DIMENSIONS OF THE INPUT-OUTPUT RELATIONSHIP IN A MOUNTAIN FARMING SYSTEM

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A Comparative analysis of single and double cropping zones of Gilgit region in Northern Pakistan

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DEDICATED TO
MY FAMILY

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INTRODUCTION

Agriculture is the dominant and major sector in most of the less developed countries. It continuos to serve as the backbone of their economies despite the development in other sectors specially industry. Agriculture is the single largest sector of Pakistan's economy. It accounts for 32% of GDP, provides 70% of export earnings from primary or processed products and provides employment to 55% of the country population. Therefore the welfare of the vast majority of the population is dependant on efficiency of agricultural resources of the country.

In Northern Areas of Pakistan more than 80% of the population depends on subsistence farming by integrating food crops, agroforestry, livestock husbandry and poultry. The farming system prevailing in this area is highly complex. Complexities of the system are often more social in nature than purely biological. Rapid population growth, multiple uses of cultivated land and emergence of other off farm economic opportunities in the region have led to changes in the management of natural resources[1].

Keeping in view the importance of agricultural sector in this region, it was felt necessary to examine the input output relationships in the crop production at a very deep level. Therefore we will analyze the changes in productivity due to input factors labour, land, manure, capital and seed. In these rural areas of northern region farmers are constrained to use traditional inputs within the context of a traditional technology. As rapid population growth occurs, framers in these areas and forced to use land of poor quality and in the absence of innovation, to apply the traditional technology in a more intensive manner. In such a situation, it is likely that the marginal productivity of these traditional inputs would be driven to low level.

This study including only the Gilgit region is conducted in a somewhat different dimension. Here we will mainly examine the degree of responsiveness of the crop production due to changes in the input factors use. One important characteristic of this analysis is the inclusion of female labour as a separate factor influencing the crop production. Women in this region, though take the responsibility of managing their household are contributing to approximately half of the required farm and agriculture related work effort. Female workloads in Northern Pakistan remain very high in terms of both the amount of physical efforts expanded as well as the intensity of that effort, mainly due to increased male out migration grown.

The empirical literature on the contribution of input factors in increasing the agricultural production reveals different views. For Battese, Malik(1993) the factors that are more responsible to bring about changes in the wheat production are land, fertilizer and seed. According to Ahmad, Azkar(1998), the land factor contributes more showing almost a 10% increase in wheat output by increasing 10% wheat area and about a 2% change in output with a 10% change in the

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[1] AKRSP, 14th Annual Report 1996.

rainfall. Thus there are different strong arguments about the relative contributions of input factors.

In this region the prevailing farming system is traditional in nature. For Shultz (1983) farming based wholly upon the kinds of factors of production that have been used by farmers for generations can be called traditional agriculture. Traditional agriculture is essentially a cultural characterization of the way particular people live. The concept of tradition agriculture implies long established routines with respect to all production activities.(Shultz, 1983).

The impact of education in this traditional agriculture is investigated. Education contributes to agricultural production and productivity through the worker and allocative effects (Welch, 1970). Its contribution to productivity is much higher in a modernizing environment than in traditional agriculture (Nelson and Phelps, Shultz 1975). While many studies (Fane 1975, Gisser 1965, Khaldi 1975, Pudasaini 1979, Wu 1977) establish education's importance in a modernizing agriculture, where it seems positively related with the agricultural production.

In the rural areas of many less developed countries, the farmers are constrained to use traditional inputs within the context of a traditional technology. In a situation where rapid population growth occurs, farmers are forced to use land of poor quality and to apply the traditional technology in a more intensive manner. Thus one would expect the marginal productivity of the traditional inputs to be driven to very low levels, possibly even to zero. A previous analysis of the situation in Egypt conducted by Aly and Grabowski in 1984 showed that the marginal productivity of labor was indeed negative. This was attributed to the lack of alternative opportunities for labor, scarce land and rapid population growth. Similarly Belbase, Grabowski and Sanchez (1985) working on the Nepalese hilly areas showed that the marginal products of both labor and fertilizers although positive were very close to zero for almost all of the farms in the sample.

OBJECTIVES

This study makes a comparative analysis of single and double cropping zones in Gilgit region using a cross sectional data for the year 1997. The main objective of the study is

1. To examine the dimensions of input output relationship in crop production and more specifically to analyze the marginal productivities of the input factors use in the crop production processes in this region.

The schematic details of the study are as follows:

The second chapter will present a brief discussion of the characteristics of the farming system prevailing in the northern areas. Chapter 3 will provide a detailed review of literature. In chapter 4 the generalized Cobb-Douglas production function and the translog cost function to be estimated will be discussed in some detail. In addition the data source and variables used will also be discussed. In chapter 5 the results of the estimation will be presented and discussed while chapter 6 will summarize the study.

THE STUDY AREA

Under the study the main focus will be on some basic facts about the area and the present farming system.

