Returns to Scale in the Agriculture of Nawal Parasi District, Nepal

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1. INTRODUCTION

The major problem confronting the growth of agriculture is how to increase average productivity of different agricultural inputs. Our planning experience reflects dismal achievement of agricultural policies and programs in increasing agricultural productivity. One of the causes for this may be the lack of empirical research works which may assist policy matters in chalking out an effective blueprint for action. As for example in the absence of a proper input–output relationship one may be in a disarray in choosing an optimum input output mix. In this paper an attempt is made to explore an input–output relationship with reference to Nawal parasi a Terai district of Nepal.

There are many evidences in economic literature that the production function for the economy as a whole is not too far from being linearly homogeneous (P. H. Douglas, 1948; and R. M. Solow, 1957). Since time immemorial, our forefathers had also observed that agriculture is subject to decreasing returns to scale in the lung run. But some empirical research studies undertaken in the recent past revealed the existence of constant returns to scale in most of the countries. Besides, most of the Indian economists with the publication of the Farm Management Study by the Ministry of Food and Agriculture in certain typical regions of India during mid fifties, have taken the twin proposition, viz., there is inverse relationship between farm size and

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land productivity; and constant return to scale prevails in the Indian Agriculture (J.P. Singh, 1975: 32–46; A.M. Khusro, 1948; 123–59; Raj Krishna, 1964; 87–97; D. Radha Krishna, 1964: 237–42; G.R. Saini, 1969: 1–18 and others).

In the backdrop of the these findings in the Indian agriculture this paper intends to test the hypothesis that there exists constant returns to scale in the agriculture of Nawal parasi district.[1]

2. THEORITICAL FRAMEWORK

The Returns to scale is generally observed by estimating production function which is a catalogue of output possibilities (C.E. Fergusoon,1972; 136). Economic theory looks into two sorts of input-output relations in production function–short run and long run–subject to proportion and scale respectively. The changes in output as a result of variation in factors proportion forms the subject matter of the Law of Variable Proportion (Ferguson; 142) whereas a change in the scale means all inputs or factors are changed in the same proportion.Thus, increase in scale occurs when all factors are increased keeping factor proportion unaltered.[2]

The study of changes in output as a consequence of changes in scale forms the subject matter of Returns to scale. As all the factors are increased by the same proportion output may increase either of the three ways (i) the same proportion (ii) a greater proportion (iii) a smaller proportion which may be reforred as constant, increasing and decreasing returns to scale respectively.

3. RESEARCH METHODOLOGY

3.1 Study Area

To test the hypothesis that Returns to scale is constant, the necessary data were collected by the researcher himself for 1979/80, from the three village panchayats chosen randomly among the then existing fourty–nine village Panchayats of Nawal Parasi district. The three panchayats are Amarban, Palhee and Benimanipur. Located in the terain part of Nawal

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1. The Terai Region of Nepal is generally flat and horizontal which is very similar to that of the land of U.P. and Madhya Pradesh of India, where the Farm Management study of India was conducted. Besides, farming techniques, cropping pattern cropping intensity of the U.P. region of India and Nawal Parasi district of Nepal are also similar.

2. Some economists have challanged the concept of Returns to scale on tne ground that all factors can not be increased in the same proportion and therefore factors proportion can not be kept constant.

Parasi district, Amarban and Palhee panchayats are on the average poor, dry and densely popu-
lated. The population of those two panchayats as estimated by the respective village panchayat
offices are 5407 and 6000 approximately. The total number of family households and total land
area in the Amarban village are 937 households and 2316 bighas respectively whereas these figu-
res for the Palhee are 731 and 1755.27 respectively. The Amarban and Palhee panchayats resem-
ble each other in all grounds except for a negligible difference in soil fertility due to presence of
some forests that has contributed the soil to be wet in some part of the former village. Rice is
the main crop in both panchayats and are planted in almost all the cultivated land. Rabi crops
include wheat, millet, gram, rahar, oilseeds and others. Both panchayats do not have a canal.

