

# Farm size and productivity research



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## **1. 0 Introduction**

The relationship between the size of Farm in hectares and the productivity in Yield/hectares is hotly debated issues in Indian agriculture economics. This issue was first raised by AK Sen in 1960s with respect to Indian economy. The major objective of this paper would be to analyze the relationship and the major factors influencing this relationship along with its implication. The size of holding depends on certain factors and the productivity also depends on certain economic factors. These factors such as irrigation, fertility, labor and capital input have an influence on the relationship between the size of land holding and productivity. Most of the economist like AK Sen and Saini have done their analysis and considered this relationship to be inverse. Countries like USA and Australia have very large holdings and the relationship between size of farm and productivity is not inverse in such cases. The application of Green revolution has been believed to change the inverse relationship to a directly proportional relationship, but still it has been not very clear. Some analysis has been done in the paper related to aggregated data with regard to present status of this relationship by comparing the factors of productivity with the size of holding. Moreover the average size of holding has been decreasing with time due to increase in population and some other factors. At the same time the government has tried to implement policies like land ceiling and consolidation of land in some relatively developed states to solve the problem of excessively large holdings (in Indian average) and small and fragmented land respectively.

## **2. 0 Farm land Holdings, Productivity and the factors influencing them independently**

Agricultural holding indicates the average size of agricultural land held by the farmers in India.. An economic family land holding can be defined as one which could provide a reasonable standard of living to the cultivator and give full employment for a family of a normal size. There are five categories of farmers in India according to their holdings. A) Marginal farmers ( $\leq 1$  hectare), b) Small farmer (1 to 2 hectares), c) Semi medium farmers (2 to 4 hectares), d) Medium farmers (4 to 10 hectares), e) Large farmers ( $> 10$  hectares). The size of holding would ideally depend on method of cultivation and nature of the crop.

Productivity here refers to the productivity of crop output so productivity in agriculture is measured as the output of the crop per unit area. Its unit is yield/hectares. At a national level the demand for agricultural product will keep rising due to increasing population of India and high GDP growth rate so the supply of agricultural products has to match up the increasing demand to keep the prices reasonable. Hence agricultural farm land productivity becomes an important parameter for the economy. India being a huge country, these factors vary a lot from region to region but artificial means can be used to enhance the factors of fertility and irrigation. The following list gives us the factors of productivity

Fertility of land – Natural fertility cannot be changed but input of fertilizers, farm yard manure and nutrients can improve the fertility but all these will increase the cost.

Irrigation facility – Any irrigation project requires heavy investment and it depends on the level of underground water and nearest source of fresh water supply.

Labor supply and quality of labor – Labor supply will depend on the presence of any other scope of employment and quality will depend on traditional work culture and climatic conditions and both the factors vary a lot in India.

Climatic condition – Floods and drought due to unpredictable nature of monsoon affect the productivity.

Since last three decades economists have been debating over issue of relationship between the size of farms and agricultural productivity in India. The debate was initiated by Prof. Amartya Sen in 1962. According to him with increase in size of farm holding, productivity declines and thus the productivity is more on small farms as compared to large farms. India has a labor surplus economy. The opportunity cost of labor is low. Small farms use much of family labor to the extent that marginal productivity of labor approaches zero. In case of small farms, output per acre is maximized while in the case of large farms using hired labor, output per unit of labor is maximized. The intensity of cultivation in case of small farm is greater than that of the large farm. Moreover, heavy input of labor on small farm is not on one crop only but in two or more crops produced in the same piece of land during a given production year. It is more so in case of irrigated land. Self-employment in the family farm equalizes the opportunity cost which is not different from market wage. Statistical validity of the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian

agriculture prior to Green Revolution. Green revolution is a capital intensive programme which was implemented in 1960s for growth of agricultural production. This capital was invested in the form of important factors of production like irrigation, fertilizer, Mechanization, Manure, pesticides, nutrients. The objective of the following analysis would be to determine all the factors like irrigation, fertilizers, Farm Yard Manure and nutrients vary with the size of farm for the present set of data

### **3. 0 Aggregated data analysis**

For all the graphs below in X-axis, 1 = Marginal holding, 2 = Small Holding, 3 = Semi-Medium holding, 4 = Medium Holding, 5 = Large holding.

In Y-axis, graph A), B), C), E), F) are values of percentage and D) is ratio value.

The calculations of these percentage value from been mentioned in tables in appendix

Graph A) and B) have been taken from table 1. C), D), F) from table 2

As per the graph A) above we can find that the marginal holding has the larger area of farm wholly irrigated about 46% and we can also observe that the percentage of the wholly irrigated land decreases with increase in the size of the holding with large holdings showing the lowest percentage of wholly irrigated area that is about 21%.

The second graph B) shows us the percentage of area of different size of holding for wholly unirrigated farm land and it show us, a lot of gap between

the marginal holding(44%) and large holdings(55%) in terms of percentage change.