The Area

The northern areas of Pakistan are situated between 35-37 N latitude and 72 75E longitude, bounded by the republic of china on the north east, the North West Frontier Province of Pakistan(NWFP) on the south. Kashmir on the east and Afghanistan on the west. This area consists of three administrative regions namely, Gilgit (two districts), Baltistan (two districts) and Diamir (one district). The region is rugged and heavily mountainous, located at the inter section of four of the world's highest mountain ranges, the Himalyas, Karakorams. Pamirs and Hindu kush. Within this fragile environment exist a variety of ecological niches upon which people base their livelihoods. The southern flanks of the Karakoram provides water to the tributaries of Indus. The area is known as the "roof of the earth"-(miller 1982).

The people

This area contains over a million people scattered in an area of 74,200 sq.km. overall population density is 13 persons per sq.km. The average familt size is 10, while the male to female ratio is 118. The occupational structure of the area shows

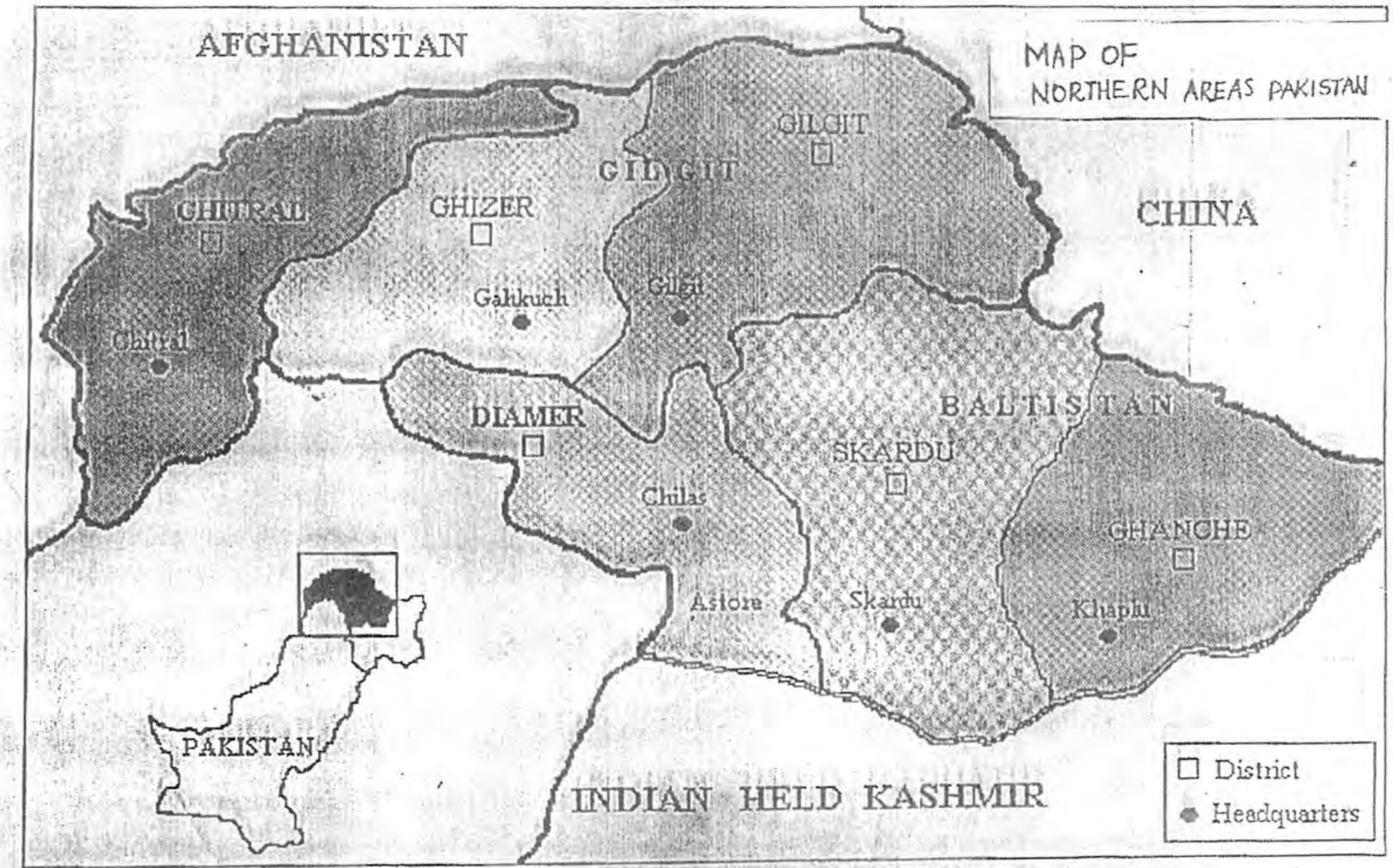

Figure: 2.1 MAP OF NORTHERN AREAS

that almost 80%of the total work force is engaged in farming and domestic work.

