FARM SIZE - PRODUCTIVITY RELATIONSHIP: SOME EVIDENCE FROM KERALA

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ABSTRACT*

In the past three decades following the implementation of land reforms, the agricultural sector in Kerala has undergone wide-ranging changes in terms of farm size, cropping pattern, cultivation practices and productivity. There has been a phenomenal growth in the number of agricultural holdings leading to the emergence of a large number of very smallholdings. Of course, agricultural productivity also increased significantly during this period. The major question examined in this paper is whether the increase in productivity of land is explained by the decrease in the size of holdings. The agricultural census figures suggest a possible relation between the two.

In order to verify this relationship data were collected through a sample survey in a rural locality in Kerala. A size-wise analysis of productivity indicated that it is the large farms, which have higher productivity. However, more detailed analysis using regression methods shows that no firm relationship exists between farm size and productivity. To identify the causal factors of productivity further in-depth analysis of the data was made. It is often held that cultivators having non-farm sources of income have more access to resource for farm expenditure than cultivators whose sole source of is cultivation and therefore able to realise higher levels of productivity. The observed data did not support this proposition. Another argument is that farms employing family labour achieve productivity higher than of farms employing only hired labour. In this case also, the observed data do not provide any conclusive evidence. On the other hand, our survey data indicate an association between crop mix and productivity. Whether this really is the case has to be verified with larger samples of data and in different parts of the country. If it is verified, it would then be necessary to identify the key causal factors underlying for the phenomenon.

Keywords: farm size, productivity, inverse relationship, cropping pattern

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I

Introduction

The basic objectives of the agricultural policy followed by the Government of India since independence were raising agricultural output to achieve self-sufficiency in food-grains production and improving the living conditions of people dependent on agriculture. The Government implemented various programmes for providing incentives to cultivators for augmenting crop production and for reducing disparities among them. Various Farm Management Studies (FMS) carried out during the late' fifties and early' sixties to assess the impact of the government programmes indicated an inverse relationship between farm size and productivity.

A proposition that is often put forward in discussions on this relationship is that small farms are more efficient since cultivators of such farms make more intense use of their lands and adopt such mixed cropping that yields higher value output implying thereby that size affects the land use and crop pattern and small farms give strength to the agriculture sector.

The present paper examines the relation between farm size and productivity in Kerala in the post land reforms era. This paper is divided into six sections. A rapid review of the debate on the relation between farm size and productivity is made in section II. In section III, data on agricultural censuses are examined to find out whether they show any pattern linking productivity and farm size. In section IV, the relationship between farm size and productivity is examined in detail using data collected through field investigation in a rural locality in Kerala. Based on the analysis of survey data a brief discussion is given in section V. A summary of the findings is given in the concluding section VI.

II

Farm size and productivity: the debate

One of the early attempts to examine the relationship between farm size and productivity was the article published by A.K. Sen (1962) in which he stated by and large, productivity per acre decreased with increase in size of holding. The inverse relationship was derived based on size

class data; and Sen himself was however, aware of the limitation of his conclusion since he was using only aggregated data. Sen (1964) subsequently gave three alternative lines of explanation for this phenomenon, (i) technique-based, (ii) labour-based, and (iii) fertility-based.

According to Dipak Mazumdar (1965), Khusro (1968), Hanumantha Rao (1966), Saini (1971) "the inverse relationship between farm size and productivity is a confirmed phenomenon in Indian agriculture and its statistical validity is adequately established.

However, some doubts were expressed about the statistical validity of the 'inverse relation', by A.P.Rao (1967) who, based on analysis of dis-aggregated data relating to individual holdings, came up with results contradicting the hypothesis that yield per acre falls as farm size increases. Rudra's (1968a) analysis of individual holding, in 20 villages strengthened this doubt. In another follow-up study, working with size-group data Rudra (1968b) challenged the validity of generalising the inverse relation for the whole of India.

On the contrary, Usha Rani's (1971) studies in Intensive Agricultural Development Programme (IADP) districts using farm level observations showed that neither cropping pattern nor inputs intensity nor even yield per acre differs across farms of different sizes. Using aggregated data relating to individual districts for the period between 1954 and 1957, Krishna Bharadwaj (1974) investigated the relationship between productivity and size of farm and found that in the majority of cases, an inverse relationship existed; however, it was not statistically significant.

