

# Relation between Farm Size and Use of Machine in Agriculture : A Study from Assam:

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## **Abstract**

There is a relation between farm size and use of machine. It was believed use of machine like tractor-power tiller needs big sized firms. The owners of small firms can not apply machine in their fields and only the large farmers tend to practice modern methods of agriculture. For a long period debate is going about the relationship between farm size and productivity in agriculture. In India, this notion restricted the small firm owners from the path of mechanization. Because of the experience of green revolution and technological transformation in agriculture, the inverse relation relationship between farm size and productivity has shifted to positive relation. Although, mechanization of agriculture in India including Assam is a slow process of technological transfer, the farmers irrespective of firm size have used machinery in agricultural activities. The findings of the survey conducted in five out of six Agricultural Development Officers' Circles indicate that there is no such relation. The use of machine is possible in firms of any size. Thus the hypothesis that farm size restricts mechanization has been rejected. This paper highlights the finding of the survey which was taken to investigate the relation between farm size and agricultural mechanization.

**Keywords:** Farm size, Green revolution, Mechanization, Technological, Transformation

## **1. Introduction**

Growth in agricultural production and income can broadly arise from two sources, namely, expansion of land surface put to agricultural use and more productive utilization of existing land surface put to agricultural use. The first source of growth is becoming fast exhausted due to population growth and growing demand for land for non-agricultural use. When the institutional arrangements in agriculture are not in shape to provide farmers with the right incentives

and opportunities, that is when the agriculture sector suffers from such institutional constraints as uneconomic size of land holding, inequitable tenurial arrangements, indebtedness and lack of access to credit and other inputs on the part of small farmers etc. institutional changes become necessary to create favorable conditions for agricultural growth. Measures such as land reforms can go a long way to remove obstacles to agricultural growth. But, on their own, these measures would raise agricultural productivity only to a certain level. For sustaining agricultural growth in the long run, institutional changes are to be followed by improvement in technique of cultivation. Thus, one of the important factors of agricultural productivity is technology adopted in the agricultural field. Technology has a relation with the firm size. For a long period a debate is going among the economists about the relationship between farm size and productivity in agriculture. The traditional belief was that bigger the firm size bigger is the chance of applying modern machines like tractor.

In the new agricultural strategy of 1960s in India was based on some newly developed crop varieties known as the High Yielding Variety. The variety was found to be giving yields much higher than those of traditional local varieties, provided of course, their use was supported adequately by complementary inputs such as chemical fertilizers, pesticides and controlled watering. The strategy was successful in boosting productivity in agriculture. But the impact was confined to certain pockets of India. Later on the strategy was expanded to other parts of the country and the use of machines increased in agriculture. Although, initially Assam remained far behind the other parts of the country in respect of agricultural mechanization now it is experiencing vast changes. According to the statistics collected from the Directorate of Agriculture and the Directorate of Economics and Statistics of the Government of Assam the use of HYVs of seeds, chemical

fertilizers, pesticides and above all agricultural machines in agriculture is increasing in agriculture of the state. However, use of agricultural machines has remained limited to selected works.

According to a recent national sample survey 40% of the farmers want to opt out of their current profession. Every year, large numbers of farmers commit suicide out of despair over failing crops and impossible high debt. The slow pace of agricultural growth, the low yield rates of crops, very limited effectiveness of HYVs in improving agricultural productivity, the small amount of fertilizer consumption per hectare and merely a marginal role of irrigation in the agriculture sector are all indicative of the continued states of backwardness of agriculture in Assam. The new agricultural strategy of the late 1960s, with its understandable early concentration in selected regions of the country, has yet to have its effective operation in Assam even in the 21<sup>st</sup> century. The performance of the entire agriculture sector and the general living conditions of the rural people of the state depends upon the success of the methods applied in the agriculture. Hence, if anything like 'Green Revolution' is to come about in Assam, it has to come through the improvement of the farming technology. In Assam, so far very little factual, comprehensive studies have been done to identify the factors facilitating and restricting agricultural mechanization. The state of Assam lacks agricultural infrastructures and regularly affected by flood. Therefore it is important to take care at the time of selection of crops to produce in the flood prone areas.