The Rural Economy

The people of the Northern areas live amongst the highest peaks and most isolated valleys in the world. Over the centuries, the people in these areas have developed social mechanisms and folk technology to help them cope with this harsh environment. (AKRSP[1], 14^{th} annual review,1996). The rural economy of this region can be described as small scale subsistence agricultural economy. Over 80% of the population make their living from farming(Khan & Khan, 1992)

Mixed Mountain Agriculture

Farmers practice mixed mountain agriculture comparable to that found in the highland valleys of the Himalya. This farming system of Northern areas is highly integrated and complex. Development and management of natural resources is mainly determined by traditional system. These areas lying in the midlalitude region, is marked by strong seasonal variations with extremely cold winters and warm summers, showing that the agricultural productivity is confined to the relatively short growing season from spring to fall. Here irrigation system is the source for cultivation.

[1] AKRSP: The Aga Khan Rural Support program is a private non-profit company with an aim to help improve the quality of life of the villagers of Northern Pakistan.

Living in such a harsh area the mountain inhabitants have learned over the centuries how to utilize the seasons and zones in order to survive. In the present production system, livestock herding and agriculture are interdependent on each other. This region is located just outside the zone of the monsoon rainfall system, in a partial rain shadow area and receives annually a precipitation of 100 to 500mm. The rain shadow landmass of outer Himalyas and its harsh and fragile terrain makes the human life even more challenging than other parts of Himalyas. Agriculture in this area is constrained by scarcity of flat land, deep/ fertile soil and irrigation of water. Another major constraint is small holdings. All methods of irrigation that is tapping rivers, springs, streams etc involve channeling water over relatively long distance. In short, small holdings, large family size, poor land quality, shortage of water, unfavorable climatic conditions, inadequate transport and credit facilities are all the causes for low productivity in agricultural sector in northern areas.

Agricultural production is mainly labour intensive with both male and female participating in it. Due to migration and diversification of male labour to off-farm income sources, the contribution of women an average has increased significantly on family farms in the area.

The problem of low productivity is very serious in the hills where, in certain areas, productivity has detoriated over time. This is because the pressure of population growth has forced an extension of farmers to marginal land. Mountain agriculture in Gilgit is characterized by traditional technology. The most abundant input is labor and in same areas bullocks are used mainly for ploughing the land. The use of improved seeds and chemical fertilizers is very limited owing to high transportation costs, unavailability of farm credit, and the unavailability of the inputs themselves. The technology used in this region is basically traditional in nature. Land is the most limiting factor of production with average land holding per family of 25 kanals out of which only 10 kanlas is suitable for cultivation. Thus this area has the characteristics which would lead one to think that the marginal products of traditional inputs to land would be vary low, perhaps zero.

Cropping Pattern

The farming system in Northern areas can be described as arable crops mixed with trees and livestock. Wheat, barley and maize are the main staple crops. A part from many varieties of vegetables, potatoes are grown as a vegetable crop, which now has become a major cash crop.

Cultivation of all these crops depends upon the altitude of the region. Up to 1850m(from sea level) double cropping is possible where corn and vegetables follow wheat. In the transitional zone around 2300m, double cropping becomes marginal and here barley and corn replace wheat. Above this level of altitude, double cropping is not possible and at high altitude(3300m) only barley, peas, turnip and potatoes are grown. An average household needs 1.5-2.0 hector of land in double cropped zone, which 2.5-3.0 h in the single cropped zone for it self sufficiency. Among annual crops, wheat takes about 27% of the land, Barley

12.5% maize, 7.5% Potato 9 % whereas others including fodder are cultivated in 40% of the total cultivable land according to 1998 estimates.

Crops	**Cropping area pattern(%)**
Wheat	27%
Barley	12.5%
Maize	7.5%
Potato	9%
Others	40%

Source; AKRSP base line survey '98.

In short self sufficiency and interdependence of crops cultivation, livestock husbandry and effective integration of mixed farming are the main characteristics of farming systems in northern areas.

LITERATURE REVIEW

There is a large number of studies available on production technology and farm productivity in the literature mainly based upon Cobb- Douglas and CES productions.

Determination of productivity of the input factors or efficiency of using them in producing output has remained the key issue in the study of production relations. In this regard the Cobb Douglas production function is widely used for examining the relative factor shares and output elasticity with respect to the given inputs.

Khaldi (1975) employed a Cobb Douglas type of production funct6ion for 1964 U.S agriculture in order to investigate the hypothesis that agriculture enhances allocative efficiency. The objective of this study was to identify the production errors and to show that in the presence of disequillibrium conditions. Education contributes to allocative efficiency. These errors were: (a) the error of cost inefficiency and (b)error in scale- the opportunity loss from failure to produce optimum level of output. These errors were treated as indices of allocative inefficiency and were then explained by the effect of allocative efficiency of operator education. The statistical results provide strong support for the basic hypothesis that education enchases allocative efficiency and weak support for the hypothesis that the pace of technological change and marginal efficiency are inversely related. The direct relations of both inputs to the scale coefficient strongly suggested that return to education and state research activity are increasing functions of farm size.