Utsa Patnaik (1972) argue that "a very considerable difference is made to the farm variables with changing economic size of farms, depending on how we measure this economic size. With acreage as a measure of economic size, i.e.; of the scale of production, we obtain one set of results; with an alternative index of the scale of production, we may obtain diametrically opposite results. Further, in a situation of changing techniques, the grouping of farm data by acreage is likely to obscure some very important feature of the dynamics of agricultural change".

Yet, another study using statistical tests with data from sources other than FMS is that of Nirmal Chandra (1974). He carried out two different exercises. One was a three-way analysis of variance,

where the three factors were different farm sizes, farms having different shares of family labour and farms having different proportions of leased in lands. His results from the two lines of analysis were however not consistent with each other.

Another important contribution to this debate is by Chadha (1978) who looked at farm level data for three agro-climatic regions in the Punjab for the year 1969-70. He found that the inverse relationship had ceased to hold in the more dynamic zones. A.K. Ghose (1979) re-examined the FMS data and argues that an essential pre-condition for the existence of the inverse relationship phenomenon is technical backwardness.

Rudra and Sen (1980) attempted to review the main findings – both analytical as well as empirical – in the light of the original presentation of the issues. The general conclusion was the diversity of Indian agriculture with regard to the relationship between size and productivity: the negative relation may hold in certain parts of the country at certain times but not everywhere and not at every time. Even when the inverse relationship held, "it may hold in certain ranges but not in others, and in many cases it is particularly noticeable only for small size classes." Rudra (1983) concluded that: "there is no scope for propounding a general law (for an inverse relationship or even for a positive relationship)."

Pol Barbier (1984) has questioned the very logic of establishing the relationship between farm size and productivity. In his view, most research on the issue has been based on wrong assumptions and methodologies. He regarded the inverse relationship thesis as spurious and without any theoretical meaning.

Madhusudan Ghosh (1989) examined the changes in the agrarian structure of rural West Bengal during the seventies. He hypothesised that in a dualistic agrarian structure in which large farms under-utilise land due to shortage of family labour and small farms under-utilise family labour due to scarcity of land, a reduction in the degree of inequality in the distribution of operational land would favourably affect agricultural productivity. He suggested that a reduction in inequality of land distribution through appropriate land reforms would result in higher agricultural productivity in West Bengal.

In his attempt to develop a theory of optimum land reform for dualistic agriculture, Raj Krishna, after examining various Indian studies based on Farm Management data, came to the conclusion that "a reduction in the size of holdings and land concentration brought out by land reform, will not be associated with a reduction in output per acre, after a new equilibrium is established. On the contrary the output per hectare and hence the total output of a given area of land is likely to increase." Vijayakrishna (1995).

A recent study by Chattopadhyay and Sengupta (1997), using farm level disaggregated data for 1989-90 for West Bengal, suggests that "the inverse relation between farm size and productivity becomes stronger in the agriculturally developed regions of West Bengal compared to the relatively less developed regions. This is possibly due to the effects of green revolution on smaller size farms. However, to arrive at a comprehensive view of the phenomenon more studies using disaggregated farm level data for different States are required." The conclusions of this study have however been questioned by Dyer (1998). On a critical examination of the data and methodology, Dyer concludes that the study by Chattopadhyay and Sengupta is defective. He however suggests that more disaggregated farm level data analysis needs to be carried out, especially using larger sample sizes. "Further, a wider range of data need to be collected which relates centrally to peasant differentiation, technological dynamism and the development of capitalist form of agriculture."

To sum up, it is often pointed out that the difference in the size of farms is one of the reasons for the difference in yields. It is argued that small cultivators increase cropping intensity on their farms or have multiple crops and that family labour works intensively on such farms thereby increasing output per unit of land. However, studies carried out on the relation between size of farms and productivity show contradicting results. Studies based on aggregated data showed an inverse relationship, but studies based on disaggregated data failed to confirm this. The latter indicates that the inverse relationship exists in certain types of farms, but the relation cannot be generalised. In addition, the relationship need not be there for all size groups, for all regions, and for all crops. The debate thus remains inconclusive.

III

Kerala experience – indications by aggregate data

The State of Kerala, formed in 1956 consequent on the reorganisation of States on linguistics basis had a complex multi-tier system of land tenure serving different types of interests on land, resting on a base of landless agricultural labourers and tenant farmers. The low productivity of land and rural poverty were often explained by the continued exploitation of the rural peasantry by feudal interests. The tenurial relations were governed by custom and usage and often conflicts arose in the interpretation of rights, leading to social tensions. It was in this context that the State Government, during the' sixties enacted land reforms with a view to regulate tenurial relationships, by law. The provisions of the Kerala Land Reforms Act 1963, as amended in 1969, were brought into force with effect from January 1970.

