

**ECONOMIC EFFICIENCY OF THE AGRARIAN STRUCTURE
IN THE NORTH WEST FRONTIER PROVINCE
OF PAKISTAN**

An Econometric Analysis



BY

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**DEPARTMENT OF ECONOMICS
UNIVERSITY OF PESHAWAR
NWFP – PAKISTAN
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**A THESIS
SUBMITTED TO THE
UNIVERSITY OF PESHAWAR
IN PARTIAL FULFILLMENT
OF AWARD OF THE
DEGREE OF *DOCTOR*
OF PHILOSOPHY
IN ECONOMICS**

**DEPARTMENT OF ECONOMICS
UNIVERSITY OF PESHAWAR
NWFP – PAKISTAN**

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DEPARTMENT OF ECONOMICS
UNIVERSITY OF PESHAWAR
NWFP – PAKISTAN

We hereby recommend that the dissertation entitled
“Economic Efficiency of the Agrarian Structure in the
North West Frontier Province of Pakistan”
be accepted as fulfilling this part of the
requirement for the degree of
Doctor of Philosophy in Economics

By

Jehanzeb

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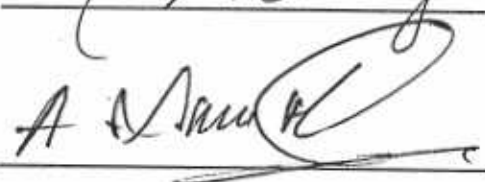


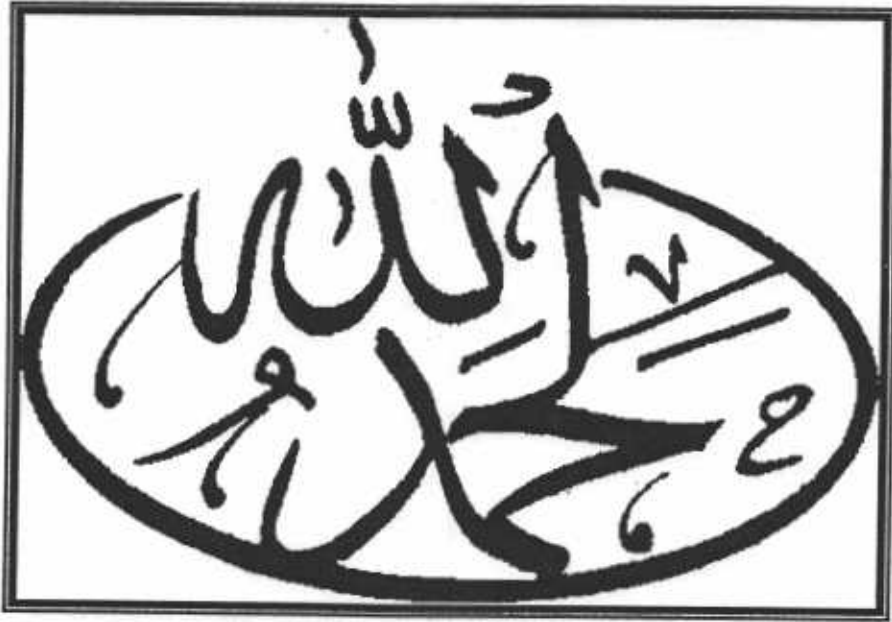
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ACKNOWLEDGEMENTS

I wish to express my gratitudes to Professor A. Samad, Director, the Centre for Applied Economic Studies, University of Peshawar, for his valuable guidance and literacy advice during all stages of this research work. The completion of this dissertation has been possible only with his willing co-operation and exertions efforts..

I am also grateful to Dr. Naeem-ur-Rahman Khattak, Chairman, Department of Economics, University of Peshawar, for his co-operation and help extended as an ex-officio member of my Supervisory Committee.

Being co-supervisors Professor Mohammad Nawab Khan, Dean, Faculty of Social Sciences, N.W.F.P. Agricultural University Peshawar and Dr. Hamayun Khan, Assistant Professor, Institute of Development Studies, N.W.F.P. Agricultural University Peshawar, extended all their possible help and guidance. Without their co-operation, especially in forwarding the letters related to the Ph.D matters, the completion of my Ph.D could not be possible in time. I appreciate and acknowledge their assistance.

The Typing of initial drafts by M/S Azhar Rauf, Ali Gauhar Khan, Jehangir Khan Khalil, and typesetting of the final manuscript by Mr. Maqbal Khan are acknowledged.

At the end, a variety of people joined in at various stages, for instance, Arbab Samiullah Khan, Mr. Muhammad Anees and Mr. Nawab Zada, to mention a few. I am grateful to all of them, indeed.

Jehanzeb

ABSTRACT

The study entitled "Economic Efficiency of the Agrarian Structure in the North West Frontier Province of Pakistan" is exclusively based on primarily data collected from 200 farmers in NWFP, during 1997-98. The farmers have been selected randomly through the stratified sampling procedure. For analysis, the sampled farmers are grouped on the basis of farm characteristics such as owners, owner-cum-tenant and tenants on one hand, and small and large farmers on the other. The core objective of the study is to quantify the economic efficiency of the agrarian structure in NWFP.

In the empirical analysis various econometric techniques have been used. This included the use of Translog Profit function, Lorenze Curve, Gini Coefficient, Cobb-Douglas Production Function and Linear Programming, etc. Beside these, the Marginal Propensity to Consume (MPC) Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) of various agricultural activities are also computed. The structural differences between different types of farms are determined with the help of Chow-F ratio.

The results obtained from various statistical and econometric applications are coherent with the economic theory and of great help for diagnosing the agrarian structure of NWFP. Specifically, it has been discovered that the agrarian structure is inefficient mainly because of the skewed distribution of operational holdings, difference in farm sizes and level of mechanization, land fragmentation, paucity of irrigation water and provision of credit facilities.

The analysis suggested that the level of inefficiency can be reduced to a greater extent by eliminating disparities of operational holdings. Significant reformative approach of land reform is proposed towards this end. The adoption of mechanization and provision of credit extension can also help to rebate this inefficiency.

CHAPTER I

INTRODUCTION

1.0 THE PROBLEM

"Agriculture is the primary sector of the economy. In many ways it sets trends for its performance. It has contributed 24 percent of the GDP and accommodated 47.54 percent of the employed labour force during the year 1994-1995. Its contribution to GDP has further increased to 25 percent, while it has engaged about half of the total employed labour force, during the year 1995-96. It is the main source of foreign exchange earnings and caters for the raw material needs of the country's major industries.

Being an agrarian economy, the role of agriculture in the economic structure of Pakistan cannot be ignored. This sector in fact involves indirectly the illiterate and unskilled working population of the rural areas in the development process of industrialization. Most of the industries in Pakistan are agro-based, which are initially fueled by agriculture sector. The surplus of the agricultural output feeds industrial sectors, while the agricultural productivity is primarily the function of the agrarian structure. The more adequate is the agrarian structure, the greater is the productivity. The agrarian structure of an economy plays a key role in enhancing agricultural productivity and raising economic efficiency of farms. The primary factors which directly describe the

agrarian structure are the operational holdings, tenurial status, physical inputs like, irrigation water, fertilizer, and improved seed, labour (hired and household), fragmentation, water logging/salinity, agricultural technology/farm practices and management skills. The economic environment, like agricultural credit, price policy and incentives, agricultural marketing and storage facilities, agricultural education, agricultural extension and research are the factors which indirectly fabricate the agrarian structure of an economy. These factors along with socio-economic conditions of the farm household members are believed to have an affect on the economic efficiency of farms.

It is presumed that economic efficiency of farms is greatly influenced by the tenurial status. The operational holdings also affect agricultural productivity significantly. Adequate irrigation facilities and appropriate water management add to the total agriculture crop output. Fertilizer continues to play a dominant role in increasing agricultural production, improved and certified seeds contribute significantly to increase in yield per acre. Mechanization helps a great deal in sowing and harvesting of crops in a very short span of time and thus reduces post harvest losses. Economic environment encourages productive investment by ensuring reasonable returns to capital and farmers. A sound farm pricing policy, incentives and agricultural credits can play an important role in providing conducive economic environment for increasing agricultural

production and raising farm productivity. Agricultural extension and basic research form the basis of development in farm sector. Agriculture sector cannot make rapid progress unless extension services and research in different disciplines of agriculture are organized and strengthened at various levels in an integrated manner. The present study focuses on describing in detail the existing agrarian structure in NWFP and determining the economic efficiency of different farms, applying econometric techniques of analysis.

The main objectives of the study and hypotheses to be tested are summarized in the subsequent Section 1.1. Research methodology and the analytical techniques are highlighted in Section 1.2 and 1.3, respectively. The organization of the study is sketched in the last section of this chapter.

1.1 RESEARCH DESIGN

1.1.i Main Objectives:

The core objectives of the study are as under:

- To describe the existing agrarian structure and agricultural technology/ farm practices adopted by the farm operators.
- To assess the impact of the existing agrarian structure (viz. tenurial status, state of mechanization, irrigation, and size of holdings etc.) on the economic output and efficiency of the farm-holdings.

- To identify the major constraints, and to formulate the linear programming models, and to undertake sensitivity analysis of the selected constraints.
- To assess the farm efficiency/productivity and farm income; and to determine the extent of farmers' participation in the development process. Also to test the relationship of profit efficiency/inefficiency (if any) with farm's characteristics.
- To examine the optimality of input-output relationship and to identify the returns to scale (or stages of production), by estimating the Cobb-Douglas production functions, and to derive the marginal physical products of factors of production.
- To ascertain the consumption pattern and standards of living of the farm households by estimating their linear consumption functions.
- To test the viability of the agricultural projects (or farming) by applying various investment criteria viz. NPV, BCR and IRR, etc.
- To propose viable suggestions/recommendations based on the analysis of the study.

1.1.ii Hypotheses to be Tested

- It is assumed that in case of small farms, the tenant cultivators use their land holdings more intensively and hence get relatively a greater output

efficiency, while in case of large farms the situation is reverse in favour of owner cultivators.

- Cropping pattern on different farms (from the purview of tenurial status, size of holdings, state of mechanization and irrigation etc.) is different.
- The consumption pattern and standards of living of farm households changes with a change in the agrarian structure.
- The agrarian structure significantly affects the input-output relationship and returns to scale (stages of production).
- Owner operated small farms are not economical.

1.1.iii Scope of the Study

The geographical coverage of this study is confined to the North West Frontier Province of Pakistan. Appropriate consideration is to cover all the ecological zones as identified by the Pakistan Research Council (PARC).

1.2 RESEARCH METHODOLOGY

1.2.i Sources of Data

The issues mentioned in the main objectives of the study and analytical techniques discussed in the subsequent section 1.3 indicate that the study is primarily based on the primary data though in certain cases data has to be secured from the secondary source also. For the collection of primary data the following research instrument has been used:

1.2.ii Research Instrument

An attempt has been made to evolve a precise, comprehensive and precoded interview schedule. This interview schedule administered to the farm operators is comprising of:

Agrarian Structure:

- Tenurial Statuses
- Operational Holdings
- Irrigation Status
- Mechanization Status
- Land Utilization
- Cropping Pattern
- Supply of and Demand for Labour Input
- Water logging and Salinity
- Fragmentation

Other Inputs/Farm Practices:

- Access to and use of Fertilizer/Farm Yard Manure
- Access to and use of Insecticides/Pesticides
- Access to and use of Agricultural Credit
- Access to and use of Agricultural Machinery
- Knowledge and Adoption of Recommended Farm Practices and Doses of Inputs (ploughing, planking, weeding/hoeing and number of irrigation etc.)

Socio-economic Conditions of Farm Households:

- Family Size, Age Composition and Sex Ratio
- Literacy Status
- Working Status
- Labour Force/Dependent Class

Costs and Benefits:

- Prices of Various Inputs
- Incentives by the Government
- Total Costs of all Inputs (including social costs and imputed costs of owned inputs)
- Total Production
- Storage Facilities
- Marketing of Surplus Output
- Marketing Costs
- Selling Prices of Outputs
- Total Benefits (social benefits and imputed values of self consumed/other disposals of outputs)

1.2.iii Sampling Frame Work

The total number of farmers in N.W.F.P. constituted the universe of this study. Since the proper sampling frame for the whole universe could not be facilitated by the secondary source, therefore, the multi-stage/stratified random

sampling technique has been used. Applying this technique, at a first stage the entire population has been categorized into various homogeneous strata on the basis of given characteristics. At a second stage, sub-sample units or sub-strata have been chosen and sample size is distributed among the different sub-sample units, applying the appropriate criterion. The simple random samples have been drawn from each sub-sample unit. Pakistan Agricultural Research council (PARC) has divided the Province into four agro-climatic zones, viz. Northern irrigated plains (or Peshawar zone), Wet mountains (or Northern hilly region), Western dry mountains (or Kohat zone) and Barani-land (or the Sulaiman pied mountains). For the purpose of this study, in the first stage, one district called a stratum has been selected from each zone on random basis. In the second stage, the number of sample villages called sub-sample units from each sample district has been proportionated to the number of villages in these districts selected randomly. In the third stage, in a similar way the sample farms are distributed and selected.

1.2.iv Sample Size and Distribution

Homogeneity is assumed in the general ecology of the villages drawn from the same agro-climatic zone, hence even a small number of villages, selected on random basis would fairly represent the whole zone. It is, therefore, proposed that twenty sample villages are to be distributed proportionately to the total number of villages in each stratum and to be selected by the random

method. Similarly homogeneity is generally found in the basic characteristics of the farms located in the same village within the same agro-climatic zone, therefore, a sample size of 200 would be fairly representative of the whole if it was drawn randomly. A list of all the farmers has been prepared for each sub-sample unit with a sample size of 200 distributed proportionately in each sample village. The respondents have been selected, using the simple random sampling technique.

For proportionate distribution, the following expression of Proportional stratified sampling technique has been applied:

$$n_s = \frac{n N_s}{N}$$

where

n_s = Sub-sample drawn from the n th stratum

n = Total size of the sample

N_s = Size of the n th stratum

N = Size of the population

1.3 ANALYTICAL TECHNIQUES

While analyzing the farm data, in addition to the proportions, averages, standard deviations and cross tabulation, the following statistical, econometric and mathematical techniques have been applied:

1.3.i Statistical Techniques

i) For testing the significance of estimated parameters the following test statistics is applied.

$$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} \quad \text{with } v = n-1 \text{ d.f}$$

ii) While testing the significance of difference between two means, where $\delta_1 \neq \delta_2$ and unknown, the following 't' statistics is used:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad \text{with "V" d.f}$$

where

$$V = \frac{\left[\left(\frac{s_1^2}{n_1} \right) + \left(\frac{s_2^2}{n_2} \right) \right]^2}{\frac{(s_1^2 / n_1)^2}{n_1 - 1} + \frac{(s_2^2 / n_2)^2}{n_2 - 1}}$$

iii) To find out the degree of relationship between the two variables e.g. X and Y, the following expression for coefficient of correlation is used:

$$r = \frac{(X - \bar{X})(Y - \bar{Y})^2}{\sqrt{\Sigma(X - \bar{X})^2 \Sigma(Y - \bar{Y})^2}}$$

1.3.ii Econometric Techniques

i) *Consumption Functions*

Applying the Ordinary Least Squares (OLS) method, the following linear consumption function is estimated for various farms.

$$C = \beta_0 + \sum_{i=1}^6 \beta_i X_i + U$$

where

C = Consumption. (in Rs.)

X₁ = Income (in Rs.)

X₂ = Family size (in No.)

X₃ = Literate members (in No.)

X₄ = D₁ = Dummy variable for farm size

X₅ = D₂ = Dummy variable for tenurial Status

X₆ = D₃ = Dummy variable for mechanization state

U = Residual term/error term

β_0, β_i = Parameters

ii) *Estimation of Cobb-Douglas Production Functions*

To analyze the input-output relationship and to ascertain the stages of production, the Cobb-Douglas production function such that $Y = AK^\alpha L^\beta e^U$ is used, with the following production function estimated for various farms:

$$\ln Y = \ln \beta_0 + \sum_{i=1}^4 \beta_i \ln X_i + U$$

Where

Y = Total farm income (in Rs.)

X_1 = Land (rental value per farm in Rs.)

X_2 = Labour (sum of expenditure on hired labour and imputed value of family labour in Rs.)

X_3 = Capital (sum of cash inputs and imputed value of assets per farm in Rs.)

X_4 = Management (imputed value of management per farm in Rs.)

U = Error term

β_0 = Annovation (impact of technology)

β_i = Parameters (factor productivity)

Ln = Natural logarithm

To test the goodness of fit and the overall significance of the estimated functions, the following expressions for the coefficient of multiple determination and F- ratio are used:

$$R^2 = 1 - \frac{\sum e_i^2}{n - K}$$

and

$$F^* = \frac{\hat{Y}^2 / K - 1}{\sum e^2 / n - K} \text{ respectively.}$$

iii) *Computation of Marginal Physical Products (MPP) of Inputs*

The Marginal Physical Products of input "i" is estimated by taking the first partial derivatives of the above mentioned estimated Cobb-Douglas production function with respect to the input "i" thus:

$$MPP_x = \frac{\partial Y}{\partial x_i} = \frac{\partial}{\partial x_i} (L\mu\beta_0 \sum_{i=1}^4 \beta_i L\mu X_i + U)$$

iv) *Test for Structural Change*

The Chow F- ratio is used for testing the structural difference between different farm sizes, tenurial statuses and other categories of the agrarian structure (e.g. mechanized and non- mechanized farming, irrigated and un-irrigated etc.). This test helps in comparing parameters of the models for different types of farms and decides whether various farms lie on the same production line. The form of the Chow F-ratio is expressed as:

$$F^* = \frac{\Sigma e_p^2 - (\Sigma e_1^2 + \Sigma e_2^2) / K}{(\Sigma e_1^2 + \Sigma e_2^2) / (n_1 + n_2 - 2K)}$$

Where

- F^* = Estimated Chow F-ratio
- Σe_p^2 = Unexplained variation in the pooled model
- Σe_1^2 = Unexplained variation in model for category-1
- Σe_2^2 = Unexplained variation in model for category-2
- n_1 = Number of category-1 farms
- n_2 = Number of category-2 farms
- K = Total number of parameters

v) *Test for Profit Inefficiency Hypothesis*

The Stochastic Translog Profit function is estimated. In this type of profit function, there are two errors, one to present efficiency component and the other the random component. The profit function is of the type as follows:

$$\ln \Pi = \beta_0 + \sum_{i=1}^n \beta_i \ln P_i + \sum_{i=1}^n \sum_{j=1}^n v_{ij} \ln P_i \ln P_j + v_L \ln L + \frac{1}{2} v_{LL} (\ln L)^2 + \sum_{i=1}^n v_{iL} \ln L \ln P_i + \epsilon_i$$

Where

Π = Normalized profit

P_i = Normalized input and output prices

L = Land input

ϵ_i = Compound disturbance term (i.e. $V_i + U_i$), U is the inefficient component)

δ_j s and V s = Constant parameters

The population average technical efficiency is as under:

$$E(e^{-U}) = 2e^{-\sigma^2 u^2 / 2} [1 - F(\sigma u)]$$

The measurement of the farm level efficiency e^{-U} , requires first decomposing of ϵ into two individual components U and V . The conditional mean of U given " ϵ " is computed by the expression.

$$E(U | \epsilon) = \frac{\sigma_U \sigma_V}{\sigma} \left[\frac{f(\epsilon \lambda / \sigma)}{1 - F(\epsilon \lambda / \sigma)} - \frac{\epsilon \lambda}{\sigma} \right]$$

Where $\lambda = \frac{\sigma_U}{\sigma_V}$, $\sigma^2 = \sigma^2_U + \sigma^2_V$, while for ϵ , λ , and σ the estimated values are used.

1.3.iii Mathematical Techniques

i) *Formulation of Linear Programming (LP) model*

The statistical and econometric techniques discussed in the above sections 'A' and 'B' provide sufficient information for the identification of various constraints and their nature. To analyze the effects of these constraints on the economic efficiency of farms (i.e. farm productivity and farmers' income) and to determine which of these constraints are binding upon and severely limiting the farmers' potential, Linear programming models are developed, with the following model applied:

The objective function is to maximize the profit that is:

$$\text{Max. profit} = \text{Max. } Y = \sum_{i=1}^n P_i X_i$$

Subject to the constraints:

$$1) \quad \text{Land} = \sum_{i=1}^n \sum_{j=1}^{12} A X_{ij} \leq A$$

$$2) \quad \text{Water} = \sum_{i=1}^n \sum_{j=1}^{12} W X_{ij} \leq W$$

$$3) \quad \text{Labour} = \sum_{i=1}^n \sum_{j=1}^{12} L X_{ij} \leq L$$

$$4) \quad \text{Bullock hours} = \sum_{i=1}^n \sum_{j=1}^{12} B X_{ij} \leq B$$

$$5) \quad \text{Working capital} = \sum_{i=1}^n \sum_{j=1}^{12} K X_{ij} \leq K$$

The non-negativity constraint is $X_i \geq 0$

where

- Y = Net revenue (in Rs.)
- P_i = Net revenue per acre from crop/activity 'I' (in Rs.)
- X_i = Area under crop "i"
- AX_{ij} = Area under crop "i" in jth quarter (in acres).
- WX_{ij} = Water used for crop "i" in jth quarter (in acre inches).
- LX_{ij} = Human labour used for crop "i" in jth quarter (in hours).
- BX_{ij} = Bullock labour used for crop "i" in jth quarter (in hours).
- KX_{ij} = Working capital allocated to crop "i" in jth quarter (in Rs.)
- A = Total availability of Land (in acres)
- W = Total availability of irrigation water (in acre inches)
- L = Total availability of human labour (in hours)
- B = Total availability of bullock labour (in hours)
- K = Total availability of working capital (in Rs.)
- i = Denoting crops, which vary from 1,2,3, ... n
- j = Denoting months of the year which vary from 1,2,3,..... 12.

After estimating the LP model, the sensitivity of the identified constraints is analyzed.

ii) *Testing the Viability of Agricultural Project/Study*

Once the agrarian structure and economic efficiency of the sample farms are analyzed in detail, then the question "whether the agricultural project or study

is economically viable?" is to be answered. For responding this question, cost-benefit analysis (CBA) is required. For this purpose an attempt has been made to identify total costs and benefits (social/economic and financial) of the sample farms, during the latest two years (i.e. two Rabi and two Kharif seasons) with the following decision criteria are applied for examining the economic viability of farming:

- * Net Present Value (NPV)
- * Benefit Cost Ratio (BCR)
- * Internal Rate of Return (IRR) (both economic and financial) for which the following computations were required:

$$NPV = \sum_{t=0}^n \frac{Bt - Ct}{(1+r)^t}$$

$$BCR = \frac{\sum_{t=0}^n \frac{Bt}{(1+r)^t}}{\sum_{t=0}^n \frac{Ct}{(1+r)^t}}$$

For the computation of IRR, two discount rates have been determined giving two NPVs (one positive and the other negative), and then the following formula has been applied:

$$IRR = \left(\text{Lower discount rate} \right) + \left(\frac{\text{Difference between the two discount rates}}{\text{Difference between the two NPVs}} \right) \times \left(\frac{\text{NPV, at lower discount rate}}{\text{Absolute difference between the two NPVs}} \right)$$

Where B and C stand for benefits and costs respectively, "t" is the time period and "r" is the discount rate.

1.4 ORGANIZATION OF THE STUDY

This thesis is organized into ten chapters. The first chapter highlights the "Introduction", with the main items discussed in this chapter are the research design (main objectives etc.), research methodology and analytical techniques etc. The "review of literature" is summarized in the Chapter II. The Chapter III describes "the existing state of agrarian structure". "Socio-economic profile of the farmers" is analyzed in Chapter IV, while Chapter V focuses on "the agrarian structure, farm efficiency and farm income". "Input-output relationship and stages of production" have been determined in Chapter VI. Chapter VII is devoted to "consumption pattern and living standard of farmers". Chapter VIII highlights "the linear programming models and sensitivity analysis of the selected constraints". The economic viability of the agricultural project/study has been examined in Chapter IX. The last Chapter X summarizes the "Conclusion and Suggestions".

CHAPTER II

REVIEW OF LITERATURE

2.0 INTRODUCTION

The main objective of this chapter is: to define various terms used in the study; and, to review the relevant literature. Such a review will provide conceptual insight for further development of a frame work for empirical analysis. This is provided in the subsequent sections that follow:

2.1 CONCEPTUAL REVIEW

The Pakistan Census of Agriculture, 1960 has defined different terms as under:

- i. *VILLAGE* means a demarcated territorial unit designated as a *mouza*, *deh* or *chak* in the revenue records.
- ii. *AGRICULTURAL HOLDINGS* are of two types:
 - a. Farms; and
 - b. Livestock holdings without land.
- iii. *FARM* is the aggregate area of land operated by one person alone or with the assistance of others, without regard to location and size or little, used wholly or partly for agricultural production. Area of land situated in different villages but under the same operational control

would constitute one farm. Operation of a farm means, planning of its utilization and the implementation of such plans.

- iv. *FARMER* is a person or group of persons, in actual possession of the farm, who plans the utilization of the farm and implements the plans either directly or through hired labour and bears the financial responsibility of these operations.
- v. *TENURE* classification of the farms has been made in the following three tenure groups:
 - a. Owner-farmer: a farmer who owns his farm;
 - b. Tenant: a farmer who operates land belonging to others and pays fixed rent in cash or kind or a share of the produce; and
 - c. Owner-cum-tenant: a farmer who owns a part of his farm and has the rest of it as a tenant.

Owner-farmer includes a mortgagee in possession of land and allocatee of evacuee property and a person in owner-like possession, for example, a son operating the land in the life time of his father.

- vi. *INDIVIDUAL FARM* means a farm operated jointly by one or more persons as members of the same household. On the other hand, *JOINT FARM* means a farm operated jointly by two or more persons of different households.

- vii. *FRAGMENT* is a piece of land farming as part of a farm. When a farm is splited into pieces and not linked with one another in any manner, each piece would constitute a fragment.
- viii. *TOTAL FARM AREA* includes total culturable and unculturable land contained in the farms, but do not include area outside the farms such as area under government forests, roads, railways, schools, playgrounds, canals, river, *abadi dehi*, urban area, undistributed government lands, etc. Consequently, the farm area of an administrative unit would be less than the total land area of that unit.
- ix. *NET SOWN AREA* means the cultivated farm area actually cropped during the year regardless of the number of crops raised and it includes area under fruit trees for the same year.
- x. *CURRENT FALLOW* means the cultivated area which is not being cropped during the current year, but has been cropped during the proceeding year.
- xi. *CURRENT WASTE* is the farm area which is fit for cultivation but which has not cropped during the survey year.
- xii. *AREA NOT AVAILABLE FOR CULTIVATION* means unculturable area of the farm and the area used for buildings, or farm roads etc. and therefore, is not available for cultivation..

xiii. *TOTAL CULTURABLE AREA* includes cultivated area and culturable waste.

xiv. *INTENSITY OF LAND USE* represents the ratio in which the net sown area stands to the culturable area of the farm. It indicates the extent to which the culturable land has been used for production. The present intensity of land use in a farm is determined as follows:

$$\frac{\text{Net sown area}}{\text{Culturable area}} \times 100$$

xv. *INTENSITY OF CROPPING* represents the ratio in which the total area of crops stand to the net sown area. It indicates the extent to which one and the same area is used for cropping. The percent cropping intensity is determined as follows:

$$\frac{\text{Total cropped area}}{\text{Net sown area}} \times 100$$

xvi. CROP SEASONS are:

- a. Kharif season; and
- b. Rabi season

Kharif crops are sown in summer and harvested in late summer or early winter. Important Kharif crops are cotton, rice, sugarcane, maize, *jawar* and *bajra*, etc.

