Study on Recent Farm Mechanization Trend in Odisha

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***Abstract*: The present study was conducted to determine the use pattern of some important farm machinery like power tiller, tractors, and combine harvesters and to establish the relationship between machine life, maintenance cost, and use pattern in selected districts of Odisha. Data was collected with the help of a developed questionnaire through personal interviews of farmers in four districts of Odisha (Khordha, Mayurbhanj, Sonepur, and Nuapada) for the study. Three blocks were selected, from each district, and two villages from each block on a random basis. Ten farmers who owned any one or more of these machines with cultivable land were randomly selected as subjects. The results showed that most of the power tiller, tractor and combine harvester owners in all the four districts had medium land holdings (4-10 ha) comprising nearly 46% of the total power tiller, tractor, and combine harvester ownerships.**

***Keywords*: Power Tiller, Tractor, Combine Harvester, Maintainance cost, Land holding, Personal Interview**

1. INTRODUCTION

1.1 Status of Farming

Odisha, one of the agrarian states of India, has the most fertile tract of land. About 65 percent of its population is dependent on agriculture for livelihood. The adoption of farm mechanization which is essential for profitable farming requires a large number of machines to be used on the farm. Among them, the use of power tiller, tractor and combine harvester is very important and has its specific place because the animal power available with the cultivators may be incapable of coping with the situation. Some of the agricultural operations, such as land development, leveling, and threshing, cannot be completed effectively with animal power. During the peak season (sowing, paddy transplanting, and harvesting) the labor cost increases abruptly resulting in a high cost of operation. Therefore, farm mechanization helps farmers to perform all farm operations timely and at a low cost.

1.2 Source of Farm Power:

A Power tiller is a two-wheeled agricultural implement fitted with rotary tillers which gives a smooth resistance to all farm activities. In fact, it has multiple uses & advantages. Power Tiller helps in preparing the soil, sowing seeds, planting seeds, and adding & spraying the fertilizers, herbicides & water. It is a farm machine that is mainly used to cultivate the land. It works effectively as it can reverse and cut soil simultaneously. In terms of maintenance, it is cheaper & economical to use & also requires less space.

A tractor is an engineering vehicle specifically designed to deliver a high tractive effort (or torque) at slow speeds, for the purposes of hauling a trailer or machinery such as that used in agriculture, mining , or construction. Most commonly, the term is used to describe a farm vehicle that provides the power and traction to mechanize agricultural tasks, especially (and originally) tillage, and many more. Agricultural implements may be towed behind or mounted on the tractor, and the tractor may also provide a source of power if the implement is mechanized.

1.3 Combine Harvester:

Combine Harvester commonly known as 'harvester' is a key invention that saves cost and time for farmers. As the name suggests, this machine simply combines the three major harvesting operations – reaping, threshing, and winnowing into a single process. Harvesting crops using this, in a single operational process saves time and cuts down work costs for farmers, which in turn increases the farm output and makes the business more profitable.
There are three major types of combine harvesters that are currently in use:

1.3.1 Self-propelled: These wheeled harvester machines are excellent for farms with hard soil. They are the standard type that is used commonly in India.
1.3.2 Track: These are fitted with tracks instead of wheels. They are very efficient in areas where wheels are likely to get bogged down. Track combines are commonly used for harvesting rice and some other crops from wetlands.
1.3.3 Tractor Mounted: These harvesters are driven by tractors that are mounted on top of them. They work best on lands where the soil is loose and the farmed area is extensive.

- Crops are gathered in by a *header* at the front that comes with *pincers* on both sides. The wider the header, the faster the cut. Different headers are used for cutting different crops in different landscapes. The header is hydraulically powered to be moved to different heights and angles.
- After passing through the header, the crops are pushed into the *cutter* by a slowly rotating wheel called the *reel* (or pickup reel). The reel has horizontal bats and vertical tines to get a good grip on the crop stalks.
- The *cutter* bar which runs the entire length of the header is located underneath the reel. Its mowing fingers open and close repeatedly to cut off the crops at their base.

- Then the cut crops are moved towards the center of the combine by spinning screws. The crops go up a conveyor to the processing mechanism inside the main part of the combine.
- At the center of the combine, a *threshing drum* beats the cut crops to break and shake the grains away from the stalks.
- Then the grains fall through sieves into a *collecting tank.*
- The chaff and stalks pass along conveyors called *straw walkers* towards the back of the machine.
- As the grain tank gets full, a trailer pulls alongside the combine and drives along. The grain is carried up from the tank by an elevator and shot out of an *unloaded* on the side, into the trailer.
- The unwanted stalks and chaff fall outside from the back of the combine. Some combines have a *spreader* that throws the straw over a wide area. The straw is chopped, spread on the field, ploughed back in, or used for bedding and limited feed for livestock.

