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FARM SIZE, TENURE AND PRODUCTIVITY IN AN AREA OF BANGLADESH[*]

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ABSTRACT

The study attempted to measure and compare resource use and productivity with respect to farm size and tenancy in an area of Bangladesh. It used empirical data collected through a lengthy intensive farm survey. It was observed that productivity per acre increased up to certain level (about 4.0 acres) then decreased as the farm size increased. Medium farms (2.0 - 3.99 acres) were found relatively more productive than small farms (below 2.0 acres) and large farms (4.0 acres and above). Share cropping tenancy was found to be inefficient in resource use and production, but cost-sharing tenancy had some favourable impact toward improving productivity on sharecropped land.

I. INTRODUCTION

In recent years a few field level studies have been conducted in Bangladesh to determine the influence of farm size and tenancy on resource use and productivity (Khan 1971 ; Zaman 1973 ; Jabbar 1977 ; Hossain 1977 ; Talukder 1980). The findings of these studies are contradictory leading to different policy implications. These varied results stem in part from the various procedures followed for farm classification and analysis of data.

Hossain (1977), for example, in his study in Phulpur and Thakurgaon, classified farms cultivating land upto 6.5 acres as owner I comprising small and medium farms, and those cultivating land above 6.5 acres as Owner II comprising large farms. Then he estimated the difference in land productivity between these two groups of farms and reported an inverse relationship between farm size and productivity, meaning by implication that such a negative relationship holds in all parts of the country and over all farm sizes from zero to infinity. As Hossain himself recognises that 6.5 acre dividing line bundles up all small and medium farms together, the use of such a wide size range might have blurred the influence of farm size on productivity when a comparison was made between these two groups.

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Furthermore, Hossain's inter-size group comparison may not be free from external influence of tenure status of farms. No doubt he carried out his tests on the samples of the same owner farm category, but his definition of owner farm is questionable. He included owner tenant farms with less than 25 per cent of cultivated land rented-in in his arbitrary definition of owner farms. Therefore, the results of his inter-size group comparison in relation to land productivity require to be verified with more practically defined owner farm data.

Like farm size and productivity, the tenancy-productivity issue has also long been debated in this country. The available evidence are mostly contradictory having varying policy implications. For example, Jabbar (1977) observed higher productivity on owner farms than on farms of other tenure categories, while Zaman (1973) and Talukder (1980) observed no significant difference in productive efficiency between owner farms and tenant farms. Besides, this is well established by a few authors that in a situation where part-tenancy is prominent, a direct comparison between tenure classes is an imperfect method of assessing impact of tenancy on productivity (Heady 1952 ; Jabbar 1975)[1]. They suggested a direct comparison between owned and rented land of the same owner-tenant farmers in assessing the influence of tenancy on productivity. Hossain (1977) attempted to improve his tenancy analysis by directly comparing productivity on owned land with that on rented land with the help of paired t-test. However, there are some methodological flaws in his t-tests which make the results dubious.

The present study attempts to verify the farm size-productivity relationship by measuring and comparing resource use and land productivity between small, medium and large farm size groups. In order to confirm that the tenure status of farms does not distort the results, a direct inter-size group comparison was made for only owner farms, i.e. farms cultivating only their owned land. To assess the influence of tenancy on resource use and productivity this study applied a direct test between owned land and rented land of the same owner-tenant farmers both on aggregate crops and on individual crops. This study further attempted to assess whether cost sharing practice between land owner and tenant farmers improved resource use and productivity on rented land.

Section II of this paper briefly discusses the collectin of data and the size-tenure characteristics of sample farms. A comparative analysis of resource use and productivity, with respect to farm size is presented in section III. Section IV presents findings on tenancy, resource use and productivity. Conclusions are summarized in the final section.

II. SIZE-TENURE CHARACTERISTICS OF SAMPLE FARMS

This study was carried out on the basis of information collected from 118 farm families during the period October 1976—September 1977. Sample farms were pur-

posively selected in a cluster from Shimla-Padurbari area of Mymensingh district. Farm survey technique was applied to collect data through regular visits.