Rabi crops are sown in winter and harvested in early summer. Important Rabi crops are wheat, gram, barley, rape seed and mustard, etc.

- xvii. SMALL FARM is defined differently by different social scientists as under:

Carlin and Crecink (1979) argued that a desirable small farm, definition should have an underlying conceptual basis. It is derived from two basic concepts: the first is that of a low volume of business establishment (poor gross farm output); the second is that of a farm operated by a family having a low level of economic income.

Wood (1978) has observed that the range in definition of small farms varies from acres of land, units of livestock, value of farm product sold, days worked off-farm, level of farm income to level of total family income.

Gangwar and Ghakhar (1975) outlined the following criteria to define small farms on the basis of previous work.

- a. Size of holding: The small farm is defined by the size of the operation holding. This is the simplest and most commonly used criterion.
- b. Income: This criterion recognizes that the size of holding is not the same for all the regions. That is irrigated and un-irrigated, plain and hilly region etc. Therefore, the small scale farm is explained in terms of income generated from the farm.

- c. Organization of the Farm: A number of dimensions are used for farm classification, e.g., the ratio of family labour to hired labour, the ratio of owned capital to borrowed capital, decision making etc.
- d. Degree of Integration: This criterion seeks to measure the extent of integration and inter-dependence of the farm with its environments. For example, the amount of production sold compared with the portion withheld for internal consumption.

They, however, pointed out that these criteria are not adequately valuable for identifying small farms. Referring to workshop on the Marketing Problems of Small Farms held at the Michigan State University, they defined a small farm as are:

- a. The bulk of labour force, management and capital come from the same household,
- b. production is either consumed on the farm and/or traded in local markets,
- c. the decision making process is hampered by limited access to marketing and political institutions; and
- d. farmers do not live much above the culturally determined subsistence level.

Umali (1975) has stated that because of variation in productivity of land, small farms cannot be defined on the basis of size of land holding alone. Thus, the definition of small farmers must include some indication of income, either individual

or household, because on disposable income depends the ability to save, to gain credit, and thus introduce improvements to the farm holding.

Singh (1979) defined small farmers as those with between 2.5 and 5 acres of operated area, whose holding at present levels of productivity provide a standard of living at the bare margin of subsistence but where future farm productivity increases could definitely provide an adequate standard of living.

From the above mentioned evidences, it is obvious that there are a number of bases for defining small farms. However, farm size is the most commonly basis. In Pakistan's Sixth Five-year Plan, holdings of less than 12.00 acres have been regarded as small farm. For the purpose of this dissertation, it is suggested to classify holdings of less than 12.5 acres as small farms, 12.5 to 25.0 acres, as medium farms and above 25.0 acres as large farms. However, broadly speaking it is decided that holdings of less than 12.5 acres are regarded as "small" farms; and above 12.5 acres are termed as "large" farms.

2.2 EMPIRICAL REVIEW

This section analyzes the literature relevant to the agrarian structure and its efficiency in empirical perspective.

2.2.i The Agrarian Structure and Productivity Efficiency

Economists have long been debating the question whether small or large farms are more productive. The answer to such a question has very crucial policy

implications. *Singh (1981)* has argued that there are commonly held view about peasant agriculture, especially in Asian conditions, but small farms are more productive than large. *Berry and Cline (1979)* and *Griffin (1970)* provided facts about an inverse relationship between farm size and productivity. A review work on this argument is presented here.

Singh (1979) held that small farmers have higher land productivity (total output per acre) under traditional technologies. He based such argument on the basis of analysis of data of farm management study (FMS) from over 3000 owner farms in 6 states of India. He observed a consistent pattern of negative relationship between farm size owned and productivity in all sample states. A large number of studies have confirmed the above finding. *Khan (1977)* using 1974 data from 498 irrigated farms in Punjab and 234 irrigated farms in Sind found a significant inverse relationship between total output per acre and farm size, in spite of significantly positive relationship between yield per acre of individual crops and farm size. *Rudra (1968)* also found that even where this inverse relationship held for all crops, it did not necessarily mean that it held for individual crops. Thus the small farms have higher productivity per acre. *Chattopadhyay and Rudra (1977)* have stated that individual crop yields are often positively related to the farm size. The higher overall productivity of small farms is, however, still evident from the results of these studies.

Mahmood and Haq (1981) have tested negative relationship for Pakistan and concluded that the observed negative or positive correlations between land productivity and the farm size in Pakistan are the result of over-aggregation. They argued that the productivity is high on small farms due to intensive labour and irrigation use and on large farms due to capital intensive input. They further observed that the middle level efficient entrepreneur farmer has so far failed to emerge.

Bardhan (1973) has interviewed 1000 individual Indian farm to analyze (a) the well-known inverse relationship between farm size and productivity (b) returns to scale, and (c) imperfection in the labour market. He observed a constant return to scale in predominantly wet area, and diminishing return to scale in paddy areas. He further stated that both in paddy and wheat agriculture, the observed negative relation between output per acre and farm size is likely to be the result more of an inverse relation between size and other inputs than of scale diseconomies. He also discussed that production uncertainty and interlinked phenomena of land and labour market imperfections are the factors which contributed to this inverse relation.

Bagi (1983) conducted a study to empirically analyze the relationship between farm size, productivity, demand for inputs of production in India. He observed that the per hectare production is about 14 percent higher on the small irrigated farms than that on the large irrigated farms. Furthermore, he argued that the irrigated small farms are able to allocate their resources relatively more efficiently as compared to irrigated large farms.

Chaudhry et al. (1985) conducted a study to examine the size and productivity relationship in Pakistan as it shaped in the seventies as an aftermath of the Green Revolution. They observed that the traditional inverse relationship between farm size and productivity still existed in Pakistan precluding the possibility of a positive or quadratic type of relationship. They further observed that the reasons of such inverse relationship are higher labour input, more intensive land use, greater manurial application and greater irrigated area of small farmers in relation to the large ones.

Chattopadhyay & Rudra (1976) and Bhardwaj (1974) held that small farms have higher cropping intensities, which are closely related to their higher irrigation intensities. They further stated that higher cropping intensities explain higher productivity per acre on small farms.

Singh (1981) described that small farmers are more efficient in the use of their resources than larger and better endowed farmers. This efficient utilization of resources also explains higher land productivity. A large number of studies have confirmed this argument and these are reviewed here.

Shultz (1964) explained that Indian peasant farmers are poor but efficient. *Hopper (1965)* showed from a small (43 farms) sample in an Uttar Pradesh village that farming in traditional Indian agriculture is efficient. He did not test for relative

efficiency by size as most of his sample consisted of ownership holdings of less than 5 acres.

Sahota (1968) explicitly tested differences in efficiency under traditional technologies using the farm management data from the 50's for various states and regions and he found no significant differences in efficiency by farm size. *Saini (1969)* also confirmed the same findings. *Lau and Yotopoulos (1971)* used somewhat improved methodology and concluded that small farms are relatively more efficient than large farms.

Khan and Maki (1980) conducted a study titled, "The relative efficiency by farm size and the green revolution in Pakistan", using the unit output price profit function, analyzed the relative efficiency of (a) old versus new seeds, and (b) large versus small farms in the production of new varieties of wheat and rice in the Indus Basin of Pakistan. They found that HYVs of wheat and rice are more efficient than old varieties. They observed no difference in efficiency by farm size in producing the new seeds of wheat and rice. A large number of other studies testing efficiency by determining whether the marginal value product of any input is equal to input price, generally found producers to be reasonably efficient. There is thus considerable evidence to support the hypothesis that there are comparatively few significant inefficiencies in the allocation of factors of production in traditional agriculture (see, for example, *Hopper, 1965; Chennareddy, 1967; Massel, 1967; Massel and*

adoption of new biological and mechanical technologies, the productivity gap between them and large farmer is being reduced and in some cases reversed.

Chattopadhyay and Rudra (1976) specially argued against the generalizations discussed earlier. They made a comparison of results from farm management studies data from '50's and the late '60's for the same districts and found weaker inverse relationship between farm size and productivity.

Singh and Patel (1975) examined the validity of the hypothesis of inverse relationship between farm size and productivity using 1969-70 data from 120 small, medium and large farms in Meerut district. They indicated that the hypothesis of inverse relationship did not hold true under the new agricultural technology in the area under study.

Khan (1979) using farm data, indicated that large farms are relatively more productive because of their greater use of non-traditional inputs. He further observed that the input intensity of large farms is due to market distortion induced by public policy.

Salam (1978) observed that previously known phenomenon of higher per acre yield under traditional farm technology obtaining on small farms is gradually disappearing. He argued that it is hypothesized that unequal access to modern factor markets including institutional and extension services may be partly responsible for

adoption of new biological and mechanical technologies, the productivity gap between them and large farmer is being reduced and in some cases reversed.

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Salam (1978) observed that previously known phenomenon of higher per acre yield under traditional farm technology obtaining on small farms is gradually disappearing. He argued that it is hypothesized that unequal access to modern factor markets including institutional and extension services may be partly responsible for

that. He pointed out that owner operated farms obtained higher per acre yields than the tenant operated farms. He also concluded that average yields obtaining on fertilizer using farms are significantly higher than those obtaining on farms not using any fertilizer.

The production efficiency is corroborated by the technical and allocative efficiencies within the reach of economic efficiency which are discussed below:

2.2.ii Technical Efficiency

Grosskopf (1986) showed that the extent of overall efficiency can be greatly influenced by assumptions about the functional forms. Restrictive functional forms, e.g., *Cobb-Douglas*, yield a relative low overall inefficiency. *Russel and Young (1983)* pointed out that economic environment is an important determining factor of economic efficiency analysis. Monopolistic influence of the government on prices does not reflect relative scarcity. Under these circumstances an individual enterpriser may maximize profit and this may not be inefficient from society's point of view.

There are several other empirical studies which have tried to measure the extent of technical inefficiency. *Shapiror and Muler (1977)* observed that there is a technical inefficiency of 34 percent of for cotton crop in Tanzania. They used a probabilistic linear programming model to estimate the technical inefficiency. *Kalirajan and Flinn (1981)* reported technical inefficiency to the tune of 53 percent for rice crop in India. *Lingard et al. (1981)*, in a research study on rice crop in

Philippines, observed that there was technical inefficiency of 50 percent. They used analysis of co-variance with firm specific dummies. *Mijindadi and Norman (1984)* have studied technical efficiency for the whole farm with a sample of 340 in Nigeria. They used probabilistic linear programming model to measure technical inefficiency. They found inefficiency of 8 percent.

Another study, *Belbase and Grabowski (1985)*, held that average inefficiency in Nepal is 20 percent. They concluded that the major factors influencing inefficiency are income, nutrition, education and experience of farmer. Like this study, *Phillips and Marble (1988)* measured average inefficiency for maize crop in Guatemala and found it to be 25 percent and the major determinant of efficiency has been education.

Taylor and Shonkwiler (1986) studied that in Brazil on the basis of the whole farm analysis the average inefficiency is 30 percent. *Kalirajan (1981)* for tamil Nadu, India reported average inefficiency for rice crop at the tune of 53 percent. Similarly *Kalirajan and Shand (1985)* in the case of Malaysia showed that there is inefficiency of 31 to 35 percent with tenancy as the main causing factor.

Kalirajan and Flinn (1983) for rice crop in the Philippines indicated that inefficiency is at the rate of 50 percent.

Shah and Parikh (1992a) has used various approaches to measure technical efficiency in the North West Frontier Province of Pakistan. They have used a cross

sectional data of 397 farms and applied Cobb-Douglas and Translog production functions to estimate technical efficiency. The estimated farm level technical efficiency has been circumscribed by socio-economic and demographic factors. It has been mentioned that credit, higher education of farmers, young age of farmers, and large assets contribute positively towards the improvement of technical efficiency.

In another study, *Shah and Parickh (1992b)* have estimated farm level efficiency using the Stochastic Frontier approach with the flexible functional form. Their results indicated that profit function based efficiency is generally lower than cost or production function based efficiency in the Pakistan's farms. Relating estimated efficiency to social, economic and demographic variables, it has been pointed out that subsistence needs in a developing agriculture largely contribute to inefficiency at a farm level. Credit and financial assets tend to reduce inefficiency, while fragmentation of land and large size of holding contribute to greater inefficiency. The results indicate that the greater family size reduces inefficiency; the older the household the greater the inefficiency; more years of education of the household head reduces inefficiency and the great wealth, assets or credit tend to reduce inefficiency. As farmers' subsistence needs are satisfied by their own production of food crops, it tends to contribute positively to inefficiency as these prevent farmers to minimize their costs and restrict them to achieving cost efficiency.

2.2.iii Allocative Efficiency

Farm efficiency is one of the most important subject in developing agriculture. How to measure farm efficiency when equally there are different factors leading to inefficiency, has drawn enormous attention in the economic literature. Three distinct approaches are: cost, profit and production oriented. *Farrel (1957)* developed the concepts of technical efficiency based on input and output relationships. Technical inefficiency arises when actual or observed output form a given input mix is less than the maximum possible output; while allocative inefficiency arises when the input mix is different from that under profit maximization. Farrel provided a measure of technical and price efficiency which can be empirically used to measure both these inefficiencies. He proposed that instead of an absolute measure of efficiency, the efficiency be measured in relative sense as a deviation from the best performance. He also introduced the distinction between technical and allocative efficiency.

Farrell's analysis of technical efficiency leads quite easily to two different measures of technical efficiency: as the ratio of technically minimal to actual inputs given output and the input mix; or as the ratio of actual to technically maximal output given input. *Fare and Lovell (1978)* pointed out that the input based measure (cost minimization principle) of technical efficiency is equivalent to the output maximization one only in the case of homogeneous technology with constant returns to scale.

T.W. Schultz has advanced the hypothesis that "the agricultural sector in a large class of poor countries is relatively efficient in using factors of production at its disposal." "Given the land at the disposal of farmers and the state of their knowledge, they are not under utilizing the land by the way they farm. Nor are they misallocating the reproducible material capital at their disposal... they are not misallocating their own labour nor other labour that is available to them...."

Schultz's hypothesis is based on a particular definition of traditional agriculture. He discards the description of traditional agriculture based on difference in "cultural" values and argues that a simple economic explanation will suffice. He treats traditional agriculture "as a particular type of economic equilibrium. Viewed ex-post, it is an equilibrium at which agriculture gradually arrives over along period, provided particular condition prevails.... The critical conditions underlying this type of equilibrium, either historically or in the future, are as follow: (1) the state of cf the arts remains constant, (2) the state of preference and motives for holding and acquiring sources of income remains constant, and (3) both of these states remain constant long enough for marginal preferences and motives for acquiring agricultural factors as sources of income to arrive at an equilibrium with the marginal productivity of the sources viewed as an investment in permanent income streams and with net savings approaching zero."

In support of his hypothesis, in the context of Indian agriculture, Schultz draws evidence from a limited though a pioneering study in a village in north India. *W.E. Hopper (1965)* though inadequate, some recent studies relating to Indian agriculture lend support to Schultz's hypothesis, yet, the evidence is either not so conclusive or not free from bias of one kind or the other¹. There also exists some findings which strongly suggest the existence in Indian agriculture of the possibility of increasing farm incomes through reallocation of given resource.² *Schultz*, however, is of the strong opinion that the widely held belief that there are many unexhausted opportunities readily available to farmers in poor countries is patently false. His views on this point are fully supported by *V.M. Dandekar (1966)*.

Some studies reject the output and profit maximizing behaviour at least in the case of small farms. But the statistical evidence on this issue is rather inadequate. For

¹ See for example, *Raj Krishna (1964)*, *Gian S. Sahota (1968)* and *Venkareddy Chennareddy (1967)*. Among similar studies, mention may also be made of *Falcon and Gostch (1967)* for Pakistan, *Totopoulos (1968)* for Greece, *Mundalk, Yair (1965)* for Israel, and *D.E. Welsch (1965)* for Nigeria.

² *D.K. Desai (1963)*, *Randhawa N.S. and Earl. Heady (1964)*. *C.H. Hanumantha Rao's* study also indicates some economic margins that remain unexhausted particularly in respect of sugarcane in Uttar-Pradesh, jute in West Bengal, and cotton in Punjab (i). Rao's evidence at best is inconclusive because it does not show whether there exists a significant potential for increasing farm incomes in the regions he studied

instance, a study (*Mellor and Stevens, 1956*) relating to 104 rice farms at Bang Chan, Thailand, employs labour stock measured in man-equivalents in estimating the productivity of labour. The ordinary least squares (OLS) linear regression results indicated that the marginal value of labour will be zero or close to zero". *Harry T. Oshima (1963)* considered it hazardous to regard this study as conclusive for either theoretical or policy use. He stated: "the spread of the data in the scatter diagram relating rice yields to labour inputs for each of the 104 farms suggests to me, not a linear regression line as it does to the authors, but inadequate data and/or dubious assumptions".

2.3 ON-FARM YIELD CONSTRAINTS RESEARCH IN PAKISTAN

A series of reports by National Fertilizer Corporation (NFC) and Ford Foundation on yield constraints research in Pakistan have spelt out the potential yield gap, factor contribution and benefit cost ratios for rice, cotton, maize, sugarcane and wheat crops, for the period of Kharif 1980, Rabi 1979-80 and Kharif and Rabi 1981-82 with the application of IRRI methodology especially designed for this purpose in Punjab, Sind and NWFP Province of Pakistan.

The NFC (1981) conducted 15 (14 irrigated and one barani) wheat experiments during Rabi 1979-80 in the above mentioned Provinces of Pakistan.

The salient findings of these experiments are:

- Although total technology package has resulted in increased per acre wheat yield, it does not present economically sound benefit-cost ratios on irrigated wheat. The potential yield gap for barani wheat is two fold of the irrigated which suggests a great scope for the introduction of technology package in barani areas.
- Chemical fertilizer is the single test factor explaining 73 to 80 per cent of the total potential yield gap in wheat irrigated, but its benefit-cost ratio has never exceeded 2.07:1 whereas in barani area, the yield gap is due to fertilizer alone.

The NFC (1981) has also conducted 15 cotton, rice and maize experiments during Kharif 1980 in the above mentioned Provinces.

The salient findings are:

- The improved technology package give higher per acre yield than farmers' practices for all crops under study.
- The total technology package (all improved practices) does not give higher per acre yield than individual test factor/factor combination.
- The total technology package does not show economically viable benefit-cost ratios for the crops under study.

- By far the single most important finding of the study is that chemical fertilizers show both the highest factor contribution and attractive benefit-cost ratios (more than 3:1) of all the test actors for the crops under study.

The NFC (1983) has further conducted 19 experiments (15 on wheat and 4 on sugarcane) during 1981-82 in the same Provinces, the salient findings of which are:

- The average per acre yield gap for wheat irrigated is 15.62 maunds which appears to be a substantial contribution of the improved practices over the farmers practices.
- The average potential yield gap is 420.57 maunds per acre in case of sugarcane which is quite a substantial contribution of improved practices.

Ali (1983) has discussed some methodological issues and considerations in constraints research in Pakistan. He has argued that constraints research concerns two major areas of investigation. The first area primarily deals with identification of biological factors responsible for yield gap at farmers field. The second area relates to the study of socio-economic constraints resulting, in low adoption of new technology by the farmers and thereby causing yield gap.

He has stated that preliminary surveys are conducted about the existing and potential yield levels to identify yield gap. The surveys include the study of input use

levels and their availability, per acre yields, farmers' knowledge, credit availability and extension services. Such information helps to identify the area with substantial yield gap. Following this, field experiments are conducted on farmers' fields using a set of 3-4 selected new technologies and compared with farmers' practices. Such experiments provide reliable information for measuring yield gap on the basis of yield obtained with the new technologies and the ones obtained under farmer practices. In fact such experiments provide answer to the question of what factors are responsible for the yield gap.

The economic analysis of experimental data helps in determining the size of yield gap. It depends upon the quality of technology used. The better is the technology, the large is the gap positively. The information collected through socio-economic survey provides answer to the question as to why the farmers are not adopting the new yielding and profiting technology.

CHAPTER III

EXISTING STATE OF THE AGRARIAN STRUCTURE

3.0 INTRODUCTION

This chapter elaborates the existing state of the agrarian structure of the study area. Specifically, it comments on: the tenurial status; size of operational holding; land fragmentation; and utilization; irrigation modes; incidence of water logging and salinity; cropping pattern; production of major crops; land use intensity; and cropping in the sampled areas.

3.1 TENURIAL STATUS

Table 3.1 shows that a majority (55%) of the farmers are owners with 25% owner-cum-tenants and 21% as pure tenants. The sampled farms are, therefore, predominantly owner farms with some owners who could not maintain their household farms and thus have enhanced their farm sizes by renting in land from others. This also infers that there are land owners who either cannot or do not want to cultivate their farms themselves and have thus rented them out. This pattern of tenurial status is being exhibited uniformly in small and large size farms together without any considerable variation (Table 3.1).

Table 3.1
Distribution of Sample Farms by Tenure and Farm Size

Tenure	Small Farms			Large Farms			All Farms
	Under 5.0 acres	5.0 to under 12.5 acres	Total	12.5 to under 25.0 acres	25.0 and above	Total	
Owner	34 (54.84)	49 (54.44)	83 (54.61)	17 (47.22)	9 (75.00)	26 (54.17)	109 (54.50)
Owner cum tenant	15 (24.19)	22 (24.44)	37 (24.34)	10 (27.78)	2 (16.67)	12 (25.00)	49 (24.50)
Tenant	13 (20.97)	19 (21.11)	32 (21.05)	9 (25.00)	1 (8.33)	10 (20.83)	42 (21.00)
All Tenures	62 (100.00)	90 (100.00)	152 (100.00)	36 (100.00)	12 (100.00)	48 (100.00)	200 (100.00)

Note: Figures in parenthesis indicate their respective percentages.

3.2 OPERATIONAL HOLDINGS

Out of 1870 acres of the operational holdings, 54% is in possession of the pure owners, 24% is managed by the owner-cum-tenant and only 22% is cultivated by the pure tenants. This distribution almost corresponds with the distribution of tenurial status of farmers the discussed earlier. Again there is no variation in the percentages of operational holdings in the small farms versus the large farms (Table 3.2.i)

The average operational holding is ranging between 9.26 to 9.35 acres, which infers that the average operational holdings are within the category of the small farm size. The distribution of operational holdings among different tenurial classes is somewhat uniform within each farm size i.e. around 6 acres in the small farms category, around 20 acres in the large farm sizes and around 9 acres on average. (Table 3.2-ii)

Table 3.2.i
Total Operational Holdings by Tenure and Farm Size

(Area in Acres)

Tenure	Small Farms			Large Farm			All farms
	Under 5.0 acres	5.0 to under 12.5 acres	Total	12.5 to under 25.0 acres	25.0 and above	Total	
Owner	101.66 (52.93)	365.05 (51.02)	466.71 (51.43)	258.32 (43.23)	284.04 (77.86)	542.36 (56.36)	1009.07 (53.97)
Owner cum tenant	45.15 (23.51)	178.64 (24.97)	223.79 (24.66)	177.92 (29.78)	54.28 (14.88)	232.20 (24.13)	455.99 (24.39)
Tenant	45.24 (23.56)	171.76 (24.01)	217.00 (23.91)	161.30 (26.99)	26.50 (7.26)	187.80 (19.51)	404.80 (21.64)
All Tenures	192.05 (100.00)	715.45 (100.00)	907.50 (100.00)	3597.54 (100.00)	364.82 (100.00)	962.36 (100.00)	1869.86 (100.00)

Note: Figures in parentheses indicate their respective percentages.

Table 3.2.ii
Average Operational Holdings by Tenure and Farm Size

(Area in Acres)

Tenure	Small Farms			Large Farm			All Farms
	Under 5.0 acres	5.0 to under 12.5 acres	Total	12.5 to under 25.0 acres	25.0 and above	Total	
Owners	2.99 (1.05)	7.45 (2.13)	5.62 (1.04)	15.20 (2.10)	31.56 (2.25)	20.86 (1.37)	9.26 (1.02)
Owner cum tenant	3.01 (0.76)	8.12 (1.11)	6.05 (1.30)	17.79 (2.33)	27.14 (3.51)	19.35 (2.01)	9.31 (1.00)
Tenants	3.48 (1.01)	9.04 (1.16)	6.78 (1.03)	17.92 (3.85)	26.50 (2.43)	18.78 (2.25)	9.64 (1.05)
All Tenures	3.10 (0.71)	7.95 (0.84)	5.97 (1.00)	16.60 (2.02)	30.40 (4.85)	20.05 (2.16)	9.35 (0.98)

Note: Figures in Parentheses are the Standard Deviations.

3.3 LAND UTILIZATION

The small farmers appear better in land utilization than the large farmers. The former cultivates 81% of land holdings while the latter cultivates only 70% of their farms. On average 75% of the land is cultivated while 25% of the farm remains uncultivated.

Analyzing the same issue from another angle it appears that tenants are the best in land utilization among different tenurial patterns. Pure tenants cultivate 95% of their farms, while pure owners cultivate only 67%. Since tenants have to pay the rent, they, therefore, have to extract as much as possible from the rented land. Thus their efficiency over the owners is circumstantial rather than technological. (Table 3.3-i).

Table 3.3.i
Land Utilization by Farm Size and Tenure

(Area in Acres)

Farm Size/ Land Use	TENURE							
	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	Area	%age	Area	%age	Area	%age	Area	%age
(A) Small Farms (under 12.5 acres)								
Cultivated	346.34	74.21	182.35	81.48	206.75	95.28	735.44	81.04
Uncultivated	120.37	25.79	41.44	18.52	10.25	4.72	172.06	18.96
Total - A	466.71	100.00	223.79	100.00	217.00	100.00	9.7.50	100.00
(B) Large Farms (12.5 and above)								
Cultivated	329.70	60.79	167.10	71.96	178.30	94.94	675.10	70.15
Uncultivated	212.66	39.21	65.10	28.04	9.50	5.06	287.26	29.85
Total - B	542.36	100.00	232.20	100.00	187.80	100.00	962.36	100.00
(C) All Farms (A+B)								
Cultivated	676.04	67.00	349.45	76.64	385.05	95.12	1410.54	75.44
Uncultivated	33.30	33.00	106.54	23.36	19.75	4.89	459.32	24.56
Total - C	1009.07	100.00	455.99	100.00	4.4.80	100.00	1869.86	100.00

The percentage of net sown area is exactly congruent with the pattern of land utilization as discussed earlier. It is 75% in the small and 64% in the large farms. The culturable waste, however, is positively correlated with farm size, which is 13% in the small and 18% in the large farms (Table 3.3-ii).