1.4 Custom hiring:

Implements were hired for agriculture work by needy people. As the landholding size had gone down raring of bullocks have become uneconomical people prefer to do operations by implement customer hiring .data were collected regarding the attitude of farmers towards custom hiring and rate of custom hiring. It was expressed in the percentage of total use hours and farmers practicing custom hiring of a total number of farmers.

2. MATERIALS AND METHODS

The survey was conducted in four districts namely Khordha, Mayurbhanj, Sonepur, and Nuapada of Odisha. In three blocks of each district, two villages in each block were considered with ten farmers from each village the details are in table 1.

The following points were considered for selecting the farmers:

- The farmer having at least one farm machines like- power tiller, tractor or combine harvester, based combination of two machines.
- Technical informations related cost economics of machine as well as general information about the farmers.
- The survey on the basis of random selection of farmers for statistical analysis.

Table 1 Details of the villages covered under present study

Sl. No	Details of villages covered under present study				
	District	Block	Village	Number of farmers (Male/Female)	
				Male	Female
1	Khordh	Khordha	Mallipur	7	3
			Keranga	6	4
		Jatni	Gangapada	8	2
			Chhatabar	7	3
		Bhubaneswar	Chandraka	9	1
			Tomando	8	2
2	Mayurbhanj	Saraskana	Saraskana	8	2
			Mundhakata	9	1
		Bangriposi	Dighi	6	4
			Joka	10	0
		Kuliana	Budhamara	7	3
			Pathuri	6	4
3	Sonepur	Dungripali	Tamamura	7	3
			Kapasira	9	1
		Biramaharajpur	Khalipali	8	2
			Arjunpur	8	2
		Binika	Rengali	9	1
			Pipilipali	6	4
4	Nuapada	Nuapada	Budhipali	7	3
			Supuli	6	4
		Komna	Dalipada	8	2
			Deodhara	9	1
		Khariar	Lodra	5	5
			Amalapali	6	4

The data was collected on a specially designed and contacting each individual farmer included personal data of farmers, availability of farming infrastructure, cropping patterns, and all other relevant information was recorded. In the technical information segment, the information on availability and make of machinery, power tiller, combine harvester, equipment used, annual use hours, maintenance and repair cost of implements adherence to maintenance schedules, and frequency of repairs was collected. To collect the data, we designed a Performa.

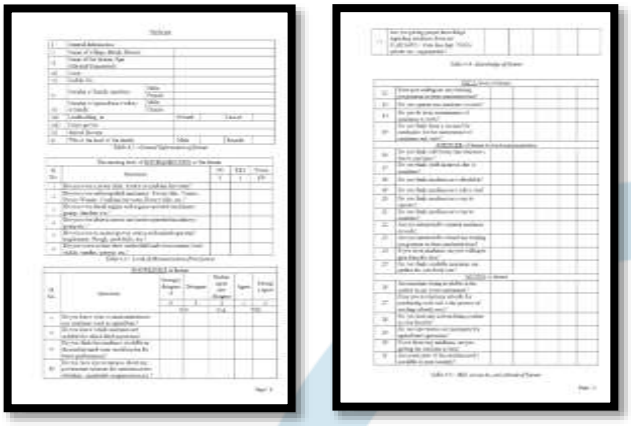

Fig 1 Performa for data collection

3. RESULTS AND DISCUSSION

3.1 Equipment ownership versus land holding:

Information based on equipment ownership and use pattern of power tiller, tractor, and combine harvester was analyzed from the data obtained from farmers. The land ownership patterns for the selected farmers of four selected districts of Odisha namely Khordha, Mayurbhanj, Sonepur, and Nuapada.

Table 2 Power tiller ownership versus land holding

Category	Land holding (ha)	Percentage of farmer owned power tiller (%)			
		Khordha	Mayurbhanj	Sonepur	Nuapada
Marginal	<1	6	3	5	4
Small	1-2	7	10	9	8
Semi medium	2-4	26	23	24	22
Medium	4-10	47	45	42	48
Large	>10	14	19	20	18

It is clear from the above data that 40-50 percent of medium land holding farmers (4-10ha) owned power tiller.

Table 3 Tractor ownership versus land holding

Category	Land holding (In-ha)	Percentage of farmer owned combine harvester (%)			
		Khordha	Mayurbhanj	Sonepur	Nuapada
Marginal	<1	1	0	0	0
Small	1-2	5	3	5	2
Semi medium	2-4	17	13	18	16
Medium	4-10	37	36	27	33
Large	>10	40	48	50	49

It is clear from the above data 40-50 percent of medium land holding farmer i.e.: - (4-10ha) owned tractor.