Fane (1975) attempted to measure the influence of education on the cost efficiency with which farmers combine various broadly defined inputs. This study used estimates of the production function parameters and of the prices of farm factor inputs to estimate the theoretical minimum cost of achieving a given level of production. An agricultural production function was estimated using data from the 1964 U.S census of agriculture for the 407 counties in Indiana, Illinois, Iowa and Missouri. The logarithm of average sales per farm was regressed an the logarithms of the average levels per farm of six conventional factor inputs livestock, seeds and fertilizer, hired labor machinery, land and building and houses worked by farm family labor. The result of the main interest was the expected negative sign of the coefficient on agriculture whose absolute value was biased upward by the omission of pre-school ability and the quality of schooling. The data grouped by counties kept per-school ability constant and yielded a much weaker relationship between average pre-school ability and the average education.

Wu (1977) studied the role of education in production for the medium stage developing agriculture of Taiwan by fitting a Cobb-Douglas and CES function. The sample contained 310 bookkeeping farms in three years (106 in 1964, 117 in 1965 and 87 in 1966) drawn from three mixed farming regions of the island. This approach investigated the effect of education in terms of technical and allocative efficiencies. Results suggest that in a densely populated agriculture where production is typically carried out by small family farms, education of farmers of a moderate level(about six years of schooling on average) is able to contribute to production when rapid development is in progress. The contribution of worker effect surpasses that of allocative and scale effects, suggesting that the relative importance of these effects may vary with farm size and with the average level of education.

Salam(1978) in his study compared the use of various factor inputs and farm productivity prevailing on different farm categories in Punjab. Data was collected through a field survey in which 192 farmers in 16 villages of Gujranwala and Sahiwal districts were interviewed. Data was divided into three categories on the basis of farm size, small, medium and large farms. The results showed that despite the tendency to use higher level of both the conventional and modern factor inputs the farmers operating small farms were obtaining lower crop yield. It appeared that the phenomenon of higher per acre yields under additional farm technology obtaining on small farms disappeared owner operated farms, generally obtained higher yield per acre than the tenant operated farms. Moreover the average yields obtaining on fertilizer using farms were significantly higher than those obtaining on farms not using any fertilizer. The farms having better farm managers out yielded the farms having average type of managers for the food grain as well as cash crops.

Khan (1979) estimated a Cobb Douglas production function for testing the land productivity of various farm sizes. His hypotheses was based on the assumption that large farms have higher land productivity than small farms. He concluded that larger farms were about 9% more productive than small farms. The result showed that the use of fertilizer, hired human labour and expenses on farms machinery increase with the farm size. In a similar study Khan and Maki(1979) derived the technical and basic efficiency parameters in order to identify and isolate possible difference between large and small farms. These estimates were based on farm data obtained from 728 farms in Punjab and Sindh provinces of Pakistan. They concluded that large farms were more efficient by 18% in Punjab and 51% in Sindh, implying a greater in efficiency on the part of small farms.

Khan and Haque (1981) in a similar study using a larger date base obtained a very different set of results on farm size and land productivity and thus refute the conclusions reached by Khan(1979). They found a negative but insignificant correlation between production per cultivated area and farm size. A negative relation between labour and farm size was found in this study.

Lockeed, Jamison and Lau (1980) surveyed the findings of 18 studies conducted in low income countries concerning the extent to which the educational level of small farmers affects their production efficiency. The 18 studies include analyses of 37 sets of farm data that allow, with other variables controlled, a statistical estimation of the effect of education. In six of these data sets, education was found to have a negative (but statistically insignificant) effect, but in the remaining, 31 the effect was positive and usually statistically significant. The survey showed that education was positively related to output among highly commercialized farms. Returns to schooling were negative in the traditional agriculture regions but became positive and increased as the regions were more modern. Education was found to be related to production efficiency but more strongly to allocated efficiency. Further the results show that the coefficient for 0 year of education was not significantly different from the one for 1-6 year education. However for 7 or more years the coefficient was significant, the evidence thus suggests a minimum threshold of 6-7 years before education affects productivity. So it was concluded that the results lend support to T.W. Shultz hypothesis that the effectiveness of education is enhanced in a modernizing environment.

Salam (1981) using the fixed survey data of agriculture development bank(ADBP) for agriculture sector of Pakistan studied the impact of tractorization on wheat productivity. The input factors used were farm size, labour, fertilizer, while tractor appeared as a dummy variable. The relationship between higher productivity and tractors was estimated by using a log-linear model. The results revealed highly significant co-efficient of fertilizer expenditures and labour use. The results of production function confirmed the significant contribution of tarctorization in achieving higher wheat yields. A comparative analysis indicated that wheat yield on tractor farms was significantly higher than on bullocks farms.