The land reforms programme had two basic objectives – one economic and the other social. The economic aim was to create conditions that would increase agricultural production, which was sought to be achieved through eliminating all elements of exploitation by providing security of tenure and ownership rights to cultivators. The social aim was to reduce disparity in the distribution of land. This was sought to be achieved by imposition of ceiling on land holding and redistribution of the surplus land to the landless. Because of the redistribution of land, the number of smallholdings sharply increased.

According to the 'Land reforms survey' conducted in 1966-67, there were 19.06 lakh agricultural holdings in Kerala, of which only one percent was above 10 ha in extent. At the lower extreme, nearly 55 percent of the holdings were below 0.4 ha. The average size of holding was only 0.72 ha. By 1971, the number of holdings increased to 20.22 lakh. In the years that followed, the holdings were divided further quite rapidly. The latest agricultural census (1990-91) shows that there were over 54.18 lakh holdings in Kerala of which nearly 84 percent were of less than half a hectare in size. With population growth and the increasing pressure on limited land resources, the holdings continue to get progressively sub-divided, leading to the emergence of still smaller holdings.

From the data published in the Economic Review of the State Planning board from 1970-71 to 1998-99, we observe that in the years following land reforms, the agriculture output in the State steadily increased up to the year 1975-76; thereafter it started to decline and the trend continued up to 1980-81. The pace of output increase picked up from that year; and after initial vacillation has steadily kept on increasing.

The redistribution of agricultural holdings and the socio-economic changes during the past three decades is important factors contributing to the changes in the agriculture sector of the State. Of this, the changing structure of agriculture holdings is a major factor affecting land use, cropping pattern, productivity, and farm employment. Cropping pattern in a particular period is usually expressed by showing the area under each crop as a percentage of total cropped area. A change in cropping pattern thus would mean a change in the proportionate areas under different crops. If, therefore, the proportionate area under a high-value crop increases, it is likely to result in an increase in the total return, (if there is no change in yield or price) provided there is no simultaneous decrease in the proportionate area under other equally or more valuable crops. The change in the pattern of land use and cultivation is the result of decisions taken by millions of farmers in the State. Among the various factors influencing their decisions, the size of farm must be considered a major one.

During the 20-year period following land reforms, the number of agricultural holdings in the State has nearly doubled. The sub-division of holdings has led to a phenomenal increase in the number of marginal holdings (i.e. holdings less than 0.5 ha). Their number has increased from 20.30 lakh in 1970-71 to 45.50 lakh in 1990-91. As a result, the size-distribution of holdings has become highly skewed, as may be seen from the Table 1.

Nearly 84 percent of the holdings are small, of less than 0.5 hectare; while at the other extreme, the percentage of holdings above 10 hectares is only 0.06. In fact, nearly 12 percent of the holdings enumerated in 1991 were less than 0.02 hectares and cover only 0.46 percent of the total area.

Table 1 Distribution of agricultural operational holdings in Kerala

Size class (Ha)	1970-71		1990-91	
	Number of holdings (lakhs)	Percentage of holdings	Number of holdings (lakhs)	Percentage of holdings
Below 0.5	20.30	71.93	45.50	83.97
0.5 – 1.0	3.68	13.04	4.66	8.60
1.0 – 2.0	2.68	9.50	2.80	5.17
2.0 – 3.0	0.87	3.08	0.76	1.40
3.0 – 4.0	0.38	1.35	0.22	0.41
4.0 – 5.0	0.12	0.43	0.12	0.22
5.0 – 10.0	0.15	0.53	0.09	0.17
10.0 & above	0.04	0.14	0.03	0.06
All	28.22	100.00	54.18	100.00

Source: Computed from Agriculture census reports, 1970-71 and 1990-91, Dept. of Economics and Statistics, Govt. of Kerala.

The marginal and smallholdings dominate the farm front, and their owners make intense use of their land and cultivate a variety of crops. In the larger holdings, there is less diversity of crops while in very large holdings the pattern is usually mono cropping with plantation crops such as tea, coffee, cardamom, and rubber.

The pattern of cultivation in holdings of different sizes is given in Tables 2 and 3. The figures of area under crops shown in the Tables may give the impression that cultivation is done under mono cropping. However, except rice and plantation crops, most crops are cultivated under a multi-tier cropping system in and around the homesteads. In most homesteads, coconut is the base crop pepper, plantain, arecanut, and tapioca are grown as inter-crops. For the purpose of crop, statistics the areas are apportioned and presented separately for each crop.

