

# Farm Size and Land Productivity Relationship in Nepal

(A case study of Nawal Parasi district)

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## 1. INTRODUCTION

There are some studies directly focussed on the efficiency and productivity differences of farms in economic literature. The differences in productivity by farm size have also been observed in many underdeveloped countries as well. While some economists have pointed out positive relationship, most of the Indian economist present an exciting inverse relationship by providing a varying extent of explanations with the publication of farm management study conducted by the Ministry of Food and Agriculture in certain typical region of India during mid fifties.<sup>1</sup>

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1. See A.K. Sen, 'Size of Holding and productivity,' The Economic Weekly, Annual number, Feb, 1964; Also see A.K. Sen, "An Aspect of Indian Agriculture," The Economic Weekly, Annual number, Feb., 1962; Deepak Mazumdar, "Size of Farm and Productivity; A Problem of Indian Peasant Agriculture," Economica, Vol. XXXII, 1965 and also "On The Economics of Relative Efficiency of Small Farmers", The Economic Weekly, Annual number Feb., 1964; A. M. Khusro, "Returns to scale in Indian Agriculture," The Indian Journal of Agricultural Economics, Oct.-Dec., 1964; Mahabub Hussain, "Farm Size and Tenancy and Land Productivity: An Analysis of Farm Level Data in Bangladesh Agriculture" The Bangladesh Development Series, Vol. V, 1977; C. H. Rao, Hanumantha, "Alternative Explanations of the inverse relationship between Farm Size and output Per Acre in India," Indian Economic Review, Vol. I, 1966; Also see 'Farm Size and Economics of Scale,' Economic Weekly, 14 Dec., 1963; Ashok Rudra, "Farm Size and Land Per Acre," Economic and Political Weekly, special number, July, 1968. Implicit in all these Research Articles is the recognition of the measurement of Productivity especially with the input land and All these stand for inverse Relationship. But for the existence of positive relationship see Mahamood Hasan, Khan, Farm Size and Land Productivity Relationship in Pakistan" The Pakistan Development Review, Vol. XVIII, Spring 1979

The most commonly stated proposition at hand is that there is an existence of inverse relationship between these two variables in underdeveloped countries. Numerous attempts have been made in this line to explain the apparently higher land productivity on small scale farms by positing the hypothesis that the farms make greater use of traditional variable inputs per hectare in underdeveloped countries.

Countries differ not only in their factor endowments but also in geographical, economic, social and other conditions. There fore it seems reasonable to any underdeveloped country to accept the inverse proposition in its own context as an universal fact which, thus, accentuate us to examine such a relationship in our context also.

For a country like Nepal staggering in the path of economic development through the planning polices and programmes in the context of inadequate data and information in the agricultural setor, a suitable empirical research work certainly useful.

The importance of the present study lies in whether smaller farms have higher productivity than bigger farms or not. It is of particular interest in deciding on issues like land ceiling, land distribution, co-operatives and other forms of land reorganization.

An attempt has been made in this paper to study the relationship between farm size and land productivity in three panchayat of Nawal Parasi district, of Western Nepal. In order to analyze the relationship of land productivity and farm size, the following hypotheses have been formulated;

- (a) There is positive relationship between farm size and land productivity.
- (b) Large farms have higher productivity than small farms because of the existence of positive relationship between farm size and its productivity.

## 2. DATA COLLECTION

Data for this study have been obtained mainly from primary source regression exercises are performed. while designing the research main concentration has been on the collection of the input, farm and output data of different size farm households.

At first the district Nawal parasi has been chosen propusively. Among its Fourty-nine panchayats only three panchayats viz. Amarban, palhee and Benimanipur are selected in a way that they represent the district more properly and facilitate for comparison among the

panchayats, In second stage sample, two-hundred farm house holds were selected to represent all sorts of farm households that were residing in these panchayats. Thus, although the random sampling technique was employed for the household sampling, all the farm households were not selected on that basis but some of them with some judgement so that even the least percentage of sampling can represent the Whole population property i.e., both the random sampling and judgemental random sampling techniques have been used.