In the present study farm size has been defined as the cultivated area which is composed of total acres owned minus acres rented out plus acres rented in during the year of investigation. Sample farms were classified into three size groups, i.e. small, medium and large farms. The dividing line between small and medium farm was arbitrarily set at 2.0 acres and that between medium and large farms was at 4.0 acres.[2]

Distribution of cultivated area of the sample farms was relatively more even than that of ownership holdings, because the widespread share-tenancy practice had somewhat equalizing effect. A considerably large number of farms (44 per cent) were small farms but they shared only 20 per cent of total cultivated land, while another 40 per cent were medium farms who shared 44 per cent of cultivated land. The remainder 16 per cent were large farms, who cultivated 36 per cent of total cultivated area (Table 1). The average farm size was 2.47 acres. It was further observed in this study that the small farmers were handicapped with not only absolute smallness of their farm size but also wth a higher degree of land fragmentation.[3]

TABLE 1 DISTRIBUTION OF FARM LAND OWNED AND CULTIVATED BY FARM SIZE GROUPS

Farm size groups (in acres)	No. of farms	%	% of owned land	% of cultivated land
0.01—0.99	26	22.0	5.3	6.3
1.0—1.99	26	22.0	13.3	13.2
2.0—2.99	34	28.8	24.6	28.9
3.0—3.99	13	11.1	13.8	15.4
4.0—4.99	9	7.6	10.9	13.4
5.0—7.49	7	5.9	17.0	14.5
7.5+	3	2.6	15.1	8.3
Small farm (below 2.0)	52	44.1	18.6	19.5
Medium farm (2.0—3.99)	47	39.8	38.3	44.3
Large farm (4.0+)	19	16.1	43.1	36.2
All farms	118	100.0	100.0	100.0

TABLE 2 INCIDENCE OF TENANCY FOR OWNERSHIP AND FARM SIZE GROUPS

Ownership Farm size groups (in acres)	Proportion of		Proportion of		% share of	
	Households renting out land	Owned land rented out	Households renting in land	Cultivated land rented in	Total land rented out	Total land rented in
	Per cent					
Ownership groups :						
0.0	na	na	12.5	100.0	na	8.5
0.01- 0.99	a	a	57.1	45.4	a	23.2
1.0 - 1.99	a	a	65.7	33.5	a	43 5
2.0 - 2.99	3.8	2.6	57.7	14.8	4.3	18.6
3.0 - 3.99	20.0	1.7	40.0	7.7	0.8	2.5
4.0 - 4.99	71.4	15.9	14.3	5.4	13.2	2.7
5.0 - 7.49	50.0	6.9	25.0	2.1	4.2	1.0
7.5+	100.0	40.6	a	a	77.5	a
Farm size groups :						
0.01- 0.99	3 8	11.3	50.0	29.9	4.3	9.7
1.0 - 1.99	3.8	19.3	50.0	24.0	18.3	16.3
2.0 - 2.99	2.9	2.2	67.7	22.1	3.9	32.9
3.0 - 3.99	30.8	9.5	53.8	24.3	9.3	19.2
4.0 - 4.99	22.2	4.4	66.7	26.8	3.4	18.4
5.0 - 7.49	57.1	13 1	28.6	4.6	15.9	3.5
7.5+	100.0	41.6	a	a	44.9	a
All farms	13.6	14.0	54.2	19.5	100.0	100.0
All households	10.0	14.0	40.0	19.5	100.0	100.0

It was elsewhere reported that about 64 per cent of all sample farms were involved in tenancy, about 14 per cent as rentiers and about 50 per cent as renters (Mandal 1980). It is reported in table 2 that majority of the households in large ownership groups (4.0 acres and above) were involved in tenancy as rentiers of about 95 per cent of total rented-out land, the largest group alone renting out over 40 per cent of total rented-out land. Interestingly, a small proportion of households in small ownership groups also rented out land for various reasons. Owner-tenant farmers rented in about 36 per cent of their cultivated land. The study revealed that about 20 per cent of cultivated land was operated under share-cropping tenancy, the prominent sharing arrangement being fifty-fifty output share without any cost share between the land owner and the tenant. It was also observed that the proportion of producers renting in land and the proportion of total cultivated land rented in varied between crops and crop seasons (Table 3).

TABLE 3 CROPWISE DISTRIBUTION OF PRODUCERS RENTING IN LAND AND AREA RENTED IN BY FARM SEZE GROUPS

Crops	Small		Medium		Large		All Farms	
	% of Producers	% of area	% of Producers	% of area	% of Producers	% of area	% of Producers	% of area
T. Aman	35	25	41	22	33	12	37	19
HYV Boro	36	41	39	34	25	4	36	24
Local Boro	26	20	40	32	21	16	30	23
B. Aus	26	20	32	22	26	15	29	20
Jute	22	17	18	13	11	4	18	11
T. Aus	38	38	20	10	a	a	21	16
All crops	50	25	64	23	42	11	54	19

a. none

Table 4 shows average land area owned, rented[4] and cultivated by different tenure groups identified in this study. The average land area owned per rentier-owner was about

four times higher than the corresponding averages of pure owner and owner-tenant. According to cultivated land, the rentiers had the highest aveage of 4.66 acres although they rented out 2.4 acres of owned land per farm.