In the early 1970s except in large holdings seasonal crops, mainly rice, vegetables and tapioca dominated. The main perennial crop was coconut. By 1991, the pattern changed. The percentage of area under seasonal crops in almost all size groups of holdings considerably declined yielding place to perennial cash crops like pepper, coconut, and rubber. Even in 1971, coconut had been a major crop in the marginal and small farms. In the years that followed, the tendency to increase the area under coconut was seen mostly in marginal and small and holdings. These holdings also

shifted from tapioca to rubber. In the marginal holdings shift from seasonal crops was mainly to coconut whereas in the smallholdings the conversion was to both coconut and rubber. The crop pattern in the large holdings remains more or less unaltered, with predominance of plantation crops like rubber, tea, coffee and, cardamom.

Table 2 Crop pattern 1970-71 (in percentage)

Size class (Ha)	Gross cropped area	Rice	Vegetables	Tapioca	Banana & Plantain	Pepper	Coconut	Rubber	Plantation crops	Other crops
Below 0.5	100.0	14.4	7.7	25.6	0.1	3.6	32.4	0.8	0.8	14.6
0.5 – 1.0	100.0	35.9	7.3	19.9	1.0	3.8	19.2	2.7	1.7	8.5
1.0 – 2.0	100.0	41.3	7.6	15.4	0.9	3.6	15.0	6.6	1.7	7.9
2.0 – 4.0	100.0	43.0	9.3	10.7	0.8	3.2	11.7	10.4	2.2	8.7
4.0 – 10.0	100.0	42.6	8.9	6.4	0.5	2.5	10.7	14.1	3.2	11.1
Above 10.0	100.0	8.2	2.7	1.9	0.2	1.0	3.2	24.4	29.3	29.1
All sizes	100.0	32.6	3.9	14.9	1.0	3.2	16.5	8.3	7.0	12.6

Source: Computed from Agricultural Census Report, 1970-71,Govt. of Kerala

Table 3 Crop pattern 1990-91 (in percentage)

Size class (Ha)	Gross cropped area	Rice	Vegetables	Tapioca	Banana & Plantain	Pepper	Coconut	Rubber	Plantation crops	Other crops
Below 0.5	100.0	8.8	2.9	8.2	11.3	6.9	42.3	5.2	1.0	13.4
0.5 – 1.0	100.0	17.7	3.1	6.6	2.8	10.0	27.0	16.6	3.0	13.2
1.0 – 2.0	100.0	22.4	4.0	3.2	4.0	9.9	20.4	21.9	3.8	10.4
2.0 – 4.0	100.0	23.2	4.2	2.9	3.5	8.7	18.1	23.5	5.8	10.1
4.0 – 10.0	100.0	24.9	2.9	1.5	3.0	7.9	14.3	26.1	7.7	11.7
Above 10.0	100.0	4.2	0.2	0.3	0.5	1.8	7.2	24.4	44.8	16.6
All sizes	100.0	16.1	3.2	5.1	5.6	8.1	27.1	16.3	6.3	12.2

Source: Computed from Agricultural Census Report, 1990-91,Govt. of Kerala.

Table 2 and 3 clearly indicate that the smaller holdings allocate more area to cash crops like pepper and coconut, and that tendency towards allocating more area to rubber increases with the

size of the holding.

A location specific study conducted by the author had noted that cultivators select crop varieties consciously to obtain better yield to increase income and cover risk. Mahesh (1999). Reallocation of farmland from food crops to cash crops has resulted in higher cash income from farm. Assessed in terms of value, the productivity of such lands has increased. Since the shift to high-valued cash crops is more pronounced in marginal and smallholdings, it is in these holdings that productivity increased most. The indication is that emergence of small farms has contributed significantly to the overall productivity and the growth of agricultural sector in the State. The possibility of the existence of an inverse relationship between farm size and productivity cannot be ruled out, in this context.

Since the discussion in this section is based on aggregate data, a certain amount of caution is necessary in interpreting the results. The apparent relationship between size and productivity could be the result of other factors also. For instance, if fertility and productivity of land is independent of farm size within a village but is different in different villages and if villages with higher fertility and productivity happen to have a preponderance of small farms, the relationship between size and productivity shown by the aggregate data for these villages taken together, turn out to be spurious. In Kerala, the lowland and the midland regions are thickly populated and have smaller average farm size, whereas in the highland region, population density is comparatively low and farm size is larger. In addition, the conditions for intensive cultivation and diversification of crops are less favourable in the highland region.

