



## Sacred Space

### Prayer for Rain

O God, / give us water with a watering through which Thou wilt/  
Make the stone hills pour, / fill the cisterns, / flood the rivers, make  
the trees grow, / bring down prices in the lands, / invigorate the beasts and the  
creatures, / perfect for us the agreeable things of provision, make grow for us  
the fields, / let flow for us the teats, and add for us strength to our strength !



Imam Ali ibn al-Husayn  
(Sent by Moorad Fazalbhoj, Mumbai).  
Times of India - Dt. 14 June, 2004.



**“AN ECONOMIC ANALYSIS OF MIXED FARMING IN  
THE SCARCITY AREA OF WESTERN MAHARASHTRA”**

by

**MARUTI NARHARI WAGHMARE**

(Reg. No. 98138)

A thesis submitted to the

**MAHATMA PHULE KRISHI VIDYAPEETH,  
RAHURI – 413722 DIST. AHMENHAGAR  
MAHARASHTRA STATE (INDIA)**

in partial fulfilment of the requirements for the degree

of

**DOCTOR OF PHILOSOPHY**

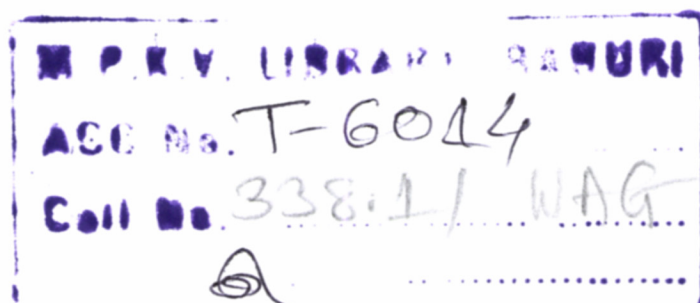
in

**AGRICULTURAL ECONOMICS**

**DEPARTMENT OF AGRICULTURAL ECONOMICS,  
POST GRADUATE INSTITUTE,  
MAHATMA PHULE KRISHI VIDYAPEETH,  
RAHURI – 413722, DIST. AHMEDNAGAR,  
MAHARASHTRA, INDIA**

**2004**

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**2004**

## CANDIDATE'S DECLARATION

I hereby declare that this thesis or part  
thereof has not been submitted by  
me or other person to any  
other University or Institute  
for a Degree or Diploma

Place MPKV, Rahuri

Dated 30/6/2004

  
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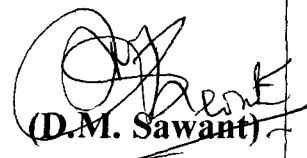
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## C E R T I F I C A T E

This is to certify that the thesis entitled, “AN ECONOMIC ANALYSIS OF MIXED FARMING IN THE SCARCITY AREA OF WESTERN MAHARASHTRA” submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist Ahmednagar, Maharashtra, in partial fulfilment of the requirements for the degree of **DOCTOR OF PHILOSOPHY (AGRICULTURE) in AGRICULTURAL ECONOMICS**, embodies the results of a piece of bona fide research work carried out by **Shri. Maruti Narhari Waghmare**, under the guidance and supervision of Dr DB Yadav, Dy Director of Research, Directorate of Research, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist Ahmednagar, Maharashtra state and that no part of the thesis has been submitted for any other degree and diploma

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Place: M.P.K.V., Rahuri

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(M.N. Waghmare)

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## ABSTRACT

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### “AN ECONOMIC ANALYSIS OF MIXED FARMING IN THE SCARCITY AREA OF WESTERN MAHARASHTRA”

by  
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 2004

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The present investigation has been undertaken to examine costs and returns, resource productivities, employment and income generated on different size groups of farms in the irrigated and rainfed regions in the scarcity area of Western Maharashtra. The study covers the primary data collected from 180 mixed farms i.e. 90 each from the irrigated and rainfed regions by survey method for the normal agricultural year 1999-2000. The sample farms have been categorized into the predetermined size classes viz, small (upto 2.00 ha), medium (2.01 to 4.00 ha) and large farms (above 4.01 ha) for the purpose of analysis. The data on various aspects of farm business were analysed to work out the estimates of per hectare and per animal resource use pattern, costs, returns and profitability of the crop production activity, livestock activity and for farm as a whole on different size groups of farms in the irrigated and rainfed regions. The analysis was further extended to work out the resource productivities, resource use efficiencies and employment and income generated on the farms.

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The land use and cropping pattern have been influenced greatly by soil type, rainfall pattern, irrigation facilities, availability of infrastructural facilities etc , among the different size groups of farms and between the regions. The family and its composition, level of literacy and types of productive assets owned by the farmers varied among the size groups of farms and between the regions. Per hectare use levels of crucial inputs viz, human labour, machine power, manures and fertilizers as well as fodder and concentrates in livestock production was relatively higher in the irrigated region. The per unit use of bullock labour in crop production activity and human labour in livestock activity were relatively more in the rainfed region. The intensity of resource use was higher on small sized farms. The use of major productive resource inputs was relatively high for the high value crops and their cultivation was found to be more profitable.

The production functional analysis indicated that there existed a great variation in the production elasticities of the resource inputs amongst the size groups of farms and across the regions. Human labour, cash expenses on crop production, area under cash crops, cash expenses on livestock production and area under fruit crops were the major resource inputs influencing the farm outputs among different size groups of farms and across the regions. Chow's test indicated that two regressions are not equal but differ significantly in their production relationships. The constant returns to scale was noticed for the crop production, livestock activity as well as for the farm as a whole.