Table 4 Combine harvester ownership versus land holding

Category	Land holding (In-ha)	Percentage of farmer owned tractor (%)			
		Khordha	Mayurbhanj	Sonepur	Nuapada
Marginal	<1	2	1	2	1
Small	1-2	23	20	22	21
Semi medium	2-4	27	23	25	22
Medium	4-10	44	45	46	48
Large	>10	4	11	5	8

It is clear from the above data 40-50 percent of large land holding farmer (>10ha) owned combine harvester.

3.2 Distribution of operator's age in the study area:

Table 5 Age-wise distribution of power tiller operators

Age	Percentage of power tiller operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
<25	17.23	13.11	12.78	15.44
25-35	38.44	36.22	34.43	35.10
35-50	44.33	50.67	52.79	49.46

Table 6 Age-wise distribution of tractor operators

Age	Percentage of tractor operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
<25	10.25	11.11	12.78	19.44
25-35	38.02	40.22	33.33	25.00
35-50	51.73	48.67	53.89	55.56

Table 7 Age-wise distribution of combine harvester operators

Age	Percentage of combine harvester operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
<25	16.44	15.21	12.75	18.42
25-35	34.02	33.32	32.36	24.02
35-50	49.54	51.47	54.89	57.56

It is cleared from the information in table 5, 6, and 7 those young farmers/operators (below 25years) are relatively less careful due to their age as compared to the other age groups. The farmers in age group 25-35 are well conversant with operation of the machines. The farmers in the age group of 35-50 are found to be well experienced and could handle minor troubles of the implements in the field. Fifty percent of the age group (35-50 years) used both power tiller and combine harvester efficiently.

3.3 Education level of implement operators/farmers:

The information on education level of machinery operators/farmers in given in Table-8, 9, and 10.

Table 8 Educational level of power tiller operators/farmers

Education level	Percentage of the power tiller operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
>10	45.98	38.89	48.33	42.68
<10	54.02	61.11	51.67	57.32

Table 9 Educational level of tractor operators/farmers

Education level	Percentage of tractor operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
>10	41.22	28.89	38.33	42.68
<10	58.78	71.11	61.67	57.32

Table 10 Educational level of combine harvester operators/farmers

Education level	Percentage of the combine harvester operator (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
>10	48.33	38.42	43.23	41.45
<10	51.67	61.58	56.77	58.55

It is observed that 25% of the power tiller operators/farmers, 30% of tractor operators/farmers, and 40% of the combine harvester have completed the 10th standard.

3.4 Implements life period in the study area:

Implements of useful life in the study area are presented in Tables 11, 12, and 13.

Table 11 Distribution patterns of power tiller life period

Year	Percentage of use of power tiller year wise (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
0-5	49.15	41.64	48.7	43.29
5-10	46.66	52.78	45.25	51
10-15	4.19	5.58	6.05	5.71

As we find from the above table 11, that when the power tiller life period increases the use of the same power tiller decreases. It is due to higher maintenances.

Table 12 Distribution patterns of tractor life period

Year	Percentage of use of tractor year wise (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
0-5	46.14	41.67	44.44	47.22
6-10	42.33	47.77	43.23	38.89
11-15	11.53	10.56	12.33	13.89

As we find from the above table 12, that when the tractor life period increases the use of the same tractor decreases. It is due to higher maintenances.

Table 13 Distribution pattern of combine harvester life period

Year	Percentage of use of combine harvester year wise (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
0-5	34.87	31.65	35.24	37.37
5-10	47.65	51.34	46.43	48.52
10-15	17.48	17.01	18.33	14.11

As we find from the above table 13, that when the combine harvester life period increases the use of the same combine harvester increases. It is due to normal maintenance.

3.5 Customer hiring rate of implements for field operations:

The customer hiring rate of power tiller, tractor and combine harvester in the four districts.

Table 14 Customer hiring rate of implements

Implements	Rates (Rs. /h)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
Power tiller	700	700	750	750
Tractor	1350	1500	1300	1400
Combine harvester	2550	2800	2600	2700

The customer hiring rate of power tiller in all districts are found to be same rate whereas the custom hiring of tractor and combine harvester is very high due to less population of the machines in the Mayurbhanj district.

3.6 Fuel consumption of the machines:

Table 15 Fuel consumption of power tiller

Implement	Horsepower range wise fuel consumption (L/h)		
	7.5-10 hp	10-15 hp	15-25 hp
Power tiller	1-2	2-3.5	3.5-5.5

Table 16 Fuel consumption of tractor

Operation	Horse power range wise fuel consumption (L/h)		
	25-35 hp	35-45 hp	45-60 hp
Tractor	2.5-4	4-6	6-8

Table 17 Fuel consumption of combine harvester

Operation	Horse power range wise fuel consumption (L/h)		
	25-35 hp	35-45 hp	45-60 hp
Combine Harvester	2.5-4	4-6	6-8

From the above tables it was observed that the fuel consumption of the machines is higher for high horse power machines in each category.