In the agricultural census, data from the three regions are pooled together. The relationships inferred from such aggregated data have therefore to be tested using dis-aggregated data of an area of uniform agro-climatic conditions, for confirmation. With this end in view, data relating to individual agricultural farms in a village were collected through a sample survey and analysed.

IV

Results at farm level

The area selected was a typical rural hamlet in Pallichal panchayat of Thiruvananthapuram District

in Kerala State. Agriculture is the main means of livelihood of the people in the area, even though a small percentage of the population is engaged in non-agricultural activities like handloom weaving, pottery, quarrying, and small trade. In this panchayat, a sample survey was conducted among 81 cultivator households for collection of data on crops grown, production, employment of both hired and family labour, and non-agricultural income through personal interview. A cultivator household is defined a household having 50 cents or more of cultivable land. Cultivator households are again classified into farming cultivator households having the major share of their income from farm (excluding livestock and poultry) and non-farming cultivator households having the major share of income from non-farm activities and possessing 50 cents or more of cultivable land. The sample farms were selected through the method of stratified random sampling. The primary sampling unit was an operational holding; and the holdings were identified through the household operating the farm. The farming and non-farming households formed the two strata. The data were collected by personally interviewing the cultivators. Even though it was planned to collect data from a random sample of 100 households, data could finally be obtained only from 81 holdings. The survey data show that nearly half the number of holdings in the village is very small of size less than 1 acre. The largest holding identified in the survey was only 5.25 acres. About 30 percent of the holding area is classified as wetland of which 45 percent is now available for rice cultivation, as remaining area have been shifted to other uses. The distribution of holdings by size is given in Table 4.

Table 4 Distribution of holdings by size. (area in acres)

Holding size	Percentage of holdings	Average area of holdings			
		Wet land	Converted wet land	Garden land	Total
0.5 – 1.0	48.2	0.05	0.11	0.52	0.68
1.0 – 2.0	33.7	0.15	0.28	0.96	1.39
2.0 – 4.0	13.2	0.33	--	2.89	3.22
4.0 & above	4.8	0.69	0.63	3.46	4.78
All sizes	100.0	0.15	0.18	1.12	1.45

Source: Survey data.

Nearly two-thirds of the gross cropped area is under perennial crops like coconut, rubber, pepper,

and other tree crops. Among the seasonal crops, rice covers only 40 percent of the total cropped area. A sizeable portion of the converted land is used for cultivation of banana and tapioca. In most of this converted land, coconut seedlings are planted and seasonal crops grown around as mixed crops. The percentage of area under seasonal crops is comparatively high in the smaller holdings and low in the larger holdings. Coconut is extensively cultivated in holdings of all sizes. Rubber cultivation takes the second highest position among the perennial crops; and in the larger holdings, a higher percentage of area is which has earlier been mainly under tapioca is allocated to rubber cultivation. Among the seasonal crops banana is gaining favour among smallholders. Rice accounts for nearly one-fifth of the gross cropped area in the smaller holdings while in the larger holdings it covers only one-tenth. (See Table 5). The crop pattern in the study area reflects approximately the overall situation of agriculture in the State (expect at the high lands).

Table 5 Distribution of area under different crops

Holding size (cents)	Gross cropped area (in acres)	Percentage cropped area							
		Seasonal/Annual crops				Perennial cash crops			
		Rice	Tapioca	Vegetables & other tubers	Banana & Plantain	Coconut	Pepper	Rubber	Other crops
50 – 100	100.0	16.5	16.8	5.7	5.7	40.6	1.5	9.5	3.7
100 – 200	100.0	20.5	18.4	0.9	6.5	38.8	0.9	12.8	1.2
200 – 400	100.0	9.0	--	0.5	--	32.0	0.7	57.0	0.8
400 & above	100.0	12.0	10.9	0.4	2.3	35.2	0.4	38.2	0.6
All	100.0	11.0	10.5	1.5	3.3	35.2	0.8	36.2	1.5

Source: Survey data.

The shift from seasonal crops to perennial crops is explained as a readjustment by the cultivators of the crop mix with a view to maximising the utility of available land. Other forces influencing the crop mix are several: resource constraints, home consumption requirements, cash requirements for meeting household needs, labour incomes and debt repayment. In this situation, it may not be realistic to treat cultivators as pure profit maximisers. A more realistic assumption would be that cultivators attempt to maximise total return from agriculture by growing a mixture of crops that

would fetch also a high market value. Therefore, gross value of agricultural output per unit of land (i.e.; yield) is treated as a rough indicator of productivity.

