

**THE RELATIONSHIP BETWEEN FARM SIZE AND PRODUCTIVITY IN  
BANGLADESH AGRICULTURE: THE ROLE OF TRANSACTION COSTS  
IN RURAL LABOUR MARKETS**

by

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## I. INTRODUCTION

Debate on the relationship between farm size and productivity is not dead. At the policy level it is still alive because in many agrarian economies redistributive land reform policies have not been successfully implemented and issues related to land rights of the poor are gathering momentum. At the analytical level new explanations for the nature of the relationship have cropped up. One major emphasis in the recent literature is that the small farms are not as efficient as the large farms in agriculturally developed regions though this may not be the case in agriculturally backward regions. There is, however, a dichotomy in explaining the relationship between farm size and productivity. While the inverse relationship is generally explained by lower opportunity costs of labour for the small farms [*Ghose 1979, Bardhan 1973, Sen 1962, Rao and Chotigeat 1981, Taslim 1989*], recent emphasis on positive relationship is explained by alluding to various imperfections in the capital market [*Heltberg 1998, Swamy 1998, Dyer 1996-7*].

In labour- based approach the inverse relationship is explained on two strong, if not unrealistic, assumptions: (a) the farmers – large and small - are passive in responding to monitoring costs of hiring large doses of labour and (b) the labour market institutions are the same and static in all regions (“backward” and “forward” or “stagnating” and “growing”). Often the implicit institutional assumption is that of the existence of time-based spot wage labour market. Various forms of complex labour contracts that are in existence are generally ignored. It goes without saying that the large farms face serious monitoring costs and associated management problems in applying increasing amount of labour along with higher doses of capital. But at the same time small farms also employ hired labour and therefore they also face supervision problems. Thus the agents, large or small farmers, will make attempts to reduce these costs. One way this can be done is through changing the nature of labour contracts if market for supervisors is non-existent. This is the basis of our argument and we will focus on the labour market institutions for testing the size-productivity relationship. This does not mean that we are downplaying the role of capital market imperfection argument. We are highlighting the institutional dimension in the labour market that may well explain the inverse relationship in one region and positive relationship in another *without bringing in the capital market imperfection argument*.

The relationship between farm size and productivity is tested for Bangladesh agriculture with data gathered during 1997-98 from two sites comprising of two clusters of villages: Madhupur (the high growth area) and Chandina (the low growth area). We have found that the large farms are more efficient in high-growth area and the small farms are more efficient in the low-growth area. We have explained this by highlighting the role played by the labour market institutions in reducing transaction costs of hiring labour in the two sites. Transaction costs, amongst others, include cost of searching and of monitoring labour. These costs are minimised more in Madhupur (the high growth area) than in Chandina (the

low growth area) and more so by the large farms in Madhupur and the small farms in Chandina. In both regions the labour market is similar in the sense that a group leader, known as a *Sardar*, organises the labourers in a group. The farmers contact the *Sardar* for hiring labourers, not individual labourers. This reduces search costs in both regions. But in Madhupur, labourers are mainly hired on a task-specific contract basis whereas in Chandina they are hired on a usual wage-contract basis. This makes supervision costs in Madhupur substantially low in comparison to those in Chandina. Thus the institutional innovation in the labour market in Madhupur patches up for a missing market for supervision and makes the old argument of lower opportunity costs of family labour almost redundant.

## II. SIZE-PRODUCTIVITY DEBATE IN BANGLADESH AGRICULTURE

Hossain [1977] and Taslim [1989] vindicated the inverse relationship between farm size and productivity in Bangladesh agriculture. Hossain [1977] explains this relationship by arguing that the cost of family labour is low for small farms and hence they use labour intensively. On the other hand Taslim [1989] raises the issue of high supervision costs of monitoring labour that explains why labour is less intensively used in large farms as against the small ones. Note that both Taslim [1989] and Hossain [1977] do not analyse whether the inverse relationship reverses in agriculturally developed regions.