Pudasaini(1983) investigated the impact of education in modernizing and traditional agriculture of Nepal by utilizing a Cobb Douglas production function framework. The empirical data was from modernizing terai and traditional hill regions. Farmers of these two areas differed significantly in their use of modern inputs and practices even though they had similar amounts of education. Farmers in the hilly region remained more traditional. The results of the analysis showed that education contributes much more to farm production by improving farmers allocative ability than by enhancing their direct output in both changing and traditional agricultures. In a changing agriculture, education enables farmers to select and introduce technologically better inputs and overall economic impact is stronger in such environment than in traditional agriculture. Also it was concluded that education contributes more to productivity in a modernizing environment than in traditional agriculture. This study suggested that agricultural efficiency and productivity can be accelerated by simultaneously investing in education and in modern innovations than in either separately.

Cornia(1985)tested relationship between land productivity and farm size for 15 developing nations of Asia, Africa and Latin America. He concluded an inverse relationship between farm size and land productivity . He showed that small farms were characterized by intensive use of land and by resource inputs higher than large farms and therefore the productivity was significantly higher for small farms both for total farm area and for cultivated areas.

Belbase, Grabowski and Sanchez (1985) estimated a relatively new form of variable elasticity of substitution (VES) production function in their study on the agricultural sector of Nepal. The study was used to show whether the marginal productivity of inputs used in Napolese hill agriculture was close to zero. Cross sectional data in this study came from a 1974-1975 survey of 600 farm families from 6 villages representing the full range of climate, soil types and altitude of the Nuwakot distt. The input factors used were land, labour, bullocks and fertilizer, while output variable represented the sum of rice, maize, millet and wheat production in kilograms, The results showed that the marginal products of both labour and fertilizer although positive, were very close to zero for almost all of the farms. While the marginal products for land and bullocks were much higher. It showed that within this area of Nepal, the application of labour and the use of traditional forms of fertilizer had reached their limit.

Mujahid and Mukhtar(1988) in their paper attempted to study how input use and productivity vary across farm sizes, with some references to the infrastructure and institutional factors. For this a comparison of two Punjabs, Pakistani and Indian was done. Annual and cross sectional data was collected from 19 districts of

Pakistan and 16 district of India from 1959-60 to 1980-81 based on annual figures of Government and private publications of the two provinces and census figures. The input factors they use were labour per hector, canal irrigation tubewell irrigation and fertilizer. The results were obtained by estimating a generalized form of Cobb-Douglas production function. The estimates showed that generally medium sized farms in Pakistan Punjab and small sized farms in Indian Punjab were the most efficient users of inputs relative to other farm sizes. Modern inputs including fertilizer canal and tubewell water and high yield variety (HYV) seeds play a significant role in agricultural output. Both Pakistani and Indian Punjab showed low labour productivity on small farms which used a relatively higher amounts of labour per hector whereas productivity of labour was highest on medium sized farms as they most likely combine the best mixture of input available, better supervision of labour and land quality. Further results revealed that small farms in Indian Punjab used the least amount of canal and tubewell water but efficiently had highest water productivity while in Pakistani Punjab, medium farms, tend to be relatively more efficient. Fertilizer productivity remained highest on large farms in Pakistan while it was highest for medium sized farms in India.

Battese, Malik, and Broca (1993) estimated a stochastic Frontier production function model of time varying technical inefficiencies, proposed by Battese and Coelli (1992). An annual data of 880 wheat farmers across the provinces from the

5 districts of Pakistan from 1986-1991 was used in this study. They included land labour (household and hired), Fertilizer, number of ploughings, quantity of seed as the input factors. The results showed that wheat farmers who are owner tenants tend to have higher wheat yields than farmers who are either pure owners or pure tenants in all four districts. It was because of the fact that owner tenants were more progressive farmers and they wanted to make the best possible use of land.

Ahmad & Azkar (1998) using the time series data for the period of 1970-71 to 1996-97 from four districts of the barani areas of Punjab, analyzed a Cobb Douglas production function to disintegrate wheat output growth into different sources. The results show that the major driving growth, factor was technical change under both conditions of barani and irrigated wheat production which contributed about 107% of the total change in the barani output and about 65% in irrigated output. The change in efficiency and inputs, respectively contributed about 3.7% and –10.3% in barani and 1.3% and 34% in irrigated wheat.

METHODOLOGY AND DATA

Specification Of Cobb Douglas Production Function

In 1928, Charles Cobb and Paul Douglas published a classic article that aimed to test empirically the theory of marginal productivity. They related value added Y to the inputs of capital (K) and labour (L) in U.S manufacturing using the log-log form

$$\ln Y = \ln A + \alpha_k \ln K + \alpha_L \ln L.$$

In order to study the relationship between the crop production and the various inputs used, we use a Cobb-Douglas production function which is extended to use for six input factors for both single and double cropping zones.