III. FARM SIZE, RESOURCE USE AND PRODUCTIVITY

To measure productivity per acre values of gross products and byproducts of different crops grown by individual farms during the period October 1976 to September 1977 were added and then divided by the acres cultivated. Products and byproducts were valued at constant average prices prevailing in the local market during the few weeks of harvest season of each crop. The following per maund prices were assumed for all farms: Taka 72.0 for Transplanted Amon, Taka 80.0 for HYV and Local Boro, Taka 84.0 for Broadcast Aus and Transplanted Aus, and Taka 130.0 for Jute. Byproduct values were estimated as farmers quoted them either from guesses or from the experience of actual buying and selling of byproducts.

TABLE 4 AVERAGE FARM LAND OWNED, RENTED AND CULTIVATED PER FARM BY TENURE GROUPS

Tenure groups	No. of farms	Average in acres			
		Farm land owned	Farm land rented out	Farm land rented in	Farm land cultivated
	1	2	3	4	5=2−3+4
Owner	54	3.35	0.71	na	2.64
Rentier-owner	16	7.06	2.40	na	4.66
Pure-owner	38	1.78	na	na	1.78
Owner-tenant	58	1.60	na	0.89	2.49
Pure-tenant	6	na	na	0.81	0.81
All farms	118	2.31	0.32	0.48	2.47

na. not applicable

Inter-size group comparison shows that productivity per acre increased gradually upto 4.0 acres but decreased drastically as the size continued to increase beyond 4.0 acres (Table 5)[5]. In other words, productivity per acre differs between farm size groups, having a positive relationship with farm size over the small and medium farm size groups and a negative relationship over the large farm size group.

TABLE 5 PRODUCTIVITY PER ACRE BY FARM SIZE AND TENURE GROUPS

Farm size groups (in acres)	Owner	Owner-tenant	Pure-tenant	All farms
	———productivity (Gross output) in taka———			
0.01—0.99	1936	2345	1777	2053
1.0—1.99	2281	2129	2324	2220
2.0—2.99	2498	2314	a	2373
3.0—3.99	2763	2379	a	2556
4.0—4.99	2495	2148	a	2264
5.0+	2036	1769	a	1983
All size groups	2271	2256	1960	2248
	——productivity (Gross Output-material inputs)in taka———			
0.01—0.99	1714	2080	1478	1804
1.0—1.99	2062	1918	2125	2006
2.0—2.99	2333	2117	a	2187
3.0—3.99	2552	2185	a	2354
4.0—4.99	2245	1987	a	2073
5.0+	1811	1582	a	1765
All size groups	2061	2050	1694	2037

a. none

Table 6 presents the estimated values of productivity and resource use per acre for each farm size group along with the percentage difference and results of one tailed t-tests[6]. The table reveals that medium farms had the highest productivity per acre, more than 13 per cent higher than that of small farms and about 15 per cent higher than that of large farms. In both the cases the differences in productivity were significant at least at 1 per cent level[7].

TABLE 6 RESOURCE USE AND PRODUCTIVITY BY FARM SIZE GROUPS

Resources and productivity	Small (1)	Medium (2)	Large (3)	Percentage difference: Medium with Small (2—1)	Medium with Large (2—3)	Large with Small (3—1)
	All farms					
Weeding labour (md/acre)	18.7	24.4	23.3	30.5**	4.7	24.6
Animal power (pd/acre)	22.0	26.0	24.2	18.2***	7.4	10.0
Seeds (taka/acre)	76.3	84.0	83.4	10.1*	0.7	9.3
Manures+ferts. (taka/acre)	20.8	31.0	36.9	49.0***	-16.0	77.4***
productivity (taka/acre)	2137	2424	2116	13.4***	14.6***	-1.0
	All owner farms					
Weeding labour (md/acre)	18.0	25.8	21.6	43.3**	19.4	20.0
Animal power (pd/acre)	21.9	27.0	24.8	23.3**	8.9	13.2
Seeds (taka/acre)	74.5	88.3	85.8	18.5*	2.9	15.2
Manures+ferts. (taka/acre)	18.3	32.1	40.4	75.4***	-20.5	120.8***
Productivity (taka/acre)	2109	2591	2161	22.9***	19.9***	2.5