Table 3.3.ii.

Land Utilization by Break up and Farm Size

(Area in Acres)

Break up of Land utilization	Small Farms (under 12.5 acres)		Large Farms (12.5 and above)		All Farms	
	Area	%age	Area	%age	Area	%age
<u>(A) Cultivated Area</u>						
Net Sown Area	686.44	75.64	617.56	64.17	1304.00	69.74
Current Fallow	49.00	5.40	57.54	5.98	106.54	5.70
Total - A	735.44	81.04	675.10	70.15	1410.54	75.44
<u>(B) Uncultivated Area</u>						
Area Under Forest	41.00	4.52	79.32	8.24	120.32	6.43
Cultivable Wastes	117.06	12.90	173.94	18.07	291.00	15.56
Not available for cultivation	14.00	1.54	34.00	3.53	48.00	2.57
Total - B	172.06	18.96	287.26	29.85	459.32	24.56
<u>(C) All Farms (A+B)</u>						
Total Farm Area (A+B)	907.50	100.00	962.36	100.00	1869.86	100.00

3.4 IRRIGATION STATUS

About 80% of the small and 73% of the large farms are irrigated. Similarly a greater percentage of the tenant farms (83%) is irrigated while a lower of 75 percent of the owner farms is irrigated (Table 3.4.i).

Table 3.4.i
Classification of the Sample Farms by Tenure
Farm Size and Irrigation Status

(Area in Acres)

Farm Size and Irrigation Status	TUNURE							
	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	No.	%age	No.	%age	No.	%age	No.	%age
(A) Small Farms								
Irrigated	64	77.11	31	83.78	27	84.38	122	80.26
Un-Irrigated	19	22.89	6	16.22	5	15.62	30	19.74
Total - A	83	100.00	37	100.00	32	100.00	152	100.00
(B) Large Farms								
Irrigated	18	69.23	9	75.00	8	80.00	35	72.92
Un-Irrigated	8	30.77	3	25.00	2	20.00	13	27.08
Total - B	26	100.00	12	100.00	10	100.00	48	100.00
(C) All Farms (A+B)								
Irrigated	82	75.23	40	81.63	35	83.33	157	78.50
Un-Irrigated	27	24.77	9	18.37	7	16.67	43	21.50
Total - C	109	100.00	49	100.00	42	100.00	200	100.00

The small farms are better placed with respect to irrigation with 92% of such farms are irrigated. In large farms the percentage of irrigated area drops to 80%. Again tenants are having a higher percentage of irrigated area than owners. (Table 3.4.ii).

Table 3.4.ii

**Irrigation Status of the Sample Cultivated Area
By Farm Size and Tenure**

(Area in Acres)

Farm Size and Irrigation Status	TUNURE							
	Owners		Owner-cum- Tenants		Tenants		All Tenures	
	Area	%age	Area	%age	Area	%age	Area	%age
(A) Small Farms (under 12.5 acres)								
Irrigated	307.34	88.74	170.10	93.28	197.75	95.65	675.19	91.81
Un-Irrigated	39.00	11.26	12.25	6.72	9.00	4.35	60.25	8.19
Total - A	346.34	100.00	182.35	100.00	206.75	100.00	735.44	100.00
(B) Large Farms (12.5 and above)								
Irrigated	253.20	76.80	135.10	80.85	148.30	83.17	536.6	79.48
Un-Irrigated	76.50	23.20	32.00	19.15	30.00	16.83	138.5	20.52
Total - B	329.70	100.00	167.10	100.00	178.30	100.00	675.10	100.00
(C) All Farms (A+B)								
Irrigated	560.54	82.82	305.20	87.34	346.05	89.87	1211.79	85.91
Un-Irrigated	115.50	17.08	44.25	12.66	39.00	10.13	198.75	14.04
Total - C	676.04	100.00	349.45	100.00	385.05	100.00	1410.54	100.00

The mode of irrigation is predominantly canal water; covering 60% of the irrigated area. The deficiency in canal irrigation is covered by tube-wells, covering approximately 18%, with the rest irrigated with alternative means such as streams, Persian wheels, etc. (Table 3.4.iii)

Table 3.4.iii

**Distribution of Sample Farms by Source of
Irrigation, Farm Size and Tenure**

(In percentage)

Source of irrigation	Small farms (under 12.5 acres)				Large farms (12.5 and above)				All Farms			
	O	O.C.T	T	All small	O	O.C.T	T	All large	O	O.C.T	T	All farms
Cannal	51.96	61.50	72.23	63.50	39.60	59.58	69.47	56.12	45.78	60.54	70.90	59.80
Tubewells	20.15	16.35	13.50	15.13	27.39	19.25	17.12	21.25	23.76	17.81	15.30	18.16
Stream	9.50	6.00	4.04	6.05	15.04	6.03	5.13	8.75	11.63	6.02	4.64	7.42
Canal + Tubewells	8.23	8.50	6.02	8.00	9.78	5.30	6.25	7.15	9.59	6.91	6.14	7.59
Others	10.16	7.65	4.10	7.32	8.19	9.84	2.03	6.73	9.11	8.75	3.08	7.03

3.5 LAND FRAGMENTATION

Land fragmentation is predominantly common in NWFP. The process of land fragmentation still continues and is getting severe over time. The data indicate as many as 86% of the farms fragmented into pieces. These percentages are 88% in small, 79% in large, 83% in owner and 91% in tenant farms. The problem of fragmentation being global is uniformly affecting farmers irrespective of their tenurial status. (Table 3.5.i). On average small farms are having 4 and large farms 5 fragmented pieces. Similarly owner farms are having 4 and tenant farms 5 fragmented pieces each. (Table 3.5-ii).

Table 3.5.i

**Distribution of the Sample Farms by Size, Tenure,
And Fragmentation Status of Land Holdings**

(Area in Acres)

Farm Size and fragmentation Status	TENURE							
	Owners		Owner-cum- Tenants		Tenants		All Tenures	
	No.	%age	No.	%age	No.	%age	No.	%age
(A) Small Farms								
Fragmented	71	85.54	33	89.19	29	90.63	133	87.50
Non-fragmented	12	14.46	4	10.81	3	9.37	19	12.50
Total- A	83	100.00	37	100.00	32	100.00	152	100.00
(B) Large Farms								
Fragmented	20	76.92	9	75.00	9	90.00	38	79.17
Non-fragmented	6	23.08	3	25.00	1	10.00	10	20.83
Total- B	26	100.00	12	100.00	10	100.00	48	100.00
(C) All Farms (A+B)								
Fragmented	91	83.49	42	85.71	38	90.48	171	85.50
Non-fragmented	18	16.51	7	14.29	4	9.52	29	14.50
Total - C	109	100.00	49	100.00	42	100.00	200	100.00

Table 3.5.ii

**Average Number of Fragments of Sample Land
Holdings by Tenure and Farm Size**

Farm Size (in Acres)	Tenure			
	Owners	Owners-cum- Tenants	Tenants	All Tenures
(A) Small Farms				
Below 5.0	3.6	3.9	4.1	4.0
5.0 to 12.5	3.8	4.7	4.9	4.5
Total - A	3.7	4.4	4.6	4.3
(B) Large Farms				
12.5 to 25.0	4.6	5.1	5.7	5.2
25.0 to above	5.2	5.4	5.9	5.6
Total - B	4.8	5.3	5.8	5.4
All Farms (A+B)	4.4	4.9	5.3	4.9

3.6 WATER LOGGING AND SALINITY

The menace of water logging and salinity is very severe in NWFP and negatively affecting the agrarian sector. It is discovered that 11% of the small and 48% of the large farmers have been affected by the problem. Similarly 23% of the owners and 14% of the tenants have been affected by it. (Table 3.6-i).

Table 3.6.i

Distribution of the Sample Farms by Tenure, Farm Size and Incidence of Water Logging and Salinity

Farm Size and Incidence of W & S	TUNURE							
	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	No.	%age	No.	%age	No.	%age	No.	%age
(A) Small Farms								
Affected by W & S	11	13.25	3	8.11	2	6.25	16	10.53
Not affected by W & S	72	86.75	34	91.89	30	93.75	136	89.47
Total - A	83	100.00	37	100.00	32	100.00	152	100.00
(B) Large Farms								
Affected by W & S	14	53	5	41.67	4	40.00	23	47.92
Not affected by W & S	12	46.15	7	58.33	6	60.00	25	52.08
Total - B	26	100.00	12	100.00	10	100.00	48	100.00
(C) All Farms (A+B)								
Affected by W & S	25	22.94	8	16.33	6	14.29	39	19.50
Not affected by W & S	84	77.06	41	83.67	36	85.71	161	80.50
Total - C	109	100.00	49	100.00	42	100.00	200	100.00

W = Water Logging

S = Salinity

On average 18% of the farm area has been affected by water logging and salinity. The percentage of the affected area is comparatively higher in large (23%) than in small farms (12%). The distribution of the affected area among different tenurial classes has not been highly skewed, it is 18% in the owner and 17% in the rented farms. (Table 3.6-ii).

Table 3.6.ii
Water logged and Saline Area on Sample Farms
By Tenurial Status and Farm Size

Farm Size and Area affected	(Area in Acres)							
	TENURE							
	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	Area	%age	Area	%age	Area	%age	Area	%age
(A) Small Farms								
Area affected by W & S	58.21	12.47	27.54	12.31	23.50	10.83	109.25	12.04
Area not affected by W & S	4.8.50	87.53	196.25	87.69	193.50	89.17	798.25	87.96
Total - A	466.71	100.00	223.79	100.00	217.00	100.00	97.50	100.00
(B) Large Farms								
Area affected by W & S	121.16	22.34	58.95	25.39	45.75	24.36	225.86	23.47
Area not affected by W & S	421.20	77.66	173.25	74.61	142.05	76.04	736.50	76.53
Total - B	542.36	100.00	232.20	100.00	187.80	100.00	962.36	100.00
(C) All Farms								
Area affected by W & S	179.37	17.78	86.49	18.97	69.25	17.11	335.11	17.92
Area not affected by W & S	829.70	82.22	369.50	81.03	335.55	82.89	1534.75	82.08
Total - C	1009.07	100.00	455.99	100.00	404.80	100.00	1869.86	100.00

W = Water Logging

S = Salinity

3.7 CROPPING PATTERN

The cropping pattern in the sample farms is such that staple crops like wheat and maize have remained dominant, covering 66% and 49% of the farm areas respectively in Rabi and Kharif seasons. Dominant variations have been occurred in

different farm sizes, for example, in small farms wheat occupies 73% while maize is cultivated on 60% of the farm area which is clearly higher to the overall averages of the same crops. The percentages of these crops have a downward movement in large farms (Table 3.7-i).

Table 3.7.i
Cropping Pattern on the Sample Farms by Farm Size

Crops	Farm Size					
	Small Farms		Large Farms		All Farms	
	Area	%age	Area	%age	Area	%age
(A) Rabi Crops						
Wheat	498.50	72.62	364.00	58.94	862.50	66.14
Gram	103.35	15.06	167.15	27.07	270.50	20.74
Barley	2.00	0.29	1.25	0.20	3.25	0.25
R. vegetable	23.50	3.42	38.85	6.29	62.35	4.78
R. fruits	2.12	0.31	10.13	1.64	12.25	0.94
R. fodder	49.50	7.21	31.70	5.13	81.20	6.23
Other Rabi crops	7.47	1.09	4.48	0.73	11.95	0.92
Total - A	686.44	100.00	617.56	100.00	1304	100.00
(B) Kharif Crops						
Maize	413.75	59.72	224.50	36.08	638.25	48.53
Sugarcane	153.75	22.19	221.50	35.60	375.25	28.54
Rice	30.50	4.40	90.00	14.46	120.50	9.16
K. vegetable	22.50	3.25	29.25	4.70	51.75	3.94
K. fruits	2.30	0.33	13.00	2.09	15.30	1.16
K. fodder	31.50	4.55	21.50	3.46	53.00	4.03
Other crops	38.49	5.56	22.50	3.61	60.99	4.64
Total - B	692.79	100.00	622.25	100.00	1315.04	100.00
Total Cropped Area (A+B)	1379.23	-	1239.81	-	2619.04	-

The dominance of staple food crops has remained intact in various tenurial classes, indicating the fact that the agricultural sector in NWFP is at the bare subsistence level, with the core activity of producing for the household than for the market (Table 3.7-ii).

Table 3.7.ii
Cropping Pattern in the Sample Farms by Tenure

Crops	Tenure							
	Owners		O.C.T		Tenants		All Farms	
	Area	%age	Area	%age	Area	%age	Area	%age
(A) RABI CROPS								
Wheat	399	64.98	211.5	66.30	252	67.93	862.50	66.14
Gram	135.5	22.07	65.5	20.53	69.5	18.73	270.50	20.74
Barley	0.25	0.04	1.25	0.39	1.75	0.47	3.25	0.25
R. vegetable	37	6.03	15.25	4.78	10.10	2.72	62.35	4.78
R. fruits	7.5	1.22	3.50	1.10	1.25	0.34	12.25	0.94
R. fodder	31.20	5.08	19.75	6.19	30.25	8.15	81.20	6.23
Other Rabi crops	3.55	0.58	2.25	0.71	6.15	1.66	11.95	0.92
Total - A	614	100.00	319	100.00	371	100.00	1304	100.00
(B) KHARIF CROPS								
Maize	278.70	45.09	140.25	43.29	219.30	58.59	638.25	48.53
Sugarcane	195.50	31.63	102.50	31.63	77.25	20.71	375.25	28.54
Rice	71.25	11.53	36.25	11.19	13.00	3.49	120.50	9.16
K. vegetable	11.50	1.86	10.75	3.23	29.50	7.91	51.75	3.94
K. fruits	9.50	1.54	4.50	1.39	1.30	0.35	15.30	1.16
K. fodder	19.25	3.12	12.25	3.78	21.50	5.76	53.00	4.03
Other crops	32.34	5.23	17.50	5.40	11.15	2.99	60.99	4.64
Total - B	618.04	100.00	324	100.00	373	100.00	1315.04	100.00
Total cropped Area (A+B)	1232.04	-	643	-	744	-	2619.04	-

3.8 LAND USE INTENSITY

The land use intensity has been estimated at 77% in the sample area. It is higher (80%) on the rented farms than (75%) on the owner farms. Similarly the small farms have appeared better in land use than the large farms. The land use intensity for the former has been 81% while it is 73% for the later. (Table 3.8).

Table 3.8
Total Production of Major Crops on the Sample Farms
By Tenure and Farm Size

(in maunds)

Tenure/Farm Size	Wheat	Maize	Sugarcane	Rice	Grams	R. Vegetable	K. Vegetable
(A) OWNERS							
Small Farms	3137	2263	19038	327	54	2581	489
Large Farms	2907	1339	33594	1281	96	3891	565
Total - A	6044	3602	52632	1608	150	6472	1054
(B) OWNER-CUM-TENANTS							
Small Farms	3376	2383	18276	350	64	2521	533
Large Farms	2765	1417	33225	1167	106	4014	606
Total - B	6141	3800	51501	1517	170	6535	1139
(C) TENANTS							
Small Farms	3582	2553	16499	397	71	2430	553
Large Farms	2445	1592	32856	1107	146	4080	628
Total - C	6027	4145	49355	1504	217	6510	1181
(D) ALL TENURES (A+B+C)							
Small Farms	10095	7199	53813	1074	189	7532	1575
Large Farms	8117	4348	99675	3555	348	11985	1799
Total - D	18212	11577	153488	4629	537	19517	3374

The higher percentage of land use intensity suggests further intervention for increasing land use, which if is raised to 100%, the farmers' income would increase to 23%. At the low level of land use, it is obvious that the agrarian sector is undergoing a deficiency which can be removed with great efforts. The 23% gap is wide enough which warrants government intervention indeed.

3.9 CROPPING INTENSITY

On average cropping intensity has been estimated at 201% in the project/study area. This infers that the net sown area is cultivated at least twice in one calendar year. The cropping intensity has remained almost the same in small and large farms together. It is, however, varying among different tenurial arrangements, for example, on owner farms the cropping intensity is almost identical with the overall average, while on tenant farms it is upto 207%.

By introducing appropriate cropping patterns the cropping intensity can further be enhanced to 300%, which would need proper propagation of crop packages developed both by the provincial and national research systems.

Table 3.9
Cropping Intensity by Tenure Farm Size

(Area in acres)

Tenure/Farm Size	Total Cropped Area	Net Sown Area	Cropping Intensity
<u>A. Owners</u>			
Small Farms	669.58	312.74	214.10
Large Farm	562.46	301.56	186.52
Total – A	1232.04	614.30	200.56
<u>B. Owners-cum-tenants</u>			
Small Farms	357.10	175.20	203.82
Large Farm	285.90	154.36	185.22
Total – B	643.00	329.56	195.11
<u>C. Tenants</u>			
Small Farms	352.55	198.50	177.61
Large Farm	391.45	161.64	242.17
Total – C	744.00	360.14	206.59
<u>D. All Tenures</u>			
Small Farms	1379.23	686.44	200.93
Large Farm	1239.81	617.56	200.76
Total – D	2619.04	1304.00	200.85

CHAPTER IV

SOCIO-ECONOMIC PROFILE

4.0 INTRODUCTION

This chapter elaborates the salient features of the farm households with special focus upon their family size, age, sex, literacy and working status. It is believed that these profiles do affect the productivity of the farmers, their priorities for various crops raising and scale of operations.

4.1 FAMILY SIZE

On average, there has been 10 members per household in the sample area. Which is in conformity with the Provincial average and is thus indicative of the accuracy and representativeness of the sample data. This average remains almost the same for different farm sizes but varies among tenurial arrangements, for example, it is still 10 in owner but rises to 11 in tenant families (Table 4.1).

Table 4.1
Family Size of the Sample Households
by Tenure and Farm Size

Tenure	Small Farms		Large Farms		All Farms	
	Total	Average	Total	Average	Total	Average
Owners	818	9.86(1.03)	261	10.04(1.95)	1079	9.90(2.07)
Owners-cum-Tenants	318	9.35 (1.01)	110	9.17 (1.43)	428	8.73(0.77)
Tenants	355	11.09(2.04)	86	8.60(0.87)	441	10.50(1.86)
All Tenants	1491	9.81(1.53)	457	9.52 (1.64)	1948	9.74(1.05)

Note: Figures in parentheses are respective Standard Deviations

4.2 AGE DISTRIBUTION AND GENDER RATIO

The female population is slightly higher to male population in both the farm sizes. About 50% of the farm population has been found in the working age (18-60 years), with more than 50% either too old or too young to work, indicating immense pressure of dependency (more than 50%) over the working population. The dependency ratio appears higher in large than in small farm families (Table 4.2-i). It is higher on owner (52%) than on tenant farms (48%) (Table 4.2-ii).

Tables 4.2.i

Age Composition of the Sample Households by Farm Size and Sex

Farm Size/Age (years)	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Small Farms						
Upto -5	92	12.60	100	13.14	192	12.89
6-17	242	33.15	260	34.16	52	3.49
18-60	366	50.14	374	49.15	740	49.63
Above -60	30	4.11	27	3.55	57	3.82
Total-A	730	100.00	761	100.00	1491	100.00
B. Large Farms						
Upto -5	35	15.70	36	15.38	71	15.54
6-17	69	30.94	79	33.76	148	32.39
18-60	107	47.98	105	44.87	212	46.39
Above -60	12	5.38	14	5.99	26	5.68
Total-B	233	100.00	234	100.00	457	100.00
C. All Farms (A+B)						
Upto -5	127	13.33	136	13.67	263	13.50
6-17	311	32.63	339	34.07	650	33.37
18-60	473	49.63	479	48.14	952	48.87
Above -60	42	4.41	41	4.12	83	4.26
Total-C	953	100.00	995	100.00	1948	100.00

Tables 4.2.ii

**Distribution of the Sample Household
Members by Age and Tenure**

Farm Size/Age (Years)	Owners		Owner-cum- tenant		Tenants		All Tenures	
	No.	% age	No.	% age	No.	% age	No.	% age
A. Small Farms								
Upto -5	116	14.18	31	9.75	45	12.68	192	12.88
6-17	273	33.37	111	34.90	118	33.24	502	33.67
18-60	396	48.41	162	50.94	182	51.27	740	49.63
Above -60	33	4.04	14	4.41	10	2.81	57	3.82
Total-A	818	100.00	318	100.00	355	100.0	1491	100.0
B. Large Farms								
Upto -5	35	13.41	30	27.27	6	6.98	71	15.54
6-17	85	32.57	33	30	30	34.88	148	32.38
18-60	125	47.89	45	40.91	42	48.84	212	46.39
Above -60	16	6.13	2	1.82	8	9.30	26	5.69
Total-B	261	100.00	110	100.00	86	100.0	457	100.0
C. All Farms (A+B)								
Upto -5	151	14.00	61	14.25	51	11.56	263	13.50
6-17	358	33.17	144	33.64	148	33.56	650	33.37
18-60	521	48.29	2.7	48.37	224	50.80	952	48.87
Above -60	49	4.54	16	3.74	18	4.08	83	4.26
Total-C	1079	100.00	428	100.00	441	100.0	1948	100.0

4.3 LITERACY STATUS¹

On average, only 18% of the population has been found literate. The literacy level has been estimated at a low level of 4% for female population. The literacy level of women is directly related to farm size, in small farm families only 1%, and

¹ The household members of at least 6 years age have been assessed while Infants and toddlers below 6 years age have been excluded.

in large farm families 11% of the women are literate. The male literacy level also creeps up with increase in farm size. (Table 4.3-i).

Tables 4.3.i
Literacy Status of the Sample Population
by Farm Size and Sex

Farm Size/Literacy Status	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Small Farms						
Literate	186	29.15	9	1.36	195	15.01
Illiterate	452	70.85	652	98.64	1104	84.99
Total-A	638	100.00	661	100.00	1299	100.00
B. Large Farms						
Literate	80	42.55	22	11.11	102	26.42
Illiterate	108	57.45	176	88.89	284	73.58
Total-B	188	100.00	198	100.00	386	100.00
C. All Farms						
Literate	266	32.20	31	3.60	297	17.63
Illiterate	560	67.80	828	96.40	1388	82.37
Total-C	826	100.00	859	100.00	1685	100.00

The literacy level of the sampled population has been sensitive to their tenurial pattern, it is estimated at 19% in the owner and 16% in the tenant groups. The male literacy level has exhibited the same pattern i.e. higher (34%) in owner and (30%) in tenant groups. The female literacy level has been 4% in the owner and 2% in the tenant groups. (Table 4.3-ii).

Tables 4.3.ii

**Distribution of the Sample Population
by Tenure and Literacy**

Farm Size/Literacy Status	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
<u>A. Owners</u>						
Literate	153	33.62	19	4.02	172	18.53
Illiterate	302	66.38	454	95.98	756	81.47
Total-A	455	100.00	473	100.00	928	100.00
<u>B. Owner-Cum-Tenants</u>						
Literate	56	31.46	8	4.32	64	17.44
Illiterate	122	68.54	181	95.77	303	82.56
Total-B	178	100.00	189	100.00	367	100.00
<u>C. Tenants</u>						
Literate	57	29.54	4	2.03	61	15.64
Illiterate	136	70.46	193	97.97	329	84.36
Total-C	193	100.00	197	100.00	390	100.00
<u>D. All Tenures (A+B+C)</u>						
Literate	266	32.20	31	3.61	297	17.63
Illiterate	560	67.80	828	96.39	1388	82.37
Total-D	826	100.00	859	100.00	1685	100.00

4.3.i Level of Education

The literate population of the sampled household (297 persons) are at different levels of education. Most of them are young and still attending schools. A quarter of them are at the primary while another quarter are at the middle schools' levels, followed by 23% at S.S.C., 16% at FA/F.Sc., 8% at B.A/B.Sc and 3% at MA/M.Sc levels, with one percent only in professional education. A higher

proportion of the literate population (at college and university levels) has been found in large farm families (Table 4.3-iii). Gaps in levels of formal education of the sample population associating with different tenurial patterns are even wider, as no one in the tenant family farms has been found educated both at postgraduate or professional levels. (Table 4.3-iv)

Table 4.3.iii
Level of Education of the Literate Sample
Household Members by Farm Size

Level of Education	Small Farms			Large Farms			All Farms		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Professional	1 (.054)	-	1 (0.51)	3 (3.75)	-	3 (2.94)	4 (1.50)	-	4 (1.35)
M.A/M.Sc	2 (1.08)	-	2 (1.03)	7 (8.75)	1 (4.55)	8 (7.84)	9 (3.38)	1 (3.23)	10 (3.37)
B.A/BSc	12 (6.45)	-	12 (6.15)	12 (15.00)	1 (4.55)	13 (12.75)	24 (9.02)	1 (3.23)	25 (8.42)
F.A/FSc	26 (13.98)	-	26 (13.33)	18 (22.5)	3 (13.64)	21 (20.59)	44 (16.54)	3 (9.68)	47 (15.82)
S.S.C	48 (25.81)	1 (11.11)	49 (25.13)	12 (15.00)	6 (27.27)	18 (17.65)	60 (22.56)	7 (22.58)	67 (22.56)
Middle	49 (26.44)	3 (33.33)	52 (26.67)	13 (16.25)	6 (27.27)	19 (18.63)	62 (23.31)	9 (29.03)	71 (23.91)
Primary	48 (25.81)	5 (55.56)	53 (27.18)	15 (18.75)	5 (22.73)	20 (19.61)	63 (23.68)	10 (32.26)	73 (24.58)
Total	186 (100.00)	9 (100.00)	195 (100.00)	80 (100.00)	22 (100.00)	102 (100.00)	266 (100.00)	31 (100.00)	297 (100.00)

Table 4.3.iv
Distribution of Sample Literate Members
by Level of Education and Tenure

Level of Education	Owners			Owner-Cum-Tenants			Tenants			All Farms		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Professional	3 (1.96)	-	3 (1.74)	1 (1.79)	-	1 (1.56)	-	-	-	4 (1.50)	-	4 (1.35)
M.A/M.Sc	7 (4.58)	1 (5.26)	8 (4.65)	2 (3.57)	-	2 (3.13)	-	-	-	9 (3.38)	1 (3.23)	10 (3.37)
B.A/BSc	15 (9.80)	1 (5.26)	16 (9.30)	5 (8.93)	-	5 (7.81)	4 (7.02)	-	4 (6.56)	24 (9.02)	1 (3.23)	25 (8.42)
F.A/FSc	24 (15.67)	2 (10.52)	26 (15.12)	10 (17.86)	1 (12.50)	11 (17.19)	10 (17.54)	-	10 (16.39)	44 (16.54)	3 (9.68)	47 (15.82)
S.S.C	29 (18.95)	6 (31.58)	35 (20.35)	14 (25.00)	1 (12.50)	15 (23.44)	17 (29.82)	-	17 (27.87)	60 (22.56)	7 (22.58)	67 (22.56)
Middle	37 (24.18)	4 (21.05)	41 (23.84)	13 (23.21)	3 (37.50)	16 (25.00)	12 (21.05)	2 (50.00)	14 (22.95)	62 (23.31)	9 (29.03)	71 (23.91)
Primary	38 (24.84)	5 (26.32)	43 (25.00)	11 (19.64)	3 (37.50)	14 (21.88)	14 (24.56)	2 (50.00)	16 (26.23)	63 (23.68)	10 (32.26)	73 (24.58)
Total	153 (100.00)	19 (100.00)	172 (100.00)	56 (100.00)	8 (100.00)	64 (100.00)	57 (100.00)	4 (100.00)	61 (100.00)	266 (100.00)	31 (100.00)	297 (100.00)

4.4 WORKING STATUS

At the working age only 45% of the farm population have been found employed. The ratio of unemployment has been very sensitive to gender, as in male 83% and in female 7% of the labour force are found employed. Some variation has also been occurred at different farm sizes, where a higher percentage has been employed in large than in small farms (Table 4.4-i).