Let us point out some of the drawbacks of Hossain [1977]'s study. *First*, that the opportunity costs of family labour are low can now be seriously questioned for many parts in Bangladesh specially where rapid and frequent out-migration has made the agricultural labour market tight. *Second*, most small farms hire outside labour as well and this implies that the opportunity cost of family labour may not necessarily be low, so is the cost of supervising

labour. *Third*, increasing involvement in off-farm activities generally fostered by increase in microfinance will also imply a relatively high opportunity cost of family labour. In our study sites almost a third of all households had at least one family member in migration for work and about three-fourth of the households reported non-agricultural income [Greeley 1999]. Thus there are several reasons to believe that family labour may not have a low opportunity cost.

Some of the drawbacks of Taslim [1989]'s study are: *First*, Taslim [1989] ignores the institutional infrastructure of rural labour markets as it relates more generally to transaction costs and more specifically to supervision costs. These institutional infrastructures will of course vary temporarily as well as spatially but they have strong impact on decision-making process of the farmers/employers. *Second*, Taslim [1989] ignores that the small farms also face supervision costs as long as they hire outside labour.

Abedin and Bose (1988) observed that there is a positive relationship between farm size and productivity for modern rice production technology because the large farms used higher doses of purchased inputs such as fertilisers and pesticides. Thus in the context of Bangladesh agriculture most studies find a negative relationship but some such as those of Abedin and Bose (1988) observe positive relationships between farm size and productivity. But as mentioned earlier, the negative relationship is explained by recourse to the labour market and the positive relationship is explained by alluding to the differential access to the capital market. Our study takes the labour market approach alone to explain both the negative and positive relationship between farm-size and productivity in Bangladesh agriculture.

### III. SAMPLING AND SETUP

The data used in this paper was collected from a fieldwork carried out in two areas, namely, Chandina and Madhupur during the period July 1997 through August 1998. In each site we studied four clustered villages, making the village total to eight. The sites were selected using agro-ecological criteria and they are neither representative of the districts or the thanas. It should also be noted that data was collected for other purposes and only a subset of the data and information collected are used in this paper.

We only considered rice crop - the main crop produced in the two sites. National figures also indicate that the crop sectors contribute more than three-fourth of agricultural product and within the crop sector rice contributes a similar proportion [*Shahabuddin and Islam 1997*]. In Madhupur the cropping pattern for rice crop is simple: it comprises mainly of transplanted aman and boro. In short, it represents a typical green revolution area depending more on purchased inputs and irrigation. In Chandina, the cropping pattern is very complex and we faced difficulty in selecting the sample for comparing between the two sites in terms of a common cropping pattern. The elevated parts of the sample villages in Chandina (Darora and Hossainpur) that are endowed with some irrigation opportunities have a cropping pattern similar to those in Madhupur. However, this part of Chandina has to struggle against unexpected flood that is rare in Madhupur. Thus our field setup provides an ideal opportunity to test the relationship between farm-size and productivity because we were able to control for technological differences between the two sites and focus on the differences in labour market contracts. We were able to interview 54 farming households from Chandina, i. e. those who cultivated mainly T. Aman and Boro. In Madhupur we surveyed 111 farming households. The analysis is therefore based on a sample of 165 farmers.

Madhupur and Chandina are around 140 km and 80km away from Dhaka (the national capital) respectively. Chandina has higher population density, greater flood risk and lower irrigation potential in the four villages there that are on the edge of the river Meghna floodplain. The four villages in Madhupur benefit also from being near to a fast growing urban centre, Madhupur town. Out migration is a standard feature in Chandina. Madhupur has been taking in-migrants for quite a long time but this process has slowed down significantly in recent years. Recent changes in the two sites include improvement in infrastructure (mainly roads, electricity in some areas of Madhupur), crop diversification (mainly in Madhupur), increasing culture of fish in ponds and paddy-fields and involvement of a large number of NGOs in Madhupur. Table 1 captures some of the characteristic features of the two sites:

TABLE 1

## BASIC FEATURES OF THE TWO STUDY SITES

<i>Chandina (Low Potential Area)</i>	<i>Madhupur (High Potential Area)</i>
Four villages 6-10 miles from the main road	Four villages 0-.50 miles from the main road
The density of population is 1137 persons per square km	The density of population is 750 persons per square km
Long history of settlement (Buddhist, Hindu)	Short settlement history, indigenous population, forests (but declining due to overexploitation)
Fertile but flood prone, flat, winter crops (potatoes)	Rare flooding, high tracts, tradition of cash crops
Rainfall of 2245 mm/year	Rainfall of 1742mm/year
Extended families, clustered settlement	Individual households
Many small village markets	Large but relatively distant markets
High population density and out-migration	Low population density and declining in-migration
No NGOs	Too many NGOs
Defunct irrigation systems	Exotic Irrigation Scheme and Shallow Tubewells
Opportunities outside	Opportunities inside
Less crop diversification	More crop diversification
Relatively long history of aquaculture	Aquaculture now gaining popularity
Main common property resources are floodplains in the monsoon and canals (more dependence on them)	Main common property resources are natural depressions in the monsoon and canals (less dependence on them)