Initially, a more than 8% sample of total population has been obtained from each Panchayat separately. Accordingly 75,60 and 65 samples of farm households are awarded to Amarban, Palhee and Benimanipur panchayats respectively. But the intended number of sampling regarding the collection of disaggregated farm level data has not been fulfilled in Amarban and Benimanipur panchayat.

With the help of an interview format data were collected from sampled farm households by direct personal interview method. To observe the relationship only input the land size which each of household has possessed were collected in bigha whereas for the output, five main crops viz. paddy, maize, wheat, and oilseeds were initially collected in physical units like muri, pathi and maund for the year 1978/79. After this all these physical productivities were transformed into monetary unit by the using local market price.

The total number of sample farms of three panchayats Amarban, Palhee and Benimanipur are 58,70 and 49 respectively. All the collected data of these sample farms of each panchayat initially, were arranged in ascending order according to farm size. The farms were, then, divided into four strata in such a way that the number of farms in each stratum can allow the estimation of production function for each strata. These four strata formed class intervals or size groups that are as follows;

Farm groups	Size
I	0.1 - 1.5 Bigha
II	1.51 - 4 "
III	4.1 - 8 "
IV	8.1 and above

Such a classification is performed for each panchayat separately and also for all the three panchayats in aggregate. To test the second hypothesis they were also classified into small and large farm size groups only by amalgamating the initial two in small and the other two into

the large farm size group. Of course, there is virtually no any specific and standered base to classify the farm size in the above manner. However, the classification is based on the economic feature, working capital, nature and composition of farm household in the concerned panchayat.

### 3. ANALYSIS OF DATA AND INFORMATION

To depict the relationship between the independent variable, the farm size, and dependent variable, the total output, a Cobb-Douglas function was used in the analysis. By expressing the variabls in log (natural) form, we introduce the linearity in the function and are thus, equipped to estimate by OLS method. To test the first and second Hypotheses, the following equations where estimated respectively.

#### HYPOTHESIS I

$$\ln Y_i = \ln B_1 + B_2 \ln N_i + U_i \text{ ----- (1)}$$

$$B_2 > 1$$

#### HYPOTHESIS II

$$\ln Y_i = \ln B_1 + B_2 \ln N_i + U_i \text{ ----- (2)}$$

$$\ln Y_i = \ln B_1 + B_2 \ln N_i + B_3 D_i + U_i \text{ ----- (3)}$$

$$B_2 > 1 \text{ and } B_3 > 0$$

Where,

Y = Gross value of output ( of five crops ) in Rs.

N = size of holding or farm size in Bigha

$$D = \begin{cases} 1 & \text{if large farm size} \\ 0 & \text{small farm size} \end{cases}$$

The relationship between farm size and output per bigha has been measured by fitting the above function in its log linear form where we have option to take Y either as output per bigha or as total output of the farm. If y is output per bigha the regression coefficient  $B_2$  should have a positive sign and if y is total output  $B_2$  should be positive and grater than unity to exhibit the positive relationship between farm size and land productivity. Therefore, in the employed regression since output is assumed in total term the expected sign for  $B_2$  is greater than unity.

In all of the above equations, the parameter  $B_i$ 's produce elasticity of output with respect to input farm size which indicate the percentage change in output with respect to a 1%

change in the farm size. The coefficient of dummy variable 'D' has the analogous interpretation. It is approximately the percentage increase in output that would result if the dummy variable has the value 1 rather than zero. As our second hypothesis has referred that large farm size has higher productivity than small farm size, we have computed a regression by amalgamating all the 177 farms into one including a dummy or indicator variable as an additional explanatory variable that is specified as 1 for large farm size and zero for otherwise.

The inclusion of  $u_i$  as error or disturbance term in each of the regression equation implies that all models are stochastic models that assume inexact relationship between total output and farm size input. The random term  $u_i$  has a well defined probabilistic propriety that allows us to use the model for statistical inference or hypothesis testing.