The functional form used is:

$$\ln Y = \beta_0 + \beta_1 \ln(FS) + \beta_2 \ln(mL) + \beta_3 \ln(FL) + \beta_4 \ln(FM) + \beta_5 \ln(K) + \beta_6 \ln(S)$$

Where Y is the total crop output in terms of its market value.

FS = farm size in Kanals

ML = Male labour in terms of no. days worked.

FL = Female labour in terms of no. days worked.

FM = Farm yard manure in terms of its market value.

K = Capital used in rupees.

S = Amount of seed used in the units of kilogram.

One advantage of using the above functional form is that the coefficients of the input factors directly gives the value of elasticities, so it becomes easier to study the responsiveness of the output due to a change in the input factors.

In order to investigate the impact of education in the traditional agriculture of this region an additional variable is included in the original production function framework in the form of a dummy variable whose value is 1 for the farmers who has educational level equal to primary or above and zero otherwise.

The functional form now looks like:

$$\ln Y=\beta_0 + \beta_1\ln(FS) + \beta_2 \ln(mL)+ \beta_3\ln(FL) + \beta_4\ln(FM) + \beta_5\ln (K) + \beta_6\ln(S) + \beta_7 D$$

Where D =1 for primary and above level of education.

=0 otherwise

In order to investigate the marginal products of each of the inputs for each of the farm, the derivatives of model with respect to land, labor, manure, seed, and capital are calculated. Taking the derivatives give.

$$\frac{\partial Y}{\partial FS} = B_1,FS^{B_1-1}.\ ML^{B2}.FL^{B3}.FM^{B4}.\ K^{B5}.\ S^{B6}.$$

$$\frac{\partial Y}{\partial ML} = B_2.FS^{B1}.ML^{B2-1}.FL^{B3}.FM^{B4}.K^{B5}.S^{B6}$$

$$\frac{\partial Y}{\partial FL} = B_3.FS^{B1}.ML^{B2-1}.FL^{B3}.FM^{B4-1}.K^{B5}.S^{B6}$$

$$\frac{\partial Y}{\partial FM} = B_4.FS^{B1}.ML^{B2}.FL^{B3}.FM^{B4-1}.K^{B5}.S^{B6}$$

$$\frac{\partial Y}{\partial K} = B_5.FS^{B1}.ML^{B2}.FL^{B3}.FM^{B4}.K^{B5-1}.S^{B6}$$

$$\frac{\partial Y}{\partial S} = B_6.FS^{B1}.ML^{B2}.FL^{B3}.FM^{B4}.K^{B5}.S^{B6-1}$$

Data

There is a general dearth of "hard" economic and social data in the northern areas of Pakistan. This scarcity of meticulous survey data in the program area is not an exception, as most of the developing countries in general and within these countries rural areas in particular, lack information related to social and economic indicators. The main objective behind this survey was to provide baseline information on economic and social indicators and to assess change in the socio-economic living standards of the people of this area. To select the sample for the baseline survey 98, multistage stratification procedures as well as systematic random sampling was used. In the first stage, the Program Area was divided into four programming regions: Baltistan, Gilgit, Chitral and Astore to obtain region-wise baseline information on the required indicators. In the second stage of stratified sampling, in the interest of representativeness, regions were divided into single and double cropping zones because of an a priori expectation that farm incomes and related indicators would be considerably different in the two zones. Next, for each zone in each region, villages were systematically selected to ensure representation of villages of different sizes, large and small. Finally, for selection of households, there was also an a priori assumption that farm incomes and assets etc. would vary with the size of their landholdings. Therefore, in the selected villages, a systematic random procedure was adopted to select the sampling units, that is households representing different levels of landholdings. a sample of 770 households was selected for the survey. These included 110 hh and 11 villages each from single and double cropping zones. Astore's sample, however, comprised a total of 110 households, since it is entirely a single cropping zone.

A total of almost four hundred queries with multiple options were asked in the survey to collect the information on the following aspects of the rural households:

- Household Characteristics
- Farm Characteristics
- Off Farm Engagements
- Expenditures and Assets
- Credit and Savings

This information has helped to determine the demographic and social patterns, incomes and their sources, household and farm expenditures, nature of household assets, and credit uptake and savings in the program area. Analysis of data under above cited aspects has enabled to calculate family size, adult literacy rate, dependency ratio, labour utilisation, land utiltisation, cropping intensity, input use, crop yields, livestock holding, fruit production and processing, fruit and forest plants inventory, total value product of timber and fuel wood, off farm incomes and their sources, net farm incomes, expenditures on various heads, assets, and savings and credit out-reach.

Some of the main findings of the baseline survey for the Gilgit region are presented in tables 2,3,4,5,6 and 7.