*Source:* Toufique (1999)

## IV. THE PROPOSITIONS

At a more general level we have to test two propositions:

P1. Productivity of land is higher in smaller farms in Chandina

P2. The inverse relationship between farm size and productivity breaks down in agriculturally developed regions such as in Madhupur

According to existing literature the first proposition is based on the implicit rationale that the small farms have low opportunity costs of labour and cultivate land more intensely while the second proposition is based on the implicit rationale that the large farms have access to the capital market at better terms and conditions and therefore could apply these resources in their plots in larger quantities or maintain the proper mix of inputs.

### *Test of the Propositions*

Following Bardhan (1973) we will test the relationship between farm size and productivity by regressing (the logarithm of) total revenue per acre (LTRPA) over (the logarithm of) acreage (LA):

$$\text{LTRPA} = a + b \text{ LA}$$

An inverse/positive relationship between farm size and productivity would be indicated by a negative/positive value of the coefficient “b”. The values of the estimated coefficients are presented in Table 2:

TABLE 2

## REGRESSION RESULTS ON FARM-SIZE AND PRODUCTIVITY RELATIONSHIP

	<i>Chandina</i>	<i>Madhupur</i>
<i>Coefficient “b”</i>	-.080	.08
<i>t-value</i>	-2.81	3.67

There is an inverse relationship between farm size and productivity in Chandina and this relationship is statistically significant. On the other hand there is a positive relationship between farm size and productivity in Madhupur and this relationship is also statistically significant. The inverse relationship between farm-size and productivity (the first proposition, P1) holds only for agriculturally backward region. Our data also supports the second proposition (P2), that is, the relationship between farm size and productivity is positive in Madhupur – the agriculturally “forward” region. We will now explain and validate why this is so from our data and fieldwork experience.

## V. SIZE-PRODUCTIVITY DEBATE: A LABOUR MARKET INSTITUTION EXPLANATION

Our main premise is that the actors change institutions to minimise transactions costs (to be defined shortly) and we will look at the labour market institutions to see how contractual arrangements affect transaction costs of allocating labour in the two regions. Earlier studies, particularly of Taslim [1989], dealt with labour market institutions but not in detail. They ignored or failed to capture its specific relevance to the size-productivity relationship. We will test the propositions in two steps. First, we will make *two main* propositions. These

propositions will be supplemented by five testable hypotheses (these may also be considered as subsidiary propositions). These (tested) hypotheses will be used to test the main propositions.

The main testable propositions are:

**M1.** TRANSACTION COSTS OF HIRING LABOUR IN MADHUPUR IS RELATIVELY **LOW** AND IT VARIES INVERSELY WITH FARM SIZE. THIS EXPLAINS THE POSITIVE RELATIONSHIP BETWEEN FARM SIZE AND PRODUCTIVITY IN MADHUPUR

**M2.** TRANSACTION COSTS OF HIRING LABOUR IN CHANDINA IS RELATIVELY **HIGH** AND IT VARIES POSITIVELY WITH FARM SIZE. THIS EXPLAINS THE NEGATIVE RELATIONSHIP BETWEEN FARM SIZE AND PRODUCTIVITY IN CHANDINA

*The Nature of Transaction Costs in the Labour Markets in Chandina and Madhupur*

In terms of the cost of hiring labour there are two important costs that should be minimised by any labour market institution, they are search costs and supervision costs. While there are other costs, direct or indirect, these two costs of hiring labour are crucial in agrarian economies. We will define transaction costs of hiring labour as the costs of searching and supervising/monitoring labour. While search costs relate to locate labour in space and in time, supervision costs relate to the costs of employing labour in terms of maximising *effort* applied by the labourers. The nature of transaction costs in the two sites is explained in Table 3:

TABLE 3

## MAIN CHARACTERISTICS OF THE LABOUR MARKET IN THE STUDY SITES

<i>Transaction Costs</i>	<i>Chandina</i>	<i>Madhupur</i>
<i>Search Costs</i>	Low	Lower
<i>Supervision Costs</i>	High	Low

Labour is organised in groups in Chandina and Madhupur under a group-leader known as *sardar*. This system of organising labour is often known as the *sardari* system. Farmers generally contact the group-leaders not individual labourers for hiring purposes. The group-leaders arrange for supplying the amount of labour demanded by the farmers. They have a pool of labourers under their control and these labourers are constantly in touch with the group-leader. In Chandina they come to see the group-leader every morning or evening to check out for their next assignment (what, where, when and at what terms). The employers do not have to search for labour on an individual basis, they have to contact a Sardar. The employers know the residential locations of the Sardars. Searching is relatively costly in Chandina because there is virtually no spot market for agricultural labourers. In Madhupur there is a spot labour market in what is known as the “bus stand” of Madhupur town. Our field work experience in Madhupur suggests that the employers directly hire from the spot market only when there is very strong demand for labour, or the group-leader fails to supply the required number of labourers or there is a demand for other minor type of agricultural activities which is frequently merged with pending household (domestic) activities. Absence of such markets for casual agricultural labourer implies that the farmers in Chandina cannot exploit such opportunities as done by their counterparts in Madhupur. This explains the elements of the first row (search costs) in Table 3. Search costs for hiring labour are low in both the sites and the sites are similar in terms of these search costs. This is the common

element of the labour market in the two sites. However, we cannot assign numerical values to quantify search costs but an equality of search costs between the two sites will be a very conservative assumption although it will be very much consistent with our analysis. This assumption is conservative because, as mentioned above, there is no spot market for agricultural labourer in Chandina and therefore potential gain from *sardari* system is much higher in Madhupur as compared to Chandina where there is no spot market for agricultural labourers whereas there is an alternative individually supplied spot market for agricultural labourers in Madhupur. Thus we have referred to search costs in Chandina as **low** and in Madhupur **lower**.

In Madhupur labour can be hired either as individuals (locally known as *din bhao*) or as groups (locally known as *chukti*). In the first case it is almost a usual wage labour market where labour time is bought. But note the difference, labour time is bought not necessarily in the sense of recruiting labour from the spot market but from an intermediary agent, the *Sardar*. However, in Madhupur the employer has the option to recruit labour from the spot market in Madhupur bus stand. In the second case where labour is hired as groups it is an operation specific fixed contract where a specific operation is transacted. The latter involves a contract that stipulates, for example, that an acre of land has to be harvested and a specific amount of money will be given for performing the task. The choice of hiring labourer in groups or in individuals lies entirely with the employer. The employer has hardly any choice on the number of labourers that is eventually used to do the work while they are employed in groups. However, he may persist on a deadline for performing the work and this is generally adhered to. In the first case (hiring labour in individuals) the employer is the residual claimant and in the latter (hiring labour in groups undertaking task-specific work) the labour is the residual claimant in terms of the amount of work done by the labourer. If the employer can monitor well and at a low cost the residue from hiring labour under standard wage

contract is high. On the other hand if a group of labourers can perform a task early by intensely doing the work it will have surplus time to do other work or to consume leisure. That is, in this contractual arrangement, the labourers are the residual claimants. Obviously, the quality of work is affected in group-specific contract and the farmers repeatedly mentioned this. Given that the contractual choice is voluntary agreed upon and alternative modes of hiring labour is available we can argue that the compromise on the quality of work constitutes an obvious trade-off.

In Chandina labour is mainly hired on a standard time basis and hence needs substantial supervision. By standard time we refer to stipulated duration of work in a day. What has to be noted is that the wage labour market in Chandina is not a spot market in the sense that buyers and sellers individually buy and sell labour time. The institution of the labour market is mediated through groups organised by the group-leaders or *sardars*. The responsibility of the *sardar* is to supply the number of individuals demanded by the farmers but *not to undertake any responsibility of completing a specific operation*. On the other hand in Madhupur the sardar decides not only on the number of labourers to be supplied he also *ensures that a specific operation is completed by the time stipulated by the farmers*. This explains the elements of the second row (supervision costs) in Table 3. We will call operation specific contracts as group labour contracts and time specific contracts as individual labour contracts. Thus transaction costs of hiring labour is low in Madhupur as compared to Chandina because search costs are lower in the former and supervision cost low whereas in the latter search cost is low but supervision costs are high.