However, all the models used in the present study are subject to traditional assumptions of classical linear regression, and thus, are estimated by applying OLS method. The subscript 'i' attached to each variable in all of the equations denote cross-sectional data for different farm households. t-test and F-test were carried out for determining the significance of the coefficient of farm input and of the regression equation respectively. The test has been performed up to 10% significance level (confidence level). As our hypothesis suggests, t-test is used to test the significance of the coefficient, and since the dependent variable  $y$  is expressed in total output form, the test has been performed by assuming a null hypothesis equal to one against an alternative hypothesis greater than one. Analogously the t-value has been computed by taking the deviation from unity. F-test has been performed by assuming the null hypothesis equal to zero against an alternative hypothesis greater than zero.

#### 4. MAJOR EMPIRICAL FINDINGS

##### a) Farm Size and Land Productivity Relationship

The first hypothesis, viz., there is positive relation between farm size and land productivity has been tested by the equation number one for the four size groups of farm for each panchayat separately. The estimated parameter and relevant statistics are shown in the following table. 1

Table 1

## Farm Size and Productivity Relationship in Case Study areas

Panchayats	Farm Size	T	Constant In $B_1$	$B_2$	t-value of deviation of $B_2$ from unity	$R^2$	$R^{-2}$	F-value
Amarban	0.1-1.5	18	7.7526	1.2132 (.1511)	1.4114***	.80	.79	64.51
"	1.51-4	15	7.6295	1.0404 (.2493)	.1622	.57	.54	17.43
"	4.1-8	12	7.6499	1.0313 (.3252)	.0962	.50	.45	10.05
"	8.1-	13	7.6918	1.0607 (.1684)	.3607	.78	.76	39.70
Palhee	0.1-15	25	7.6182	.5006 (.1179)	-4.2368°	.44	.42	18.04
"	1.51-4	22	8.4472	.2646 (.3223)	-2.2825*	.03	-	.67
"	4.1-8	16	6.9089	1.4348 (.2489)	1.7471***	.70	.68	33.24
"	8.1-	7	7.4365	1.1395 (.2080)	.6709	.86	.83	30.02
Benima-nipur	0.1-1.5	10	8.0845	1.6752 (.1352)	5.0322°	.95	.95	155.88
"	1.51-4	12	8.6280	.4742 (.5534)	-.9501	.07	-	.73
"	4.1-8	16	8.8133	.6124 (.2918)	-1.3284	.24	.19	4.41
"	8.1	11	9.1030	.5933 (.2154)	-1.8887**	.46	.40	7.59

Note: Figure in parentheses are standard errors.

\* Significant at 2.5% probability level.

\*\* Significant at 5% probability level.

\*\*\* Significant at 10% probability level.

° Significant at 0.5% probability level and below this level.

(One tail t-test is used)

In the table we observe that in seven out of twelve cases, the  $B_2$ 's coefficient are greater than unity which imply that production per bigha increases with the increase in farmsize. In other words, with the increase in farm size by 1%, output can be increased by more than 1%. For this phenomenon to be valid statistically, it is necessary that the  $B_2$  coefficient should be significant. On testing the significance of deviation of the coefficients from the unity, we found that only one of the coefficients that is for Benimanipur first farm size group is significant greter than unity even at less than 0.5% level of significance, and the other two coefficients are significant at some higher level of significance. on the other hand, the remaining five coefficients are less than unity of which one is significant at less than 0.5% significance level and other two significant at 2.5 and 5% significance level.

But there are three equations out of twelve that have least  $R^2$  and the F-test suggest that the overall explanatory power of those equation are not significantly different from zero at 5% probability level which reflects the role of other excluded inputs. Thus, if we exclude them from the table, we have now only two statistically significant coefficients that are supporting negative relationship between farm size and land productivity.