The rate of employment has been estimated at 46% and 44% in the owner and tenant farm families, respectively (Table 4.4 ii).

Tables 4.4.i
Working Status of the Sample Labor Force
(18-60 years age group) by Farm Size and Sex

Farm Size/Working Status	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Small Farms						
Employed	310	84.70	21	5.61	331	44.73
Unemployed	56	15.30	353	94.39	409	55.27
Total-A	366	100.00	374	100.00	740	100.00
B. Large Farms						
Employed	84	78.50	14	13.33	98	46.22
Unemployed	23	21.50	91	86.67	114	53.78
Total-B	107	100.00	105	100.00	212	100.00
C. All Farms (A+B)						
Employed	394	83.30	35	7.31	429	45.06
Unemployed	79	16.70	444	92.69	523	54.94
Total-C	473	100.00	479	100.00	952	100.00

Tables 4.4.ii
Working Status of the Sample Force
(18-60 years age group) by Tenure and Sex

Tenure/Working Status	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Owners						
Employed	217	83.46	21	8.05	238	45.68
Unemployed	43	16.54	240	91.95	283	54.32
Total-A	260	100.00	261	100.00	521	100.00
B. Owner-cum-Tenants						
Employed	83	81.37	9	8.57	92	44.44
Unemployed	19	18.63	96	91.43	115	55.56
Total-B	102	100.00	105	100.00	207	100.00
C. Tenants						
Employed	94	84.68	5	4.42	99	44.20
Unemployed	17	15.32	108	95.58	125	55.80
Total-C	111	100.00	113	100.00	224	100.00
D. All Tenures (A+B+C)						
Employed	394	83.30	35	7.30	429	45.06
Unemployed	79	16.70	444	92.70	523	54.94
Total-D	473	100.00	479	100.00	952	100.00

4.4.i Locus of Employment

A majority (92%) of the employed population has been engaged in their own farms while 8% have had off farm emplacements. It is common in NWFP that some family members work outside their farms for supplementing household income. The number of the off-farm workers in absolute term stands higher in men than in women, while in percentages females have taken the lead, which infers that the ratio of off-farm workers to farm workers is higher in women than in men. This is true also in case of both the farm sizes but with their ratio differences. (Table 4.4.iii). Considering this in context of different tenurial patterns, the ratio is higher for male tenants than for male owners. In the tenant group, however, no female has had off the farm employment. Hence on average, the ratio of the off-farm workers to farm workers stands higher in tenant than in owner families (Table 4.4 iv).

Tables 4.4.iii
Locus of Employment of the Employed Members
By Farm Size and Sex

Farm Size/Locus of Employment	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Small Farms						
On Farm	290	93.55	18	85.71	308	93.05
Off Farms	20	6.45	3	14.29	23	6.95
Total-A	310	100.00	21	100.00	331	100.00
B. Large Farms						
On Farm	78	92.86	10	71.43	88	89.80
Off Farms	6	7.14	4	28.57	10	10.20
Total-B	84	100.00	14	100.00	98	100.00
C. All Farms (A+B)						
On Farm	368	93.40	28	80	396	92.31
Off Farms	26	6.60	7	20	33	7.69
Total-C	394	100.00	35	100.00	429	100.00

Table 4.4.iv
Locus of Employment of the Employed Members
by Tenure and Sex

Tenure/Locus of Employment	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Owners						
On Farm	203	93.55	17	80.95	220	92.44
Off Farms	14	6.45	4	19.05	18	7.56
Total-A	217	100.00	21	100.00	238	100.00
B. Owner-cum-Tenants						
On Farm	79	95.18	6	66.67	85	92.39
Off Farms	4	4.82	3	33.33	7	7.61
Total-B	83	100.00	9	100.00	92	100.00
C. Tenants						
On Farm	86	91.49	5		91	91.91
Off Farms	8	8.51	-	100.00	8	8.09
Total-C	94	100.00	5	100.00	99	100.00
D. All Tenures (A+B+C)						
On Farm	368	93.40	28	80	396	92.31
Off Farm	26	6.60	7	20	33	7.69
Total-D	394	100.00	35	100.00	429	100.00

4.4.ii Dependency

The ratio of dependency is generally high in Pakistan, it is even higher in NWFP, because of joint family system and high ratio of unemployment, which is even strongly endorsed by data of the sampled population. Generally the ratio of dependents to the earners has been estimated at 51:49 in the sampled area, it is 50:50 in small, 54:46 in large farm families and 50:50 and 52:48 ratios between male and female population of the sample area respectively. (Table 4.4.v) This ratio with respect to tenurial status has remained at 52:48 for owner and 49:51 for tenant groups. (Table 4.4.vi).

Tables 4.4.v
Dependent Class by Farm Size and Sex

Farm Size/Dependent Class	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
A. Small Farms						
On Farm	364	49.86	387	50.85	751	50.37
Off Farms	366	50.14	374	49.15	740	49.63
Total-A	730	100.00	761	100.00	1491	100.00
B. Large Farms						
On Farm	116	52.01	129	55.13	245	53.61
Off Farms	107	47.99	105	44.87	212	46.39
Total-B	223	100.00	234	100.00	457	100.00
C. All Farms (A+B)						
On Farm	480	50.37	516	51.86	996	51.13
Off Farms	473	49.63	479	48.14	952	48.87
Total-C	953	100.00	995	100.00	1948	100.00

Tables 4.4.vi
Dependent Class by Tenure Size and Sex

Tenure/Dependent Class	Male		Female		Both Sexes	
	No.	% age	No.	% age	No.	% age
<u>A. Owners</u>						
Dependent Class	270	50.94	288	52.46	558	51.71
Labor Force	260	49.06	261	47.54	521	48.29
Total-A	530	100.00	549	100.00	1079	100.00
<u>B. Owner-cum-Tenants</u>						
Dependent Class	110	51.89	111	51.39	221	51.64
Labor Force	102	48.11	105	48.61	207	48.36
Total-B	202	100.00	216	100.00	428	100.00
<u>C. Tenants</u>						
Dependent Class	100	47.39	117	50.87	217	49.21
Labor Force	111	52.61	113	49.13	224	50.79
Total-C	211	100.00	230	100.00	441	100.00
<u>D. All Tenures (A+B+C)</u>						
On Farm	480	50.37	516	51.86	996	51.13
Off Farm	473	49.63	479	48.14	952	48.87
Total-D	953	100.00	995	100.00	1948	100.00

CHAPTER V

THE AGRARIAN STRUCTURE FARM EFFICIENCY AND FARM INCOME

5.0 INTRODUCTION

Every rational producer tries to enhance the efficiency of his farm by producing maximum possible farm output with given inputs. Numerous socio-economic and technological factors influencing the farm productivity and efficiency along with their various constraints, have been identified and elaborated in the preceding chapters. The analysis discovered those socio-economic and agrarian factors responsible for affecting the farm output, income and efficiency. This chapter quantitatively examines the impact of the agrarian structure on the farm efficiency (productivity and income). The chapter is split into various sections, analysing crop yields, farm efficiency (productivity) of key inputs, overall levels of farm income, test of profit inefficiency hypothesis, Lorenz curve and Gini co-efficient of the farm land/income distribution.

5.1 CROP YIELDS

The data in Table 5.1.i reveal that yield per acre of almost all the crops has been higher on the large than on the small farms. However, the labour intensive crops like vegetables indicated higher yield on the small farms. Regarding the impact of tenurial status on the crop yield, a mixed trend has been

observed with per acre yield of wheat lower on the tenant than on the owners' farms, and the reverse of this for the maize.

Table 5.1.i
Per Acre Yield of Major Crops on the Sample Farms by Tenure and Farm Size (In maunds)

Tenure/ Farm Size	Wheat	Maize	Sugarcane	Rice	Grams,	Rabi Vegetable	Kharif Vegetable
(A) OWNERS							
Small Farms	19.05	16.70	375.00	32.18	1.54	329.13	65.11
Large Farms	23.95	17.92	455.00	42.76	1.75	300.49	57.88
Total-A	21.43	17.29	418.00	37.45	1.68	315.01	61.53
(B) OWNER-CUM-TENANTS							
Small Farms	2.050	17.59	360.00	34.45	1.81	321.50	71.08
Large Farms	22.78	18.97	450.00	38.95	1.94	310.00	62.14
Total-B	21.65	18.25	410.00	36.65	1.86	315.64	66.06
(C) TENANTS							
Small Farms	21.75	18.84	325.00	39.16	2.00	309.99	73.65
Large Farms	20.14	21.32	445.00	36.98	2.66	315.04	64.37
Total-C	20.98	20.04	380.00	38.15	2.32	312.72	68.98
(D) ALL TENURES (A+B+C)							
Small Farms	20.26	17.40	350.00	35.21	1.83	320.51	17.00
Large Farms	22.29	19.37	450.00	39.50	2.08	308.49	61.50
Total-D	21.12	18.14	409.00	38.41	1.99	313.02	65.20

5.2 FARM EFFICIENCY IN TERMS OF PRODUCTIVITY OF KEY INPUTS

How far the relationship between the farm size and output productivity is positive or negative is important to be resolved. Different views are being held on this issue. Many observe an inverse relationship between them; on the other hand a significant number of applied economists believe that large farms are more productive than the small ones. However, different outcomes could be expected in different situations on this polemic. The negative or positive correlation between land productivity and the farm size could even be over aggregated. The productivity may be high on the small farms due to intensive use of labour and good irrigation use, while it may be equally high on the large farms for intense use of capital and other inputs. This section empirically examines the land, labour, capital and overall productivities of different farm sizes and different tenancy arrangements.

5.2.i. Land Productivity

The productivity of land is studied from two purviews: yield per acre of crops, which has been computed in terms of maunds (40 kgs) and in terms of money. While the yield per acre has been enumerated in table 5.1.i, and their monetary values are presented in table 5.2.i. The land productivity has been Rupees 4863 per acre. The data has revealed a direct relationship between the land productivity and farm size. The value of output per acre has been Rs. 5004

on the large farms and Rs. 4713 on small farms. The corresponding monetary values of the farms operated by the owners, owner-cum-tenants and tenants have been computed at Rs. 5,039, Rs. 4,787 and Rs. 4,780 respectively, with average of Rs. 4,863.

Table No.5.2.i
Land Productivity of the Sample Farms
by Tenure and Size

Tenure	Productivity (in rupees / acres)		
	Small Farms	Large Farms	All Farms
Owners	4593	5685	5039
Owner-cum-Tenants	4759	4840	4787
Tenants	4874	4675	4780
All Tenures	4713	5004	4863

5.2.ii. Labour Productivity

It is generally assumed that the supply of labour is comparatively greater than demand for labour in the rural areas. Consequently, the labour productivity is low. This subsection describes the situation in the sample area with regard to labour productivity.

The labour productivity of the major crops has been obtained by dividing their production (in kgs) per cultivated acre by labour input (in man-months) per cultivated acre. It is pointed out that the measurement of time span spent by

labour, on the farm is fairly a complicated procedure, resulting from seasonality of farm production and inter farm variation in labour requirements. In this context, the time spent by permanent, hired, casual, family and female labours have been converted into their working man-months. One female working month has been assumed to be equal to 3/4th of man-months. The converted labour input provided by females into man-months and the per cultivated acre production with corresponding per cultivated acre labour productivity for major crops by farm size are enumerated in Table 5.2.ii.

Table 5.2. ii
Labour Productivity of the Sample Farms by Farm Size

Farm size/crop	Production per cultivated Acre (kgs.)	Labor per cultivated acre (Man-Months)	Labor Productivity col.2÷col.3
(1)	(2)	(3)	(4)
A) <u>Small Farms</u>			
Wheat	810	4.5	180.0
Maize	696	4.5	178
Sugarcane	14000	3.9	3255.8
Rice	1408	5.4	260.7
Grams	73	1.2	60.8
Other crops	19840	5.9	33.62.7
All crops	6138	4.3	1427.4
B) <u>Large Farms</u>			
Wheat	892	2.6	343.1
Maize	775	2.9	267.2
Sugarcane	18000	4.1	4390.2
Rice	1580	4.9	322.5
Grams	83	0.9	92.2
Other crops	22764	5.2	4377.7
All crops	7350	3.5	2100.0
C) <u>All Farms (A+B)</u>			
Wheat	845	3.6	234.7
Maize	726	3.3	220.0
Sugarcane	16360	4.2	3895.2
Rice	1536	5.2	295.4
Grams	80	1.1	72.7
Other crops	21554	5.6	3848.9
All crops	6851	3.8	1802.9

For a given piece of one acre of farm land with other required inputs, the average production for all crops per unit of labour input, has been estimated at 1802.9 kgs. Which is 1427.4 kgs for small and 2100.0 kgs for large farms. The

labour productivity of sugarcane, rice, wheat and maize for all sample farms has been calculated at 3895.2 kgs, 295.4 kgs, 234.7 kgs and 220.0 kgs respectively. Almost the same pattern is found on large and small farms. The data reveal that the labour productivity of various crops on large farms is significantly higher than on the small farms, which is attributed either to the small quantity of labour input applied or the use of machinery on the large farms. It is pointed out that the difference in the productivity of various crops is due to the difference in the crop nature and their monetary values and weights, especially vegetables, sugarcane, grams and conversion of fodder into kilograms. The production of one crop per unit of labour appears higher than the other, but its income and importance is less than that of the later crop. For example the productivity of fodders is approximately sixteen times higher than wheat, while the productivity of sugarcane stands seventeen times higher to that of wheat, but in terms of their selling prices or income values such differences in productivities are vanished, which is an indication of the efficiency of labour.

The productivity of labour in major crops by land tenure is shown in table 5.2.iii, which indicates that it is high in almost all crops of the owners and owner-cum-tenant farms, but lower in the rented farms. The difference in productivity is described towards the adoption of mechanization by the land owners.

Table 5.2. iii
Labour Productivity of Major Crops by Tenure

Tenure/crop	Production per cultivated acre (kgs.)	Labor per cultivated acre (Man. Months)	Labor Productivity col.2/col.3
A) <u>Owners</u>			
Wheat	857	3.2	267.8
Maize	692	2.9	238.6
Sugarcane	16720	3.6	4644.4
Rice	1498	4.9	305.7
Grams	67	1.0	67.0
Other crops	19964	5.4	3697.0
All crops	6637	3.5	1896.3
B) <u>Owner-cum-tenants</u>			
Wheat	866	3.4	254.7
Maize	730	3.2	228.1
Sugarcane	16400	4.0	4100.0
Rice	1467	5.1	287.6
Grams	74	1.2	61.7
Other crops	21807	5.5	3964.9
All crops	6879	3.7	1859.2
C) <u>Tenants</u>			
Wheat	839	4.2	199.8
Maize	802	3.7	216.8
Sugarcane	15200	4.8	3166.7
Rice	1526	5.6	272.5
Grams	93	1.2	77.5
Other crops	22890	5.9	3879.7
All Crops	6894	4.2	1641.4
D) <u>All Tenures (A+B+C)</u>			
Wheat	845	3.6	234.7
Maize	726	3.3	220.0
Sugarcane	16360	4.2	3895.2
Rice	1536	5.2	295.4
Grams	80	1.1	72.7
Other crops	21554	5.6	3848.9
All crops	6851	3.8	1802.9

5.2.iii. Capital Productivity

The capital productivity is the ratio of output to capital, which is an important indicator of farm efficiency. For the computation of output-capital ratio, rent as a reward of land and wage as a reward of labour have been excluded while the costs of all other inputs such as seeds, fertilizers, use of farm machinery, insecticides and pesticides etc. have been included in the capital. In this way, the output-capital ratio includes the value of inputs capital, while holding constant the values of land and labour. The total value of farm output comprising of major crops is thus added and divided by the total amount of capital. Output-capital-ratio is the ratio contribution of the capital (excluding the values of land and labour) to aggregate output of the sample farms. Output-capital ratios of the major crops of the sample farms by farm size and tenure are presented in table 5.2.iv.

Table 5.2. iv

Capital Productivity of Major Crops by Farm Size and Tenure
(value of crop output/total capital in Rs.)

Farm Size/Crop	Owners	Owner-cum-Tenants	Tenants	All Farms
A) <u>Small Farms</u>				
Wheat	1.99	2.00	2.05	2.01
Maize	2.29	2.31	2.41	2.34
Sugarcane	2.23	2.09	2.02	2.12
Rice	2.24	2.17	2.16	2.19
Grams	2.79	2.14	0.98	1.97
Other crops	2.23	2.28	2.86	2.45
All crops	2.28	2.16	2.09	2.17
B) <u>Large Farms</u>				
Wheat	2.63	2.64	2.75	2.67
Maize	2.09	2.07	2.17	2.11
Sugarcane	2.71	2.38	2.38	2.49
Rice	2.80	2.43	2.39	2.54
Grams	1.69	1.64	1.58	1.64
Other crops	1.92	1.97	2.37	2.08
All crops	2.31	2.20	2.28	2.28
C) <u>All Farms (A+B)</u>				
Wheat	2.31	2.32	2.41	2.35
Maize	2.19	2.20	2.29	2.21
Sugarcane	2.46	2.24	2.20	2.30
Rice	2.51	2.30	2.27	2.37
Grams	2.25	1.88	1.28	1.81
Other crops	2.07	2.13	2.62	2.27
All crops	2.31	2.19	2.18	2.23

On average, the productivity of capital for all crops on all the farms has been computed as 2.23, which is statistically significant. It shows that for every one rupee invested (cost) the output has been at the value of Rs. 2.23. This output-capital ratio has been 2.28 on the large farms, which stands higher to the corresponding ratio of 2.17 on the small farms. The capital productivities of rice, wheat, sugarcane and maize have been 2.37, 2.35, 2.30 and 2.21 respectively on all farms. The capital productivities of all crops except maize, grams and other crops are significantly higher on large farms as compared to the corresponding productivities of small farms. The value difference may be attributed to the adoption of recommended farm practices and availability of sufficient amounts of inputs by the large farmers. The higher productivity of other crops on small farms could be due to the production of cash crops like vegetables and fodder.

In terms of the impact of tenurial status on the efficiency of capital, the owners have been on the top, followed by owner-cum-tenants and tenants. The output-capital ratios on these farms have been 2.31, 2.19 and 2.18 respectively. The same trend has been found on the large and small farms. In almost all crops, owners and owner-cum-tenants attained relatively higher productivities, but in case of labour intensive crops (other crops and maize) the tenants remained better.

5.3. OVERALL/AGGREGATE PRODUCTIVITY OR UNDISCOUNTED BENEFIT-COST RATIO

The decision whether or not to remain in the farm business, depends primarily on the overall aggregate productivity of the farm. The farm productivity of the individual factors of production may suggest a positive response, but in aggregate the business may be at a loss. This subsection focuses on the overall aggregate productivity of the sample farms. The individual productivities of land, labour and capital examined in the preceding subsections have portrayed general idea of the efficiency of each factor of production. For computing the aggregate productivity of the sample farms, an attempt has been made to calculate the monetary value (in rupees) of the total farm output and cost. The total farm cost is the sum of the imputed and actual costs. The imputed cost includes those for which no cash expenditure have incurred, instead they are met by using the available resources and includes rental value of land, estimated wage of family labour and depreciation/interest of farm machinery and implements etc. The actual costs are those which have been met from "own pockets", and involves real cash outflows (in certain cases in kind) from farm household, including costs incurred on seeds, fertilizers, insecticides, pesticides, water charges, wages of hired labour, farm yard manure and payments made for the services of hired farm machinery.

The aggregate farm productivity or the undiscounted benefit-cost ratio is obtained by dividing the total value of the farm output by its total costs. The macrolevel farm productivity of the major crops by farm size and tenure is enumerated in table 5.3.

Table 5.3
Aggregate Productivity of Major Crops by Farm Size and Tenure
(value of farm output/total cost in Rs.)

Farm Size/Crop	Owners	Owner-cum-Tenants	Tenants	All Tenures
A) <u>Small Farms</u>				
Wheat	1.26	1.21	1.16	1.22
Maize	1.18	1.14	1.20	1.17
Sugarcane	1.29	1.22	1.18	1.23
Rice	1.04	1.05	1.02	1.04
Grams	1.06	1.04	1.04	1.05
Other crops	1.33	1.29	1.31	1.31
All crops	1.20	1.16	1.15	1.18
B) <u>Large Farms</u>				
Wheat	1.53	1.48	1.47	1.49
Maize	1.11	1.11	1.13	1.12
Sugarcane	1.61	1.55	1.50	1.55
Rice	1.40	1.38	1.32	1.37
Grams	1.17	1.12	1.07	1.12
Other crops	1.16	1.18	1.23	1.19
All crops	1.34	1.30	1.28	1.31
C) <u>All Farms</u>				
Wheat	1.40	1.34	1.31	1.35
Maize	1.15	1.13	1.16	1.15
Sugarcane	1.45	1.38	1.34	1.39
Rice	1.22	1.22	1.17	1.20
Grams	1.11	1.08	1.05	1.08
Other crops	1.24	1.23	1.27	1.25
All crops	1.27	1.23	1.21	1.24

The aggregate productivity of all crops on all farms has been 1.24, which implies that the investment of one rupee correspondingly generated an income of Rs. 1.24 , or in other words, with the cost of one rupee, the sample farmers earned a net benefit/profit of twenty-four paisas. The ratio of aggregate farm income to the aggregate farm cost is significantly higher on the large farms (1.31), as compared to that of the small farms (1.18). It infers that farm efficiency in aggregate has had a direct relationship with the farm size. Similarly, the productivity of sugarcane has been the highest one (1.39), with corresponding figures for large and small farms as 1.55 and 1.23 respectively. Except maize and other crops, the productivities of all crops remained higher on the large farms as compared to the small farms. However, the positive interaction between the farm productivity and size, might be attributed to the use of farm machinery, practices and application of recommended doses of inputs on large farms due to sufficient availability of resources.

The tenancy arrangements indicated exactly the same trend as is shown in the productivities of individual factors of production. From the purview of undiscounted benefit-cost ratio, the corresponding productivities have been 1.27, 1.23 and 1.21 respectively for owners, owner-cum-tenants and tenants. The tenants data reveal that aggregate productivity in case of all crops on the owners' large farms has been the highest (1.34), and the lowest (1.15) on the small farms

operated by the tenants, implying that farm efficiency is positively/directly related to the farm size and ownership of land.

5.4 LEVELS OF FARM INCOME

The efficiency of a farm can be judged either by the productivities of individual factors of production or by the level of farm income. The farm productivities have been analyzed in the preceding sections of this chapter, while this part examines the farm income of the sample farms. There are various devices for measuring farm income and economic efficiency, such as net farm income, and net farm household income, etc. As a main objective of the study, net farm income and net farm household income are being examined in the following subsections, providing a true picture of the economic performance of the sample farms.

5.4.i Net Farm Income or Undiscounted Net Benefit

The most significant important measure of the efficiency of a farm is the "net farm income", which is the net difference between the aggregate farm receipts and costs. The aggregate farm cost is the sum total of the imputed family labour cost, rent of land, cash costs and depreciation/interest on capital assets. The net farm incomes of all the sample farmers have been added in rupees and are classified at different levels of net farm incomes. The distribution of sample

farmers by their net farm incomes and sizes are presented in table 5.4.i. A more than one fourth (that is 26.50 percent) of the sample farmers have reported negative net farm incomes on their farms with their proportions as 31.58 and 10.42 on the small and large farms respectively. The question arises, why do the farmers operate their farms with negative net farm income? To answer this question, a significant amount of rental value of land, imputed family labour cost and profit enter their pockets, which keep their survival within the farm business.

Table 5.4.i
Classification of the Sample Farms by Net Farm Income and
Farm Size (In Rupees per Annum)

Level of Income	Small Farms		Large Farms		All Farms	
	No.	%age	No.	%age	No.	%age
Negative	48	31.58	5	10.42	53	26.50
0 - 6,000	66	43.42	16	33.33	82	41.00
6,000 - 12,000	23	15.13	12	25.00	35	17.50
12,000 - 18,000	8	5.26	5	10.42	13	6.50
18,000 - 24,000	5	3.29	4	8.33	9	4.50
24,000 - 30,000	1	0.66	3	6.25	4	2.00
30,000 - 36,000	1	0.66	2	4.17	3	1.50
36,000 & above	--	--	1	2.08	1	0.50
Total	152	100.00	48	100.00	200	100.00

In other words, they sold their labour and so earned livelihood by operating their farms even with negative net farm incomes. A highest percentage of 41.00 percent of the sample farmers fell in the income group of rupees less than six thousands per annum, followed by the corresponding income groups of Rs. 6,000 to Rs. 12,000 and Rs. 12,000 to Rs. 18,000 per annum, with 17.50 percent and 6.50 percent respectively. Only one group of farmers could earn net farm income of Rs.36,000 and above per annum.

Two points with respect to net farm income are important to note. First, the majority of the sample farmers have earned negative or lower levels of income, and second the corresponding percentages of the large farmers are higher in the high levels of income as compared to their percentages in the small farmers. The data confirm a direct relationship between the level of farm income and farm size.