SUMMARY OF FINDINGS

Table 2: Human Resource & Demographic Features

Household size	9.71
Male	53%
Female	47%
Male to female ratio	112
Dependency ratio	108
Children <10 years	36%
Age 10-60	60%
Age >60 years	4%

Table 3: Educational status

Adult literacy rate	46%
Male literacy rate	57%
Female literacy rate	32%

Table 4: Occupational structure

Farming and domestic work	55%
Off farm work	16%
Students	29%

FARM FEATURES

Table 5: Features of Land

	Kanals
Total Land	25
Cultivated Land	10
Irrigated Pasture Land	9
Barren land	5

Table 6: Average farm income

	Rs.
Crops	28359
Fruits	7537
Forestry	10152
Livestock	32204
Poultry	1120
Total Gross Outputs	79372

Table 7: Average Farm Expenditures

Inputs	**Rs.**
Seed	2049
Fertiliser	621
Pesticides	38
Tractor Hired	417
Labor Hired	845
Feedstuff	760
Vaccination/Medication	98
Transportation	230
Marketting	90
Processing	49
Others	250
Total Variable Costs	5448
Fuel and Repair	2359
Total Cost including Fixed Cost	7807

Table 8: Average Off Farm Incomes and Percapita Income

Off Farm Incomes	**Rs.**
Employment/Off Farm Labour	39923
Transfer Incomes	5478
Rental Incomes	2985
Others	2354
Total Off Farm Incomes	50749
Total Household Incomes	122314
Household Size	9.71
Annual Per Capita Income	**12597**

Variables

The gross output of crop production used in the analysis is in the form of its market value. Labour used for the study is in the units hours worked. The price of labour is computed by dividing the total household labour expenses by the number of hours worked. Both male and female labour are included in studying the contribution of input factors on crop output. Market value of capital is used for the analysis. Data on manure was available in the form of its value. Price of manure is derived by using the data on total expenditure of manure and the amounts used by each household in the sample. Seed factor is used in the units of kilograms. Its price is computed by using the expenditure and quality data. The land holding by each farmer is used in the units of kanals. However to study the possible factor substitution data on its price is used. For analysing the dimensions of input -output relationships, educational level of the head of family is used as a dummy variable. Th value for this variable is 1 incase of a household with a primary or above education and zero otherwise.

RESULTS

The Cobb Douglas production function is estimated using the ordinary least square estimation for the single cropping zone, double cropping zone and for the over all sample. The results of the estimated coefficients, their t-values and the standard deviations are presented in table 9,10,and 11.

The results show that most of the coefficients are significant with expected signs. High R2 and small values for standard errors show high explanatory powers of the variables. The coefficients of the estimated model show that the major contributors of the crop output growth are labour (both male a female) and land.

In the single cropping zone (table 9) the magnitude of the coefficient of land is 0.557 showing that a 10% increase in farm size beings about 5.5% change in the total crop production. In case of labour a 10% increase in male labour increases the production by 1.97% and it is 1.42% for female labour. There is no significant difference between the two coefficients showing that male and female labour contribute equally in the total production of crop in the single cropping zone. This may be due to the fact that in very high altitude areas, most of the male labour usually is not present during the cropping season because of mainly their services in relatively low altitudes areas. Therefore in such an area, much of the burden of production goes on to the female labour. In this region, the seed factor is seen playing a major role in enhancing the production with a 2.3% increase when the use of this factor is increased by 10%. The main problem in this region is the extreme cold climate, which

Table 9: Estimates Of Coefficients For Single Cropping Zone

VARIABLES	COEFFICIENTS	T-VALUE	STD.ERROR
Constant	5.76	11.7	0.49
Land	0.557	6.8	0.08
Male lab.	0.197**	2.07	0.095
Female lab.	0.142*	3.196	0.044
Capital	0.069***	1.75	0.039
Manure	0.0279	1.13	0.024
Seed	0.232	3.42	0.068
D.(edu.)	-0.024	-0.197	0.126

R^2=0.617
Adj. R^2= 0.59
Dubin,W.Stat=1.669
***Significant at 1% level of significance.**
**** Significant at 5% level of significance**
***** Significant at 10% level of significance**

TABLE 10: Estimates Of Coefficients For Double Cropping Zone

VARIABLE	COEFFICIENTS	T-VALUE	St.ERROR
Constant	4.0	8.81	0.453
Land	0.2668*	2.32	0.11
Male lab.	1.008*	3.46	0.426
Female lab.	0.188**	1.8	0.104
Capital	0.077	1.176	0.065
Manure	-0.228	-0.52	0.44
Seed	0.253	3.6	0.07
D2(edu)	-0.137	-0.62	0.22

R^2 = 0.745
Adj. R^2 = 0.725
Dubin W stat= 1.89
*** Significant at 5% level of significance**
**** Significant at 10% level of significance**