Before a detailed analysis of the data is taken up, an attempt is made to find out the pattern underlying the yield differentials among the various categories of farms. To begin with, the yield differential between small and big farms is examined. For the purpose of this analysis, a small farm is taken as an agricultural holding of size less than or equal to 2 acres. (See Table 6)

Table 6 Average yield per acre by category of farm.

Categories	Average yield (Rs)	SD	SE	n
Small farms	14400	10100	1250	66
Big farms	18700	6000	1500	15
All farms	15200	9660	1073	81

Source: Survey data.
Note: SD = standard deviation; SE = standard error of estimate; n = number of farms.

The estimates show that the average yield is higher in big farms. The statistical test confirms that the difference in average yield between the small farms and large farms is significant, (at 5 % level). This does not necessarily mean that 'larger the farm higher the yield', because a different categorisation might show a different result as could be seen later.

Reverting to the hypothesis of an inverse relationship between farm size and productivity, our attempt is to examine whether it holds true for Kerala. The hypothesis is that no relation exists between farm size and productivity. For testing this hypothesis, it is assumed that the yield (value of output per unit area) is largely accounted for by the size of the farm and that the relation is linear. With this assumption the model can be written as:

$$Y_i = \beta_0 + \beta_1 X_i + e_i$$

Where Y_i = the gross yield per acre (gross value of output per acre in the i^{th} farm), X_i = the size of the i^{th} farm, β_0 and β_1 are constants and e_i, the classical error term.

The parameter β_1 can be interpreted as the change in Y for unit change in X. If the inverse relationship exists the sign of β_1 will be negative. β_0 is the yield per acre that is not related the size

of the farm that is X. Therefore, the sign of β_0 is positive. This model was fitted to the data collected from 81 farms using the ordinary least square regression method. The regression estimates are given Table 7.

A preliminary examination of the results shows that the standard error of estimate is high, indicating that the regression equation does not show good results. The estimate of coefficient β_1 is positive but very near to zero. The 95% confidence interval of this coefficient gives the lower boundary as -0.029 and the upper boundary as 0.338. This shows that the coefficient could very well be zero, in which case the inference is that there is no linear relationship between the sizes of the farm and yield. The fact that the coefficient of determination (R^2) is negligibly small (0.035) shows that the overall fit of the model is very poor and that the size of the farm does not in any way explain the yield.

Table 7. Regression estimates of the three categories of households.

Category	β_0	β_1	S.E	R^2	n	F
All households	12932	0.155	9554	0.035	81	2.826
	1718.9*	0.092*				
	752.3†	1.681†				
Farming cultivator households	15126	-0.003	11470	0.0001	32	0.004
	4829.7*	0.513*				
Non-farming cultivator households	11878.2	0.190	8273	0.085	49	4.361
	2069.3*	0.091*				

Note: * are the standard errors of the coefficients, † are the t values and S.E the standard error of the estimate, n - the number of observations.

In specifying the model the sign of the coefficient, β_1 was hypothesised to be negative but the regression analysis shows that the assumption need not necessarily be correct. In order to find out whether the inverse relation would hold good for any of the two categories of cultivator households, (farming and non-farming households) separate regression exercises were carried out for the two groups. The regression estimates are given in Table 7. None of these regression estimates shows any relationship between the size of the farm and yield. The conclusion is that the observations do not support the hypothesis that there is any pattern in the relationship between farm size and productivity, let alone an inverse relationship. It is clear from the above analysis that

no direct relation exists between the size of the farm and productivity. To identify factors influencing productivity, the search has to be directed at characteristics other than size.

It is seen from the survey that 81 percent of the farming households have income from various non-agricultural sources; in fact, 40 percent of their net income accrues from non-agricultural sources. In the case of non-farming cultivator households non-agricultural income accounts for 80 percent of their net income. Owners of large farms have a larger resource base and this often helps them to engage in non-agricultural activities and augment their income. With this assumption, an attempt is made to find out whether this is justified by the survey data. For this, the coefficient of correlation between farm size and non-agricultural income was worked out. The correlation coefficient for all farm sizes turned out to be negligibly low at 0.04. Even when the analysis was restricted to holdings of size more than two acres, the correlation coefficient was found to be very low at 0.1. This indicates that the choice of non-farm activity is not dependent on farm size.