***, **, * indicate that t values estimated from separate variances significant at least at 1,5 and 10 per cent level respectively.

md. man-days

pd. pair-days

As indicated in the table, higher productivity of medium farms relative to small farms can be explained by significantly higher level of resource use, e.g. weeding labour, animal power, seeds, manures and fertilizers on these farms. This can also be noted that cropping intensity was significantly higher on medium farms than on others (Table 7). The possible explanation for the observed higher levels of resource use on medium farms

TABLE 7 CROPPING INTENSITIES BY FARM SIZE/TENURE GROUPS AND RESULTS OF T-TESTS

A. Cropping intensity by farm size groups

Variable	Small	Medium	Large	Percentage differences		
				Medium with Small	Medium with Large	Large with Small
	(1)	(2)	(3)	(2-1)	(2-3)	(3-1)
Cropping intensity[a]	163	180	168	+10·4*** (2·46)	+7·1** (1·50)	+3·1 (·51)

B. Cropping intensity by tenure groups

Variable	Owner	Owner-tenant	Pure-tenant	Percentage difference		
				Owner-tenant with Owner	Owner-tenant with Pure-tenant	Pure-tenant with Owner
	(1)	(2)	(3)	(2-1)	(2-3)	(3-1)
Cropping intensity	174	168	158	−3·4 (·99)	+6·3 (·72)	−9·2 (·97)

C. Cropping intensity on owned land and rented land of owner-tenant farms (paired t-test)

Variable	Owned land (1)	Rented land (2)	Difference (2-1)	%
Cropping intensity	169	152	-17	-10·1** (2·08)

Figures within parentheses are estimated t-values (one-tailed tests)
*** 't'-values significant at least at 1 per cent level.
** " " " " " 5 " " "
a Cropping intensity is definied as : total cropped area/total cultivated area x 100. It is thus different from land use intensity which is defined as : net sown area/total cultivated area plus cultivable waste area x 100. Cropping intensity for all farms was 170 per cent.

is that, unlike large farmers medium farmers cultivated relatively smaller acreages which could be managed mostly with the available fixed labour, casual labour, work animals and implements. Unlike small farmers they did not hire out much family labour so that most of the family workers could be made available for farm work during the peak seasons of farm operations (Mandal 1980).

Weeding labour was considered for test because weeding is the most important operation influencing crop yield depending on its time and intensity. It was observed in this study that medium farmers used for weeding operations 24·4 man-days of labour per acre of which about 36 per cent was supplied by family. On the other hand, large farmers used for weeding 23·3 man-days of labour per acre of which 29 per cent was supplied by family (Mandal 1979, Table 4·17). It is realized that the comparison of labour use between farm size/tenure groups could be improved if peak season labour uses instead of only weeding labour use were applied. However it was elsewhere reported that, in general, medium farms, compared to small and large farms, could make available higher amount of labour in the second and the highest peak of the year in August (Mandal 1980.)

Furthermore, medium farmers could use relatively more institutional credit for production purposes than did either small farmers or large farmers (Table 8). Thus they could also manage to put in more non-land non-labour inputs for production which they also supervised as better managers. All these factors taken together obviously resulted in higher productivity on medium sized farms.

The main reason foı significantly lower use of labour on small farms relative to medium farms was that the small farmers hired out labour in critical periods of farm operations (Mandal 1980). The small farmers had limited access to institutional credit so that they had shortages of cash to be expended on material inputs such as seeds, manuıes and fertilizers. Besides, 60 per cent of small farmers did not have any work animal so that they could not complete important farm operations on time.

Large farmers depended more on hired labour than on family labour to meet the peak season demand, compared to small farmers and medium farmers (Mandal 1980). The hiring-in of a large number of casual wórker and supervising them over the scattered plots seemed to have created serious management problems for large farmers in peak periods. Furthermore, large farmers depended for a part of their animal power requirements on hired work animals, which also could not be contracted satisfactorily in peak seasons. In addi tion, their added source of income in the form of land renting, money lending and salaried services of the members of the family might have reduced their dependence on farming. In some cases this is likely to have separated land ownership interests from effective management and supervision of farming.