In such a situation, it is hazardous to assert either of the relationships between farm size and land productivity since none of the proposition stand in strong position. However, it may be said that there is much more possibility of positive relationship than negative relationship in the study area.

Now let us examine the relationship for each panchayat separately with the help of the same table. It seems that for Amarban panchayat, the coefficients of all the farm size groups is greater than unity indicating that as farm size increases output per bigha increases more than proportionately. With a closer observations, it is apparent that the coefficient is lessening for the successive large farm size groups, except one of the largest farm size group, that indicate that for the successive large farm size the increase in size of holding adds less to total output in comparison to its preceding small farm size groups which contradicts with the proposition that larger farms have higher productivity than smaller farms. But only one of the four coefficients is statistically different from unity. we have also computed the regression for Amarban panchayat as a whole to observe the relationship by combining all of the four group into one which is-

$$\ln Y_i = \ln 7.6940 + 1.0395 \ln N_i \quad (\text{AMARBAN})$$

$$N = 58 \quad (1.3178) \quad R^2$$

$$F = 1202.658 \quad R^{-2}$$

The t-value in parenthesis shows that the coefficient for farm size is significantly greater than unity at 10% significance level which implies the positive relation in Amaran panchayat.

The case is different for palhee gaon panchayat. Among the four coefficients of four farmsize groups, three coefficients are less than unity while only one that is for 3rd farm size group is greater than unity and also significant at 10% probability level. Of the three less than unity coefficients, only one is significantly less than unity and the next one, though significant, has been excluded since the over all explanatory power of its corresponding equation is not significantly different from zero as suggested by F-test. The single equation estimation irrespective of the farm size classification for palhee panchayat as a whole shows the negative relationship between farm size and land productivity.

$$\ln Y_i = \ln 7.7442 + .9735 \ln N_i \quad (\text{Palhee})$$

$$N = 70 \quad (-.8749) \quad R^2 = .938$$

$$F = 1029.31 \quad R^{-2} = .938$$

(t - value in parenthesis)

But is evident that the less than unity coefficient of farm size is not statistically less than unity and therefore we can not say that the inverse relationship is existing in palhee panchayat.

The Benimanipur panchayat can be ascribed to have a positive relationship. the coefficient for the smallest farm size group is greater than unity and is the largest among the four coefficients which is significant too. The overall explanatory power of the medium two farm size groups is not significant statistically and, thus, they are excluded. And the remaining one coefficient for largest farm size group is not significantly less than unity implying the inverse relation. To know the relationship for Benimanipur panchayat irrespective of farm size, a single equation for all 49 sample farms has been estimated that shows existence of positive relation since the deviation of coefficient from unity is significant at 2.5% level.

#### Benimanipur:

$$\ln Y_i = \ln 7.9045 + 1.1161 \ln N_i \quad R^2 = .906$$

$$N = 49 \quad (2.2072) \quad R^{-2} = .904 \quad F = 451.04$$



The preceding analysis related to farm size and productivity for three panchayats separately has envisaged that positive relationship is operating in two panchayat where as palhee panchayat inherits the relationship though not statistically valid. By computing a regression for all 177 sample farms of the three panchayats, we sum up that as farm size increases land productivity increases. This increasing phenomenon is statistically valid too, Which is exhibited in the following equation -

$$\text{Ln } Y_i = \text{Ln } 7.7631 + 1.0518 \text{ Ln } N_i$$

$$N = 177 \quad (2.2047) \quad R^2 = .92$$

$$F = 2006.55 \quad R^2 = .92$$

( t-value in parenthesis )

#### b) Productivity Variations

For the purpose of examining the second hypothesis relating with larger farms having higher productivity than small farms, four regression equations have been computed for four size groups aggregating the respective groups of three panchayat into one. The computed regressions are:

##### GROUP I (0.1 - 1.5)

$$\text{Ln } Y_i = \text{Ln } 7.832 + 1.2490^* \text{ Ln } N_i$$

$$N = 53 \quad (2.9662) \quad R^2 = .81$$

$$F = 221.36 \quad R^{-2} = .81$$

##### GROUP II (1.51 - 4)

$$\text{Ln } Y_i = \text{Ln } 8.0933 + .6909^{**} \text{ Ln } N_i$$

$$N = 49 \quad (-1.3807) \quad R^2 = .17$$

$$F = 9.53 \quad R^{-2} = .15$$

##### GROUP III (4.1 - 8)

$$\text{Ln } Y_i = \text{Ln } 8.4868 + .6406^{**} \text{ Ln } N_i$$

$$N = 44 \quad (-1.3738) \quad R^2 = .13$$

$$F = 5.99 \quad R^{-2} = .10$$

Figures in parentheses are t-values.

\* Significant at 0.5% significance level.

\*\* Significant at 10% significance level.

## GROUP IV (8.1 - above)

$$\ln Y_i = \ln 8.2810 + .8502 \ln N_i$$

$$N = 31 \quad (-1.0807) \quad R^2 = .60$$

$$F = 42.79 \quad R^{-2} = .58$$

Among the four coefficients for four farm size groups, three coefficients are significant at 10% probability level. A closer observation on these regression coefficients indicates that the first farm size group has higher productivity than its succeeding other large farm size groups. Thus, it indicates that small farm size has high productivity than large farm size. But the coefficient for largest farm size group is less than that of its preceding farm size groups and also not significantly less than one. Therefore, it seems that there is not any systematic pattern of relation among the farm size groups between farm size and productivity.

To avoid vagueness, however, we now divide farms only into two groups by assembling the former two groups into one referring as small farm size groups and the latter two as large farms. The estimated equations of the each two sizes are:

## Small farm size (0.1 - 4)

$$\ln Y_i = \ln 7.7585 + 1.030 \ln N_i$$

$$N = 102 \quad (.8088) \quad R^2 = .823$$

$$F = 463.46 \quad R^{-2} = .821$$

## Large farm size (4.1 - 8)

$$\ln Y_i = \ln 7.8912 + .9968 \ln N_i$$

$$N = 75 \quad (-.0498) \quad R^2 = .766$$

$$F = 238.61 \quad R^{-2} = .763$$

(t-value in parentheses)

It is obvious that the small farm size group has a coefficient greater than the coefficient a large farm size group which implies that higher productivity accrues on small farms. A comparison of the t-value computed by taking the deviation of coefficient from unity with its corresponding table t-value suggest that both of the coefficients are not significantly different from unity. Thus, the result seems inconclusive. Besides we have also computed a regression by combining all the sample farms into one including a dummy variable which is -

$$\ln Y_i = \ln 7.77624 + 1.0295 N_i + .0606 D_i$$

$$N = 17.7 \quad (.7789) \quad (.7509)$$

$$F = 1001.06 \quad R^2 = .920$$

$$R^{-2} = .919$$

And its corresponding regression without having the dummy variable is -

$$\ln Y_i = \ln 7.7631 + 1.0518 \ln N_i$$

$$N = 177 \quad (2.2047) \quad R^2 = .92$$

$$F = 2006.55 \quad R^{-2} = .919$$

( t-value in parentheses )

By comparing the two regression, we observe that when we include the dummy variable the coefficient for land decreases significantly and result in the coefficient not significantly different from unity. Thus, increasing returns to scale with the farm size has been turned to constant returns to scale by the inclusion of dummy. Also the overall explanatory power of the equation has not been improved. Rather F- value decreased significantly implying less confidence level of overall explanatory power of the equation. Further, the coefficient for dummy variable is not significantly different from zero that implies large farm size has zero effect on output. Thus, a comparison between all relevant statistics of these two equations do not validate to the hypothesis that the large farm size has higher productivity than small farms.

To be specific about this hypothesis, we have also computed incremental F-value that can be used here for testing the improvement of fit obtained from the inclusion of additional variable as an explanatory variable.