The same pattern has been found in different tenorial classes. However it is important to note that all tenants fell in income levels of less than Rs. 24,000 per annum. In the higher income levels, only owner farmers have been found alike. (table 5.4.ii)

Table 5.4.ii

**Distribution of the Sample Farms by Net Farm Income and Tenure
(Rupees per annum)**

Level of Income	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	No.	%age	No.	%age	No.	%age	No.	%age
Negative	34	31.19	11	22.45	8	19.05	53	26.50
0-6,000	41	37.62	20	40.82	21	50.00	82	41.00
6,000-12,000	14	12.84	11	22.45	10	23.81	35	17.50
12,000-18,000	7	6.42	4	8.16	2	4.76	13	6.50
18,000-24,000	6	5.51	2	4.08	1	2.38	9	4.50
24,000-30,000	3	2.75	1	2.04	--	--	4	2.00
30,000-36,000	3	2.75	--	--	--	--	3	1.50
36,000 & above	1	0.92	--	--	--	--	1	0.50
Total	109	100.00	49	100.00	42	100.00	200	100.00

5.4.ii Net Farm Household Income

The most important criterion for assessing the economic efficiency and welfare of a household is to examine its net household income, that is the total net income from all sources. For this purpose, the net farm household income has been obtained by subtracting the total farm costs from the total farm receipts and addition of the non-farm income earned by the household members. The total farm costs included, the rental value of land, total cash costs on different inputs and interest/depreciation on farm machinery, implements and other farm

assets. Distribution of the sample farmers by net farm household income and farm size are presented in table 5.4.iii.

Table 5.4.iii
Distribution of the Sample Farms by Net Farm Household Income and Farm Size (Rupees per Annum)

Level of Income	Small Farms		Large Farms		All Farms	
	No.	%age	No.	%age	No.	%age
< 6,000	8	5.26	1	2.08	9	4.50
6,000 - 12,000	25	16.45	7	14.58	32	16.00
12,000 - 18,000	37	24.34	9	18.75	46	23.00
18,000 - 24,000	39	25.66	11	22.92	50	25.00
24,000 - 30,000	28	18.42	6	12.50	34	17.00
30,000 - 36,000	6	3.95	4	8.33	10	5.00
36,000 - 42,000	4	2.63	3	6.25	7	3.50
42,000 - 4,8000	3	1.97	3	6.25	6	3.00
48,000 - 54000	2	1.32	2	4.17	4	2.00
54,000 & above	--	--	2	4.17	2	1.00
Total	152	100.00	48	100.00	200	100.00

In absolute terms, 50 out of the 200 sample farm households (25.00 percent) fell in the income group of Rs. 18,000 to Rs. 24,000 per annum.

On the whole, 68.50 percent of the sample households have earned less than Rs. 24,000 per annum as a net household income; or in other words nearly 32 percent of the sample households has earned more than Rs. 14,000 per annum.

A significant percentage of 17.00 percent of the sample households fell in the income group of Rs. 24,000 to 30,000. Comparing the net farm household income and the net farm income together, it is observed that a majority of the farm household members has earned their incomes from the off-farm sources. A very small proportion (1.00 and 4.50 percents) of the households have been found in the income groups of Rs.54,000 and above, and Rs. less than 6,000 per annum respectively.

Comparison between the incomes earned by the small and large farmers indicated notable differences. A majority of the large farmers (22.92 %) fell in the income group of Rs. 18,000 to 24,000; while 25.66 percent of the small farmers fell in the same income group. Very important to note is that only 35.91 percent of the sample households has earned income less than Rs. 18,000 per annum on large farm, and the rest of the large farmers have earned above this level. While 46.05 percent of the small farmers has earned less than Rs.18,000, such percentages for the farm households earning Rs.54,000 and above per annum, have been nil and 4.17 on small farms and large farms respectively. The difference between the net farm household incomes in favour of large farmers can be attributed to higher farm incomes associated with large farm holdings, application of recommended farm practices and inputs etc; and, earnings from off-farm sources.

It is evident from the data of the net farm household income presented in table 5.4.iv, that a significant percentage of the tenants has been found in the income group of less than Rs.24,000 per annum, while a negligible proportion of tenants has been recorded in the higher income groups. The owner farmers are better off with regard to the net farm household income. A considerable number of the sample households have been observed in the high income brackets.

Table 5.4.iv

Classification of the Sample Farms by Net Farm Household Income and Farm Tenure (Rupees per Annum)

Level of Income	Owners		Owner-cum-Tenants		Tenants		All Tenures	
	No.	%age	No.	%age	No.	%age	No.	%age
< 6,000	5	4.59	2	4.08	2	4.76	9	4.50
6,000 - 12,000	17	15.60	8	16.33	7	16.67	32	16.00
12,000 - 18,000	25	22.94	11	22.45	10	23.81	46	23.00
18,000 - 24,000	26	23.85	13	26.53	11	26.19	50	25.00
24,000 - 30,000	18	16.51	9	18.37	7	16.67	34	17.00
30,000 - 36,000	7	6.42	1	2.04	2	4.76	10	5.00
36,000 - 42,000	4	3.67	2	4.08	1	2.38	7	3.50
42,000 - 48,000	3	2.75	2	4.08	1	2.38	6	3.00
48,000 - 54,000	2	1.83	1	2.04	1	2.38	4	2.00
54,000 & above	2	1.83	--	--	--	--	2	1.00
Total	109	100.00	49	100.00	42	100.00	200	100.00

5.5 TEST FOR PROFIT INEFFICIENCY HYPOTHESIS

5.5.i Rationale

The core objective of this section is to estimate the profit inefficiency (for details see Farman Ali, and Jehanzeb, 1993) by farms using the behavioural profit function. Where profit is calculated after deducting all direct expenses incurred on variable inputs like wages of human labour, animal labour, manure, chemical fertilizer and tractor use from the value of output. The derived inefficiency measure based on half-normal distribution of Stochastic error term is related to the socio-economic variables. Among these, the higher age of farmers, the time devoted to off-farm work, fragmentation of land, size of holding and subsistence needs contribute positively towards inefficiency. Family size, level of education, farm and non-farm assets, working animals, credit and extension visits, on the contrary, improve upon efficiency.

5.5.ii Stochastic Translog Profit Function

A translog profit, function has been popularized by *Aigner et al (1977)* and *Muesuen Van den Broeck (1977)*. In the profit function, there are two errors, one to represent the efficiency component, and the other random component. Let the profit function be

$$\begin{aligned} \ln \Pi = & \alpha_0 + \sum_{i=1}^n \alpha_i \ln p_i + \sum_{i=1}^n \sum_{j=1}^n \gamma_{ij} \ln p_i \ln p_j \\ & + \gamma_L \ln L + \frac{1}{2} \gamma_{LL} (\ln L)^2 + \sum_{i=1}^n \gamma_{Li} \ln L \ln p_i + \varepsilon_i \end{aligned} \quad (5.5.1)$$

where Π is normalized profit, ε_i is a disturbance term, P_i are normalized input and output prices and L is the land input. The error term is assumed to be in a manner consistent with the frontier concept. i.e.

$$\varepsilon_i = V_i + U_i \quad (5.5.2)$$

The compound disturbance term (ε) is the sum of symmetrically distributed variables and a one-sided one. V_i is allowed to be normally distributed to reflect the random factors such as weather, and use a one-sided disturbance, U_i to represent the inefficiency component. For U it is assumed $U = |U|$ and $U \sim N(0, \sigma_U^2)$, while $V \sim N(0, \sigma_V^2)$, U and V are assumed to be independent of each other.

Anticipate that the symmetric error V is distributed as $V \sim N(0, \sigma_V^2)$, and non-negative error U is distributed as the absolute value of a normal distribution, half normal. The population average technical efficiency is

$$E(e^{-U}) = 2e^{\sigma_U^2/2} [1 - F(\sigma_U)] \quad (5.5.3)$$

where F is the standard normal distribution function.

The measurement of the farm level efficiency, e^U , requires first the estimation of the non-negative error U, i.e. decomposing ε into two individual components, U and V. *Jandrow et al (1982)* suggested a decomposition method from the conditional distribution of U given ε . Given the normal distribution of V and the half-normal distribution of U, the conditional mean of U given ε is shown to be:

$$E[U|\varepsilon] = \frac{\sigma_U \sigma_V}{\sigma} \left[\frac{f(\varepsilon\lambda/\sigma)}{1-F(\varepsilon\lambda/\sigma)} - \frac{\varepsilon\lambda}{\sigma} \right] \quad (5.5.4)$$

where $\lambda = \frac{\sigma_U}{\sigma_V}$ and $\sigma^2 = \sigma_U^2 + \sigma_V^2$, and f and F are the standard normal density function (PDF) and the standard normal distribution function (CDF) respectively evaluated at $(\varepsilon\lambda/\sigma)$. For ε , λ and σ , the estimated values are used to evaluate the density and distribution function.

The maximum-likelihood (ML) estimates of the profit frontier (5.5.i) are given in Table 5.5.i. The equation has been estimated by LIMDEP, an econometric package developed by *Greene (1992)*. The ratio of the standard errors of U and V (λ) is 2.6883. This implies that one sided error term U dominates the symmetric error V. The discrepancy between the observed profit and the frontier profit is primarily due to both technical and allocative inefficiencies.

Table 5.5.ii shows the frequency distribution of the estimates of the inefficiencies for each farmer. The result shows a wide variation in the level of inefficiencies across the farms. The population average inefficiency from equation (5.5.3) is estimated to be 23.9 per cent, which suggests that on an average, 23.9 percent of the profit is lost due to inefficiency. The maximum and minimum inefficiency are 95.0 and 4.9 percent respectively. These estimates are important in the sense that they provide detailed information for policy makers.

One of the important features of developing agriculture is the subsistence needs which force farmers to produce crops which do not take them to the frontier. The inefficiency can arise due to socio-economic, demographic and environmental factors and the governments in these countries can possibly adopt a policy to remove the inhibiting factors leading to profit inefficiency. The measure of profit inefficiency is related to various explanatory variables are estimated the following equation.

$$\begin{aligned}
 PI_i = & \alpha_0 + \alpha_1 FSZ_i + \alpha_2 AGE_i + \alpha_3 EDU_i + \alpha_4 OFF_i + \\
 & \alpha_5 AST_i + \alpha_6 NST_i + \alpha_7 ANI_i + \alpha_8 CRT_i + \alpha_9 FRG_i + \\
 & \alpha_{10} HLD_i + \alpha_{11} SUS_i + \alpha_{12} EXT_i + \varepsilon_i
 \end{aligned}
 \tag{5.5.5}$$

The estimated parameters, t-ratios and other statistics are presented in Table 5.5.3. The results indicate that the greater family size reduces inefficiency; the older household has a negative impact on efficiency; and more years of education of the household head reduces inefficiency, large size of the holding contributes positively

to inefficiency, while the extension visits expose farmers to better techniques which contribute to improvement of efficiency. As farmers' subsistence needs are satisfied by their own production of food crops, they tend to contribute positively to inefficiency because this prevent the farmers from achieving maximum.

5.5.iii Summary and Conclusion

The objectives of this exercise have been to test the hypothesis of technical and allocative efficiency. The profit inefficiency has been estimated by using the translog profit frontier. The results indicate that farmers are both technically and allocatively inefficient. The average inefficiency is 23.9 percent with a wide variation of maximum of 95.0 percent and minimum of 4.9 percent. Which shows that a substantial amount of profits is lost due to inefficiency.

The identification of the factors causing variations in profit inefficiencies across the farms then becomes necessary for policy makers. This study suggests that better rural education, extension services for expansion, propagation of modern techniques of production and availability of agricultural credit can bridge the gap between the efficient and inefficient farms.

Table 5.5.i
Maximum Likelihood Estimates of Translog Cost Frontier
(Significant variables only)

Name of Variable	Parameters	Coefficients	T-ratio
Constant	α_0	1.7513	2.48*
Output	α_M	-1.8202	-2.69*
Fertilizer x Output	γ_{FO}	-0.7339	-3.42*
Human x Human	γ_{HH}	0.9405	2.13*
	$\lambda = \frac{\sigma_u}{\sigma_v}$	2.6883	6.12*
	$\sigma = \sqrt{\sigma_u^2 + \sigma_v^2}$	0.2729	23.33*
	σ_u^2	0.0842	
	σ_v^2	0.0122	
	Log Likelihood	107.08	

* = Significant at 5% level of significance

: The subscript F,H,M and O stand for prices of fertilizer, human labour, manure and value of output respectively.

Table 5.5.ii
Frequency Distribution of Farm Specific Technical
Inefficiencies in Stochastic Translog Profit Frontiers

Inefficiency Index (%)	Number of Farmers	%	Inefficiency Index	Number of Farmers	%
1 - 10	20	6.7	50 - 60	50	16.7
10 - 20	30	13.2	60 - 70	40	13.3
20 - 30	40	13.3	70 - 80	25	8.3
30 - 40	40	13.3	80 - 90	10	3.3
40 - 50	45	15.0	90 - 100	0	-
			All	300	100

Table 5.5.iii
Relationship of Profit Inefficiency with
Significant Farm Characteristics
(Significant Values only)

Variable Name	Variables Description	Coefficients	t-ratio
	Constant	0.17927	5.33*
FSZ	Family Size (numbers)	-0.00612	-2.85*
AGE	Age (years)	0.00113	3.35*
EDU	Education (years)	-0.00384	-2.22*
EXT	Extension Visits (number)	-0.006101	-3.36*
HLD	Holding Size (acres)	0.00099	2.02*
SUS	Subsistence (Rs/acre)	0.2731×10 ⁻⁵	2.44*

* = Significant at 5 % level of significance

5.6 LORENZ CURVE AND GINI CO-EFFICIENT OF FARM LAND AND INCOME DISTRIBUTION

To determine the inequality of the farm land (operational holding) and farm income distribution, the following procedure has been used.

The total number of farmers/farm households have been divided into distinct groups of 20 farmers and the individual operational holding and farm income have been sorted out in an ascending order. The cumulative percentages have been calculated for all farmers, their operational holdings and farm incomes. The proportions of farm holdings and farm incomes have been determined for each group. The results are presented in Table 5.7 with the following three measures used.

- (a) First of all the cumulative percentages of the operational holdings (or farm incomes) corresponding to each group have been identified. The relevant figures to the bottom 20 percent and the top 20 percent of the farm operators have been compared and the inequality has been determined.
- (b) Based on the data enumerated in Table 5.7 a curve known as Lorenz Curve has been drawn. It is also a common practice to analyse the size (land or income) distribution. Lorenz Curve indicates the actual quantitative relationship between the individual groups and their respective shares in land/income. The curve is constructed in a square box by cumulating the individuals' percentages and percentages of their shares in size as shown in diagram 5.7.i and 5.7.ii below. Each point on the diagram line shows the percentage of size (farm/income) received which is exactly equal to the percentage of farmers. In other words the diagonal is representative. "Perfect equality" in the size distribution of land/ income, and distance between the Lorenz Curve and the diagonal line shows the absolute degree of inequality. The further the Lorenz Curve away from the diagonal (perfect equality), the greater is the degree of inequality and vice versa.

- (c) Another quantitative device used is to calculate the ratio of the cumulative percentages of farm holdings (or farm income) of the bottom 25 percent farmers to the cumulative percentages of the holdings (or farm income) of the top 25 percent farmers. The ratio of less than unity shows the inequality. The lesser the value of ratio, the higher is the inequality.
- (d) The most commonly used measure for the distribution of size (land or income) is the device of Gini co-efficient, which shows the relative degree of inequality. One can determine the severity of inequality by the value of Gini co-efficient, if its value is one, the distribution is perfectly unequal, contrarily if it is zero the distribution is perfectly equal and any value in-between zero and unity shows the varying degrees of equality in the distribution. The following formula has been used for the calculation of Gini co-efficient.

$$G = 1 + \frac{1}{n} + \frac{2}{n^2 \bar{Y}} [Y_1 + 2Y_2 + 3Y_3 + \dots + nY_n]$$

Where

G = Gini Co-efficient.

\bar{Y} = Average Land/Income

That is $\frac{\sum Y}{n}$

5.7.i Analysis of Quantitative Evidence/Results

This section focuses on the analysis of quantitative evidence. The quantitative measurements of farm land distribution, farm income distribution and economic efficiency of agriculture have been determined as follows.

(a) *Farm Land Distribution*

The sample size of 200 farmers has been divided into 10 groups of 20 farmers with their cumulative percentages for each group, their corresponding cumulative percentages of farm holdings and farm income are presented in the Table 5.7.

Table 5.7
Group-wise Cumulative Percentages of Sample Farmers
Farm Holdings and Farm Income

Groups of 20 farmers each	Cumulative %ages of Sample Farmers	Cumulative %ages of Individual farm holdings.	Cumulative %ages of farm Income
1	10.00	3.20	1.84
2	20.00	5.80	4.15
3	30.00	12.16	7.63
4	40.00	19.55	11.78
5	50.00	25.00	18.00
6	60.00	32.19	26.58
7	70.00	41.53	32.75
8	80.00	48.68	41.75
9	90.00	65.15	58.25
10	100.00	100.00	100.00

Source: Field Survey.

It is observed that the bottom 20 percent of the sample farmers are operating only 5.80 percent of the sample holdings, while the top 20 percent of the sample farmers are operating 51.32% of the total holdings. It is also important to note that the bottom 50% of the farmers have held only 25 percent of the land, which also infers that 75 percent of the farm land has been operated by the top 50 percent of the farmers. Thus the distribution of land has been unequal in cases of very small and very large farms, but approximately equal in case of medium farms, which is one-fourth of the whole. The ratio of the commutative percentage of holdings of the bottom 20 percent of farmers to the cumulative percentage of the holdings of the top 20 percent farmers (i.e. $5.80 \div 51.32$) is 0.11. This ratio shows that the distribution of operational holdings is unequal among farmers.

The unequal distribution of farm holdings can be noted in diagram 5.7.i. where the gap between the diagonal line and the Lorenz Curve is significant. Convexity of the Lorenz curve towards the horizontal axis indicates the notable unequal distribution of farm land.

The Gini co-efficient calculated for the land distribution is approximately 0.62, which also reveals the unequal distribution of land among the farm operators.

(b) *Farms Income Distribution*

The cumulative percentages of farm income corresponding to each group of 20 farmers are shown in column 4 of table 5.7.i. It is observed that the bottom 20% of the farmers have got only 4.15 percent of the farm income, while the top 20 percent have received 58.25 percent of the total farm income. An important point to note is that the bottom 50% of the farmers have received only 18% of the farm income. The severity of unequal distribution of farm income could be seen from the gap between the diagonal line and the Lorenz Curve in diagram 5.7.ii. The ratio of the percentage of farm income received by the bottom 20 percent of the farmers to the farm income received by the top 20 percent farmers (i.e. $4.15 \div 58.25$) is 0.07. This ratio is in the neighbourhood of zero, which indicates greater inequality in the distribution of farm income.

The Gini-coefficient calculated for the farm income distribution is 0.79, which is significantly unequal.

The two Lorenz curves have revealed that a relatively smaller inequality in the distribution of farm land is resulting into a higher inequality in the distribution of farm income. Thus, poverty in the small farmers' scenario (which is greater in number) may adversely affect the process of economic efficiency of farms.

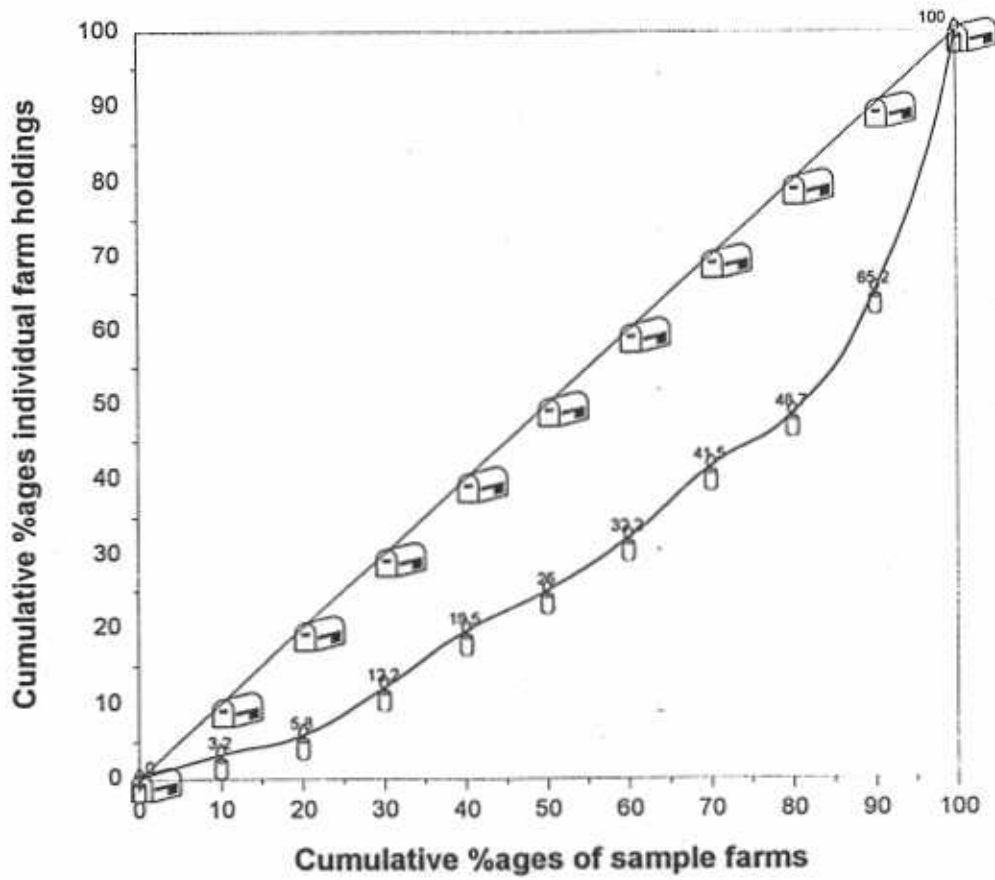


Diagram 5.7.i. Lorenze Curve for Farm Land Holdings

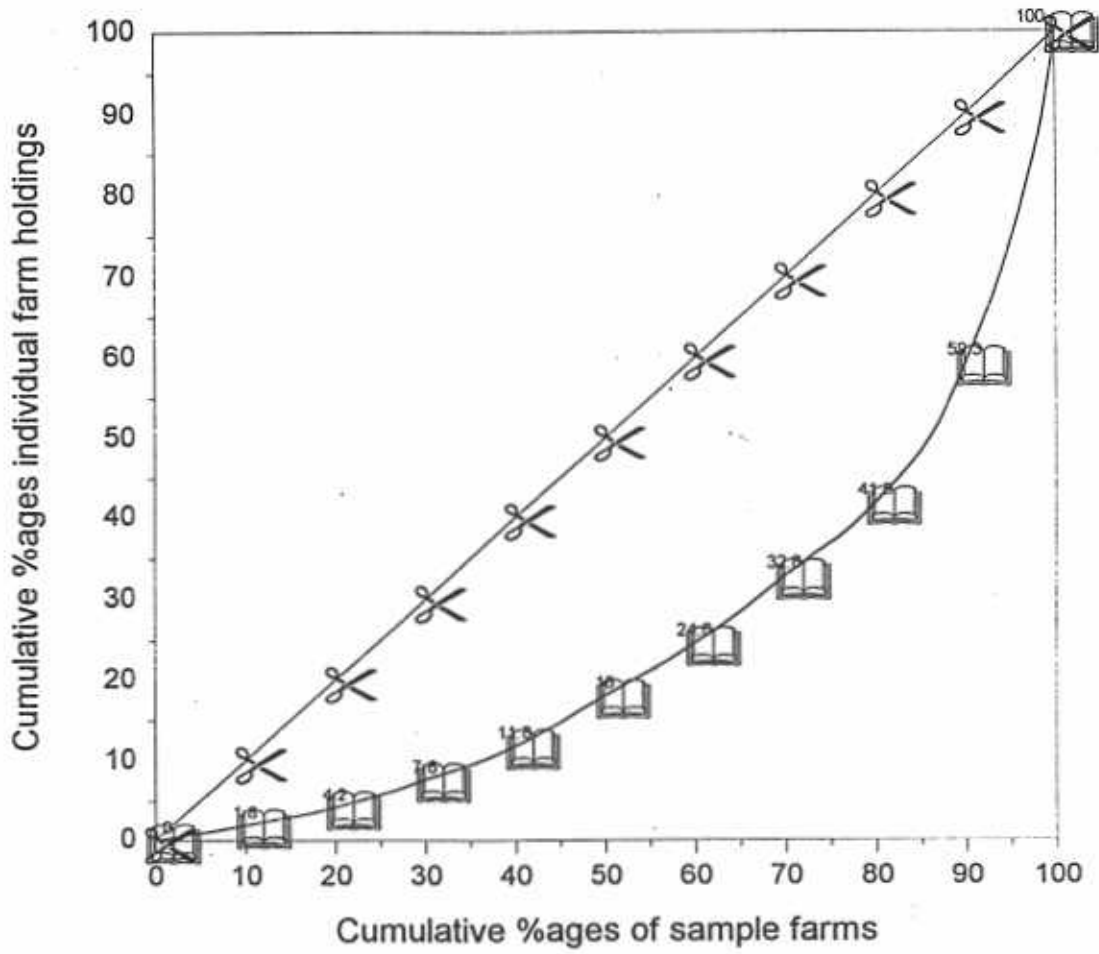


Diagram 5.7.ii. Lorenze Curve for Farm Income

5.8 CONCLUSION

The above results revealed that a considerable level of inefficiency is prevailing in the agrarian sector. The farm output can be increased to a level of 24% without recourse to further resources. Similarly the distribution of farm land is unequal. As a result of inequality in the farm land distribution, the farm income is also unequally distributed. The small farmers are producing in a stage of increasing returns to scale, while the large farmers are operating their farms in a stage of decreasing returns to scale. Both are thus utilizing their farm lands inefficiently. A very small segment of the cultivable land is being managed by a very large number of farmers. Contrarily a very large portion of the farm land is operated by a very small number of farmers. In the pretext of the analysis, it is suggested that an appropriate and effective land reform is needed.

CHAPTER VI

INPUT- OUTPUT RELATIONSHIP AND STAGES OF PRODUCTION

6.0 INTRODUCTION

The relationship between inputs and output is generally known as production function. The farm output is determined by the application of various inputs viz; land, labour, seeds, fertilizer, insecticides, pesticides, irrigation water, farm machinery, and management skill etc. The agrarian structure also has a significant impact on the farm production. For the purpose of this thesis, the inputs have been categorized in four major factors of production, land, labour, capital and management. To identify the impact of the agrarian structure on farm efficiency, different production functions for different farm categories have been determined. These input-output relationships have enabled to differentiate output elasticities of the various inputs and technological gap between small and large farms, owner farm operators and tenants, irrigated and un-irrigated, mechanized and non-mechanized farms. This chapter focuses on the development of econometric model, which takes into account the specification, estimation, verification and interpretation of the model. It also identifies the stages of production in which different types of farms are being operated. Moreover, the values of marginal physical products (MPPs) of the key inputs computed from the estimated production function are examined.