TABLE 8 USE OF CREDIT FOR DIFFERENT PURPOSES BY FARM SIZE/ TENURE GROUPS

Size/Tenure groups	Proportion of credit used for				
	Production	Buying land	Consumption	Repaying debt, social obligation etc.	All credit
Farm size groups :					
Small	18.2	4.7	69.1	8.0	100.0
Medium	41.1	27.6	27.2	4.1	100.0
Large	33.5	38.6	20.1	7.8	100.0
Tenure groups :					
Owner	24.6	18.8	50.9	5.7	100.0
Rentier-owner	50.3	22.4	27.3	a	100.0
Pure-owner	13.8	17.2	60.9	8.1	100.0
Owner-tenant	34.6	26.0	34.3	5.1	100.0
Pure-tenant	3.8	8.3	87.9	a	100.0
Landless labourer	a	a	100.0	a	100.0
All farms	30.7	23.2	40 8	5.3	100.0
All tenures	30.1	22.8	42.0	5.1	100.0

a. none

One may wonder at this point whether the estimated productivity with respect to farm size was entirely without the hazards of tenure effect as all farms were lumped together

irrespective of their tenure status and then sub-classified according to the chosen size ranges. An attempt was made in this study to control tenure effect by considering only owner farms classified into three size groups (Table 6). The results confirmed the earlier conclusion that medium farms had the best performance in respect of resource use and productivity.

The above observation on farm size and productivity relationship goes against the popular dictum of the protagonists of inverse relationship that productivity per acre in Bangladesh decreases as the farm size increases and that, by implication, such a negtive relationship holds in all regions and over all farm sizes from zero to infinity (Hossain 1977). Indeed, it can be argued on the basis of findings of this study that a certain relationship (either positive or negative) may operate in certain regions over certain farm size groups, but the same relationship may not hold true in other regions and over all farm size groups because resource endowments and cropping patterns do very between regions. What is more surprising is that Hossain himself seems to have contradicted his earlier (1974) findings (where he used the same data from Phulpur, Mymsensingh) that the lowest size group (below 2.5 acres) had lower productivity per acre than that of the next upper size group, 2.5-4.99 acres (Hossain 1974). This can be argued from the experience of the present study that a further disaggregation of Hossain's lowest size group would have shown a lower productivity for the very small farm size groups, implying a positive relationship between these two variables up to certain farm size limit. All one can say from this study is that productivity per acre increases up to certian level (about 4.0 acres) and then decreases as the farm size increases. It indicates that both small farms (below 2.0 acres) and large farms (above 4.0 acres) were less productive than medium farms.

IV. TENANCY, RESOURCE USE AND PRODUCTIVITY

One satisfactory way to determine the influence of tenancy on resource use and production is to compare the level of inputs and output on owned land directly with the level of inputs and output on rented land cultivated by the same owner-tenant farmers. It can be emphasised here that such pairing of variables for each owner-tenant farm will control the effect of extrinsic factors such as managerial skill and resource availability of farms, although farm size effect cannot be removed altogether.

In the present study paired t-test was done both on (i) aggregate inputs and output on owned and rented land for the whole year ; and also on (ii) a crop by crop basis. First, aggregate resource use and productivity were compared between owned and rented land. The relevant estimates with the results of paired t-test are presented in Table 9. The table shows that owner-tenant farmers produced about 17 per cent lower output on rented land than on their owned land and the difference was significant at least at 1 per

cent level. Thus the hypothesis of equality of means between owned and rented land with respect to productivity is rejected. The reason for this difference in productivity was that owner-tenant farmers used systematically less of all the inputs on rented land than on owned land, while differences in all the input levels were statistically significant at 1 and 10 per cent level, except for weeding labour. It was also observed that cropping intensity on rented land was 10 per cent lower than on owned land (Table 7). Hotelling's T^2-test showed that the vector of differences in means of input and output between owned and rented land was significantly different at least at 5 per cent level ($T^2=15.24$, $F=2.83$ with 5 and 53 degrees of freedom). Thus it further confirmed that owner-tenant farmers used less input on rented land than on their owned land and achieved lower level of output.

It has been shown that tenure status of farms remaining the same, variation in tenure status of lands they cultivated caused variations in resource use and productivity. One may wonder what happens with resurce use and productivity if tenure status of farms vary but tenure status of land they cultivate remain unchanged. In other words, this is important to know whether there is any significant difference in resource use and productivity between land of owner farms and owned land of owner-tenant farms. A one-tailed t-test was done for this purpose and the results are presented in Table 9. The table reveals that the performance of owner-tenant farmers on their owned land with respect to resource use and productivity was not significantly different from the performance of owner farms on their land except for manures and fertilizers. This important result indicates that unlike on rented land owner-tenant farmers may not be less productive on their owned land. The implication of this is that in a situation like Bangladesh where part tenancy is dominant, it is not necessarily tenure status of farms **per se** but tenure status of land they cultivate which influence productive efficiency.

