mechanized district (Puri) than in its counterpart (Khurdha). The power operated and the tractor operated are 100% covered in the sample village of Puri district, though it remained as 58% and 66% in that order in khurdha district. Hired machinery costs and hired labour costs are the major costs in the cost of cultivation of paddy. The mechanised costs are high in more mechanised district. The marketed surplus is high in more mechanised district and the similar trend is found with the value of output. The high mechanization reflects in the use of operation wise use of machinery and its use in the cultivation. A great deal of 'Time use' appears for agricultural machinery in Puri district compared to Khurdha district. Cost of cultivation per ha is high in less mechanized district (Khurdha) rather than in another study district.

7.5Pattern of Mechanization in Selected Districts of Odisha:

It is found that the number of hours and toiling is high in less mechanized district and vice versa for various operations of cultivation. In Puri and Khurdha districts, the animal operation and tractor operation is synced up in the number of hours toiled for ploughing and seedbed preparation. In more mechanized district, there is no animal operation for sowing and planting. The planting operation by tractor is found 100% for sowing and planting in Puri district. However, it is found complete manual and animal operation in Khurdha district, and therefore, we will not find any information under this variable-farm machinery. The irrigation costs per ha appear high in Khurdha district for both diesel and electric pumps. In both sample villages, the costs of electric pumps are lower than the costs of diesel pumps. The manual operation is the single operation in both villages for weeding and therefore, the manual operation becomes 100% in use in weeding and inter-culture in the study area. The costs for plant protection are 100% under manual operation and no other alternative method of device is adapted in study districts. The more mechanized district reports very low level of harvesting costs per ha through tractor operation and it is traced the opposite picture in Khurdha district. The machine operation or tractor operation is 100% for 'threshing' activity and the farmers of the sample villages of Puri district engage no other operation. For Khurdha district, still farmers engaged 92% threshing through animal

operation and 8% through tractor operation. It is found that the transportation and marketing is 100% mechanized in Puri district, whereas it is 86% animal operation and 14% tractor trolley operation in Khurdha district.

7.6Farmers' Opinion Survey and their Major Problems with Machinery Used:

6.Part – A: Farmers' Opinion Survey:

In the use of machinery, the farmers express much for the 'quick operation' of cultivation activities. In the priority of operations in both districts, ploughing is given first rank followed by the irrigation and the threshing. In the second rank also, farmers expressed similar priority to irrigation and threshing. In the agricultural operations, the machines are preferred much for ploughing, irrigation, threshing and transportation in both sample villages. In Puri district, farmers are much accustomed to machines rather than in Khurdha district for different farming activities. The priorities of the farmers in the use of machines indicate same level of preference of activities in study districts. It is observed that the animal operation of plough, disc harrow and cultivator are not there in Puri district, while it is found 34% in Khurdha district for ploughing by animal operation.

Still in Odisha, farmers are in the habit of manual sowing in either area of the selected districts. It is observed that the farmers of both sample villages are in much use of electric pump sets rather than diesel pumps. All the farmers from both study districts are 100% dependent on manual operated devices for plant protection. It could be considered the smaller machine instrument, which suits much the farmers across the region under study. The farmers prefer to use combined harvester, rather than paddy thresher in study districts. All the farmers (100%) have used tractor trolley to transport the produce from farm gate to market in Puri district, while it is low in another study district.

7.6 Part-B: Farmers' Major Problems with Machinery Used:

In the tractor ploughing, the cultivators (24%) view that they are particular over higher price of tractor to purchase in Puri district. In less mechanized district (Khurdha), the farmers (34%) expressed high price of the tractor, as it takes much investment by the farmer. It is the machinery of 'tractor planter' in sowing and planting in both Puri and Khurdha districts in Odisha. The remaining machines are not useful under 'manual' and 'animal' and hence, cultivators are not in the use of other machinery. The cultivators from

the study are very particular regarding the price of 'tractor operated planter'. In Puri district, farmer did not show any problem over the machinery of irrigation, weeding and plant protection and it informs the good adaption of machinery in these lines of activities in cultivation. In Khurdha district, farmers expressed some problem over irrigation machinery. In harvesting of paddy, the farmers (16%) informed the problem in receiving yield at expected level in use of manual sickle for harvesting in Puri district and the farmers (24%) expressed the problem of high cost of 'tractor harvesting machine' in the same district. The different picture appears in Khurdha district for harvesting.