As observed from the graph C) the application of fertilizers decreases with the increase in the size of holding with the marginal holding having an area of 77% and large holdings having an area of 52% under the application of fertilizers.

The graph D) related to nutrients does not show us the % of area but it shows us the quantity to area ratio. In this case the slope of the graph is steeper and it shows us trend that the intake of nutrients reduces with the increase in the size of holding. The marginal holding has a ratio of 126 and the large holding has a ratio of 56.

In case of farm yard manure graph E) there is a slight increase in the percentage application from marginal holding to small holding but after that the fall continues. Here the small holdings has the highest percentage of application that is 34% and the large holding has the lowest percentage that is 18%.

Application of pesticides in a in farmland is an important preventive measure to prevent pests. The graph F) does not show a negative trend completely in relation to percentage of area with relation to holding size but the large farm land shows a dip in 4%.

The data above is for 2001 agriculture census which is the latest. In post green revolution period the application additional inputs i. e. factors of production like irrigation, fertilizers, farm yard manure, nutrients, pesticides

shows that their intensities of application is inversely proportional to size of land.(As studied above with various data and corresponding graphs.). In other words the application of additional factors of production is more in case of small farms compared to large farms. The resultant output which is directly proportional to application of input to a reasonable extent must increase yield proportionately. Thus logically it follows that after green revolution also the inverse relationship between size of farm and productivity should hold good. It's not a direct cause and effect relationship between all the factors of productivity and farm size but there might be some common factors which might be affecting these relationship. On the other hand there can be an alternative hypothesis to this, stating large farm land are in naturally fertile and irrigated regions of this country so they do not need artificial irrigation or fertilizers to enhance their productivity. Therefore a direct inverse relationship cannot be established between Farm size and productivity by only using aggregated data related to factors of productivity. If we observe the distribution of various size of holding throughout India in table 3 of appendix larger and medium size holdings are mostly found in bigger states like Madhya Pradesh, Andhra Pradesh and Maharashtra which are not densely populated but have a larger area. The more densely populated states like West Bengal and Kerala have more number of marginal and small holdings. The natural factors of productivity are distributed among these states so the main hypothesis cannot be rejected. The alternative hypothesis can be true in some regions but not true everywhere because the different sizes of holding have been distributed as per density of population and not as per natural factors of production. Although it can be said that

inverse relationship between productivity and farms size is present in some areas of India but it is not a general law for the whole country.

#### **4.0 Methodology for analyzing disaggregated data**

The analysis above shows us the analysis done for aggregated data but this same analysis can also be done using disaggregated sample data taken from various villages. If the sample data is taken from nearby villages then the conditions like Fertility , Irrigation, climatic condition and labor can be assumed to be constant.

Y1, Y2, Y3,———Y100 can be the data set for productivity in yields/hectares

X1, X2, X3,———X100 can be the data set for size of holding hectares

The data above can only be obtained by doing a direct survey in a particular area having common factors of productivity. Then we can do a regression analysis for the dataset having Y = Productivity and X = Size of farm land. The relationship thus obtained either positive or negative can be used to find out the relationship between productivity and size of farm for a particular area at a micro level. And this method can be used in various areas of the country having same factors of productivity . And then the trends can be observed whether its positive or negative or has no affect. This kind of analysis using disaggregated data can be done by also taking the same crop .

#### **5.0 Labor as a factor**

As discussed before labor input is an important criteria for better productivity in farm land and becomes more important if the process in more manual . In

Indian agriculture the Farm land labor can be divided into two type, family member workers and the other is hired workers. Generally in case of smaller size of holding the family members are mostly involved in the cultivation process and in larger farms it is a mix of both. In case of a marginal and small holding where in most of the cases only the family members are involved in farm cultivation the marginal productivity is not a factor. If required all the family members can be involved in the agriculture productivity process because the situation is more desperate and as result the intensity of cultivation is also more. The owner of smaller farm land does not have to employee hired peasants but in case of larger farms the situation changes. In case of larger farm land the owner has to take the marginal productivity of hired labor into consideration. As the intensity of cultivation for the small farm is more, the application of fertilizers, farm yard manure and nutrients might be affected as per the aggregated data analysis done before. As the small farm owner is more desperate even he can use manual means of irrigation to irrigate his land and its not possible in large farms due to its large size. It can be argued that the large farm owner would have more access to mechanized methods and capital for investment so his productivity can be higher at least after green revolution. Here the problem looks more like management of farm input resources rather than their availability. The better management of resources for small farm owner with more intensive cultivation has a bigger impact on productivity than the impact of advantage the large farm owner has in terms of more mechanization and capital availability. But the characteristics of land size holdings that is reduction in the average size of holding with time.

Even the relationship between irrigation and fertilizers is also very direct. If one wants to apply more fertilizers then the irrigation facilities have to be very good so as per the irrigation data and fertilizers data both seem to follow the same pattern even if we consider labor not be a major factor here. This is clearly evident in Table 2 where more fertilizers are always applied when irrigation is high.