It was further examined on a crop by crop basis whether owner-tenant farmers discriminated against rented land with respect to input use and had a lower level of yields. The mean levels of inputs and yields for five individual crops and the results of paired t-test are presented in Table 10. Main features of the table are as follows : (i) for all the crops owner-tenant farmers had lower yields on rented land than on their owned land, the difference ranging from 11 per cent for Local Boro to 35 per cent for Broadcast Aus. In 3 out of 5 crops including Transplanted Amon, which covered about a half of total cropped area, the observed differences in yield levels were significant at 1 and 5 per cent levels; (ii) as regards input use, in 12 out of 15 cases there was less input use on rented land than on owned land, the observed difference being statistically significant. The absence of any statistically significant difference in input and yield levels mostly for Local Boro and Jute was perhaps due to a very small number of samples in each case.

The evidence presented above both on aggregate and crop by crop basis leads one to conclude that on owner-tenant farms there is a systematic bias against rented land with

TABLE 9 RESOURCE USE AND PRODUCTIVITY ON OWNER FARMS AND ON OWNED LAND AND RENTED LAND CULTIVATED BY THE SAME OWNER-TENANT FARMS

Resources and productivity	Owner N=54	Owner-tenant N=58		Percentage difference	
		Owned land	Rented land	Owned land (OT) with Owned land (Owners)	Rented land (OT) with Owned land (OT)
	(1)	(2)	(3)	(2-1)	(3-2)
Weeding labour (md/acre)	21.2	24·5	22·6	15·6 (1·20)	-7·8 (·52)
Animal power (pd/acre)	24·1	25·9	20·8	7·5 (1·15)	-19·7*** (3·04)
Seeds (taka/acre)	81·2	85·5	69·8	5·3 (·83)	-18·4*** (2·91)
Manures and Fertilizers (taka/acre)	27·2	33·5	25·5	23·2 (1·48)	-23·9* (1·57)
Productivity (taka/acre)	2271	2369	1973	4·3 (·84)	-16·7*** (2·66)

OT Owner-tenant

Figures within parentheses are estimated 't' values

*** 't' values significant at least at 1 per cent level

* „ „ „ „ at 10 „ „

TABLE 10 RESOURCE USE AND YIELD OF DIFFERENT CROPS GROWN ON OWNED LAND AND RENTED LAND CULTIVATED BY THE SAME OWNER-TENANT FARMERS

Resources and yield	Owned land (1)	Rented land (2)	Difference (2-1)	%
		T. Amon (N=33)		
Labour[a] (md/acre)	29.8	30.5	+0.7	+2.3 (.53)
Animal power (pd/acre)	15.9	9.7	−6.2	−39.0*** (6.71)
Material inputs (taka/acre)	25.0	20.0	−5.0	−20.0** (8.80*)
Yield (maund/acre)	18.7	15.2	−3.5	−18.7*** (5.75)
		HYV Boro (N=11)		
Weeding labour (md/acre)	20.3	12.2	−8.1	−39.9** (2.18)
Animal power (pd/acre)	19.0	17.3	−1.7	−8.9 (.57)
Material inputs (taka/acre)	204.7	116.0	−88.7	−43.3* (1.38)
Yield (Maund/acre)	27.0	21.3	−5.7	−21.1** (2.08)

(continued)

Table 10 (Continued)

Resources and Yield	Owned Land (1)	Rented land (2)	Difference (2-1)	%
		Local Boro (N=9)		
Labour (Md/acre)	45.5	37.6	—7.9	—17.4 (.84)
Animal power (Pd/acre)	15.5	14.2	—1.3	—8.4 (.29)
Material inputs (taka/acre)	124.0	88.6	—35.4	—28.5* (1.74)
Yield (Maund/acre)	25.2	22.4	—2.8	—11.1 (.76)
		B. Aus (N=18)		
Weeding labour (Md/acre)	25.8	20.9	—4.9	—19.0* (1.30)
Animal power (Pd/acre)	16.0	17.1	+1.1	+6.9 (.68)
Material imputs (taka/acre)	123.1	89.5	—33.6	—27.3*** (2.63)
Yield Maund/acre)	13.3	8.6	—4.7	—35.3*** (3.39)
		Jute (N=6)		
Weeding labour (Md/acre)	86.4	77.4	—9.0	—10.4 (.40)
Animal power (Pd/acre)	14.6	16.0	+1.4	+9.6 (.57)
Material inputs (taka/acre)	96.3	54.4	—41.9	—43.5*** (4.23)
Yield (Maund/acre)	6.9	4.7	—2.2	—31.9 (.91)

a. Since very little labour was used for weeding T. Amon and Local Boro, labour used for ploughing, land preparation, weeding and transplanting was considered for test in these two crops.