However, the question remains whether cultivators having non-farm income tend to spend more on agriculture leading to higher productivity of their land. For this, the average farm expenditure per unit of land for cultivators having non-farm income and the others were worked out and compared. Since the non-farm income of many of the households was very small, only those households with annual non-agricultural income exceeding Rs. 20,000 were considered as households having sufficient resource for spending a higher amount on cultivation. Out of the 81 households surveyed 21 come under this category. Their annual expenditure on farm was found to be Rs. 4,890/- per acre as against Rs. 4,440 for households with meagre or no non-agricultural income. The difference is not significant. The analysis thus shows that there is no clear relation between non-farm income and intensity of cultivation.

There is a proposition that in farms employing family labour cultivation is carried out more efficiently. One of the reasons for differences in productivity among farms is to attribute to this factor. To examine this proposition, the sample holdings are categorised into two groups: namely; farms employing family labour, and farms employing only hired- in labour. The average productivities estimated from these two categories are given in the Table 8. The productivity

figures indicate that farms employing family labour are more efficient than farms employing only hired-in labour. However, no firm conclusion can be arrived at, since the difference is not statistically significant (at 5 % level).

Table 8 Productivity (value Rs/acre) in farms employing family labour and employing only hired-in labour.

Category of farms	Average productivity	SD	SE	n
Employing family labour	15650	10238	1300	62
Employing only hired-in labour	13736	7532	1728	19

Source: Survey data.
Note: SD = Standard deviation; SE = Standard error of the estimate; n = no. of observation

Table 9 Crop pattern (% area) in holdings with high productivity and low productivity.

Crops	Farms with	
	Higher productivity (above Rs. 16,200/acre)	Lower productivity (below Rs. 14,100/acre)
Rice	13.0	20.3
Tapioca	7.1	17.0
Vegetables	1.0	2.5
Plantain & Banana	6.0	0.8
Coconut	23.6	33.7
Pepper	0.7	0.9
Rubber	47.4	23.3
Others	1.2	1.5
All	100.0	100.0

Source: Survey data

A plausible explanation for the variation in productivity among farms can be the differences in the crop mix. To examine whether such an explanation would be satisfactory one, the sample holdings with higher productivity and those with lower productivity were grouped into separate categories and their crop pattern examined. The pattern in the two categories is shown in Table 9.

The patterns indicate that in the farms with higher productivity, area under perennial crops, especially area under rubber, is comparatively high. However, it was seen from earlier analyses that rubber is grown mostly in large holdings. While it is possible that higher productivity in larger holdings is due to the cultivation of rubber, in smaller holdings it may not be so. To investigate this, the crop pattern in smallholdings was analysed separately and the results obtained are given in

Table 10.

Table 10 Crop pattern (% area) in holdings with high productivity and low productivity in small farms.

Crops	Farms with	
	Higher productivity (above Rs.16,200/acre)	Lower productivity (below Rs.14,100/acre)
Rice	17.5	20.5
Tapioca	11.2	21.2
Vegetables	2.2	3.4
Plantain & Banana	15.4	0.3
Coconut	40.3	37.5
Pepper	1.0	1.1
Rubber	10.0	14.3
Others	2.4	1.7
All	100.0	100.0

Source: Survey data.

In the smallholdings with higher yield, the major crops are coconut, rice and banana. In the holdings with lower productivity, the crop combination is almost the same, but the percentage area under rice and tapioca is higher, while that of banana is negligible. The results indicate that, (i) in large holdings, area under rubber is a deciding factor in determining productivity. (ii) smallholdings with higher productivity have larger percentage of area under coconut and banana. (iii) smallholdings with lower productivity have larger percentage of area allocated to rice and tapioca. (iv) the analysis thus indicates that higher productivity is associated with certain types of crop mix. However, whether the crop mix is the sole reason for higher productivity cannot be confirmed. This requires further investigation.

V

Discussion

The purpose of analysis of the data collected in the sample survey was to examine the relationship between farm size and productivity. In the analysis, area of the holding and gross value of output per acre, were taken as the proxy variables for size and productivity respectively. As a first step, the farms were grouped into two categories, small (less than 2 acres) and big (more than 2 acres) and productivity in the two were worked out and compared. In the big farms, the average

productivity was found to be Rs. 18,700 per acre as against Rs.14,400 per acre in small farms. Statistical tests carried out over the sample estimates showed that the difference is significant. The results suggest that the larger farms have a higher productivity. However, there is a weakness in the analysis, as it may be argued that the basis of classifications as big and small is arbitrary. A different measure of classification might have given a different result. Further, the finding is contrary to the results of earlier studies, which indicated an inverse relation between farm size and productivity. A detailed examination of the data was therefore necessary.