Now the issue is how these institutional aspects of the agricultural labour market relate to size of the farms and productivity? **First**, we would expect that more group labour contracts would be prevalent in Madhupur as against individual labour contracts. This is so because this will substantially reduce supervision costs given that search costs are already

low. Supervision problems being particularly higher in large farms as compared to small farms we may observe more and more group labour being employed in large farms. Thus, the labour market institutions in Madhupur are such that they make supervision costs low, more so in large farms as they employ a larger number of labourers. Such contractual arrangements characterising the institutional setup of the agricultural labour market either substitute the missing market for “supervision” or make the existence of such market unnecessary. **Second**, supervision costs have to be minimised any way and therefore the farmers in Chandina, possibly having more family labour, will substitute it for group labour. Family labour can perform the task of supervision in lieu of group labour. Thus if small farms are more endowed with family labour then they will have relatively lower supervision costs of employing labour as compared to the large farms. **Finally**, increasing application of capital inputs will result in increasing application of labour. Madhupur, being more capital intensive, will therefore require more managerial effort to supervise labour and a group labour based contract will be more conducive to such optimisation strategy. Thus we can explain the relationship between farm-size and productivity by the institutional setup of the labour market: *ceteris paribus*, productivity differential can be explained by how transactions costs of hiring labour are minimised in a given region.

Based on this analysis and description of the institutional characteristics of the labour markets in the two sites we will now state the following testable hypotheses:

H1: IN MADHUPUR GROUP LABOUR EMPLOYED PER ACRE IS HIGHER THAN INDIVIDUAL LABOUR EMPLOYED PER ACRE

H2: IN CHANDINA FAMILY LABOUR EMPLOYED PER ACRE IS HIGHER THAN FAMILY LABOUR EMPLOYED PER ACRE IN MADHUPUR

H3: EMPLOYMENT OF INDIVIDUAL LABOUR PER ACRE IN CHANDINA IS HIGHER THAN EMPLOYMENT OF INDIVIDUAL LABOUR PER ACRE IN MADHUPUR

H4: THE RATIO OF GROUP LABOUR TO INDIVIDUAL LABOUR VARIES POSITIVELY WITH FARM SIZE IN MADHUPUR

H5: THE RATIO OF FAMILY LABOUR TO INDIVIDUAL LABOUR VARIES INVERSELY WITH FARM SIZE IN CHANDINA

If hypotheses H2, H3 and H5 are jointly true then proposition M2 is also true which in turn provides an explanation for proposition P1 i. e. why smaller farm are more efficient in allocating labour than the large farms. If hypotheses H1 and H4 are jointly true then proposition M1 is also true which in turn provides an explanation for proposition P2 i. e. why large farms may more efficiently hire labour in agriculturally developed regions and therefore produce more output per acre. In the following we provide the results of the tests of the hypotheses.

### *Test of hypothesis 1*

We have estimated the amount of group and individual labour hour employed per decimal in Madhupur. The results are presented in Table 4.

TABLE 4

GROUP AND INDIVIDUAL LABOUR HOURS PER DECIMAL IN MADHUPUR BY CROPS

	<i>T. Aman</i>	<i>Boro</i>	<i>All</i>
<i>Group Labour Hour Per Decimal</i>	1.85	2.66	2.26
<i>Individual Labour Hour Per Decimal</i>	1.35	1.34	1.35

As can be seen from Table 4 that group labour hour per acre is higher than individual labour hour per acre for all crops in Madhupur. It is about 37% higher for T. Aman but the corresponding figure is about double for Boro. Thus hypothesis 1 is verified.

#### *Test of Hypothesis 4*

We have estimated that the correlation coefficient between the ratio of group labour to individual labour to farm size is positive (.24) and significant (at 1% level of significance) in Madhupur. This means that higher the acreage larger is the concentration of labourers hired in groups. Thus hypothesis 4 is verified.

The hypotheses H1 and H4 explain why the inverse relationship between farm size and productivity is reversed in a predominantly green revolution site of Madhupur. The higher the size of the farm the ratio of group labour to individual labour will also be high. Since group labour requires no monitoring, the supervision costs will be lower and hence output per acre will be higher. The main proposition M1 is therefore verified.