## **6.0 Changing pattern of Size of Farm land holding with time**

The tables 4 and 5 in appendix shows us the distribution of holdings in various states of India but there is one more important factors to this analysis that is the average size of holdings have been decreasing with time. The number of marginal holdings and small holdings have increased and the also area under marginal holdings and small holdings have increased. At the same time the number of Medium and Large holdings have decreased and also has the area under them decreased. There are two major reason for such a trend, they are as follows

Increasing population – With the rapid increase in population the same area of cultivable land is getting divided among more people. As a result of this the size of the holdings is reducing and area under marginal and small farms increase. To control the growth of rural population is even tougher in rural India due to lack of awareness of people due to limited education.

Law of inheritance – Under Hindu as well as Muslim Law of inheritance the landed property of a person has to be equally divided among all his sons and daughters which has led to more and more division of land and hence

increase in marginal and small farms. Even if the land size is large now, it will get sub-divided when it goes to the next generation.

Decline in the joint family system – Earlier lot of families used to be joint families but this has declined over time and people generally prefer to stay with only single families. As a result the farm land is also divided more.

Slow growth in handicraft industry – In the villages the handicraft industry used to a source of employment for the village labor. But it has not grown sustainably with increase in rural labor so the rural population have had to depend more on agriculture as a source of employment.

## **7.0 Problems related to subdivision of land holdings**

If the fragmentation and subdivision of land continues at this rate then average size of the holdings will become even smaller and there will be more marginal holdings. Application of new technology becomes more difficult. A lot of cultivable land will be lost in making boundaries. One may argue that as in case of India the productivity of farm land will be more due to more intensive cultivation. But the per capita income of the owning family of the farm reduces with reduced farm land. Moreover if the whole family is involved to increase the intensity of cultivation the labor might be under employed for the same return. If the labor is flexible then he can move to a bigger farm as peasant if there is a demand. As seen from the statics the number of large holdings is reducing in the country and hence is the employment opportunity for hired peasants. Another factor which limits the labor flexibility is when labor tries to move from one region to another language is a big barrier. Although Hindi is India's national language and

English is the official one still lot of rural population speaks only the local languages and to be more specific only the local dialect. Skill becomes a barrier when the labor wants to move to industry in urban sector.

As per our analysis till now the inverse relationship between the productivity and size of farm does hold good at least in some areas of the country if not throughout the country. At the same time if the farm land gets more divided and sub-divided the holding no longer remains economic for a single family. The ideal holding size has to be somewhere between the smaller and large holdings of around 4-5 hectares. The farm size are large and they are well managed and supervised by using modern methodology like it is done in USA and Australia they achieve high productivity. But the same thing is not easy to achieve in India as discussed beforehand. The government has introduced land ceiling in some developed states. This means that family owning excessively large farm land have to give up their excessive land to public authorities and it will be distributed among families having uneconomic holdings. This process is not at all easy because if the land is fertile than none of the owning families would like to give up their land and also have to think about their future generations. Moreover any kind of ceiling will go against the market forces of demand and supply and affect the prices of land. When we talk about division and fragmentation then in many cases the farm land of a single owner is scattered throughout the village. In that case all the land in the village can be converted into a compact block and then the same land can be proportionately distributed among all the families which is called consolidation of Farm land. In states like Punjab, Haryana and Madhya Pradesh this process has been taken up seriously but in some other

states like Assam and West Bengal the process has not even started. There are few reasons for which consolidation process is not easy. People in India are more attached to their piece of land, if someone has a better piece of land he would not like to sacrifice them. Both land ceiling and consolidation of farm land are policies to reach that optimal size of holding but they have not been easily to implement for the factors as mentioned before.

## **8.0 Final remark**

The inverse relationship between size of holding and productivity was considered to be very strong when it came for the first time under observation of AK Sen. But after the green revolution this relationship should have change to a directly proportional one as per expectation. This might be happening in some areas of India but still there are areas where the inverse relationship between size of farm and productivity still exists. As per the aggregated data analysis the factors of productivity are being affected by some common factors which helps to maintain the inverse relationship between productivity and size of farm in some areas. As mentioned before these common factors are intensity of labor and problems of management and supervision in large farms. At the same time the size of the land holding have been reducing which is leading to more uneconomic holdings for small farm owners. At this point the government should implement the policy of land ceiling and consolidation of holdings judiciously in order to increase the number of semi-medium and medium size holding where optimal productivity can be achieved along with economic holding. In long term consolidation of holdings and cooperative farming should be encouraged in an organized way. The proper management of labor along with other factors

of productivity and usage of mechanized technology in large farms would go a long way to improve productivity in larger consolidated farms. This would be made easier if lesser population is dependent on agriculture only if more employment opportunities are created in other sectors and the rural population upgrades to new skill requirements of the market.