6.1 ECONOMETRIC MODEL / PRODUCTION FUNCTION

For the quantitative measurement of input-output relationship, an econometric model has been developed. Main objectives of this exercise are twofold: first, to see the technological gap between different categories of the farms; and second, to estimate the marginal physical products of the major inputs, land, labour, capital and management. The details are provided in the subsequent sections.

6.1.i Specification of the Model

Here the specification of the model, its mathematical form, and the expected signs and magnitudes of the parameter are considered. The monetary value of the farm output has been computed for each sample farm and thus the dependent variable, such that gross farm output "Y" is obtained. The major inputs (factors of production) used as explanatory variables are also appropriately aggregated and their monetary values are computed for each sample farm. These variables are the rental value of land (sum of actual rent of hired land and imputed rent of owned land) "X1", the wages of labour input (sum of imputed cost of family labour and actual cost of hired labour) "X2", total costs of consumable inputs (water, seeds, fertilizer, insecticides/pesticides etc.) and capital assets (farm machinery, implements etc.) "X3", and the imputed cost of management "X4". Thus the production function is:

$$Y = F (X_1, X_2, X_3, X_4)$$

The non-linear Cobb-Douglas production function of the type $Y = AL^{\alpha}L^{\beta}$ has been considered to be the appropriate form for expressing the input-output relationship. The general mathematical form of the model thus is:

$$Y = \beta_0 X_i \beta_i e^{U_i}$$

and in log linear form it is:

$$\text{Ln } Y = \text{Ln} \beta_0 + \beta_i \sum \text{Ln } X_i + U_i$$

Where the constant " β_0 " shows the impact of innovation or technology, the i th parameters " β_i " indicates output elasticity of the i th input and the residual term " U_i " absorbs the effect of those variables which are not included in the model.

On the basis of economic priori criteria, it is obvious from the very nature of the variables that the expected signs of the output elasticities " β_i " of inputs " X_i " would be positive and their individual expected magnitudes would be less than unity.

In addition, one pooled production function for all sample farms, nine other production functions are:

- two for small and large farms
- three for owners, owner-cum-tenants and tenant farmers

- two for irrigated and un-irrigated farms.
- two for mechanized and non-mechanized farms.

The estimated results are reported in the subsequent sections respectively.

6.1.ii. Estimation and Verification of the Model

The explanatory variables are truly exogenous. None of the regressors are determined within the model. Therefore, the method of Ordinary Least Squares (OLS) has been used for the estimation of single equation log linear model. It is assumed that the parameter estimates would be, without simultaneous equations, bias and inconsistency. For different farm categories different production functions have been estimated with the help of computer. Farm size-wise complete results of the log linear production function are shown in the Table 6.1.i.

The standard errors indicate that all the parameters are statistically significant. The co-efficients of multiple determination R-squares of all the models indicated that the "FITS" are good. The very high F-ratios verified the overall significance of the models.

Table 6.1.i
Estimated Production Functions for
the Sample Farms by Farm Size
(in log. linear form)

All Farms:

$$\begin{aligned} \text{Ln}\hat{Y} = & \text{Ln}2.8303 + 0.2763 \text{Ln}X_1 + 0.3702 \text{Ln}X_2 + 0.3562 \text{Ln}X_3 + 0.1741 \text{Ln}X_4 \\ & (0.1131) \quad (0.0210) \quad (0.0312) \quad (0.0141) \quad (0.0215) \\ R^2 = & 0.73, \quad \Sigma e_p^2 = 329.03, \quad F^* = 217.39, \quad n = 200, \quad \text{d.f} = 195 \end{aligned}$$

Small Farms:

$$\begin{aligned} \text{Ln}\hat{Y} = & \text{Ln}2.6261 + 0.2041 \text{Ln}X_1 + 0.2530 \text{Ln}X_2 + 0.2171 \text{Ln}X_3 + 0.1581 \text{Ln}X_4 \\ & (0.9120) \quad (0.124) \quad (0.1400) \quad (0.0231) \quad (0.1201) \\ R^2 = & 0.76, \quad \Sigma e_1^2 = 103.76, \quad F^* = 186.35, \quad n_1 = 152, \quad \text{d.f} = 147 \end{aligned}$$

Large Farms:

$$\begin{aligned} \text{Ln}\hat{Y} = & \text{Ln}2.9997 + 0.3240 \text{Ln}X_1 + 0.4802 \text{Ln}X_2 + 0.4861 \text{Ln}X_3 + 0.1902 \text{Ln}X_4 \\ & (1.0141) \quad (0.0152) \quad (0.0223) \quad (0.1043) \quad (0.0047) \\ R^2 = & 0.68, \quad \Sigma e_2^2 = 189.66, \quad F^* = 157.48, \quad n_2 = 48, \quad \text{d.f} = 43 \end{aligned}$$

Note: Figures in parenthesis are the respective standard errors.

In order to test whether structural differences have existed between the small and large farms, the following Chow F-ratio has been calculated.

$$\begin{aligned} F^* &= \frac{\Sigma e_p^2 - (\Sigma e_1^2 + \Sigma e_2^2) / K}{(\Sigma e_1^2 + \Sigma e_2^2) / (n_1 + n_2 - 2K)} \\ &= \frac{[329.03 - (103.76 + 189.66)] / 5}{(103.76 + 189.66) / (152 + 48 - 2(5))} = 4.6 \end{aligned}$$

The calculated value of F-ratio is significantly greater than the theoretical value of F at 5% level of significance with $V_1 = 5$ and $V_2 = 190$ degrees of freedom. The null hypothesis that there is no structural difference between the production lines of both the categories are rejected and it is concluded that

structural differences existed in the production processes of the small and large farms. This infers that they operated their farms at different levels of technology.

6.1.iii Interpretation of the Model/Analysis of Results

For clear comparison, the estimated production functions in log. linear form for the sample farms by farm size (Table 6.1.i) have been reproduced in the Cobb-Douglas production form in Table 6.1.ii below. It is observed that the signs and magnitudes of the parameter estimates are logical and according to the expectations.

Table 6.1.ii
Estimated Production Functions for the
Sample Farms by Farm Size
(in Cobb-Douglas form)

S.No.	Farm Size	Estimated Production Functions
1)	Small farms	$\hat{Y} = 13.82 X_1^{0.20} X_2^{0.23} X_3^{0.22} X_4^{0.16}$
2)	Large farms	$\hat{Y} = 20.08 X_1^{0.32} X_2^{0.48} X_3^{0.49} X_4^{0.19}$
3)	All farms (pooled)	$\hat{Y} = 16.95 X_1^{0.28} X_2^{0.35} X_3^{0.36} X_4^{0.17}$

Source: Based on Table 6.1.i

The table indicates that a significant difference is found between the parameter estimates " $\hat{\beta}_i$ " of the production function for small and large farms. The output elasticity of labour input on large farms has been more than two times of output elasticity of labour input on small farms. The corresponding figures are 0.48 and 0.23 respectively. This may be attributed to mechanization on the large

farm. The output elasticities of all inputs on the small farms have been notably lower relative to the output elasticities of inputs on the large farms. In other words there is sufficient room to improve the efficiency of the small farms by utilizing the inputs more efficiently. The response of output to the capital on large farm reveals that the use of farm machinery enhanced the output elasticities of all inputs on large farms. The output elasticity of management input is the lowest in all cases. The trend of output elasticities of inputs on small, large and all farms has been the same. From the output elasticities point of view the inputs could be ranked as follows:

Capital standing first, followed by labour and land, while management has remained in the last position.

The co-efficient " $\hat{\beta}_0$ " of the estimated production functions on the small and large farms has revealed that there is a notable technological gap between the production processes of the two types of farms. The relevant co-efficients are 13.82 and 20.08 respectively, which support the above-mentioned conclusion derived by the Chow F-ratio.

It is evident that the sum of output elasticities of all the inputs is less than unity on the small farms, which implies that the small farmers are producing in the decreasing returns to scale. On the other hand, the large farms are operated in

the increasing returns to scale, because the sum of their output elasticities is greater than unity. The same situation has been observed on all the sample farms.

To examine the impact of the agrarian structure on the output elasticities of different production functions for different farm sizes, tenurial status, irrigation status and mechanization state have been considered. The co-efficients " $\hat{\beta}_0$ " and output elasticities " $\hat{\beta}_i$ " are presented in Table 6.1.iii.

Table 6.1.iii
Results of the Estimated Production Functions
 $Y = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} e^u$ by Agrarian Structure

Agrarian Structure	Output Elasticities of				
	Annotation $(\hat{\beta}_0)$	$X_1 =$ Land $(\hat{\beta}_1)$	$X_2 =$ Labour $(\hat{\beta}_2)$	$X_3 =$ Capital $(\hat{\beta}_3)$	$X_4 =$ Management $(\hat{\beta}_4)$
1. Farm Size:					
i) Small farms	13.82	0.20	0.23	0.22	0.16
ii) Large farms	20.08	0.32	0.48	0.49	0.19
2. Tenurial Status					
i) Owners	18.88	0.31	0.28	0.49	0.18
ii) Owner cum tenants	16.95	0.28	0.35	0.38	0.17
iii) Tenants	15.01	0.24	0.48	0.15	0.16
3. Irrigation Status					
i) Irrigated	14.23	0.43	0.63	0.59	0.24
ii) Un-irrigated	6.57	0.13	0.11	0.09	0.10
4. Mechanization State					
i) Mechanized farms	20.8	0.38	0.48	0.51	0.21
ii) Non-mechanized farms	9.02	0.18	0.27	0.17	0.13

The table reveals that the output elasticities of all inputs except labour have been higher on the farms operated by owners, followed by owner-cum-tenants and tenants. But this situation is the reverse in case of labour input. The output of labour input has been the highest on the farms operated by tenants. The reason is very obvious for the tenants used the rented land more intensively to meet their requirements of the farms, in addition to pay rent to the land lord. The magnitudes of co-efficient " $\hat{\beta}_0$ " indicate that owners adopted better technology than the owner-cum-tenants and the tenant farmers.

The production functions estimated for irrigated and un-irrigated farms indicated a very significant difference between the output elasticities " $\hat{\beta}_i$ ". The value of output to land input on irrigated farms has been more than three times of the value of output on un-irrigated farms. The output elasticities of capital and labour inputs on large farms have been more than six times and four times of the corresponding elasticities on un-irrigated farms. The impact of technology has been also very high on the irrigated farms. This implies that irrigation plays a vital role on the efficiency of farms irrespective of the farm size and tenorial status.

Comparing the production functions of mechanized and non-mechanized farms, like the irrigated, the mechanized farms also responded very well. The output elasticities of all inputs on mechanized farms remained notably higher relative to the elasticities of inputs on the non-mechanized farms. The output elasticity of capital input is the highest on the mechanized farms followed by the

elasticity of labour input. The encouraging output elasticities of all inputs on the mechanized farms can be attributed to the use of farm machinery. The coefficient " $\hat{\beta}_0$," that is the impact of technology on the mechanized farms also has revealed that mechanization has had a significant impact on the efficiency of the farms.

Although different categories of the agrarian structure have different influence on the efficiency of farm, but one thing has been found common in almost all the categories, that is the sum of output elasticities of all the inputs is greater than unity, which implies that all the sample farmers have been operating their farms in the stage of increasing returns to scale.

6.2 MARGINAL PHYSICAL PRODUCTS OF INPUTS AND STAGES OF PRODUCTION

The marginal physical products of the major inputs, land, labour, capital and management have been estimated from the estimated production functions for different types of farms. For the estimation of MPP for the i th input, the estimated production function "i" is partially differentiated with respect to the i th input that is

$$MPP_{\alpha} = \frac{\partial \text{Ln} \hat{Y}}{\partial \text{Ln} X_i} = \frac{\partial}{\partial \text{Ln} X_i} [\text{Ln} \hat{\beta}_0 + \hat{\beta}_i \text{Ln} X_i]$$

OR

$$MPP_{\alpha} = \frac{\partial \hat{Y}}{\partial X_i} = \frac{\partial}{\partial X_i} [b_0 X_i^{\beta_i}]$$

After differentiating each estimated function, the mean values of " X_i " have been substituted and the numerical values of marginal physical products (VMPPs) are derived. Values of marginal physical products of key inputs by agrarian structure are presented in Table 6.2.

Table 6.2
Values of Marginal Physical Products of
Key Inputs by Agrarian Structure

Agrarian Structure	VMPPs of Inputs			
	$X_1 =$ Land	$X_2 =$ Labour	$X_3 =$ Capital	$X_4 =$ Management
1. <u>Farm size:</u>				
i) Small farms	2.13	1.46	2.36	0.70
ii) Large farms	2.19	2.50	3.12	0.74
2. <u>Tenurial Status</u>				
i) Owners	2.19	2.61	2.80	0.76
ii) O.C.Ts	2.16	2.06	2.53	0.71
iii) Tenants	2.13	2.11	1.89	0.69
3. <u>Irrigation status</u>				
i) Irrigated	3.17	3.92	4.17	0.73
ii) Un-irrigated	1.15	2.04	1.31	0.71
4. <u>Mechanization State</u>				
i) Mechanized farms	3.08	3.99	3.43	0.75
ii) Non-mechanized farms	1.24	1.97	2.05	0.69
All Farms	2.16	2.98	2.74	0.72

The data on VMPPs indicate that VMPP of capital input has been the highest on the small as well as on the large farms and there is no meaningful difference between the VMPPs of land on both sizes of the farms. However, a significant difference has been observed in case of VMPP of labour input on the small and large farms.

The table shows that tenurial status has no remarkable impact on the VMPPs of inputs. Nearly VMPP of each input is the same in all tenancy arrangements. However, the VMPPs of all inputs have been slightly higher on the farms operated by owners.

Irrigation status indicated a notable effect on the VMPPs of inputs. In case of irrigated farms, VMPPs of all inputs have been comparatively higher than the VMPPs on the un-irrigated farms. Capital input in this regard is on the top followed by labour input. The VMPP of land input on irrigated farms has been approximately three times of the VMPPs on the un-irrigated farms.

Mechanization has also enhanced the marginal physical products of inputs. The VMPPs on both types of farms viz. mechanized and non-mechanized have been different. The VMPPs of land, labour and capital inputs are significantly higher on the mechanized farms. The VMPPs of management input have been more or less the same on all types of the farms.

CHAPTER VII

CONSUMPTION PATTERN AND LIVING STANDARDS OF FARMERS

7.0 INTRODUCTION

Economic efficiency of the agrarian structure predominantly influence the consumption pattern and standards of living of the farmers. The more is the economic efficiency of the farms, the higher is the level of consumption and standards of living of the farmers. This impact of the agrarian structures on the productivities of various inputs, net farm incomes and the overall economic efficiency of the farms has been analyzed in detail in Chapter V. This chapter specifically examines the consumption pattern and standards of living of the sample farmers. In the former case different consumption functions have been determined and analyzed, in the subsequent section 7.1, while the later has been determined in section 7.2.

7.1 CONSUMPTION PATTERN OF THE SAMPLE FARMERS

Consumption function refers to the income-consumption interrelationship. J.M. Keynes propounded the fundamental psychological law of consumption stating that "men are disposed as rule and on the average to increase their consumption as their income increases but not by as much as the increase in their income". This law identifies the concept of marginal propensity

to consume (MPC), which specifies the fraction of each additional rupee of disposable income received to be spent on consumption. Thus, the greater MPC implies the higher standards of living and vice versa. The vertical intercept of the linear consumption function, indicating the level of consumption at zero level of income, also leads towards rising standards of living.

7.1.i Specification of the Consumption Function

Multiple factors determine the aggregate consumption of the farm households. For this study a few determinants of the total monthly consumption "C" (dependent variable) have been taken into account. The most important among these is the net farm household income (in Rs. per month) "X₁", the rest of the explanatory variables are family size "X₂", number of literate members "X₃". The three dummy variables "D₁", "D₂" and "D₃", for farm size, tenurial status and mechanization respectively are also included in the model. The large farm is represented by unity and zero otherwise, owner farmer is denoted by one and otherwise by zero, while mechanized farm is represented by one and zero otherwise. In this way the numerical values of the dummy variables D₁, D₂ and D₃ have been obtained. Thus the consumption function for the sample farmers becomes as follows:

$$C = f(X_1, X_2, X_3, D_1, D_2, D_3)$$

and the linear mathematical form was as under:

$$C = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 D_1 + \beta_5 D_2 + \beta_6 D_3 + U$$

where " β_0 " is the autonomous consumption, " β_i " are the respective co-efficients and "U" the residual term indicating the influence of all those factors which have not been included in the model. As is obvious from the very nature of the variables, consumption is positively related to the explanatory variables. Thus the expected signs of all the parameters estimated would be positive.

It has been assumed that the different types of the agrarian structure viz. farm size, tenurial status and mechanization state would affect consumption differently. Therefore, in addition to the above mentioned dummy variables model for all the sample farm households, eight other consumption functions for each category and one for all households without dummy variables have also been estimated.

7.1.ii Estimation and Verification of the Consumption Functions

Although the explanatory variables " X_i " and " D_i " are related to each other and are not truly exogenous, but since they are also not perfectly linear related, therefore it is assumed that there is no "multicollinearity" among them. Similarly it is also assumed that the problems of "heteroscedasticity" and "autocorrelation" do not exist. Without applying any appropriate test for the detection of these econometric problems and the assumption of non-existence is one of the limitations of this study. Since, there is a single-equation model for each category

of farm, hence the Ordinary Least Squares (OLS) method has been used for the estimation of the model. Holding the usual assumptions of the OLS method, the parameter estimates " β_i " would be "blu" (best, linear and unbiased) and consistent.

So far as the verification of the models is concerned, the results displayed in the subsequent section indicate that all the models are statistically significant. In all cases, the co-efficients of determination, R-squares have been greater than 0.5, hence the FITS have been good. Higher values of F-ratios have also suggested that the estimated models are overall significant. The standard errors verify that the individual parameter estimates are statistically significant. Differences between the parameter estimates of the consumption functions on small and large farms, mechanized and non-mechanized farms and on farms operated by owners and tenants are tested, applying the Chow F-ratio test mentioned earlier. The differences in all cases are statistically significant.

7.1.iii Interpretation of the Consumption Functions

Applying the OLS method, the dummy variables model of linear consumption function for all sample farm household has been estimated. The results obtained are as follows:

$$\hat{C} = 1074 + 0.70X_1 + 94.5X_2 + 47.4X_3 + 13.3D_1 + 12.6D_2 + 14.9D_3$$

(5.30) (0.21) (1.76) (2.09) (1.01) (2.50) (1.10)

$$R^2 = 0.59, \quad F^* = 122.3, \quad Ee^2 = 385.4$$

Figures in parentheses are the standard errors of the respective parameter estimates. R-square, the co-efficient of determination has indicated that 59 percent variation in consumption is due to the explanatory variables included in the model. The autonomous consumption on average is Rs.1074 per month, while the marginal propensity to consume is 0.70, which implies that on average sample farmers have consumed 70% of the increased income and the rest is saved. The situation is in conformity with most of the developing countries. The standard of living in terms of consumption is not unusual. The data has revealed that the family size and the number of literate members (students) have had a remarkable impact on the consumption of farm households. The co-efficients of dummy variables have indicated that mechanization (D3) has relatively greater influence on the consumption as compared to the farm size (D1) and tenurial status (D2). The relevant figures are 14.0, 13.3 and 12.6, respectively.

To compare the equality between parameters of the consumption functions on small and large farms, separate functions have been estimated and the results are presented in Table 7.1.

Table 7.1
Results of the Estimated Consumption
Function by Farm Size

Farm Size	Results
A) <u>Small Farms</u>	$\hat{C}_S = 417 + 0.91X_1 + 37.8X_2 + 6.9X_3$ <p style="text-align: center;">(2.31) (0.04) (1.71) (0.81)</p> $R_i^2 = 0.67 \quad F_i^* = 136.8 \quad \sum e_i^2 = 329.6$
B) <u>Large Farms</u>	$\hat{C}_L = 1045 + 0.72X_1 + 95.5X_2 + 60.1X_3$ <p style="text-align: center;">(5.03) (0.11) (1.96) (2.07)</p> $R_2^2 = 0.61 \quad F_2^* = 133.4 \quad \sum e_2^2 = 348.2$
C) <u>All Farms</u>	$\hat{C}_P = 733 + 0.82X_1 + 67.2X_2 + 13.9X_3$ <p style="text-align: center;">(1.76) (0.05) (1.03) (1.00)</p> $R_p^2 = 0.65 \quad F_p^* = 134.7 \quad \sum e_p^2 = 348.2$

Figures in parentheses are the standard errors

The Chow F-ratio suggests that the parameters of the two types of consumption functions are statistically significant at 5% level of significant.

The data indicate that the autonomous consumption (consumption at zero level of income) of the large farmers has approximately been two times the autonomous consumption of the small farmers. Clearly the standard of living in former case is twice of that in the later case. The MPC (0.91) of the small farmers when are compared with MPC (0.72) of the large farmer, indicate that the small farmers have been just in the neighborhood of "break even" point of

income. In other words they have been operating their farms on the subsistence level. The co-efficient of "X3" on the large farms has approximately been ten times higher than the corresponding figure on the small farms. It infers that the fraction of spending on education has been significantly lower on the small farms. The family size "X2" has added to the consumption of the large farmers at the rate of 95.5, which is more than two and a half times of the small farmers. The results of the pooled consumption function have indicated average of the two extremes of the small and large farmers.

Table 7.2 indicates the results of the estimated consumption functions by tenure.

Table 7.2
Results of the Estimated Consumption
Function by Tenure

Tenure	Results
A) <u>Owners</u>	$\hat{C}_o = 996 + 0.75X_1 + 82.3X_2 + 33.6X_3$ <p style="text-align: center;">(1.07) (0.02) (1.13) (0.97)</p> $R_o^2 = 0.62 \quad F_o^* = 115.3 \quad \Sigma e_o^2 = 341.6$
B) <u>Owner-cum-tenants</u>	$\hat{C}_{or} = 803 + 0.79X_1 + 85.4X_2 + 10.1X_3$ <p style="text-align: center;">(3.51) (0.10) (0.76) (1.01)</p> $R_{or}^2 = 0.65 \quad F_{or}^* = 131.9 \quad \Sigma e_{or}^2 = 320.8$
C) <u>Tenants</u>	$\hat{C}_T = 401 + 0.96X_1 + 35.2X_2 + 4.9X_3$ <p style="text-align: center;">(2.11) (0.07) (0.86) (0.89)</p> $R_T^2 = 0.68 \quad F_T^* = 138.1 \quad \Sigma e_T^2 = 318.5$

The intercepts of the consumption functions estimated for owners, owner-cum-tenants and tenants have been Rs. 996, Rs. 803 and Rs. 401 respectively. Obviously the first category is enjoying relatively higher standard of living as compared to the last category. The respective MPCs are 0.75, 0.79 and 0.97, which indicate that owners are in a position to save 25% of the increased income while tenants are slightly above the break even point. They are just earning their livelihood. The co-efficient of explanatory variable X3 (number of students) has revealed that expenditure on education is the lowest on the farms operated by tenants, while it is the highest on the farms managed by the owners.

So far as the impact of mechanization on consumption irrespective of farm size and tenurial status is concerned, table 7.3 indicates that autonomous consumption of the non-mechanized farm households has been one-third of the autonomous consumption of the mechanized farm households. The respective levels are Rs. 364 and Rs. 1102 per month. The MPCs indicate that the farmers on the non-mechanized farms have earned income nearly equal to the break even point (zero saving level income), while mechanized farmers could save 33% of their increased income. The impact of family size on consumption in case of mechanized farms is higher. The co-efficient of literate members "X3" on the non-mechanized farms is 1.9 while it is 34.6 on the mechanized farms. Spending

on education, which is an important indicator of standard of living is high in the later case.

Table 7.3
Results of the Estimated Consumption
Function by Mechanization State

Mechanization	Results
A) <u>Non-mechanized Farms</u>	$\hat{C}_{NM} = 364 + 0.97X_1 + 36.3X_2 + 1.9X_3$ <p style="text-align: center;">(1.36) (0.12) (1.02) (0.61)</p> $R_{NM}^2 = 0.73 \quad F_{NM}^* = 155.6 \quad \sum e_{NM}^2 = 203.7$
B) <u>Mechanized Farms</u>	$\hat{C}_M = 102 + 0.67X_1 + 93.4X_2 + 34.6X_3$ <p style="text-align: center;">(3.97) (0.08) (1.11) (2.07)</p> $R_M^2 = 0.57 \quad F_M^* = 109.8 \quad \sum e_M^2 = 422.4$

7.2 STANDARD OF LIVING OF FARMERS

There are two main indicators which determine the standard of living. The first examined in the preceding section have been the marginal propensity to consumption and the level of consumption; the second are comprising of the item-wise expenditures and provisions enjoyed by the households. An attempt is being made to analyze the later indicator in this section.

7.2.i Items-wise Expenditure

A detailed information has been obtained on item-wise expenditure of the farm households. For determining standard of living, all those items have been

categorized in five main categories, and their percentages by farm size and tenure have been calculated which are enumerated in the Table 7.4

Table 7.4
Percentages of Item-wise Expenditure of the
Sample Households by Farm Size and Tenure

S.No.	Farm Size/Item-wise Expenditure	Owners	Owner cum tenants	Tenants	All Tenures
A)	<u>Small Farms</u>				
i)	Food, clothes and shelter	43.42	41.86	39.77	41.68
ii)	Health	8.25	7.02	5.00	6.76
iii)	Education	7.90	6.45	4.75	6.37
iv)	Custom/Tradition	21.15	22.14	24.25	22.51
v)	Other Items	19.28	22.53	26.23	22.68
B)	<u>Large Farms</u>				
i)	Food, clothes and shelter	48.50	45.52	43.61	45.79
ii)	Health	13.20	12.48	11.13	12.27
iii)	Education	15.18	13.50	12.19	13.62
iv)	Custom/Tradition	9.57	12.25	14.00	11.94
v)	Other Items	13.55	16.52	19.07	16.38
C)	<u>All Farms</u>				
i)	Food, clothes and shelter	45.96	43.55	41.69	43.37
ii)	Health	10.73	9.75	8.07	9.52
iii)	Education	11.54	9.98	8.47	10.00
iv)	Custom/Tradition	15.35	17.19	19.13	17.22
v)	Other Items	16.42	19.53	22.64	19.53

The data indicate that in case of all tenures on all farm sizes, 43.73% of the expenditures have been spent on basic essentials like food, clothes and shelter. Only 10% and 9.52% of the spendings have incurred on education and health. A very significant amount of 17.22% has been spent on customs/traditions, which is absolutely an uneconomic expenditure.

Evaluating critically the situation on the small and large farms, the high percentages of spending on food, clothes, shelter and education, and the corresponding lower percentages of spending on custom/traditions and other items by the large farms, clearly indicate their better standard of living.

The same trend has been witnessed in favour of the owner farmers in comparison with the tenant farmers.

Consequently, because of better efficiency of the large farms managed by owners farmers, the standards of living have enhanced; in case of the small tenants they have been found deteriorating.