As the country is marching ahead for second 'Green Revolution' in near future, the state of Assam cannot be kept isolated from receiving the benefits of agricultural technology and recent development. This study was conducted to analyze the extent of agricultural mechanization and its problems in Assam. The objective was mainly to concentrate in the relation of farm rise and use of machines like tractors and power tillers in agriculture. The hypothesis of the study was that farm size restricts the use of machine.

## 2. Review of Literature

Sen (1962) observed an inverse relationship between farm size and productivity in India. He argued that with the increase in the size of holding, productivity declines and thus the productivity was more on small farms in comparison to large farms. His propositions were (a) when family labor employed in agriculture is given an "imputed value" in terms of the ruling wage rate, much of the Indian agriculture seems unremunerative, (b) by and large, the profitability of agriculture increases with the size of holding, (c)

by and large, productivity per acre decreases with the size of holding. Several other economists also found the same result. Saini (1971) also wrote "by and large, the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and its statistical validity is adequately established by an analysis of disaggregated data.

Mazumdar (1963) observed that the higher output per acre in small farms is really a function of higher input of labor per acre; the other factors varying more or less in same proportion as labor. It was thus established that intensity of cultivation on smaller farms is quite greater than the larger farms. Heavy input of labor on small farms is not only on one crop but also on two or even more crops produced in the same plot of land during the particular year. This also reveals higher productivity on smaller farms and confirms the inverse relationship between farm size and productivity. Swami Nathan (1973) remarked that the situation is deteriorating rapidly and the entire farming sector is heading for a total collapse if no rapid remedial measures are taken. The situation in Assam is no exception. Bezbaruah (1994) in his study on the technological transformation of agriculture found the farmers in Assam in general are not averse to changes and that on the contrary, they are willing to innovate and experiment. In his study he also observed that farmers by and large have already adopted the use of new varieties of seeds. As per the study overall agricultural productivity in the state has not improved very much despite the widespread adoption of HYVs by farmers here, is because of the farmers' inability to use it extensively and effectively.

Saikia (2004) in his case study on the problems and prospects of Rabi Crops in flood prone Majuli Sub division of Assam has suggested for the change of agricultural strategy and selection of crops to grow in the flood prone areas of the state. The study indicates that Rabi crops are getting importance among the farmers of flood prone areas of the state. Because of the effects of flood the farmers get less time for land preparation. Therefore to save time, the use of machine, particularly that of tractor and power tiller for tillage is expected to increase in future.

## 3. Methodology

Data were collected from five out of six agro-climatic zones of the state namely- (1) Lower Brahmaputra valley (2) Upper Brahmaputra valley, (3) Central Brahmaputra valley, (4) North Bank Plains and (5) Barak valley zone. From each of these five zones one Agricultural Development Officer circle (henceforth referred as ADO circle)

was selected for the field study. The five ADO circles selected are, namely (1) Bongshor (2) Furkating (3) Bhurbandha (4) Dumunichowki and (5) Silchar. Bongshor circle is located in Lower Brahmaputra Valley Zone and nearest to the state's capital-Guwahati. Here, a large section of farmers cultivate vegetables along with paddy. Furkating circle is located in Upper Brahmaputra Valley Zone and it touches the boundary of Nagaland. The circle is inhabited mostly by other backward class people. Bhurbandha circle belongs to Central Brahmaputra Valley Zone and regularly affected by flood. Dumunichowki circle falls in North Bank Plains Zone and inhabited by mostly Muslim people. Silchar circle is situated in the Barak Valley Zone and inhabited by Bengali speaking Muslim people. The sample design used in selecting the households in each ADO circle was two-stage random sampling, in which villages constituted the primary