Figures within parentheses are estimated 't' values (Paired to-test)

***'t' values significant at least at 1 per cent level

** " " " " 5 " " "

* 't' values signicant at least at 10 per cent level

respect to resource use, which ultimately results in significantly lower production on such land. This, howevr, supports the 'Marshallian' view that sharecropping as an institution causes serious inefficiency in agricultural production.

Cost-Sharing Tenancy

The most commonly cited reason for the alleged inefficiency of tenancy is the traditional rental arrangement of 50-50 output share without any share of input. Assuming profit maximising behaviour on the part of both the sharing parties (land owner and share cropper) a sharecropper will tend to use less variable input as he will always try to equalize his half marginal value product (MVP) with marginal factor cost (MFC). This argument then generates a testable hypothesis that a proportionate sharing of cost by landowners will encourage share croppers to put in more inputs than normal on rented land and improve production.

In the present sample 32 owner-tenants (55 per cent) and 5 pure tenants (83 per cent) received a part of input cost from their land owners in terms of seeds, fertilizers and irriga tion (Table 11). The remaining owner-tenants and pure-tenants received no input cost from their land owners but gave away usual fifty per cent of gross output as rent. The mean levels of resource use and productivity on owned and rented land of the owner-tenants with and without cost sharing and the estimated t-values are presented in Table 12. The differences between productivity of owned and rented land of owner-tenant farms with cost-sharing and the differences between productivity of owned and rented land of owner-tenant farms without cost-sharing are compared.

It can be observed from the table that resource use and productivity on rented land were significantly lower than on owned land of owner-tenant farms without input cost sharing. The finding is quite consistent with the theory of share-tenancy. In case of owner-tenant farms with input cost-sharing with their land owners, there was no significant difference in productivity between owned and rented land. It was estimated that

TABLE 11 RENTAL ARRANGEMENTS FOR OWNER-TENANT AND PURE-TENANT FARMS

Type of cost and output sharing	Owner-tenant		Pure-tenant	
	Number	Percentage	Number	Percentage
(1) 50-50 output share without cost share	26	44.8	1	16.7
(2) 50-50 output share with some cost share	32	55.2	5	83.3
i. 50-50 output share with 50-50 seed cost	8	13.8	1	16.7
ii. 50-50 output share with 50-50 fertilizer cost	1	1.7	a	a
iii. 50-50 output share with 50-50 irrigation cost	a	a	a	a
iv. 50-50 output share with 50-50 seed and fertilizer cost	8	13.8	1	16.7
v. 50-50 output share with 50-50 seed and irrigation cost	5	9.6	2	33.33
vi. 50-50 output share with 50-50 fertilizer and irrigation cost	4	6.9	a	a
vii. 50-50 output share with 50-50 seed, fertilizer & irrigation cost	6	10.3	1	16.7

a. none

TABLE 12 RESOURCE USE AND LAND PRODUCTIVITY ON OWNED LAND AND RENTED LAND CULTIVATED BY OWNER-TENANT FARMS WITH AND WITHOUT COST-SHARE

Resources and land productivity	Owner-tenant farms with cost-share N=32		Owner-tenant farms without cost-share N=26		Percentage difference	Percentage difference
	Owned land (1)	Rented land (2)	Owned land (3)	Rented land (4)	(2-1)	(4-3)
Weeding labour (md/acre)	20·3	16·7	29·8	29·8	-17·7 (1·26)	0·0
Animal power (pd/acre)	24·9	20·8	27·1	20·8	-16·5 (1·77)	23·2*** (2·60)
Seeds (taka/acre)	83·9	71·1	87·5	68·3	-15·3 (1·85)	-21·9** (2·24)
Manures + Fertilizers (taka/acre)	30·8	30·1	36·8	19·9	-2·3 (·09)	-45·9*** (3·15)
Productivity (taka/acre)	2309	2195	2443	1700	-4·9 (·51)	-30·4*** (4·39)

Figures within parentheses are estimated 't' values (paired t-tests)

*** 't' values significant at least at 1 per cent level

** " " " " " 5 " " "

these cost-sharing owner-tenant farms received only 13 per cent of total variable cost from their land owners to give away 50 per cent of gross output as rent (Table 13).