Table 11: Estimates Of Coefficients For Overall Sample

Variables	Co-efficient	t-Value	St. error
Constant	4.79	15.44	0.31
Land	0.635	4.82	0.132
Male lab.	0.598	6.7	0.089
Female lab.	0.19*	3.83	0.04
Capital	0.087**	2.26	0.03
Manure	0.098*	3.18	0.03
Seed	-0.193	-1.36	0.14
D	-0.005	-0.044	0.12

R^2 = 0.752
Adj. R^2= 0.744
Dub w.stat = 1.93
F.stat= 92.02
*** Significant at 1% level of significance**
**** Significant at 5% level of significance**

hinders twice production of crops in a year, as a result an increase in the seed factor or application of better variety seeds would bring about a big difference in the crop production. Capital and farmyard manure are not significantly affecting the production, though both have a positive relationship with the output. It may be because of use of traditional agricultural tools that are inefficient in making a significant impact on the overall crop production and the over supply of manure in the production process.

In the double cropping zone, male labour is the major contributor showing that a 10% increase in it increases the output by 10.08%. Farm size and seed have an equal share bringing about 2.5% increase in the total output when both the inputs are increased by 10%. The coefficient of female labour is 0.188 proving itself a main source of change in production. Here also capital and farmyard manure have no significant role in increasing the crop production.

In table 11, for the over all sample, farm size and male labour appear to play equal major roles in increasing the gross crop output. With a 10%increase, results show that output increase by 6.35% due to farm size and 6% due to male labour. The magnitude of the coefficient of female labour is 0.19, showing a 2% increase in output due to 10% increase in female labour. The difference between the coefficients of the male and female labour in the overall sample is because of the complicated farming system prevailing in these areas. Here male has to do the tough job of bringing water for irrigation. Capital and manure in the overall sample have significant coefficients with magnitudes 0.087 and 0.098 respectively. However seed factor and the crop output seem to be negatively related, but the t-value is insignificant.

Results

One interesting result is the expected negative and insignificant relationship of education level with the crop output. Education has no role to play in increasing the crop production in this area because of the fact that education is expected to contribute more in a modernized environment rather than in a traditional one. Most of the farmers in this area are either illiterate or have educational level below primary. As the effect of education can be easily viewed in an environment where the literacy rate is high so one reason of zero effect on crop production may be the low literacy rate among the farmers.

It is found that in the single cropping zone none of the inputs have negative marginal productivity's. However the marginal products of manure capital and seed are very close to zero. For almost all of the farms in the sample. It is to be noted that much of the fertilizer used by these farmers is compost, not commercially produced chemical fertilizers for a limited farm size these seems to be intense use of seed and capital showing that the use of these traditional inputs has reached its limit. Here marginal products of both female and male labor are positive.

In the double cropping zone we have a negative marginal product for the manure factor showing its over supply. However in this zone, the marginal products of labor and seed factor is comparative greater than the single cropping zone, showing that in this zone, there is a possibility of enhancing crop production through the employment of more labor and use of new high variety seeds. However the magnitudes of these marginal products are not very large. Similarly for the total sample, the marginal products of seed is negative.

CONCLUSION

This study represents an attempt to examine the relationship between input and output in a more detail and to explore the marginal productivities of the input factors labour, land, capital, seed and manure in the crop production of the Gilgit region. For this a Cobb-Douglas production function has been estimated. The study is based on a comparative analysis between the single and double cropping zones of the region, using 110 observations from each zone.

The results revealed that the major contributors of the output production growth are the two input factors, land and male labour in both single and double cropping zone. However in the single cropping zone male and female labour seems to contribute equally. Capital and farmyard manure in both zones are not playing significant roles in the increase in the production.

This paper also examined whether allocative effect of education contributes to production in the prevailing traditional agriculture of Gilgit region. The results show a clear indication of no effect of educational level on the crop production in both single and double zones. These results are consistent with the findings of Pudasaini,1983 who concluded that education has no significant effect on farm productivity of traditional agriculture.

The profitability of using a new agricultural factor is a strong explanatory variable in analyzing the observed rate of acceptance by farmers. Most farmers in such poor agricultural communities are too small and too isolated to undertake a search for new agricultural factors; it simply would cost them too much relative to the return they could realize from the search. The knowledge and skills are in essence an investment in farm people. Learning only from experience is not only slow but for many purposes much more expensive than are alternative ways of learning. On the job training has a large role to play, especially for a generation, until schooling can take over most of the basic work required in producing the foundation for knowledge and skills.

The marginal products of most of the factors are close to zero except that of land and labor. In order to increase output , a new technology is essential. Such a technology would involve the application of chemical fertilizers. Further, there is a need to use high yield variety seeds is order to get better crop production. There are a large areas of study in the farming system of northern region which are needed to be explored. There is a need of new research and further work should be done in this connection.

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