#### 4. Results

The explanations in favour of the inverse relationship between farm size and productivity by previous researches can be summarized as (a) fertility of small farm is higher than the larger farms (b) smaller farms normally use relatively superior techniques and they are efficiently managed (c) in small farms indivisible factors have higher impact in comparison to larger farms (d) due to fragmentation of land small farmers are left with better quality of land as they go for distress sale of poorer quality of land to the bigger landlords (e) family labour is comparatively cheaper than the hired labour and in a small farm family labour is predominantly used and that leads to higher labour-land ratio and subsequently a higher productivity as compared to large farm, (f) application of agricultural input is more intense in small farms as they the small farmers are under compulsion to provide for themselves and for their families (g) intensity of irrigation in small farms is quite higher than the larger farms (h) large farms normally offer more preference to leisure as compared to small farmers as they have no economic compulsion to work more. Rudra (1982) directly challenged the statistical validity of this inverse relationship. His opinion is that such inverse relationship between farm size and productivity may hold good in certain areas but this cannot be taken universal phenomenon and thus cannot be said to operate in all different parts of the country. **Our field study gives the following result-** There is no indication that size of farm determines the use of machine in agriculture. Contrary, to the belief It was said that to apply tractors, power tillers etc. the farm size

sampling units and the farm households were the secondary and ultimate sampling units. In the first stage of selection, in each circle five villages were selected at random, subject to the condition that at least in one of the selected villages agricultural infrastructure (mainly irrigation and credit) was reasonably developed for the practice of modern machineries and implements. In the second stage, about 10 % of farm households in each village were selected at random. A total of 224 farm households selected in this manner from the five ADO circles constituted the whole sample of the field study. The survey was conducted in the year 2005 and data were updated in the year 2016.

The data collected from the field study were tabulated and processed using the computer software SPSS. The findings of the field study have been combined with the available statistics.

should be larger we found that irrespective of size of farm, farmers have used the tractor, power tiller etc. in the agricultural fields. There is no indication of larger farmers only tending to use machine in agriculture. Still the larger farmers emerged as the market leader. The larger farmers have started the use of machine earlier than the smaller farmers.

#### 5. Discussion

##### 5.1. The type of land and size of operational holdings

The type of land and the size of operational holding in five circles have been shown in the **Table-1**. The table shows that the total area for homestead is 46.48 hectares and average area is 0.23 hectares. The total area for agricultural land is 439.14 hectares and average area is 1.96 hectares. The total land leased in is 63.28 hectares average is 0.28 hectares. This includes total agricultural land.

The distribution of the sample farms according to the size of their operational holdings is shown in **Table-2**. The figures in the table reveal that out of 224 sample farmers 58% of the sample farmers had operational holdings of size below two hectares only 3% had operational holdings above 8.0 hectares. Majority of the farmers are in the group of 1.0-2.0 hectares. Farmers having operational holdings above 8.0 hectares are highest in Furkating circle and lowest in Bongshor and Silchar. In Furkating 8% of the sample farmers have operational holdings above 8.0 hectares. In Silchar no one is there in this group. The combined area of all the operational holdings comes to 635.84 hectares, which means that the average size (arithmetic mean) of the operational holdings was 2.84 hectares.

**Table-1: The types of land in the five circles (area in hectare)**

Types of land	Descriptive Statistics		
	Maximum	Sum	Average area
Home stead land	3	46.48	0.23
Agricultural Land	9.24	439.6	1.96
Other Land	98	145.32	0.65
Leased in Land	6.3	63.28	0.28
Total Land	105.14	631.14	2.84