7.2.ii Provisions

Provisions of certain facilities like, radio/tape-recorder, television, dish-antenna, refrigerator, air-conditioner, motor car, etc. are also among the determinants of the standards of living.

It is observed that a majority of 70.50% of the small tenant farmers have had radio/tape-recorder only, with no other provision of the above mentioned items. A very few (12.50%) of the small owners and owner-cum-tenants possessed radio/tape-recorder with television. Among the large owner farmers only 8.50% have had tape-recorder, television and refrigerators.

None of the tenants could have televisions and refrigerators. In absolute terms only four (2.00%) of the large owner farmers, who managed mechanized farms could afford possess television, dish-antena and refrigerator. Only two (1.00%) of the sample farmers, who operated large, mechanized and owned irrigated farms have availed the provision of radio/tape-recorder, television, dish-antena and refrigerator and only one (0.50%) of the same category could have a car in addition to all these provisions.

This analysis thus implies that the standards of living and provisions are positively related to the farm size, mechanization and ownership of the farm land.

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CHAPTER VIII

LINEAR PROGRAMMING MODELS AND SENSITIVITY ANALYSIS OF SELECTED CONSTRAINTS

8.0 INTRODUCTION

The analyses carried out in chapters III, IV, V and VI of this thesis have revealed that inadequate agrarian structure, that is, the smallness of the small farms and the largeness of the large farms, tenurial status, irrigation status and mechanization state, are among the main constraints, which have adversely affected the farm efficiency. Lack of knowledge about the recommended farm practices also have a direct bearing on the efficient utilization of resources.

It could be argued that it is not enough to know about the constraints only. It would be useful to know which of the constraints have had binding and limiting affects on the farm efficiency. Linear programming (LP) technique, helps in both by sorting out the effects of such constraints on economic efficiency of the farms.

Linear programming provides a method of specifying all or any of the constraints, both of a technical (e.g. water) or of an institutional (e.g. credit) nature, for studying the effects of these constraints on a multi-product or multi-activity farming system. The sensitivity analysis further enables to analyse the effects of any change in the constraints on the overall farm activity. This ability

to analyse simultaneously changes in the constraints and in the resource use and production gives LP an advantage over production function technique.

To (*Jhol and Kapur, 1967*) Linear programming is a more systematic and accurate method of determining mathematically the optimum combination of inputs so as to maximize the income or minimize the cost within the limits of available resources. Linear programming model is the most important tool in economic theory for optimizing production and minimizing cost. For its mathematical accuracy and scientific standard calculation, particularly in the limited farm resource condition, linear programming technique is highly useful and can be used in any economic situation where there exists a framework of (i) resource restrictions, (ii) alternative activities or processes and (iii) quantifiable objective viz, maximization of profit or minimization of cost.

LP is equally capable of accommodating a large quantum number of variables and is simple enough in terms of data requirements. Therefore, in the condition of Pakistan and especially of the sample area (NWFP), the LP can prove to be a suitable technique used in this study.

One of the main advantages of linear programming, compared with other methods of planning, is that a complex situation can be studied in a more comprehensive and realistic manner, with computations carried out by computer, which produces unique optimal solution. However LP has its own limitations

Where:

Y	=	Net revenue (in Rs.)
X_i	=	Area under crop (activity) i
P_i	=	Net revenue per acre from activity i (in Rs.)
WX_{ij}	=	Water allocated to crop i during month j (in acre inches)
hx_{ij}	=	Human labour hours allocated to crop i during month j
kx_{ij}	=	Working capital allocated to crop i during month j
L	=	Total availability of land in acres
W	=	Total availability of irrigation water in acre inches
HL	=	Total availability of human labour in man hours
BL	=	Total availability of bullock labour in bullock hours
K	=	Total availability of working capital (in Rs.)
i	=	1, 2,, n
j	=	1, 2,, 12

8.2 EXPLANATION OF THE MODEL**8.2.i Objective Function**

The objective of the model is to maximize the net revenue profit of the farm, subject to the technical constraints of the production function and the level of resource availability.

8.2.ii Selected Activities

The cultivation of a crop has been termed as an activity. For the purpose of this LP model, the following crops from irrigated areas have been considered as "activities:"

- | | |
|-------------------------|----------------------|
| 1. Wheat | 2. Barley |
| 3. Maize | 4. Sugarcane |
| 5. Rice | 6. Rabi Pulses |
| 7. Kharif Pulses | 8. Rabi vegetables |
| 9. Kharif vegetables | 10. Rabi fodder |
| 11. Kharif fodder | 12. Other Rabi crops |
| 13. Other Kharif crops. | |

8.2.iii Constraints

The constraints have been divided into two categories, namely.

- A. Fixed resource constraints (including land, canal water, family labour and bullock labour).
- B. Special constraints that restrict the range of feasible cropping patterns.

Due to the seasonal nature of crop production, the total amount of various resources and their availability during different stages of production is important.

For this, the amount of land, canal water, family labour hours, and bullock hours have been expressed each as 12 monthly constraints. The analysis of various individual constraints are as follows:

Fixed Resources

i) Land Constraint

The acreage available for growing crops has been determined by the farm size. A 7.5-acre farm is taken as the representative sample size, corresponding to the average size of the farms emerging from the field survey. The land constraint has been expressed as 12 monthly constraints.

ii) Family labour Hours Constraint

Again, based on the field study survey, the average family labour hours available on a 7.5 acre farm have been taken as 250 man hours per month. The family labour constraint has been expressed as 12 monthly constraints.

iii) Bullock Hours Constraint

The field survey showed that on average, one pair of bullocks has been kept on a 7.5 acre farm. It is assumed that the bullocks can actively work for 25 days in a month and 8 hours per day, which gives 200 bullock hours per month on a 7.5 acre farm. The bullock hours constraint has also been expressed as 12 monthly constraints.

iv) Canal Water Constraints

Without a tubewell, the water availability is limited by the canal water supplied by the government, and this amount varies with the size of the farm. The data on the monthly acre inches of canal water available at farm level have been derived from the field survey and are enumerated along with other fixed resources, available to 7.5 acre farm in table 8.1.

Table 8.1
The Fixed Resources Available to a 7.5 Acre Farm

Month	Fixed Resources			
	Land (Acres)	Family Labour (Hours)	Bullock Power (Hours)	Canal Water (Acre Inches)
April	7.5	11.85	312	200
May	7.5	17.12	312	200
June	7.5	19.93	312	200
July	7.5	20.00	312	200
August	7.5	20.14	312	200
September	7.5	18.50	312	200
October	7.5	17.10	312	200
November	7.5	12.76	312	200
December	7.5	12.94	312	200
January	7.5	04.99	312	200
February	7.5	09.76	312	200
March	7.5	09.15	312	200

Source: Field Survey

Special Constraints

There are other constraints in addition to the above mentioned of the fixed resource constraints, which restrict the feasible cropping activity of the representative farm acreage (7.5 acres). These constraints include minimum acreage of fodder for bullocks and acreage of wheat/maize for domestic consumption. The working capital constraint also limits the crop production. Which has been assumed to the total savings of the farm households.

8.3 SOLUTION OF THE LP PROBLEM

For the solution of this LP problem the simple method has been used. The computations has been carried out by the computer. It is assumed that the availability of working capital is Rs. 3,000 per year with additional tubewell water to the extent of 25 percent of the total irrigation water. The activity wise results of the model by tenurial status are presented in the following table 8.2, in addition, the cropping pattern, the total cropped area, cropping intensity and net revenue are also indicated in the table.

Table 8.2
Activity Levels of the Basic Model

Description	Tenurial Status		
	Owner	Owner-cum.tenant	Tenant
	Area in acres		
(i) CROPS:			
a) <u>Rabi Crops:</u>			
Wheat	1.45	1.40	1.55
Barley	1.25	1.15	--
Pulses	0.95	0.80	0.25
Vegetable	1.15	0.95	1.85
Fodder	0.35	0.65	1.10
Other crops	0.20	0.25	0.35
Sub total (A)	5.35	5.20	5.15
b) <u>Kharif Crops:</u>			
Maize	1.30	1.35	1.40
Sugarcane	1.10	1.00	0.90
Rice	0.85	0.85	0.70
Pulses	0.55	0.40	--
Vegetable	0.95	1.00	0.90
Fodder	0.25	0.30	0.50
Other crops	0.15	0.20	0.55
Sub total (B)	5.15	5.10	4.95
(ii) Total Cropped Area (A+B)	10.50	10.30	10.10
(iii) Cropping Intensity	140.00%	137.33%	134.67%
(iv) Shadow Prices of Resources	RUPEES	RUPEES	RUPEES
a) <u>Water (Rs.)</u>			
Water (February)	90.75	89.85	88.00
Water (April)	270.20	265.50	262.50
Water (July)	75.25	75.00	70.25
Water (November)	185.16	180.25	175.50
b) <u>Working Capital (rupees)</u>			
	2.31	2.52	2.95
(v) Net Revenue (Profit):			
Annual Total (rupees)	8541.77	7856.16	7309.13

8.4 ANALYSIS OF THE LP PROBLEM

According to the results of the model, the profit maximizing owners, owner-cum-tenants and the tenants should grow 10.50, 10.30 and 10.10 acres of land respectively.

For reaching the optimal allocation of land and water, the "shadow prices" of the working capital and the water constraints as reported in table 8.2, have indicated very high values.

It is observed that the cropping intensities obtained from the basic solution of LP model have been 140.00%, 137.33% and 134.67% on the farms operated by owners, owner-cum-tenants and tenants respectively. The different types of farms are in conformity with the differences in the allocation of fixed resources among crops.

The high shadow prices of water in a particular month of a year indicates its shortage in that which is confirmed by the results of LP model, indicating a significant shortage of water in the month of April followed by the month of November. The lower shadow price of water in the month of July indicates its relative shortage in this month. A gradual, but by tenants, owner-cum-tenants and owners has been found respectively. The shadow prices of water in the months of April and November have been estimated at Rs. 270.20 and Rs.

185.16 respectively in the optimum farm plan of the owner farmers, which implies that the supply of an additional acre inch of water has increased the net revenue by Rs. 270.20 and Rs. 185.16 respectively. Similarly the net revenue of the owner-cum-tenants and tenants can be enhanced if the supply of an additional acre inch of water is increased. It can be concluded from the above analysis that water supply in the month of April and November has remained an effective constraint on the economic efficiency of the farms.

The shadow prices of the working capital have been estimated at Rs. 2.31, Rs. 2.52 and Rs. 2.95 on farms of owners, owner-cum-tenants and tenants respectively, showing that there has been the shortage of capital on these farms. This equally implies that an increase of one rupee in the working capital would rise the net revenue of the farmers equal to their respective shadow prices. The lack of working capital thus establishes the fact that there is an intense need for expanding credit facilities in the project area.

The basic solution of the LP model indicates the optimal annual net revenues of the owner farmers, Owner-cum-tenants and the tenants worth of Rs. 8541.77, Rs. 7856.16 and Rs. 7309.13 respectively. Obviously differences in the net revenues or economic efficiencies of the farms could relatively be attributed towards mechanized farming.

8.5 SENSITIVITY ANALYSIS OF THE MODEL

Lee et al. (1981) have argued that the analysis of parametric change and their effect on linear programming solutions is referred to as "sensitivity" or "post-optimality" analysis. In other words, it is the study of parametric changes and the relative sensitivity of the basic solution to these changes. The most obvious means for analysing these changes is to record the changes in the original problem formulation, solve again via old. The difference between these two solutions would indicate the effects of parameterization.

The results of the basic model indicate that the farmer of a 7.5 acre of farm holding has been unable, at prevailing water supply and capital restriction imposed, to generate the internal surpluses that are required to move systematically towards a higher level of technology, and in turn to enhance economic efficiency of the farm. In the following part of the section, two parameters in the model have been changed to provide a better picture of the interaction between credit, water (technological change) and the growth of output on sample farms in the irrigated area of N.W.F.P.

In this exercise, credit and water are scaled upward in increments of 20 and 25 per cent of the available assumed working capital and water respectively. The consequences of such upward adjustments are presented in the table 8.3.

Table 8.3
Optimal Cropped Area, Cropping Intensity and
Net Revenue for a Rang of Credit and Water Availability

Description	Total Cropped Area (acre)	Cropping Intensity (%)	Shadow Price of Credit (Rs.)	Net Revenue (Rs.)
1. Owner				
i) A	10.50	140.00	1.90	8541.77
ii) B	10.95	146.00	1.65	9370.15
iii) C	11.15	156.67	1.65	9804.50
2. Owner-cum- Tenants				
i) A	10.30	137.33	1.99	7856.16
ii) B	10.80	144.00	1.65	8241.75
iii) C	11.14	148.53	1.65	8673.15
3. Tenants				
i) A	10.10	134.67	2.01	7309.13
ii) B	10.35	138.00	1.65	7727.16
iii) C	11.02	146.93	1.65	8205.26

A = Canal + purchsed tube well water with initial working capital of Rs. 3,000
 (credit Rs. 15000+25% water

B = Increase of credit by 20% + the same amount of 25% water

C = Increase of credit by 20% + 50% water

The results reveal that the net revenue of the owner farmers has increased from Rs. 8541.77 to Rs. 9370.15, when the credit is increased by a rate of 20% of the initial working capital, holding water supply constant. It enhanced to Rs. 9840.50 when water is increased by 25%. The impact of upward shifts in the

amounts of credit and water supply can be judged in the same direction on the farms operated by owner-cum-tenants and tenants. The sensitivity of a rise in the quantities of credit and water supply with respect to corresponding increase in the net revenue (economic efficiency) has been remarkable, increasing net revenues by 14.78%, 12.26% and 10.40% on the farms managed by owners, tenants and owner-cum-tenants farms, respectively.

The sensitivity of results indicates that for the addition of credit and irrigated water to the initial working capital and available water, the farmers would still be willing to pay more than the prevailing interest rate and tubewell water charges.

It is evident from the data enumerated in table 8.3 that the total cropped area has increased with a corresponding rise in the amounts of credit and irrigation water on all types of the farms. The proportions of increase on the farms operated by the tenants, owner-cum-tenants and the owners have been 9.11%, 8.16% and 6.19% respectively. The results further indicate that the availability of working capital (credit) and irrigation water has been relatively more sensitive for tenants than for the owners, which reflects that credits have enabled the farmers in general and the tenant operators in particular in purchasing the inputs and in increasing their total cropped area.

The results of the LP model after relaxing the credit and water constraints, have shown that the cropping intensities have also significantly increased on all types of the farms.

The data given in Table 8.3 reveals that relaxing of more water constraints, further increase the acreage of the farm crops. Furthermore, the increase in net revenue and rise in the shadow price of credit can contribute towards more credit utilization efficiency.

8.6 CONCLUSION

The above exercises undertaken describe the conditions of the sample farmers, under a variety of assumptions of the availability of credit and water. The results suggest the possibilities of a trade-off between land and borrowed capital as well as land and water availability. Access to credit and tubewell water is clearly substantial for improving the economic efficiency of farms.

CHAPTER IX

ECONOMIC FEASIBILITY OF THE PROJECT/STUDY

9.0 INTRODUCTION

Is the project/study economically feasible?, or is the farm business worthwhile (beneficial)? In other words, to find out whether the key inputs of land, labour, capital and management used in farming are economically beneficial. It is purely an investment decision, where the application of evaluation/appraisal techniques have a special significance. Appraisal is an ex-ante analysis, where before a project/study has been put into operation, its costs/benefits are pre-determined to arrive at the investment decision. In evaluation, it is ex-post analysis, where the project has already commenced and costs/benefits are actually incurred and it is to find out whether the investment decision is profitable or not.

In fact both appraisal and evaluation techniques are used for determining the economic viability, of a project/study. For the purpose of this study, evaluation technique has been used, as the actual data of costs and benefits collected relate to the project/study that has already commenced. This type of evaluation is known as concurrent evaluation, which is very useful in identifying the pitfalls and suggesting the remedial measures for successful implementation.

Evaluation thus determines the economic feasibility and usefulness of a project/study in its totality. The cost-benefit analysis is an important tool of evaluation, where the value of a project/study is determined through,

- (i) technical analysis (such as the input and output relations);
- (ii) financial analysis (for estimating the costs and returns flows of returns) and
- (iii) commercial analysis (for determining whether the output specifications, market plans and organizational structure are sound).

The chapter under review, focuses on the financial analysis of the project/study. The three criteria of investment decision viz., the net present value (NPV), the benefit-cost ratio (BCR or B/C) and the internal rate of return (IRR) have been applied for testing the economic viability of farming in N.W.F.P.

9.1 IDENTIFICATION OF COSTS AND BENEFITS

For the cost-benefit analysis (CBA) of a project/study, identification of costs and benefits is an important and technical task. Double counting or excluding of an important item may lead the evaluator to a faulty decision. To identify accurately the total costs and benefits of farming is equally a very difficult task. However, identifying the monetary values of qualitative cost

(pains) and qualitative benefit (pleasures) or the social-costs/benefits analysis in the field of agriculture is not an easy job. Therefore, for simplicity and error free results, the qualitative or social costs/benefits analysis which determines the, indirect and incommensurable effects of farming are excluded, which may be considered as a limitation of the study. Farming being a very vast field, the cost-benefit analysis for the purpose of this thesis has been confined to the economic costs/benefits of the crops production only, which may be another limitation of the study. However, an attempt has been made to secure all the possible economic costs of each and every input used for growing the crops and value of the consuming/marketing final products and their by-products. Costs have been identified for the following items.

- Actual rent of rented in land.
- Imputed cost of owned land.
- Cost of seeds.
- Cost of ploughing, weeding and hoeing, etc.
- Cost of fertilizer and farm yard manures.
- Cost of insecticides/pesticides.
- Actual cost of hired labour.
- Imputed cost of family labour
- Actual cost of hired tractor/machine services.
- Imputed cost of owned tractor/machine services.

- Actual cost of hired bullock labour.
- Imputed cost of owned bullock labour.
- marketing and transportation costs.
- Other costs (imputed value of rent of farm house, and storage costs etc.).

Similarly values of returns (benefits) of the various crops have been determined as follows.

- Crop-wise monetary value of the main products at the prevailing market price.
- Value of by-products.
- Value of the crops used as fodder.
- Value of the fodder.
- Other revenues.

Since different farm activities take place at different periods of time, for example, cost of seeds and land preparation etc. are incurring at the start of the season (rabi/kharif), while returns accrue after three/four or six even more than six months. Therefore, the costs and benefits have been aggregated month-wise in a year. The sample farmers have been asked to provide carefully the different costs and returns for each and every month of the rabi and kharif crops. The month-wise averages of costs and benefits by tenure, farm size and

mechanization state, have been calculated and reproduced in a tabular form. Since money has a time value and costs incurred in January may not be compared with the benefits obtained after 12 months in December, therefore the costs (C_t) benefits (B_t) and net benefits ($B_t - C_t$) have been discounted on the monthly basis at the average of the prevailing market interest rates of 13.5% per annum.

9.2 TEST OF FEASIBILITY

This section is devoted to the cost-benefit analysis (CBA) and testing of the economic feasibility of farming. The following three important criteria have been used for examining whether farming is worthwhile/beneficial.

9.2.i The Net Present Value (NPV) Criterion

The net present value (NPV) is the sum value of the discounted net benefits costs or more specifically, N.P.V is the difference between the sum value of the discounted benefits costs, that is

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+r)^t}$$

OR

$$NPV = \sum_{t=0}^n \frac{B_t}{(1+r)^t} - \sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

Where

NPV	=	Net present value
B_t	=	Gross benefits in time/period 't'
C_t	=	Gross costs in time/period 't'
n	=	Discounting rate
r	=	Number of months (Project life)
$1/(1+r)^t$	=	Discounting factor in time/period 't' at the discounting rate of 'r'

Different financial institutions pay different rates of interest to the investors. In this study an average of the different prevailing market interest rates has been taken as the discounting rate 'r' for discounting the future streams. In this way the discounting rate computed has been 13.5% p.a. Since costs in general and benefits in particular are spread over the year, therefore the net benefits ($B_t - C_t$) have been discounted on the monthly basis, that is the discounting factor (D.F) is calculated by the expression $1/1+r/6$, where $6 = 12$. The following table 9.1 indicates the NPVS of the sample farms by their tenure size and mechanization state.

Table 9.1

**Net Present Values for the Sample Farms by Tenure, Farm Size
and Mechanization State (in Rs.'000')**

Tenure	Small Farms			Large Farms			All Farms		
	M	NM	Total	M	NM	Total	M	NM	Total
Owners	12.07	8.91	10.50	37.95	19.45	28.70	25.01	14.18	19.60
Owner-cum-Tenants	10.51	-2.07	4.22	24.80	16.63	20.72	17.64	7.28	12.47
Tenants	9.64	-2.93	3.36	16.09	13.55	14.82	12.87	5.31	9.09
All Tenures	10.74	1.30	6.03	26.28	16.54	21.41	18.51	8.92	13.72

M = Mechanized farms.

NM = Non - Mechanized farms

Note = The discounting rate $r = 13.5\%$ p.a.

The data reveal that from the NPV point of view, the efficiencies of different tenancy arrangements have been different. They are ranked as owners, owner-cum-tenants and tenants. The relevant figures on the small farms have been Rs. 10.50, Rs. 4.22 and Rs. 3.36 thousand per annum respectively, but more significantly higher on the large farms as Rs. 28.70, Rs. 20.72 and Rs. 14.82 thousand per annum respectively. The same trend is found in case of all farms. Three points are important to note:

- (i) The NPVs of the mechanized farms on all tenures, and of all farm sizes are significantly higher as compared to the NPVS of the non-mechanized farms in all tenures and farm sizes. This implies that mechanization is positively related to the efficiency of the farms.

- (ii) Results of the NPVs reveal that the tenants remained at the worst position, followed by owner-cum-tenants, while owner farmers in all cases have enjoyed remarkable NPVs.

Thus, owners are running their farms efficiently than the other tenancy arrangements. Which can be attributed to the availability of sufficient owned resources and access to credit facilities.

- (iii) The NPV is significantly higher on the large farms as compared to the small farms, within the same tenurial status. This infers that the farm efficiency is directly related to the farm size. Almost all types of farms have given positive NPV, which support the economic feasibility/viability of farm business. However there is sufficient room for improving the efficiency of the farms by optimal allocation of resources.

9.2.ii The Benefit-Cost Ratio (BCR) Criterion:

The benefit-cost ratio (BCR) is the ratio of the sum of benefits to the sum of costs. It is expressed as under:

$$B / R = \frac{\sum_{t=0}^n \frac{Bt}{(1+r)^t}}{\sum_{t=0}^n \frac{Ct}{(1+r)^t}}$$

Where

B/C	=	BCR
B _t	=	Gross benefits in time/period 't'
C _t	=	Gross costs in time/period 't'
r	=	Discounting rate
n	=	Number of months

A project is worthy to be accepted, if its BCR is greater than unity and vice versa. For the purpose of this study the discounting rate as determined in the above section 9.3.i (i.e. $r = 13.5\%$ p.a) used for finding the present worth of costs and benefits streams, is valid. Benefit/cost ratios of the sample farms by tenure, farm size and mechanization state are presented in the following table 9.2.

Table 9.2
**Benefit Cost Ratios of the Sample Farms by Tenure,
Farm Size and Mechanization State**

Tenure	Small Farms			Large Farms			All Farms		
	M	NM	Total	M	NM	Total	M	NM	Total
Owners	1.55	1.00	1.38	2.92	1.89	2.41	2.26	1.44	1.87
Owner-cum-Tenants	1.26	0.95	1.11	2.27	1.66	1.97	1.78	1.32	1.56
Tenants	1.12	0.90	1.01	1.67	1.35	1.51	1.41	1.13	1.27
All Tenures	1.32	0.96	1.16	2.29	1.63	1.96	1.82	1.30	1.57

M = Mechanized farms.

NM = Non - Mechanized farms

Note = The discounting rate $r = 13.5\%$ p.a.

The benefit cost ratio (BCR) and the NPV have led to the same conclusion in case of the present study. The BCRs given in table 9.2 show the trend as shown by the NPVs in table 9.1. In case of tenants and the owner-cum-tenants of the small farms operating farms without mechanization, their BCRs have been less than unity, which implies that they have been running their business on loss basis. That is the present worth of costs are greater than the present worth of benefits. However, the rest of the farms hold their BCR greater than unity, which supports the economic viability of farming. The owner farmers only, who operated small non-mechanized farms are running their farming on no-profit and no-loss basis. The BCR of 2.92 on mechanized large farms in case of owner farmers infers that for one unit of capital invested 2.92 units of returns are earned by the respective farmer. Approximately the benefits of these farmers have been three times of their costs. The overall trend of the BCRs on different types of farms has revealed that.

- Farm size and farm efficiency are positively related,
- Tenancy arrangements and farm efficiency are inversely related and.
- Mechanization enhance the farm efficiency.

9.2.iii The Internal Rate of Return (IRR) Criterion

Internal rate of return (IRR) may be either financial IRR or economic IRR. For this study, the financial IRR is the discounting rate which equates the

initial costs (C_0) and sum of future net discounted benefits, that is

$$C_0 = \frac{B_1 - C_1}{(1+r)^1} + \frac{B_2 - C_2}{(1+r)^2} + \dots + \frac{B_t - C_t}{(1+r)^t} + \dots + \frac{B_n - C_n}{(1+r)^n}$$

Since the IRR is the average earning power of money invested in a project, therefore, it is the appropriate criterion to determine the project worth. Applying this criterion for the viability of a project, the IRR is compared with the opportunity cost of capital (OCC). A project is worthy if its IRR is greater than the opportunity cost of capital. The computation of IRR conserves, two different discounting rates, which are identified on trial and error basis, one giving positive and the other negative NPVs in the neighborhood of zero. The discounting rate corresponding to the positive NPV is the lower discount rate while the other is the higher one. And the following formula is used for its determination:

$$IRR = \left(\begin{array}{c} \text{Lower} \\ \text{Discount} \\ \text{rate} \end{array} \right) + \left(\begin{array}{c} \text{Difference} \\ \text{between the two} \\ \text{discount rates} \end{array} \right) \left(\begin{array}{c} \text{NPV at the Lower discount rate} \\ \text{Absolute difference} \\ \text{between the two NPVs} \end{array} \right)$$

The results of the financial IRRs of the sample farmers, by tenure, farm size and mechanization state are shown in Table 9.3.

Table 9.3

**Internal Rates of Return of the Sample Farms by Tenure,
Farm Size and Mechanization State**

Tenure	Small Farms			Large Farms			All Farms		
	M	NM	Total	M	M	Total	M	NM	Total
Owners	15.07	13.50	14.26	18.13	16.51	17.32	16.57	15.02	15.79
Owner-cum Tenants	14.67	12.84	13.75	17.04	15.36	16.21	15.86	14.10	14.98
Tenants	14.05	12.18	13.12	15.41	14.76	15.09	14.73	13.50	14.11
All Tenures	14.58	12.84	13.71	16.86	15.54	16.21	15.72	14.20	14.96

M = Mechanized farming.