#### *Test of Hypothesis 2*

We have estimated the amount of family labour hour employed per decimal in Chandina and Madhupur. The results are presented in Table 5.

TABLE 5

## FAMILY LABOUR HOURS PER DECIMAL BY SITES AND BY CROPS

	<i>T. Aman</i>	<i>Boro</i>	<i>All</i> *
<i>Family Labour Hour Per Decimal in Chandina</i>	.50	.60	.55
<i>Family Labour Hour Per Decimal in Madhupur</i>	.22	.28	.25

As can be seen from Table 5 that family labour hour per decimal in Chandina is higher than family labour hour per decimal in Madhupur and this is true for all crops. It is actually more than double for each crop and for all crops taken together. Thus hypothesis 2 is verified.

*Test of Hypothesis 3*

We have estimated the amount of individual labour hour employed per decimal in Chandina and Madhupur. The results are presented in Table 6.

TABLE 6

## INDIVIDUAL LABOUR HOURS PER DECIMAL BY SITES AND BY CROPS

	<i>T. Aman</i>	<i>Boro</i>	<i>All</i> *
<i>Individual Labour Hour Per Decimal in Chandina</i>	2.03	2.25	2.56
<i>Individual Labour Hour Per Decimal in Madhupur</i>	1.35	1.34	1.35

As can be seen from Table 6 that individual labour hour per decimal in Chandina is higher than individual labour hour per decimal in Madhupur and this is true for all crops. For T. Aman it is more than 50% higher and for boro it is about 68% higher. Thus hypothesis 3 is therefore verified.

### *Test of Hypothesis 5*

We have estimated that the correlation coefficient between the ratio of family labour to individual labour to farm size is negative (-26) and significant (in at 1% level of significance) in Chandina. This means that larger the size of the farm higher is the concentration of labourers hired as individuals. Thus hypothesis 5 is verified.

The hypotheses H2, H3 AND H5 explain why an inverse relationship between farm size and productivity is plausible in Chandina. The higher the size of the farm the lower would be the ratio of family to individual labour. Since less and less family labour will be available for monitoring individual labour supervision costs will be high. This explains why output per acre will be low in large farms. The main proposition M2 is therefore verified.

## VI. SUMMARY AND CONCLUSIONS

We have seen that the large farms are more efficient in a high-growth area such as Madhupur and the small farms are more efficient in a low-growth area such as Chandina. We have explained this by highlighting the role played by the labour market institutions. We looked at transaction costs of hiring labour in two sites. Transactions costs include the cost of searching and supervising labour. Such costs are minimised more in Madhupur (the high growth area) than in Chandina (the low growth area) and more so by the large farms in Madhupur and the small farms in Chandina. Whereas in Madhupur the nature of labour contracts reduced transaction costs further, in Chandina a somewhat second-best solution was provided by higher use of family labour for supervision. This was possible by hiring labour in groups on a contract (task-specific) basis in Madhupur. Thus the role that is played by the labour market in Madhupur in terms of reducing monitoring costs through hiring task-specific contract

based labour; this is exactly what is missing in Chandina. This role is not marketed in Chandina but substituted by involving available family labour. In terms of transaction costs of employing labour this is the main difference between the two labour market institutions. There is apparently a missing market for supervision in both sites. In Madhupur this missing market is substituted by changes in the labour market institutions (hiring of the labourers in group) whereas in Chandina this market is (inadequately) substituted by the use of family labour. The extent to which family labour can do monitoring depends on the size of the farm. The larger the farm the lower will be its capability to use family labour for supervising hired labour. Thus the labour market institutions in Chandina are relatively inefficient as compared to the labour market institutions in Madhupur.

This paper raises several important issues. *First*, the assumption that the actors remain passive to a missing supervision market should be seriously questioned. The dynamic changes in agrarian contracts are frequently overlooked in the literature on farm size and productivity. *Second*, institutional constraints are relatively less binding or more amenable to change in agriculturally developed areas. The supply of institutions is more elastic in agriculturally developed region. *Finally*, an across the board redistributive land reform or transferring land rights to poor may not be an effective policy if based on farm-size and productivity argument alone.

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