With different geographical and climatic conditions, the third panchayat–Benimani-
pur is situated near the mountainous part of Nawal parasi district. To some extent, this pancha-
yat has irrigation facility and most of the lands are fertile. Maize is the major crop. Besides,
paddy, wheat oilsseds, mustard oil and negligible amount of pulses of different varities are
grown.

The method of land cultivation, cropping intensity are similar in all these three
panchayats. Socially, various castes such as Brhamin, Tharu, Chhetri, Yadav, harizan and other
lower castes reside in those panchayats.

3.2 Household sampling

The population of the present study can be defined as all those farm households
who resided in these three panchayats in 1979/80. From the population, a sample of 200 farm
households were selected with the help of random sampling techniques so that sampling can
represent the population. As such 75, 60 and 65 samples were selected from Amarban, palhee
and Benimanipur panchayats respectively. But, since the possibility of drawing the desired num-
ber of samples for collecting disaggregated farm level input–output data was rather difficult in
Amarban and Benimanipur, more samples were selected from Palhee panchayat. As such a total
of 177 farm householdswere sampled 58, from Amarban, 70 from Palhee and 49 from Beni-
manipur.

3.3 Data collection and processing procedure

All the necessary input–output date were collected in physical local units of measure-
ment like muri pathi, mana, maund at first hand with the help of a predeveloped questionnaire.

These were converted into value terms multiplying by the respective local prices of each input and output.

3.4 Specification of model

In the real world multi–input and multi–out–put production functions present a serious problem in graphing since graphing is possible only if the production function has two inputs and a single output, totalling three variables or less. Hence, the option is to deploy some regression exercises, though not completely satisfactory. This technique followed in the present study. The renowned Cobb–Douglas production function in its log–linear form has been fitted to estimate the elasticites of factor inputs. The unrestricted Cobb–Douglas form, that is, an equation linear in the logarithm of the varibles, has been chosen for its ease of manipulation. Due to its theoritical fitness to agriculture (Griliches Zvi, 1963; Earl Q. Heady and J. L. Dillon, 1961) and its computational manageability, almost all production function studies in agriculture have used this function.

For the estimation of productivity in agricultural sector. Heady and Russel Shaw among other writers had also used this function justifying "while Douglas applied the Cobb–Douglas function to a heterogeneous mass of data from contrasting firms and industries, our sample represents a relatively homogeneous group of firms within a single sub–industry of the agricultural industry .... other types of algebraic functions might have been used in the cross–sectional study, but they require resources beyond those available in this study (Heady and Shaw, 1954: 243). Such a justification is also suitable in the present case because other sorts of algebraic function (non–linear) and factor analysis are not possible. The unrestricted form of Cobb–Douglas function is :–

$$Lny = LnB_1 + B_2 LnX_{i2} + B_3 Lnx_{i3} + B_4 Lnx_{i4}$$

Where,

Y_i = Value of output

X_{i2} = Size of farm

X_{i3} = Human Labour

X_{i4} = Plough (The subscript 'i' refers to cross-sectional data)

If all the above variables are identically expressed, then observing the sum of their co–efficients in the above estimated equation, we can find out returns to scale. However,

above equation can be used to estimate the production function either in total or per bigha term. But if we express all the data in per bigha term, the most important variable, farm size, will be cancelled out. So, it does not permit us to estimate the eqation by expressing all of the variables in per-bigha term. Though the economic theory suggests that the estimation of equation by using data in per unit term yields a comparatively better estimation of coefficients than its estimation in total terms which produces upward bias the computational difficulties have precluded the inclusion of all the inputs used in agriculture which provide a better estimate of the sum of all coefficients. In a study related to efficiency of Nepalese agriculture, Sharma did not include land size as an input in the production function justifying that in preliminary exercises it appeared as a dominant variable (Sharma, 1980 : 23). But in the present study if we drop out the land input most of the regression equations would turn insignificant. Because of all these problems, the above Cobb–Douglas function is neither used in per bigha term nor in total term. Rather following Bardhan's approach all inputs except land size are expressed in per bigha term (P. K. Bardhan, 1973 ; 1372 – 76). So, the coefficient for land size B_2 is the sum of the factor elasticities and the coefficient for land size minus unity provides a test for the returns to scale. Because of computational difficulties, only three traditionally important inputs, e. g; land, labour and plough have been estimated. Besides, for the ease of calculation sampled farms have been classified into four farm size groups in each panchayat on the basis of economic feature, working capital, and nature and composition of farm households. These four strata intervals are as follows :