**Table -2: Distribution of sample farmers by the size of operational holdings (area in hectares)**

Size class	Number of sample farm					
	Bongshor	Furkating	Bhurbandha	Dumunichowki	Silchar	Total
Below 0.5	4 (7.54)	1 (2.56)	6 (13.04)	2 (3.77)	2 (6.06)	15 (6.69)
0.5 to 1.0	10 (18.86)	6 (15.38)	13 (28.26)	8 (15.09)	7 (21.21)	44 (19.64)
1.0 to 2.0	18 (33.96)	10 (25.64)	14 (30.43)	17 (32.07)	11 (33.33)	70 (31.25)
2.0 to 3.0	9 (16.98)	6 (15.38)	4 (8.69)	12 (22.64)	10 (30.30)	41 (18.30)
3.0 to 5.0	8 (15.09)	4 (10.25)	6 (13.04)	11 (20.75)	1 (3.03)	30 (13.39)
5.0 to 8.0	3 (5.67)	9 (23.07)	2 (4.34)	2 (3.77)	2 (6.06)	18 (8.03)
8.0 and above	1 (1.88)	3 (7.69)	1 (2.17)	1 (1.88)	0	6 (2.67)
Total	53	39	46	53	33	224

Source: Field survey

### 5.2. Cultivated area and land use pattern

The land use pattern of the samples of five circles selected for the survey has been shown in the **Table-3**. As a whole the sample farmers of the five circles selected for the survey posses 631.14 hectares of land. Out of this land area agricultural land is 439.6 hectares (i.e. 69% of the total land).

Home stead occupies 46.48 hectares (i.e.7% of the total land). It is seen that out of total cultivated land 63.28 hectares are leased in land which amounts 14.39%. In Bongshor and Dumunichowki land area for home stead is more being average 13% of the total land of the farmers.

**Table-3: Land use pattern of the sample farmers in the five circles (area in hectares)**

Circle	Homestead	Agricultural land	Other land	Total land
Bongshor	15.4 (13.25)	98 (84.33)	2.38 (2.04)	116.2 (100.0)
Furkating	4.2 (1.77)	107.66 (45.38)	125.86 (53.05)	237.22 (100.0)
Bhurbandha	7.42 (8.17)	73.78 (81.32)	9.52 (10.49)	90.72 (100.0)
Dumuni chowki	16.52 (13.12)	101.22 (80.42)	6.3 (5.00)	125.86 (100.0)
Silchar	2.94 (4.65)	58.94 (93.34)	1.26 (1.99)	63.14 (100.0)
Total	46.48 (7.34)	439.6 (69.43)	145.32 (22.95)	633.14 (100.0)

Source: Field survey \* figures in the parenthesis indicate the percentage share in the total land

In Furkating homestead area is lowest at 2% of the total land. Agricultural land is more in Silchar being 93% of the total and less in Furkating being 45% of the total. Land used for other purposes is more in Furkating (53%) and less in Silchar (only2%). Leased in area is more in Silchar (27% of the total area) and less in Furkating and

Dumunichowki (6% of the total). On the other hand mortgaged in area is more in Bongshor (6% of the total) and in Silchar it is nil. Again mortgaged out area is more in Bhurbandha (2%) and nil in Silchar circle. Data relating to combined cultivated area of the sample farmers in the five circles are shown in the table 3. As whole the sample farmers of five

circles have 440 hectares agricultural land. Sample farmers of Furkating circle possess highest amount of agricultural land (108 hectares) and the sample farmers of Silchar and Bhurbandha possess lowest amount of agricultural land (59 and 74 hectares respectively). Furkating circle falls in the upper Brahmaputra valley and the valley is rich in oil industry. On the other hand the farmers of Silchar and Bhurbandha circle are religiously minority. The Bhurbandha circle is regularly affected by flood and Silchar circle is in a geographically disadvantaged position. The general condition of the farmers of Furkating circle is better than the condition of farmers of Bhurbandha and Silchar.

### 5.3. Farm size wise variation in agricultural mechanization

The **Table-4** shows the distribution of farmers according to the farm size. The table reveals that out of 224 farmers there are 3%

farmers in the below 0.5 hectare group, 25% in the 0.5-1 hectare group, 32% in the 1-2 hectare group, 16% in the 2-3 hectare group, 12% in the 3-5 hectare group, 8% in the 5-8 hectare group and 3% above 8 hectare group. The table also shows that majority of the farmers fall in the 0.5-1 hectare and 1-2 hectare groups. Important point to be noted here is that tractor, power tiller and irrigational machine etc. have been used by all types of farmers irrespective of their farm size. Except 5-8 hectare group in all the groups above 80% farmers of the total of that concerned group have used tractor. In the 5-8 hectare group use of tractor is more than the use of power tiller. Farmers of all the groups have used power tillers. In the below 0.5 hectare group 71% have used power tiller. Similarly in the above 8 hectare group 43% of the farmers have used power tiller. As a whole out of 224 sample farmers 86% have used tractor and 54 % have used power tiller.