In order to identify possible relationship between farm size and productivity by a visual examination of the data, a scatter plot of yield (productivity) against size was taken. The plot brought out two characteristics (1) there is wide variation in productivity among holdings, especially in the lower size groups and (2) it is difficult to identify any firm relationship between size of holding and productivity. Even so, a linear regression with size as independent variable and productivity as dependent variable was fitted to the observed data using the method of ordinary least squares. The estimated parameters and the related statistics did not show any significant linear relationship.

While doing the analysis, it was recognised that the sample consisted of two different categories of cultivators, namely, those who mainly depended on agriculture (farming cultivators) and others for whom agriculture was a subsidiary occupation (non-farming cultivators). The existence of some relationship between farm size and productivity in the holdings of farming cultivators seemed to be a possibility. Therefore, the same regression model was fitted to the holdings of the two categories of cultivators separately. Here again the estimates did not indicate any direct relationship between farm size and productivity.

An argument often raised in favour of inverse relationship is that small farms engage family labour in crop production and that in such farms cultivation is done more efficiently leading to higher output. To see whether the observed data support this argument, the average productivity in farms employing family labour and employing hired labour only were worked out and compared. It was found that the average productivity in farms employing family labour was slightly higher

(Rs.15,650 per acre) than that in holdings employing only hired labour (Rs.13,736 per acre). However, appropriate statistical tests showed that the difference was not significant. The analysis of survey data has not able to establish any firm relation between farm size and productivity. In the circumstances, we have to look at other factors that affect productivity.

In searching for the possible factors the following points, deserve special attention. (i) Productivity is the result of the quality of inputs administered at the right time irrespective of the size of the farm. Largely the inputs depend on the resources available for the cultivator. Substantial income from sources other than agriculture provides additional resources for farm inputs. Here it may be argued that owners of large farms have a higher access to non-farm sources of income. This argument also needed to be looked into. (ii) Secondly, the choice of crop mix directly affects productivity. How the choices of crops are made and what the motivational factors behind a particular choice are, also are important determinants. As regards the first point, the observed data showed that there is no significant correlation between farm size and non-agricultural income. This means that the choice of non-farm income is not necessarily dependent on farm size. The average farm expenditure in holdings of cultivators with non-farm income exceeding Rs. 20,000 per annum was found to be slightly higher than the farm expenditure in other holdings. However, the difference was found to be statistically not significant. It follows that availability of additional resources is not a major factor influencing productivity. (iii) Finally, the search for factors influencing productivity narrowed down to the choice of crop pattern in the holdings. Here the analysis began by looking what the crop pattern was in holdings having large productivity differences. It was found that in holdings with lower productivity, the percentage area under perennial crops especially rubber was comparatively high. Since rubber cultivation is done mainly in large holdings, the effect of this has to be separated out. Therefore, a second analysis of the same type was carried out in holdings of smaller size. It was seen that in the smallholdings with high productivity larger percentage of area is allocated to coconut and banana. On the other hand, in smallholdings with higher productivity a larger percent of area is allocated to rice and tapioca. This indicates that productivity is associated with the crop mix.

The basic assumption in the analysis was that 'the farmers act rationally and try to maximise output in the short run'. In reality, this may not be the situation. In actual practice, farmers select a range of crops both for sale and for home consumption. While selecting crops for sale, the objective may be not only higher income, but also overcoming risk. While selecting crops for home consumption, the deciding factor will be taste, nutritional value, habit and custom, etc. The selection based on these criteria need not necessarily be crops of high value output. The crop choice will also depend on ease of management, resistance to pests and diseases, sustainability of soil fertility, etc. If this line of argument is followed, the question has to be reformulated as, 'finding the relation between crop pattern and productivity'. In this case, the search has to be aimed at identifying factors influencing crop pattern.

VI

Conclusion

The search for the causal factors of productivity remains inconclusive. Farm productivity may be related not to the size of farm but to a complex of various factors including size of farm. Choice of crops, administration of inputs at the right time, management of crop-related activities, etc. could make all the difference, irrespective of the size of the farm. In the case of perennial crops once a choice is made, productivity depends only on the management of inputs; and results begin to appear after a time lag. As Pol Barbier (1984) has remarked, if correlation of productivity is to be found it should not be with the size of land only, but with different packages.

To sum up, productivity of farms does not show any clear relationship with farm size. It is possible that the productivity is related to a variety of factors like crop mix, input use, labour employed, management of crop-related activities etc. in addition to farm size. In that case, the enquiry should be aimed at identifying the key factors and establishing the relation between a composite index of such factors and farm productivity.

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