Farm groups	Size
I	0. 1 –1 .5 Bigha
II	1.51 – 4 Bigha
III	4.1 – 8 Bigha
Iv	8.1 Bigha and above.

A separate eqation has been estimated for each of the farm size group for each panchayat separately. Since the classification of farm households in the above manner is by no means scientific three regression equations have been estimated by adding all the four farm size groups of each panchayat separately and another equation is estimated for all the 177 sampled farm households.

3.5 Measurement of the variables

The definition and the measurement of the variables included in the above model (cross-sectional data) are as follows:

3.5.1 Dependent variable: Output

In the present study the dependent variable is the total output which includes the values of five main crops, viz., paddy (early and late), wheat, maize, pulses and oilseeds valued at their respective local market prices. All these five crops were valued seperately and then aggregated.

3.5.2 Independent variables

The choice of independent variables to be included in the study is largely dicated by the availability of data, their relative importance in farming and the availability of resources. As the data permit, the following explanatory variables have been chosen to expalin the variation in total output.

Land

Land can be measured either in unstandardized or standardized bighas corrected for differences in fertility of soil. Land revenue, rental value, prices of land, and productivity index are generally used as the indicator of soil fertility. In Nepal, fertility studies are not available. Besides rental value and price of land are ever fluctuating due to the absence of perfect land market. However, the Ministry of Finance of Nepal, has classified land for revenue purpose into four classes on the basis of soil fertility: Awal, Doam Sim and Chahar; But since such a classification of land is done hazardously without a scientifically based soil test, this classification is not considered is the standard basis for collecting data relating to land input for the present study.

Human Labour

It is measured in man-days. In the farming business of the panchayats related for the study two types of labour, i.e., family and hired labour are used of which the latter is either permanent or occassional. Hence, both family and hired labour, are taken into consideration without discrimination since generally in all sorts of agricultural activities the wages for all kinds of labourers are same and if different in some cases these are adjusted to one standard rate. The wage is expressed in money value by multiplying the materials by the local market pricess.

Plough

It is the most important input in terms of cost in the existing agriculture. It is measured in animal labour pair–days associated with a man who directs the animal labour to work (plough) in the field. Both family and hired animal labour are valued in rupees. In those farms where both sorts of animal labour are used, valuation difficulty, was solved by counting the number of total ploughs used which were then multiplied by the local market price for a plough, i.e., the price paid for a hired plough.

4 . RESULTS AND INTERPRETATIONS

For finding out the returns to scale the log linear Cobb–Douglas production function has been estimated by the OLS methods for the twelve sets of data of three panchayats for four farm strata. The estimated coefficients and relevant statistics are presented in the table 4.1.

Table 4.1

Statistics Relating to Returns to Scale

Pancha-yats	Farm Size (Bigha)	No. of Observations	Cons-tant Ln B_1	Co-effi-cient for Farm Size Ln B_2	t-value of devia-tion of B_2 from unity	R^2	R^{-2}	F-value
Amarban	.1–1.5	18	7.4818	1.0606 (.229)	.2645	.83	.79	22.59
' '	1.51–4	15	5.4070	1.3420 (.2722)	1.2561	.71	.63	9.13
' '	4.1–8	12	5.7995	1.1026 (.4524)	.2267	.60	45	3.97
' '	8.1—	13	5.5012	1.0963 (.1625)	.5925	.86	82	18.77
Palhee	.1–1.5	25	5.0172	.9357 (.0995)	–.6465	.82	.80	32.35
' '	1.51–4	22	2.1561	.8479 (.2489)	–.6109	.60	.53	8.82
' '	4.1–8	16	4.6251	1.3066 (.2581)	1.1878	.76	.70	12.85
' '	8.1—	7	1.5454	.9473 (.3834)	–.1374	.88	.76	7.39
Benma-nipur	.1–1.5	10	4.7459	1.2307 (.4055)	.569	.96	.94	48.95
' '	1.51–4	12	6.0164	.6160 (.5616)	–.6838	.39	.16	1.71
' '	4.1–8	16	5.1725	.5583 (.2602)	–1.6978*	.49	.36	3.79
' '	8.1—	11	1.9540	1.2607 (.2642)	.9867	.83	.75	11.26