In the event that less than proportionate cost-sharing (not proportionate cost-sharing) was practised between land owner and owner-tenants, the absence of any significant difference between productivity of owned and rented land appears to be inconsistent with the theory. One possible explanation for such result may be that as the land owner shares a part of variable costs with his tenant, he (land owner) is likely to take active interest and supervise production in order to make sure that the tenant also puts in his share of family supplied inputs on rented land adequately and in time. One of the shortcomings of this study is that the detailed information on the sharing of individual inputs,owner-tenants' sources of inputs (family supplied or bought/hired), and timing of input application are not available so that the observed result can be adequately explained.

However, since the productivity of rented land of cost-sharing owner-tenant farms was significantly lower than the productivity of their owned land, the absence of any significant difference between productivity of owned and rented land of owner-tenants without cost-sharing implies that cost-sharing (even though less than proportionate) is likely to improve productivity of sharecropped land. It is therefore suggested that further investigations are needed to confirm whether or not less than proportionate cost-sharing will remove difference between productivity of owned and rented land of owner-tenant farms.

TABLE 13 PROPORTION OF OWNER-TENANT FARMS SHARING COST WITH LAND OWNERS AND PROPORTION OF VARIABLE COST SHARED FOR DIFFRENT CROPS

Crops	Cost-sharing farms		Average amount shared per farm (Taka)	Average variable cost per farm (Taka)	Proportion of variable cost shared %
	Number	Per cent			
T. Amon	16	27.6	8.4	173.2	4.8
HYV Boro	17	29.3	65.8	313.9	21.0
Local Boro	13	22.4	58.7	346.1	17.0
B. Aus	11	19.0	26.1	159.0	16.4
Jute	5	8.6	11.1	225.0	4.9
T. Aus	1	1.7	8.0	76.0	10.5
All crops	32	55.2	74.0	560.0	13.2

V. CONCLUSIONS

The findings of this study do not suggest that there is a unique inverse relationship between farm size and productivity per acre so that such relationship holds true in all regions and over all farm size groups from zero to infinity. It was observed that productivity per acre increased upto crertain farm size limit (about 4.0 acres) and then decreased as the farm size increased. Inter size group comparison revealed that the medium sized farms were relatively more productive than small and large farms.

Sharecropping tenancy was found inefficient as the level of inputs and output on owner-tenants' rented land was significantly lower than on owned land. It was observed that a considerable number of owner-tenants and pure-tenants had less than proportionate cost-sharing with their land owners in terms of new and improved inputs. It was observed that cost-sharing improved productivity on sharecropped land.

The implications of these findings are that agricultural production in this country can be considerably improved by reallocation of farm resources through a series of interrelated reform measures.

Notes :

1. A straight comparison between tenure classes is difficuit because extraneous variables such as farm size, resource position and managerial skills of individual farms in each tenure group will of course influence the results. Besides, a direct comparison between owner farms and owner-tenant farms, for example, is further difficult because the level of tenancy will vary among these two groups of farms (e.g. zero for owner farms and any positive value betwee zero and hundred for owner-tenant farms).
2. The dividing line between small and medium farms was used following the meticulous mathematical calculation of Bertocci (1970) who set 2.0 acres as subsistence level of farms in two Comilla villages growing annually two rice crops like in our case. The dividing line between medium and large farms was somewhat impressionistically devised.
3. A detailed description of how land fragmentation causes serious problem for Bangladesh agriculture is given in Chapter III of author's Ph.D. thesis (Mandal 1979).
4. In this study rented land means land rented on sharecropping basis.
5. This relationship was further confirmed by fitting simple scattered diagrams showing two-way relationship between cultivated acres (farm size) on the one hand and land productivity on the other. See (Mandal 1979). pp. 205-209).
6. It may be questionable to apply statistical tests where non-random samples are used. This is because the results of such tests cannot then be generalized for the population. However, as long as the non-random samples are considered as 'population' the use of statistical tests can be legitimised for the study area, but of course the implications and limitation of the results for the regional or national population should be borne in mind.

7. Hossain (1977) applied t-test in comparing land productivity between small and large farm size groups. However, the whole series of t-test done by him appeared to be dubious as he ignored the assumption of equal variance of the variables in the two sample tests. He found in most cases of his analysis this assumption of equal variance to be 'inapproriate' (but he did not explain why inappropiriate), yet "t-values have been estimated from pooled variances, rather than from separate variances as under Fisher's test" (Hossain 1977, p. 314). Such an improper estimation of t-values might have distorted his results and obscured understanding on the farm size, tenancy and productivity issue.

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