Farmers (18%) expressed the high cost of price of the tractor for threshing purpose in the cultivation in both districts. The farmers are much concerned with the price of tractor and its trolley and hence, it would be better either to increase the amount of subsidy or to reduce the price of tractor and its trolley by the producers of the tractors. By and large, farmers from both districts have recognized the usefulness of machines in the cultivation. They understood clearly the use of machines for good cultivation in fields and for better incomes. The farmers are much interested in subsidy, best practices of the machine and the training to use the machine. It shows that farmers are well aware of the usefulness of government programme; however, there is variation among the study districts. Much mechanization effect could be estimated in Puri district rather than in Khurdha district. Therefore, the mechanisation programme is still to knock the doors of the farmer in Khurdha district.

7.7. Conclusions and Policy Implications:

7.7.1. Conclusions:

1. There is a lot of possibility of agricultural mechanization in Odisha, since this study clearly identified the clear trends in cost of cultivation favourable to mechanization. Cost of machine labour clearly shows the lower shares compared to the shares of human and bullock labour in operational costs and total costs and further in the value of production. Though paddy crop is much popular for agricultural mechanization, it also divulges a lower stratum for the machine labour in the cost of cultivation. Interestingly, paddy has lower level of growth rate for the cost of machine labour compared to bullock labour in Odisha.

2. If it is compared to the growth rates of yields of different crops, the growth rate of machine labour is very low. Machine labour does not show much share for any crop in the value of production, as it covers up to 2.68% only for paddy crop, having other crops placed below to it. Hence, there is good scope for mechanization of agriculture across Odisha.

3. In the Puri district, the extent of farm machinery displays at large compared to Khurdha district. The Value of output and marketed surplus are high in Puri district compared toits counterpart.

4. Still the agricultural mechanization is to be taken place in weeding and inter-culture, and plant protection in both study districts, as these districts report 100% manual operation in weeding and plant protection.The less mechanized district (Khurdha) shows higher number of hours for every operation in the cultivation compared to more mechanized district. The mechanization achieved 100% in irrigation, harvesting, threshing and transportation and marketing in Puri district, though khurdha district lags in achieving 100% in threshing and transportation.

5. In more mechanized district, there is no animal operation for sowing and planting however, it is 100% manual and animal operation in Khurdha district. The irrigation costs per ha appear high in Khurdha district for both diesel and electric pumps. In both sample villages, the operation costs of electric pumps are lower than that of the operation costs of diesel pumps.

6. Still, Khurdha district shows animal and manual operations for threshing and transport and marketing and the costs of these heads are high. Time use is also high in these operations in Khurdha district.

7. In both sample villages, early completion of cultivation activities is shown much weight followed by higher yield in the adaption of machines. In less mechanized district, drudgery is also given certain importance in the consideration of machine use in cultivation. In both districts, the ploughing is given first rank followed by the irrigation and the threshing. In the second rank also, farmers expressed similar priority to irrigation and threshing. In the agricultural operations, the machines are preferred much for ploughing, irrigation, threshing and transportation in both sample villages.

8. The appropriate machine for the ploughing is much considered as tractor across two study districts. However, the level of use is much high in Puri district. The machine-combined harvester is preferred for harvesting in the study area and the tractor trolley is always preferred one for transport and marketing produce.

9. In both study districts, farmers expressed that the purchase of tractor and trans-planter is a highly expensive one and they informed the high expenses of hiring a tractor in the agricultural season and similar trend appeared for tractor trolley.

10. Puri district shows much awareness than in Khurdha district over government programmes. There is great deal of difference over subsidy, demonstration of best practices, and training to the farmers in between two study districts and Puri district has better edge in every aspect of the study. Many farmers viewed the non-usefulness of mechanization programme in Khurdha district. Much mechanisation effect could be traced in Puri district rather than in Khurdha district. The rise of production for paddy is at 6.80% and 1.02% per ha in Puri and Khurdha districts, respectively.