Figures in parentheses are their respective standard errors.

* Significant at 10% level of singificance for one tailed test.

It is clear from the above table that the values of R^2 are above fifty in all cases except for two. The farm strata in Benimanipur three traditional variables included in the equation explain between 39% to 96% of total variation in the gross value of output. It is also apparent that seven coefficients for farm size are greater than unity, five coefficients are less than unity implying that in seven out of twelve cases returns to scale is increasing and in the rest it is decreasing.

The deviations of these coefficients from unity can be tested statiscally to yield a measure of the returns to scale. It these coefficients are not significantly different from unity returns to scale is constant; if it is significantly below (above) unity, returns to scale are decreasing (increasing).

Thus, to test the statistical valadity of each of the coefficients of farm size cf its deviation from unity, t-statistics have also been computed which are also presented in the above table. A comparison of these computed t-values with their corresponding critical t-values reveal that out of twelve coefficients, eleven coefficients for farm size are not significatly different from unity implying that the percentage change in total output with respect to one percentage in farm size (with all other inputs) is proportionate.

The single equation estimation for all of farm sizes for each of the three panchayats is presented below :

Amarban

$$Ln y_i = Ln \; 6.4492 + 1.0354 \; Ln \; X_{i2} + .0752 \; Ln \; X_{i3} + .1471 \; Ln \; X_{i4}$$
$$(1.1831) \qquad\qquad (.4370) \qquad\qquad (1.3415)$$

$$N = 58 \qquad\qquad\qquad R^2 = .958$$

$$F = 406.17 \qquad\qquad\qquad R^{-2} = .955$$

Palhee

$$Ln y_i = Ln \; 2.9865 + 1.0637 \; Ln \; X_{i2} + .8821 \; Ln \; X_{i3} + .1524 \; Ln \; X_{i4}$$
$$(2.3377) \qquad\qquad (5.2887) \qquad\qquad (1.5936)$$

$$N = 70 \qquad\qquad\qquad R^2 = .966$$

$$F = 626.69 \qquad\qquad\qquad R^{-2} = .965$$

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$N = 70$ $\qquad\qquad R^2 = .966$

$F = 626.69$ $\qquad\qquad R^{-2} = .965$

$$N = 177 \qquad R^2 = .940$$

$$F = 898.152 \qquad \overline{R}^2 = .938$$

The corresponding statistics given within brackets under the coefficients of different inputs confirm that labour and plough are significant to explain the variation in total output and the existence of constant returns to scale at 5% probability level.

Therefore, with an overview of preceeding analysis, it can be generalized that constant returns to scale is now operating in the agriculture of Nawal Parasi district.

5. Conclusion

The foregoing analysis validate the hypothesis that there exists constant returns to scale in the agriculture of Nawal Parasi district. When we observe the single equation estimated for all the samples, it can be seen that the coefficient of farm size is greater than unity but not statistically significant, which suggests that increasing returns to scale is just being replaced by decreasing returns to scale.

The next thing that can be explored from the above analysis is that the twin propositions that the Indian economists have stated, viz; existence of negative relationship between farm size and land productivity and constant returns to scale in the Indian agriculture also happens to be true in the present study.[3] If it were not true, the coefficient of labour and plough must not be positively significant in case of constant returns to scale. It also shows that the relationship between farm size and land productivity can be observed in a better way by estimating a two variable equation (i. e. by considering only a single input, i. e; the farm size) instead of one including all the inputs.