3.7 Implements availability and their use:

The availability of implements in the study areas is given in (*Table 18*). Implements owners in the selected districts are having a number of farms implements for tillage. In the four districts, the tractor owners have cultivator and trolley.

Table 18 Use of implements

Implement	Khordha		Mayurbhanj		Sonepur		Nuapada	
	No.	%	No.	%	No.	%	No.	%
Cultivator	44	100	40	100	38	100	38	100
Combine harvester	14	73.23	9	64.33	11	70.23	10	67.45
Trailer/Trolley	43	100	40	100	39	100	38	100
Tractor	46	100	43	100	42	100	41	100
Power tiller	68	100	63	100	58	100	60	100

3.8 Numbers of implements supply in 5 years:

The number of machines suppled in last five years in the four districts are presented in table 19.

Table 19 No. of equipment supplied to four districts in 5 years

Equipments	Numbers of Implements supply to four Districts in 5 years			
	Khordha	Mayurbhanj	Sonepur	Nupada
Power tiller	895	819	819	878
Tractor	228	208	211	213
Combine harvester	105	63	62	70

The availability of power tiller and tractors are same in the four districts whereas the combine harvester population is approximately 45% higher in Khordha district as compare to other districts individually.

3.9 Women worker in different agriculture field operation:

The women workers in the agricultural field operation in the four districts are presented in table 20.

Table 20 Women workers in different operations

Different field operation	Percentage of women worker in agricultural field operation (%)			
	Khordha	Mayurbhanj	Sonepur	Nuapada
Transplanting	54	60	56	59
Weeding	96	99	98	99
Harvesting	28	39	36	38
Winnowing	16	20	23	21

Agriculture sector employs 80% of all economically active women in India. They comprise 33% of the agriculture labor force and 48% of the self-employed farmers. In India, 85% of rural women are engaged in agriculture, yet only about 13% own land. Among the sample farmers, 55 % had education up to middle school level, 21 % high school education, 12 % higher secondary/college education and the remaining were illiterate.

The percentage of involvement of women in transplanting, weeding and winnowing is almost same in all four districts except harvesting in Khordha district. It is due to the availability of more number of combine harvester.

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5. CONCLUSIONS

- The average annual use of the power tiller was 2,412 hours.
- The average annual use of the power tiller was 1,788 hours.
- The average annual use of the combine harvester was 1,712 hours.
- Power tillers were used for the farmer's own work as well as for custom work. The percentage of power tiller use for their own work was 42.53. For the rest of the time, the power tiller was used for custom work.
- Tractors were used for the farmers own work as well as for custom work. The percentage tractor use for their own work was 29.53. For rest of the time, the tractor was used for custom work.
- Combine harvester were mostly used for custom work. The percentage of combine harvester use for their own work was 15.43. For the rest of the time, the power tiller was used for custom work.
- The average cost of operation of the power tiller, tractor and combine harvester was more initially and, thereafter, decreased with an increase in useful life of the machines.
- The Break-even point increased with the increase in the size of the power tiller. The maximum break-even point was 219 hours for the 9 hp power tiller.
- The Break-even point increased with the increase in size of the tractor. The maximum break-even point was 685 hours for the 35 hp tractor.
- The Break-even point increased with the increase in the size of the combine harvester. The maximum break-even point was 78 hours for the 75 hp combine harvester.
- Since average annual use in each case was higher than the breakeven point, the purchase and use of a power tiller, tractor and combine harvester were profitable in the study area.
- All the tractor owner farmers had cultivators and trolleys. Some farmer had harvesting machinery. Thus, there existed a clear gap in machinery ownership.
- The breakdown of power tiller and combine harvester occurred due to brake failure, gear damage and negligence of the operator.

- The majority (46%) of medium farmers (4-5 ha), 23.34% semi medium farmers (2-4 ha), and 21% small size farmers (1-2 ha) preferred purchasing of combine harvester over power tiller followed by 1.34% marginal farmers category (less than 1 ha). This may be due to the versatility of the combine harvester for performing most of the farm operations.
- Only about 15.2% of the farmers had proper training for the use and maintenance of power tiller or combine harvester and about 55% of them had a license to drive the machines. Ninety percent of farmers were facing difficulty in maintaining animals, about 64% of the farmers had problems related to non-availability of labor during peak periods/agricultural seasons and about 61% had problems of timeliness of farm operations. These were the main reasons given by the farmers for buying farm machinary.

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