7.7.2. Policy Implications:

1. **Extensive Programme:** It is indispensable to take extensive programme to increase the agricultural mechanization to new heights. To this end, it is to increase the outlays to these programmes, as the amount Rs.521 crores spent (see box-2 in Annexure) during 2013-14 was very much meager and insufficient to meet the big demand of agricultural mechanization across fields of Odisha. Though paddy is prominent for agricultural mechanization, it has not reached the required level of mechanization. It indicates apparently the need of the hour of widespread and rigorous programme to enhance the yield and income of the peasant.

2. **Proper Coverage:** There is a need of proper coverage of the present agricultural mechanization programme in the less mechanized districts in Odisha to increase the production and yields, as this study vividly demarcates the existing variation in between two study districts- Puri and Khurdha.

3. **Need of Adaption of Suitable Machines in Weeding and Inter-culture:** Still there is no use of machines in weeding and inter-culture, and plant protection in Odisha. As such, it would be much imperative to adapt the suitable and relevant size

of machines in the cultivation. The big size of machine is not useful to the farmers and they could not bear and maintain them for these activities in the fields. The low, horsepower and size machines are much useful compared to the cost of human labour. Then the farmer can substitute these machines successfully.

4. **Urgent Displacement of Diesel Pump Sets:** Unanimously and unequivocally, the farmer says that they want electric power and electric pump sets. Now, the farmer foregoes much amount of income in the form of expenditure towards purchase diesel and the maintenance of diesel pump set to meet the requirement of irrigation. The electric pump set and power may be given at subsidy keeping in view the marginal, small and medium farmers.

5. **Ploughing, Harvesting, Threshing and Transportation and Marketing:** To these operations in the cultivation, farmers give much priority to use machines like tractor, combined-harvester and tractor trolley, as the study says. Hence, it could be much appropriate to make them available with the following:

   i) Prices of these machines: All the farmers say that they are unable to meet the high expensive prices of these machines. It would be better to fix lower prices with some lower scale of machine and limited features, which are only needed in the cultivation.

   ii) Minimum Size and Suitable Scale of Machine: Many farmers say that the size and scale of operation of machine is very huge to bear its price and the costs of operation and maintenance. There should be adaptability among the peasant community of particular machine and further it could be suitable for scale of operations and maintenance. Therefore, governments or the executives of agricultural mechanization may seriously look into this aspect to find the suitable machine of the programme.

   iii) Subsidy over Machines: All these machines are very much costly and their scale of operations may be at large suitable to large farmers. Therefore, there could be given possible weight to small farmer size groups and the educated youth (sons and daughters of soil) may be considered to give these machines on high subsidy over these machines.

6. **Awareness over Machines:** There appears much low awareness over machines and its uses among farmers. To make a great success in agricultural mechanization,

it would be much need to disseminate information of assorted sizes of machines and its relative prices, uses and fuel efficiency. Hence, the printed booklets on various equipments may be distributed to all the gram panchayats in Odisha (mother tongue) to be utilized by the farmers. The Department of Agriculture may be entrusted this job to distribute some booklets. It may procure from the producers of machines and it can arrange translation from English to Odia. This will enable the farmer to interact with extension staff of the agriculture department and fellow farmers to find a suitable machine suitable to his/her landholding size and cropping pattern with reference to the relative uses and prices of different machines.

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Annexure – 1

Table – 1: Farm Mechanization (Including Central Assistance)