The statistically significant positive coefficients suggest that the use of additional labour and plough is justifiable in the agriculiure of Nawal Parasi. But from the view point of separate panchayats, it is better to add more labour and plough in Palhee and Benimanipur panchayats but their additional use in Amarban is not productive and profitable.

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3) There are two groups of economists; one group support the inclusion of all inputs or more than one input for positing the relationship between farm size and land productivity, the other group assert that this phenomenon can be exhibited evidently with the inclusion of single input, the farm size only. For details see Saini, G. R. Farm size, Resource use efficiency and Income Distribution: A study in Indian Agriculttre with special reference to VP and Punjab, Bombay: Allied publishers, 1979.

Since the present study is related to a few panchayats of Nawal Parasi district, the findings can not be assumed to be the representative of the national level situation as the country is composed of varying geo–climatic regions. However the exploration of such a relationship between the variables and ascertaining of returns to scale for different districts of Nepal would certainly yield some guidelines for setting agricultural programs at the micro level one should be aware of the fact that the existence or nonexistence of constant returns to scale also depends upon the choice of probability or significance level chosen for testing the hypothesis. In addition, the presence of statistical fallacies should be carefully scrutinized while drawing any conclusive facts form the empirical work.In this context, though the twin propositions confirmed by the Indian economists have been proved as two distinct phenomena, it, however, creates some doubt if we consider only positive or negative relationship between farm size and land productivity on the one hand, and existence of constant returns to scale on the other. Instead, it seems more proper if it is tested in ease where there is existence of increasing (decreasing) returns to scale on the one hand and negative (positive) relation between farm size and land productivity on the other because constant return is a point which lies between these two opposing situation. Given these absurdities only the emperical research on a district by district or a village by village basis would provide a realistic frame for planning purpose.

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Book Review

Sriram Poudyal, **Planned Development in Nepal, A Study.** New Delhi: Sterling Publishers, 1983, pp. IV + 135. Tables, Index and References. I.C. Rs. 80 (cloth).

A large number of works devoted to Nepali economy have appeared during the past decade from Nepali and foreign scholars. These scholars, ranging from political scientists, economists and historians, have spoken with authority wisdom on the various facets of Nepali economy. However the performance and prospect of the Nepali economy continues to be an enigma to planners, administrators and researchers for a number of reasons: first, Nepal though the cradel of one of man's earliest civilization, yet, is classified as one of the "least developed" twenty five nations of the world; secondly, the pattern of planned economic development Nepal has followed during the last two decades has not registered any significant improvement either in the agricultural or the industrial sector: hence in the gross domestic product; and finally, poverty, inequality of income and mass-unemployment continues to plague the Nepali society inspite of accelerated growth of infrastructures and the increasing flow of capital from abroad.

These trends, or perhaps, distortions continue to baffle scholars statesmen, and social workers. The author Sri Sriram Poudyal, who is an Associate Professor in Tribhuvan University, has made a very sincere and honest efforts to unfold the riddle in the Nepali economy by judicious, painstaking and objective analysis in his book entitled **Planned Development in Nepal. A Study.** The basic thrust of this study is to provide a critical, realistic appraisal of the economic situation in Nepal by focussing the development syndrome in its proper perspective. The author vizualizes the process of development into two broad framework: the development for the fulfilment of the "few" and the development for the material and psychological benefits of the "many." It was with the emergence of the notion of "mass civilization", towards the beginning of the nineteenth century, the very structure and the thematic content of planning went through a complete metamorphosis due to radical changes and innovations. The result:

the welfare of the "few" was replaced by the "many", or to put it more graphically the prosperity of the "miscroscopic minority" was substituted by that of the "masses", equated with the "majority". Thus, the concept of planned development is really a corollary to the emergence of the concept of "mass civilization" in the nineteenth century. The result was that the cobbler, the tailor, the potter and the carpenter became the focus of planning while the marques, the douches and the dukes began to recede into the backgrund.