The computed incremental F-value is -

$$F = .5638$$

$$V_1 = 1., V_2 = 174$$

The value is less than its corresponding critical F-value which points out that the inclusion of dummy variable has not improved the explanatory power of the equation. In other words, the large farm size can not explain the more variation in output. Thus, the second hypothesis is invalidated.

The invalidation of second hypothesis contradicts, to some extent, with the validity of the first hypothesis. But the hardly validity of the first hypothesis can also be traced to the invalidation of second hypothesis. However, it can be said that there is existence of positive relationship between farm size and productivity, though the strong relationship does not hold.

## 6. CONCLUSIONS AND RECOMMENDATIONS

The conclusions that emerge from the present study can be expressed in the following point:

- a. There is positive but a weak relation between farm size and land productivity in the agriculture of Nawal parasi district which may be attributed to the Fact that the large Farm are superior-quality Farms.
- b. The positive relationship between Farm size and land productivity does not necessarily imply that the large Farms have higher productivity than small Farms. The phenomenon of comparatively higher productivity on large scale Farms depends upon the magnitude of Farm size and on the total number of observations constituting either of the farm size groups, i.e, on the farm size classification.

On the basis of the above points, the folloing suggestions can be made:-

- (I) The present study concluded, on the one hand, that there is existence of positive relation and on the other hand, that large farms have not higher productivity than small farms. From these two unlike conclusions, it can be generalised that positive relation between farm size and land productivity only holds up to a level of farm size beyond which the productivity does not increase with the increase, in farm size. Thus, it supports to fix the ceiling on land holding and does not suggest for the extensive farming. Rather, it can be recommended that the peasantry farms should either be increased quantitatively or qualitatively by providing productivity augmented measures at subsidized rate. Further, the present ceiling on land holding for Tarai Region seems quite arbitrary since it is multiple of five or six times in comparison to the farms that average farm households have possessed and neither of the farm households come into purview who has owned that maximum limit.
- (II) The existence of positive relationship can be traced to the wide pre valence of poverty in the study area which may be due to the inefficient public policies. Therefore, the central thrust of public policy should shift to on elimination of such policy induced distortion. More

competitive- markets for land and other inputs can best be achieved by land reform which, among other things, introduce such measures as ceiling, on land holding, greater dispersion of extension services and greater availability of farm credit in reality. Even at present, it is asserted that the land reform programme has to fulfil its responsibility regarding the elimination of oligopolistic and oligopsonistic element in the economy.

(III) The wide existence of poverty-ridden society can be attributed to the extremely small sizes of the farms held by the major portion of the households which, of course, are uneconomic that neither are able to support the family members nor can keep and maintain capitals equipment properly essentials for farming. Therefore, it can be suggested that government should keep special attention on all these poverty-stricken farms.

(IV) The existence of positive relationship between farm size and land productivity suggest that the existing land taxation in regressive is nature. But the governmental practices regarding the exemption of taxes on extremely small farms since two years, however, introduce the element of progressiveness. The limit of exemption of land taxes should be extended up to three bighas and beyond which the land tax should be levied progressively.

In developing country, generally, there is existence of inverse relationship between farm size and land productivity on which land reform rests aiming to improve the state of peasantry farms. In this context, the extence of positive relationship can be attributed to the dismal performance of land Reform Programme in Nepal. Thus, there is urgent demand for the proper implementation of Land Reform Act 1964,

The study since is concentrated to a limited area and existence of wide variability in the results which may be due to the inaccuracy in data obtained by less standardized procedures and absence of standardized classification of farm size, however, does not provide much more space for policy recommendations until further evidence is available in this regard. Thus, it seems appropriate to end this paper with a plea for further research into the structure of farm size and land productivity at the public level. The evidences presented in the foregoing analysis evidently demonstrate that a major research effort in this direction is warranted. Accumulating such informations for a wide range of districts may be an important step in designing and reformulating policies related to land reform and others which will result in a significant reduction of rural poverty and inequality of income distribution in the developing country, Nepal.

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