i)	Tractor	50% of the cost limited to Rs. 90,000/- Tractors up to 40 PTO HP
ii)	Power Tiller	a) Power Tiller of 8 BHP & above @50% of the cost, limited to Rs. 75,000/-. b) 50% of the cost, limited to Rs.40,000/- Lightweight power tiller below 8BHP for hill regions
iii)	Self-propelled Reaper, paddy trans planter and other similar self-propelled machines	**Self-propelled** – a) Paddy Reaper-@50 %of the cost limited to Rs. 80,000/-. b) Paddy Reaper cum binder - @ 50% limited to Rs. 1,50,000/- c) Walk behind type Trans planter - @75% of the cost limited to Rs. 1,50,000/- d) Riding type Transplanter – 75% of the cost limited to Rs. 5,00,000/- to be paid in 3 instalments in 3 years in the ratio of 2:2:1 which can be availed by Individual/Agro Service Centres/PACS/LAMPS etc. e) Seeding raising machine for transplanting mat preparation @ 75% of the cost limited to Rs. 2,00,000/- (other self-propelled machines will be included in the subsidy fold with approval of SLTC)
iv)	Specialized power driven equipments	Special power driven equipment like – a) All type Axial flow threshers (tractor & power tiller operated) @ 50% of the cost limited to Rs. 70,000/- b) Rotavator/Rotary tillers 75% of the cost limited to Rs. 80,000/- c) Others like ground nut digger, potato planter, potato digger, all type of power weeders, brush cutter, post hold digger, straw reaper etc., - 50% of the cost limited to Rs. 60,000/- d) Post-harvest machineries like Rubber roll Sheller, Mini oil mill, Mini Dal Processing Unit, all type of cleaner cum graders, Power ground nut decorticator. Maize Sheller and other related machines – 75% of the cost limited to Rs. 2,00,000/- (other self-propelled machines will be included in the subsidy fold with approval of SLTC)

v)	Power driven equipment (Tractor/power tiller operated/Conventional implements)	Power driven equipment like all type of Tractor/power tiller drawn implements like – a) Disc ploughs/harrows, all type of MB ploughs, all type of tillers, ridgers, levellers, power tiller trailer, etc. @ 50% of the cost limited to Rs. 25,000/- b) All type of seed cum fertilizer drills, Zero till cum seed drills, etc., @ 75% of the cost limited to Rs. 45,000/- (other self-propelled machines will be included in the subsidy fold with approval of SLTC)
vi)	a) Manually operated implements/tools b) Animal operated implements/tools	@ 75% of the cost, limited to Rs. 6,000/-
vii)	Animal drive tool carrier	50% of the cost limited to Rs. 12,000/- Animal driven specialized implements viz., a) Multi tool bar/carrier/tropicultor (with minimum four attachments). b) Pre-germinated paddy seeder.
viii)	Power Threshers (All types)	50% of the cost, limited to Rs. 24,000/-
ix)	Diesel/Electric/Petrol/ Kerosene pump sets up to 10BHP/7.5 KW	Diesel/Electric/Petrol/ Kerosene centrifugal monobloc pump sets from 1 KW up to 7.5 KW @ 50% of the cost limited to Rs. 15,000/-
x)	Laser Guided Leveller	75% of the cost, limited to Rs. 3.00 lakh
xi)	Plant Protection Equipment	
	a. Manual	50% of the cost, limited to Rs. 1,600/-
	b. Power operated	50% of the cost, limited to Rs. 4,000/-
	c. Tractor mounted	50% of the cost, limited to Rs. 8,000/-
	d. Aero-blast sprayer	50% of the cost, limited to Rs. 50,000/-
xii)	Combine Harvesters	
	a. Self-propelled track type	50% of the cost, limited to Rs. 6.00 lakh
	b. Self-propelled wheel type	50% of the cost, limited to Rs. 6.00 lakh
	c. Tractor mounted combine	50% of the cost, limited to Rs. 5.00 lakh (subsidy will be provided for combine only exclusive of tractor)
xiii)	Miscellaneous if any	Any suitable machine/implement will be included with approval of SLTC.

Source: Odisha Economic Survey – 2013-14 Government of Odisha, Bhubaneswar.

Table – 2: Subsidies for Agricultural Equipment – Odisha: 2012-13

Sl.No.	Machines	Quantity supplied (in nos.)	% of total
1	**2**	**3**	**4**
1	Tractor	4360	8.37
2	Power Tiller	10557	20.28
3	Diesel Pump sets	39217	75.32
4	Reaper/Transplanter/Rotavator	1718	3.30
5	Hydraulic Trailer	1394	2.68
6	Combined harvester	79	0.15
7	Power thresher-cum-winnower	3200	6.15
8	Others	NA	--
9	Total	520.67	100.00

Source: State Agriculture Policy of Odisha – 2013, Government of Odisha, Bhubaneswar.

ACTION TAKEN

There are no comments to make changes in the draft report from the Co-ordinator

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