NM = Non - Mechanized farming.

It is assumed that the average prevailing market invest rate determined in section 8.3.i of this chapter is the opportunity cost of capital. This average rate $r = 13.5\%$ may not reflect the trainsick (true) value of capital. It may require shadow pricing. However due to lack of accurate relevant information the market average interest rate equals to 13.5% is assumed to be the social discount rate (or opportunity cost of capital).

The results of IRRs for different categories of farms given in table 9.3 indicate more or less the same situation as is shown by the NPVs and BCRs in the proceeding sections. In almost all cases, except the non mechanized small farms, the IRRs have been greater than the opportunity cost of capital. Thus this criterion also suggests that the business of farming is worthy to be accepted. The

IRR for all sample farms irrespective of mechanization state, farm size and tenure has been 14.96% (say 15%), which is one and half percent greater than the O.C.C, implying that the overall sample farms gave 1.5% benefit over and above recovering all the cost incurred. The highest IRR is known as the "break even" rate is 18.13%, which has been found on the large mechanized farms managed by the owner farmers. This indicates that farm efficiency is strongly related to mechanization, ownership and largeness of the farm. The acceptable IRR slightly above the opportunity cost of capital, which is known as the "cut-off" rate indicates that the project is at the margin worth while. The above mentioned IRRs indicate that mostly small, non-mechanized and tenants farms remained within cut-off rates. Thus the economic efficiency of these types of farms has been relatively lower than the one of the large farms, farms operated by owners or owner-cum-tenants and mechanized farms.

9.3 CONCLUSION

Applying the three different criteria viz. NPV, BCR and IRR suggest that the agricultural project/study is economically viable. The large farms are relatively more efficient than the small ones. Mechanization significantly enhances farm efficiency and proper tenancy arrangement encourage results in favour of owner farmers. The efficiency of owners' large farms can be attributed to the availability of resources and access to agricultural credit.

CHAPTER X

SUMMARY, FINDINGS, CONCLUSIONS AND SUGGESTIONS

10.0 INTRODUCTION

The preceding chapters, have explored highlighted the agrarian structure and the socio-economic profiles of the sampled farms. Applying various econometric/ quantitative techniques, the economic efficiency of the agrarian structure in NWFP has been also analyzed. This chapter focuses on the summary/findings, conclusions and suggestions for improvement.

10.1 SUMMARY & FINDINGS

10.1.i Existing State of the Agrarian Structure

The number of the small farms has been more than the large farms, however, a majority of the sampled farmers has been found operating their farm land with their own resources, which has influenced the productivity levels positively. The average operational holdings is 9.35 acres. The mean farms size on the large farms is 20.05 acres, which is far less than the limit of the economic holdings of 50 acres in NWFP. It is only 5.97 on the small farms. There is no significant difference in the average operational holdings of the different tenorial classes within each farm size. Out of 1870 acres of the operational holdings, 55% is in the possession of the pure owners and 21% of holdings is being managed by the pure tenants.

The cultivated area has been 75.44 percent of the total sample farm area, which is three times higher than the uncultivated area (24.56%). The culturable wastes is comprising of 15.56 percent of the total farm area. It implies that there is sufficient room to improve the land use, by redeeming culturable wastes for cultivation. The proportions of the small and large farms within the cultivated area has been 52.14 and 47.86 respectively. Nearly the same trend has been found in case of uncultivated area. A significant wastage of the culturable land on the small farms (40.23%) have attributed to the smallness (poverty) of the small farmers. The higher percentage of "not available" land for cultivation (70.83) on the large farms may be for reasons of area under buildings, grounds and *Hujras* of the rich households. The proportion of the uncultivated area (4.72) has been the lowest on the pure tenant farms.

Approximately 78.5% of the total cultivated area has been under irrigation from various sources, with 21.5% un-irrigated (dry land). The proportions of the irrigated land areas on the small and large farms have been 92 and 80 respectively. It implies that irrigation and farms size are inversely related in the sample area. The main source of irrigation is canal, which has irrigated 59.80 percent of the total cultivated area, followed by tubewells, which irrigated 18.16 percent of the sample farms. Those who exclusively depended on rainfall for cultivation have been 18.56 percent. The majority of the pure tenants have had

irrigated lands and are comparatively better off. Similarly, a significant proportion of the land irrigated by tubewells has been found on the large owners farms.

Out of the total sample farms, 85.50 percent has been fragmented. Within the fragmented farms group the proportion of the small farms is 75, which is significantly higher to the proportion of the large farms (25%). Within the small farms group, the percentage of the non-fragmented farms is 12.50. The corresponding figure in case of large farms is higher. The average number of fragments has been 4.9 in comparison to the population average of 3.7. The average number of fragments on the large farms has been 5.4, while it is 4.3 on the small farms. There has been a direct relationship between the farm size and the number of fragmented farms.

The proportion of the fragmented farms in case of the pure tenants has been higher (90.48) to that of percentage of the large farms (83.49). The average number of fragments has been 4.4, 4.9 and 5.3 on the farms managed by the owners, owner-cum-tenants and tenants respectively. The 19.50 percent of the total farm area is affected by water-logging and salinity. The proportion of the affected land has been 47.92 on the large farms, with the corresponding figure of 10.53 percent on the small farms. Within the Water-logged and salined area the percentages of the large and small farms have been 67.40 and 32.60 respectively.

A direct relationship has been found between the farm size and the area affected by water-logging and salinity. Within the affected area, the proportions of the owners, owner-cum-tenants and tenants have been 53.53, 25.81 and 21.26, respectively.

Of the total cropped area 50.23 percent has been under kharif and 49.77 percent under rabi crops. Almost the same trend has been observed on the small as well as on the large farms. The small farmers allocated greater area to food crops, like wheat and maize, etc, while the large farmers earmarked greater area to cash crops, like sugarcane, grams, vegetables and fruits, etc. The cropping pattern of the farms operated by the pure tenants is nearly the same as has been of the small farms. Similarly, the cropping pattern of the pure owners has been in conformity with the pattern of the large owners. The proportions of production of wheat, maize and barley have been higher on the small farms as compared to the large ones. Contrarily, the proportions of production of rice, sugarcane, grams and vegetables have been higher on the large relative to the small farms.

The farm land has been used more intensively by the tenants (79.96%). It has been more than seventy (76.64%) percent in case of all tenurial arrangements. A notable difference between the intensities of land use on the large and small farms has been observed, with the corresponding proportions as 72.74 and 80.52 respectively. In general, the 77% of land use intensity identifies the gap of 23%

between the potential and the realized land. In other words, income could be increased by 23%, if the appropriate land use intensity is adopted. The cropping intensity has remained almost the same on the small and large farms together, but has varied among different tenurial arrangements. On average, the cropping intensity has been 20.1 percent in the sample area, which means that the net sown area has been cultivated at least twice in one calendar year. In case of appropriate cropping patterns this intensity can be raised to 300 percent.

10.1.ii Socio-Economic Profile

The average family size has been 10, which is not significantly different from the population mean. The average family size on the large farms is (9.52) which is lower to the average family size on the small farms (9.81). The family size has been approximately 10 in all cases with the exception of owner-cum-tenants having 8.73. Approximately 90 percent of the sample household members has been in the working age group of 18 to 60 years. More than 50% of the population has been either too old or too young to work. No significant difference has been found in the percentages of the male and female members in various age groups. There has been no systematic relationship between the farm size and the age distribution.

The ratio of females to males has been 1.04, with female population estimated at 51.08% and male population at 48.92% respectively. The proportion

of the males on the small farms (48.96) has been lower to that of the males (50.98) on the large farms.

The ratio of the literates to illiterates has been 0.21, with 18 percent of the total sample population educated. The proportion of the illiterate females is 96.40, with 3.60 percent only as literates. The proportion of literate farm members has been 26.42, with 15.0 on the large and 11.25% on the small farms respectively. In aggregate, a positive relationship between literacy and farm size has been recorded. Although women are generally in a disadvantageous position compared to men, their literacy level has been positively related to the farm size.

The majority (71.05 %) of the literate members has been educated up to matric level. The relationship of high level of education has remained positive with the farm size. Only 1.03 percent of the farm members has passed MA./M.Sc on the small farms, with the corresponding figure of 3.37 percent on the large farms. The 1.35% of the literate members of the large farms has got professional education also.

The proportion of the employed labour force has been 45.06, which is 22.02 percent of the total sample population. The involvement of the females in employed group is just nominal (7.31%), with negligible economic contribution. However, the employment level of the females has been fairly large on the large

than on the small farms. The proportions of employment have been 46 and 44 on the farms managed by the pure owners and tenants, while employed females have been two times more in the former case as compared to the later.

The majority (92.31%) of the employed members has been engaged in on-farm working, of which 92.93 percent are males and the rest are females. Only 7.69 percent has been in the off-farm activities, of which 20 percent are females. The proportion of the on-farm employed members has been 78.80 on the small farms, which stands sufficiently higher to the proportion of the large farms (16.22). The 35.71 percent of the female within the female group from large farm households, has worked on-farm. On the other hand only 3 females have been found working in off-farm activities from the households of the small farms. There has been discovered an inverse relation between the farm size and the on-farm employment. The percentage of employed members working on-farm has been nearly the same in all terminal arrangements (92% approximately). However, there has not been any female on the tenant farms found engaged in the off-farm activities. The 19.05 percent of the females have been recorded engaged in the off-farm activities.

The ratio of the dependents to the earners has been estimated at 51:49 in the sampled area. It is 50:50 in the small, with 54:46 in the large farm families. The ratio between males and females has been 50:50 and 52:48 respectively. The

ratios of dependents to earners are 52:49 and 49:51 in the owner and tenant groups, respectively.

The reasons for not adopting the recommended farm's practices and required doses of inputs are ranked in descending order of proportions; as under.

- i. High prices of farm inputs
- ii. Stringency of credit facilities
- iii. Paucity of owned funds
- iv. Distance from input supply points
- v. Non availability of technical guidance
- vi. Shortage of labour at peak times
- vii. Expensive farm equipments
- viii. Fragementation of land holdings
- ix. Shortage of irrigation water and
- x. Waterlogging/salinity

The reasons for not using the institutional credit, reported by the sample non-user are ranked as:

- i. Non-availability of credit
- ii. Difficulties in obtaining credit
- iii. Lack of information, and awareness
- iv. No need

10.1.iii Agrarian Structure, Farm Efficiency and Farm Income

Economic Efficiency of the agrarian structure has been examined from two perspectives viz., the productivity of inputs and the levels of farm income

The data on production of the major crops has revealed that yield per acre of almost all the crops is higher on the large farms, however, the labour intensive crops have indicated higher yield on the small farms. The trend of yield per acre is nearly similar on all the tenures. But the pure owners have shown more efficiency in the crops of wheat, sugarcane and rabi vegetables, while the pure tenants have produced maize, rice, grams and kharif vegetables more efficiently.

In momentary terms, the land productivity indicated an inverse relationship between the farm size and productivity. In aggregate the value of output per acre has been Rs. 4713 on the small farms and Rs. 5004 on the large farms, while it is Rs. 4780 on the farm operated by tenants and Rs. 5039 by the owner farms.

The labour productivity has been estimated at 1802.9 kgs on the small farms. The labour productivity of the large farms is significantly higher to the small farms. The positive relationship between the farms size and the labour productivity has been due to the use of farm machinery and small quantity of labour input on the large farms. The labour productivities of the owners, owner-

cum-tenants and tenants have been Rs. 1896, 1859 and 1641, respectively. In aggregate, the capital productivity or output-capital ratio has been estimated at 2.23 which is significant. The capital productivity of the large farms (2.28) stands higher of the small farms (2.17). The positive relationship between the farm size and output-capital ratio is attributed to the adoption of recommended farm practices and doses of inputs on the large farms. The capital productivities have been 2.31, 2.19 and 2.18 on the farms operated by owners, owner-cum-tenants and tenants respectively. The overall productivity or the undiscounted benefit-cost ratio of the sample farms has been calculated at Rs. 1.24. It implies that with a cost of Re. 1, the sample farmers have earned paisas twenty-four only. The ratio of the total farms receipts to the total farm costs has been notably higher on the large farms (Rs. 1.31) than on the small farms (Rs. 1.18). The direct relationship between the overall farm productivity and the farm size is attributable to the use of farms machinery, recommended farm practices and proper doses of inputs on the large farms, and sufficient owned resources. The highest aggregate productivity has been recorded in the large farms (1.34) followed by the owners (1.27), owner-cum-tenants (1.23) and tenants (1.21) respectively.

The majority of the sample farmers (26.50%) has reported negative net farm income on their farms. The corresponding proportions on the large and small farms have been 10.42 and 31.58, respectively. The percentages of earning

(Rs. 0-6,000) are 43.42 on the small farms and 33.33 on the large farms. Approximately 50% of the sample farmers have been in the income bracket of Rs. 0-12,000, which is lower than the subsistence income level. The percentages of the large farmers are higher in the higher levels of income as compared to the corresponding percentages of the small farmers and vice versa. A positive relationship between the net farm income and the farm size has been ascertained.

With regard to the tenurial arrangements, only owners have been found in the higher income group. The proportion of the tenants who earned up to Rs. 24,000 per annum is only 2.38. No tenant has been found in the income scenario of Rs. 24,000 and above. Only one (0.92%) of the owners could earn net farm income of Rs. 36,000 and above.

The majority of the sample farmers (25.00%) fell in the income group of Rs. 19,000 to 24,000 per annum. Only 25 percent of the large farmers has earned income less than Rs. 18,000 per annum, or in other words, 75 percent of the large farmers has earned higher levels of income. Contrarily, 46 percent of the small farmers has earned less than Rs. 18,000 per annum. The proportions of the sample households earning Rs. 36,000 and above have been 21 percent on the large farms and 6 percent on the small farms. This implies that there is a high positive correlation between the farm size and net farm household income.

The highest proportions of all tenurial arrangements have been found in the income scenario of Rs. 18,000 – 24,000 per annum. The percentages of the owners, owner-cum-tenants and tenants in the income bracket of Rs. 36,000 per annum and above have been 10.08, 10.20 and 7.14, respectively. None of the household of tenant or owner-cum-tenant, could earn Rs. 54,000 and above per annum, implying that income has varied directly with tenancy arrangement. The owner farmers, who operated the large farms are more better off in this regard.

10.1.iv Determination of Technical Efficiency

Another way to analyze the farm productivity is testing technical and allocative efficiency of the farms. The profit inefficiency has been determined by the Translog profit frontier, showing the results that farmers are both technically and allocatively inefficient. The average inefficiency has been estimated at 23.9 percent with a wide variation of maximum of 95.0 percent and minimum of 4.9 percent, indicating that a substantial amount of profits is lost due to inefficiency.

Identification of the cogent factors causing variations in the profit inefficiency across farms included better rural education, extension services, and propagation of modern techniques of production and availability of agricultural credit, for bridging the gap between the efficient and inefficient farms.

10.i.v Distribution of Farm Land and Income

The bottom scenario of 20 percent of the sample farmers has been operating 5.80 percent only of the sample holdings, while the top 20%, 51.32% of the total farm land, with the ratio difference of the former to the later, indicating the severity of unequal distribution of the farm land. The convexity of the Lorenz Curve from the line of equality and the Gini co-efficient (0.62) have further established a significant unequal distribution of farm land.

Consequently, the unequal distribution of the farm land has also skewed the distributed of the farm income, with the bottom 20% of the sample farmers receiving 4.15% only of the farm income, while the top 20% getting 58.25% of the total farm income. The ratio of income received by the bottom 20% farmers to the income received by the top 20% has been estimated at 0.70, which implies that most of the farm incomes have been pocketed by the top few farmers. The severity of unequal distribution of farm income has been also indicated by the gap between the lorenz curve and the line of equality and the Gini co-efficient (0.8) together.

10.1.vi Input-Output Relationship and Stages of Production

To test whether structural differences existed between the small and large farms, the Chow F-ratio has been used. The test suggested that production processes of the small and large farmers are significantly different from each other.

Indicating the input-output relationship the Cobb-Douglas production functions of the type $Y = \beta_0 X_i^{\beta_i} e^U$ have been estimated for different categories of the agrarian structure. The output elasticity of the labour input on large farms has been twice of the output elasticity of the labour input on the small farms. The high efficiency of labour on the large farms is attributed to the use of mechanization. The output elasticity (efficiency) of all inputs have been relatively lower on the small farms in comparison to the elasticities on the large farms. The impact of technology denoted by the co-efficient " β_0 " are 13.82 and 20.08 on the small and large farms respectively, which means that there is a notable technological gap between the production process of two types of the farmers.

The sum of output elasticity of all inputs is greater than unity on the large farms, which implies that the large farms are operating in the stage of increasing returns to scale or generally as in the 1st stage of production.

The empirical results obtained from the production functions estimated for the different tenorial arrangements, irrigation status, and mechanization state, have indicated the same trend of higher output elasticities of various inputs on the farms managed by the large owners irrigated farms and mechanized farms. These types of the farms are also being run in the first stage of production (or increasing return to scale). All types of the agrarian structure have been producing on the different lines of production.

The marginal physical products of all the key inputs have indicated that the inputs are used more efficiently on the large farm, pure owners' farms, irrigated and mechanized farms as compared to their MPPs of inputs used on the small farms, pure tenants' farms, un-irrigated and un-mechanized farms respectively.

10.1.vii Consumption Pattern and Living Standard of Farmers

The linear consumption function estimated for all the sample farmers has revealed that the autonomous consumption is estimated at Rs. 1074 per month, while the marginal propensity to consume (MPC) at 0.70, implying that, on average the farmers consumed 70% of their increased income and the rest is saved. This finding is in conformity with most of the developing countries. The high values of intercepts and MPC are attributed to the large family size at the margin of break even point level of income. Thus the standards of living in terms of consumption is substandard. The 30% savings are the compulsory savings like payments of debts. etc.

The co-efficient of dummy variables used for farm size, tenurial status and mechanization state have been 13.3, 12.6 and 14.9 respectively. This means that those types of farming have had a significant impact on the level of consumption and the standards of living.

The autonomous consumption of the small farmers has been approximately half of the autonomous consumption of the large farmers. Clearly large farmers are enjoying high standards of living as compared to the small ones. The higher MPC (0.91) of the small farmer has indicated that they are nearly earning at a break-even point of income, or below the subsistence income level.

In terms of consumption, the pure owners are relatively at a advantage than the pure tenants. Similarly the households of the mechanized farms are more better off than the non-mechanized farm operators.

The proportion of spendings on basic needs (food, clothes and shelter), education and health have been 45.79, 13.62 and 12.27 respectively on the large farms, while the corresponding figures on the small farms are 41.68, 6.37 and 6.76.

Regarding spending on various items the same difference has been found between the pure owners and pure tenants as is recorded in the case of the large and small farms.

The percentage of expenditure on uneconomic pursuits like customs/traditions has been significantly higher (22.68) of the small than of the large farmers (11.94).

The majority (70.50%) of the small tenant farmers have had radio/ tap-recorder only, the 8.50% of the large owner possessed radio/tape-recorder with television and refrigerator. With regard to the household's provisions, the small and tenant farmers have been more worse than the large and owner farmers.

10.1.viii Linear Programming Model and the Sensitivity Analysis of the Selected Constraints

Results of the LP model suggests that the profit maximizing owners, owner-cum-tenants and the tenants should grow 10.50, 10.30 and 10.10 acres respectively.

The cropping intensities obtained from the basic solution of the LP model are 140.00%, 137.33% and 134.67% on the farms operated by the owners, owner-cum-tenants and the tenants respectively.

The shadow prices of the working capital have been Rs. 2.31, Rs. 2.52 and Rs. 2.95 on the farms of owners, owner-cum-tenants and tenants respectively, indicating that there is a shortage of capital on these farms.

The results of the sensitivity analysis indicated that the net revenue of the owner farmers has increased from Rs. 8542 to Rs. 9370 with the credit increasing by 20% and has increased further by 25% with a rise in credit and water supply.

10.1.ix Economic Viability of the Project/Study

The net present values (NPVs) of the small farms operated by the owner farmers, owner-cum-tenants and tenants have been Rs. 11, Rs. 4 and Rs. 3 thousands per annum respectively, while the corresponding figures for the large farms are Rs. 29, Rs. 21 and Rs. 15 thousand per annum. According to the NPV criterion, the large mechanized farms managed by owners have been the most efficient, while the small non-mechanized farms operated by pure tenants are inefficient.

Since the benefit-cost ratio (BCR) of most of the small farms, especially non-mechanized farms has been less than unity, hence, the non-mechanized small farms have not economically been viable. However, BCR criterion has suggested that the farm size and farm efficiency are positively related. Tenancy arrangement and farm efficiency are inversely related and mechanization enhances the efficiency.

The internal rate of return (IRR) for all the sample farms irrespective of farm size, tenorial status and mechanization state, has been 15% which is one and half percent greater than the opportunity cost of capital. This implies that the sample farm has earned 1.5% benefit over and above all the recoverable costs incurred. The IRR criterion has also led to the same conclusion that the non-mechanized small farms have operated by tenants are not economically beneficial.

Contrarily, the mechanized, large farms operated by the owners have been the most efficient one.

10.2 TEST OF HYPOTHESES

- 1) The first hypothesis stating that "in case of small farms, the tenant cultivators use their land holdings more intensively and hence get relatively greater output, while in case of large farms, the situation is the reverse in favour of owner cultivators," has been partially proved and partially disproved (see table 3.8). The tenants have used their lands more intensively both on the small as well as on the large farms.
- 2) The second hypothesis describing that the "cropping pattern on different farms (from tenurial status, size of holdings, state of mechanization and irrigation status points of view) is different" has been proved.
- 3) The third hypothesis assuming that "the consumption pattern and the standards of living of the farm households, changes with a change in the agrarian structure." This assumption has proved positively and has been verified by the consumption functions estimated for the different types of farms viz. small and large, owners, owner-cum-tenants and tenants mechanized and non-mechanized, irrigated and un-irrigated farms.

- 4) The fourth hypothesis has been that "the agrarian structure significantly affects the input-output relationship and the returns to scale (stages of production)." This hypothesis has also proved correct. The Cobb-douglas production functions estimated for different types of the agrarian structure have verified this assumption.
- 5) The fifth hypothesis assumes that "agricultural projects (or farming) are not economically viable if the farm size is small and is operated by the owner cultivators", has stood valid.

10.3 CONCLUSION

From the analysis of the agrarian structure, it may be concluded that there is no systematic correlation between farm type and land productivity of the various crops. In case of capital-inputs intensive crops, the relationship between productivity/efficiency by farm size, ownership, irrigation and mechanization is positive, while an inverse relationship is found between these variables for labour-intensive-crops. The labour productivity is significantly higher on the large, owner, irrigated and mechanized farms than on the small, tenant, un-irrigated and non-mechanized farms. Similarly the output-capital ratio on the large, owner, irrigated and mechanized farms is significantly higher than on the small, tenants, un-irrigated and non-mechanized farms. The ratio of total farm receipts to the total farm costs (i.e. the overall productivity) is significantly lower

on small, tenants, un-irrigated and non-mechanized farms as compared to the large, owner, irrigated and mechanized ones. The marginal physical products of all the factors of production on the large, owner, irrigated and mechanized farms are relatively higher than on the small, tenants, un-irrigated and non-mechanized, farms. It is also inferred that the agrarian structure of the sample farms is substandard. The average size of the operational holdings is less than the limit of economic holdings on the large farms and below the subsistence holdings on the small farms. Inadequate land utilization, unequal distribution of farm land, higher incidence of water logging and salinity, paucity of irrigation water, fragmentation of operational holdings, undesirable cropping pattern in-appropriate land use intensity and inadequate cropping intensity have notable inverse influence on the economic efficiency of the farms. It is concluded that the general ecology (demographic cum social factors) of the farm households are conducive enough to promote the economic efficiency of the sample farms. The high average family size, uneven age and sex distribution, low literacy ratio, low level of education of the literate population, high rate of dependency, low proportion of the employed population, negligible participation of the females in the economic activities adversely affect the efficiency of the sample farms. This situation is comparatively more worse on the small than on the large farms. Similarly the pure tenants are at a disadvantage in comparison to the pure owners.

The estimated production functions indicate that almost all types of farms viz. small and large, owners, owner-cum-tenants and tenants, mechanized and non-mechanized, irrigated and un-irrigated farms are operated at the different production lines are in the stage of increasing returns to scale (or in the first stage of production). This implies that all the sample farmers are utilizing their resources less efficiently than at the optimum level of utilization. The low yield per acre, substandard productivities of the factors of production and the less efficient utilization of resources are attributed to the adverse impact of inappropriate agrarian structure and socio-economic factors of the sample farms.

10.4 SUGGESTIONS

The following suggestions are made to improve the economic efficiency of the agrarian structure in the North West Frontier Province of Pakistan.

- i) Inequality in the distribution of farm land adversely affects the economic efficiency of the farms. The empirical results suggest that to avoid both the extremes of very small and very large farms, appropriate and effective land reforms are needed. To avoid conflicts and problems of implementation, it is proposed that land should not be taken away from the very large owner farmers. The ownership of land may not be disturbed. A policy may be evolved such that minimum and maximum limits are fixed for the

operational holdings, irrespective of the tenurial status, whereby the operation holdings are transferred from the very large to the very small farm operators on reasonable and equitable terms and conditions on continuous basis.

- ii) Mechanization displays a very vital role in the enhancement of efficiency. It is suggested that the availability of mechanized services with their subsidized rates may be ensured by the public sector. What types of mechanization are approximately needed on the small farms, need a separate exploration for further enlightenment
- iii) The LP model and sensitivity analysis show that a very small increase in the working capital results in a very handsome rise in the net revenue of the farms. The results of this study suggest that availability of credit will enhance the economic efficiency of the farms. There is a substantial need for an indepth review of the existing institutional credit structure and major overhaul of credit disbursement procedures, for further boosting farm efficiency.
- iv) In the project/study area, the effective size of holding has reduced due to waterlogging and salinity. Farmers have to be motivated and advised to use gypsum and green manuring or to grow crop varieties/tree species

which are salt tolerant. This will reduce salinity in the soil. They may also be motivated to launch the drainage system in the water logged area. Either small financial support by government or self-help campaigns by the farmers may help to reclaim/rehabilitate the salined and water logged soils.

- v) Empirical evidence of the study identifies that fragmentation of the holdings is also one of the primary constraints of economic efficiency. In this context, a detailed research study is needed to find out the appropriate ways and means for the further consolidation of land holdings in NWFP.
- vi) The economic efficiency is very well affected by the irrigation system. Efforts are needed to improve the existing irrigation system. Irrigation water can be betterly utilized by rehabilitation of canals and their proper maintenance that can further help in equiatable availability of water at the heads and tails of canals. Remodeling of canals and financial support by farmers in drilling the tubewells, need a serious attention from the government and farmers together.

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