Shri Poudyal goes ahead and uses this model of development to study the development and prospects of Nepali economy. He neatly divides the long phase of Nepali development into two parts: the pre–1950 and the post 1950 periods. If in the former, in particular the Rana period, the basic objective was the economic aggrandizement of the single family and their close associates than in the latter the main thrust was the promotion of the interest of the people at large. Thus, it is quite natural for Nepal to go through a process of periodic planned development. Up to now Nepal has passed through one three year plan and four "five year plans", and is in the middle of the Sixth Five year plan. In short the basic objective of planning was the growth and expansion of agriculture, industry, communication and social services. The aim was always the same: the speedy promotion of the fruits of development to the masses.

The book is divided into four chapters, though the last chapter constitutes only a sum up–the conclusions. The first chapter explores the intricacies of planning and outlines the major objectives of the plan. In all these plans the growth of GDP constituted the primary objective, but the author laments over the fact that despite two decades of planned development neither GDP (and hence per capita GDP) nor the basic structure of economy has registered any growth. This is a "poor tribute" to the genius of our planners and administrators. A distinguishing feature of this chapter is that it contains a section on historical antecedents, which gives us a glimpse of the Nepali economic development in the past. But this analysis of the economy in the past is very sketchy, uneven and inadequate. An analysis of the economic posperity of Nepal in the madieval and the early modern period, when Nepal monopolized the entire apparatus of the Trans–Himalayan trade would have been a plus factor in enabling us to understand the path and momentum of our present economic process. The picture of Nepal's past economic development is confined to the Rana period. He sees the Rana period as a stumbling block in Nepal's development process; and lables the then Nepali economy as "primitive" (p. 3). While the shoe often fits, this caricature ignores the basic fact that the Ranas did begin the process of modernization Nepali economy and the society. At the very outset in this chapter the writer astutely

remarks that of the "one unique features of Nepal, not typical of other least developd countries is that it has been an independent soverign nation since its birth as a nation and has never been subject to foreign domination" (p. 2). It would have been profitable if the author had toyed with the corelation between Nepali independence and economic development, or the lack of it through centuries. Nepali history beares ample testimony to the fact that her policy of "splendid isolation" if on the one hand did help to preserve her sovereign independent status, yet at the same time, was instrumental in preventing the wave of "mass culture" from penetrating into the Himalayas— thus shielded her from the concepts of "mass democracy" and "mass-development".

The second chapter evaluates the performance in agriculture production by assessing the impact of policies and the other measures aimed at increasing production. Here the author is extremely critical about the land reform program which he rightly lables as a measure "imposed from above on the basis of what the bureaucrats thought fit for the peasants" (p. 36). The result was that the peasants found their conditions increasingly deteriorated; and their dependence upon the feudal lords became even more stronger. The writer then goes on to narrate how the rate of production has failed to increase and match with the growing needs of the people.

The third chapter presents the picture of the industry, which is as pathetic as that of agriculture. The efforts at industrialization at both the Government and Private sector has been poor.

The author has painted a very gloomy and dismal pictur of the present and future trends in Nepali planned development process. What is frustrating to every Nepali is that despite two decades of development and planning there has been hardly any improvement in agriculture and industry, and hence in GDP. Even the building of the road infrastructure and flow of capital from abroad has not changed the pictur. The pictur unfolded in this book is bleak. It is bleak because the story it is telling is bleak-in fact, the total economic future is bleak. Apparently, after two decades planning we have come in front of an abyss from which the nation can either retreat or go forward.

To conclude one may say that the writer has given an excellent diagnosis of the monumental problems facing the ailing Nepali economy, but the prescription for the cure is rather weak. perhaps the Prescription part does not fall within the scope of the book, a chapter on the possible remedial measures would have been very useful and pertinent. One can only wish

that the author would come out with a second volume involving the theme of prescription for the cure in the form of both as the short term and long term measures. However, among all the studies on Nepali planning and development, this work surpasses in its condidness and documentation. The bold attempt of the writer in the exposing the loopholes of our planning process deserves merit and appreciation.

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