**Table-4: Use of machines by the farmers of different category of land**

Type	Category of land (in hectare)							Total
	Bellow 0.5	0.5-1	1-2	2-3	3-5	5-8	8 and above	
Number of farmers	7 (3.1)	55 (24.6)	72 (32.1)	37 (16.5)	28 (12.5)	18 (8.0)	7 (3.1)	224 (100.0)
Tractor	6 (85.7)	46 (83.6)	64 (88.8)	31 (83.7)	24 (85.7)	14 (77.7)	7 (100.0)	192 (85.7)
Power tillers	5 (71.4)	32 (58.1)	34 (47.2)	20 (54.0)	15 (53.5)	12 (66.6)	3 (42.8)	121 (54.0)

Source: field study

**Table-5: Years of use of machine by farmers of different category of land**

Years of use of machines	Category of land							Total
	Bellow 0.5	0.5-1	1-2	2-3	3-5	5-8	8 and above	
Bellow 3 years	1	18	15	8	5	3	2	52
4-6 years	6	37	54	28	20	8	4	157
7-9 years	0	0	2	1	1	3	1	8
10-12 years	0	0	1	0	2	3	0	6
13 and above	0	0	0	0	0	1	0	1
Total	7	55	72	37	28	18	7	224

Source: field study

The **Table-5** indicates farmers having more land started using the machine earlier than the farmers having less amount of land. The small farmers have started the use of machine recently. In the group of farmers of 0.5-1 hectare land, out of 55 farmers 33% have used the machines for below 3 years and 67% have used for last 4-6 years. But in the group of farmers having 5-8 hectares, out of 18 farmers only 1 farmer has used machine for more than 13 years and 17% have used for last 10-12 years and 17% have used for last 7-9 years. Thus it is found that majority of the farmers (more than 70%) have used from last 4-6 years. In the group of farmers of 0.5-1 hectare land, out of 55

farmers 33% have used the machines for below 3 years and 67% have used for last 4-6 years. But in the group of farmers having 5-8 hectares, out of 18 farmers only 1 farmer has used machine for more than 13 years and 17% have used for last 10-12 years and 17% have used for last 7-9 years. Thus it is found that majority of the farmers (more than 70%) have used machines from last 4-6 years.

### 5.4. Some recommendations

(i) Need to develop the extension network for transmitting the knowledge of mechanization.



(ii) The electronic media can give practical knowledge to the farmers for developing their farming techniques.

(iii) Trainings can help the farmers in effective use of the machine which will help in reducing the cost of mechanization.

(iv) The bank and other non bank institutions working in the rural areas of Assam need to give loan for purchasing machine.

(v) Because of the paucity of government fund private participation will also be necessary.

(vi) The Agriculture Universities can develop flood resistant high yielding varieties of seeds.

(vii) Need proper policy to check the negative effects of mechanization.

## 6. Conclusion

From the analysis, it is found that small size of land has not remained as the restricting factor of mechanization in agriculture in Assam. The study says that cost factor has played an important role in the expansion of mechanization of agriculture. The cost of traditional system has been high compared to modern system. The farmers of small farmers have calculated the cost of rearing two bullocks and full time labor compared to rental charges for hiring the tractor, power tiller etc. already, a market of service of agricultural machine- machineries is emerging in the state and therefore the small farmers have also started using such machine- machineries in different stages, particularly in the stage of tillage. The large farmers have of course used machine-machineries

in their fields. So it is expected that in near future use of machine by small farmers will increase and the service market will grow as a profitable business.

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