The marginal value productivity indicated that there was greater efficiency in the use of different resources in the total farm production on different size groups of farms in different regions. The degree of resource use

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efficiency was relatively more for area of cash crops area and human labour in the irrigated region and area of fruit crops and gross cropped area in the rainfed region. In the total employment, share of crop activity was the highest in the irrigated region, while the share of livestock activity was the highest in the rainfed region. The total employment of family workers depended mostly on the resources such as cropped area and number of milch animals on the farms in both in the regions. The share of income from crop production in the total income was about 73 per cent in irrigated region and 50 per cent in the rainfed region. The share of income from crop production increased with the size group of farms in both the regions, while the share of income from livestock production showed reverse trend. There is a scope to enhance the income by using more capital on non-human resources on the farms in both the regions.

There is a need for diversification of the present cropping pattern through increased irrigation and credit facilities. Besides this, more importance should be given to subsidiary enterprises like dairy. There is need for increasing strength of crossbred cows alongwith local cows.

The findings of the study spells the need for adoption of integrated production approach conducive to bring about the shifts in the economic status of the cultivator more towards profitable scenario.

There is the need for evolution of suitable location specific low cost production technologies for farm production. Efforts are needed to foster the farm level adoption of various aspects of crop production and livestock production technologies for obtaining economic output levels on individual farms.

Chapter Opener Page

# INTRODUCTION



# 1. INTRODUCTION

## 1.1 Indian Agriculture

The agricultural sector occupies the place of prime importance in the Indian economy. This is because 61 per cent of Indian population still depends on agriculture for its livelihood. Besides, the agriculture sector contributes 24.9 per cent of gross domestic products and provides sizeable export earnings (Rs 28,657 crore i.e. 14.23 per cent of total export earnings during 2000-01). Over the period of time, the percentage share of agriculture in national income is decreasing but the percentage of population dependent on agriculture is not decreasing proportionately. On the other hand, in absolute terms population dependent on agriculture is increasing. This has resulted into continuous decrease in average size of holding with more and more fragmentation of land and unemployment. Land being the most limiting factor, dependence on it has touched its climax.

Since the scope to bring additional land under cultivation is limited, significant increase in agricultural production is possible only by increasing productivities of crops per unit land, labour and capital. But, the agricultural sector in many developing countries like India could not move ahead because of large number of physical, natural, economical, social, political and human factors (Mishra and Puri, 2001). The sign of development in agriculture sector shown by some of developing countries prior to the late sixties was of traditional type. The introduction of HYV seed, fertilizer and irrigation package with plant protection measures expanded production largely in irrigated region which strengthened the linkage between farm and livestock due to availability of required fodder exchanged with organic system of farm.

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A multiprolonged strategy with emphasis on enlargement of the productive asset base of landless, marginal and small farmers through development of subsidiary activities like animal husbandry, rural industrialization etc has to be adopted to tackle the problems of poverty and inequality. Next to agriculture, livestock is the largest source of income and employment for rural population (Sawant, 1999)

Livestock sector is constantly gaining economic importance in the Indian economy. With a view to mitigate the risk and uncertainties of income from crop enterprises and reducing the time lag between input costs and returns, it is essential that the farmers incorporate livestock enterprise in their production programme which yield regular income throughout the year. Besides this, the mixed farming creates natural chain between crop production and livestock raising, which gives more sustainability to the business. The subsidiary occupation of livestock enterprise is of complementary nature to the farmers and helps not only in increasing the farm income but also in making economic use of apparently waste by-products of the farm for subsidiary occupations like dairying, poultry keeping, sheep and goat rearing, etc. This generally provide a continuous income to the farmer and plays an important role in farmer's subsistence economy. The importance of livestock sector in India, can also be corroborated from the fact that the share of agriculture in the country's G D P has been declining, whereas the value of output from livestock shows an increasing trend over time (Government of India, 1998)

## **1.2 Importance of Mixed Farming**

On macro level, the livestock sector in India looks bright and is steadily marching to prepare itself for the challenges in the new millennium. In India, the land man ratio is quite low and the distribution of land is skewed

The diversification of crop based rural-economy into an animal husbandry mixed farming system must be encouraged for rapid economic development and for generating equitable income and employment in the country (Birthal et al 1999)

Mixed farming is a type of farming in which crop production is combined with livestock rearing. 12<sup>th</sup> National Conference of Agricultural Economics held at Chandigarh in 1960 agreed, on the basis of available data that farms having at least 10% of its income must be contributed by livestock will be called mixed farms. The upper limit of gross income to be contributed by livestock activities was fixed at 49% under Indian conditions. The livestock enterprise is complementary to crop production programme which provides balanced and productive system of farming. In India, mixed farming implies dovetailing of crop production and animal husbandry to the best advantage of the farmer. This relationship of two may be expressed as complementary. In Maharashtra, where the famines are of common occurrence and majority of area is dry, mixed farming offers special advantages such as balanced farming providing more employment, income and covering risk of complete failure of mono-cropped farming.

With the adoption of mixed farming, the farmers and their families find an extra remunerative employment throughout the year in their homestead. Besides, higher net profit, a continuous flow of income, improvement in fertility of soil through additional manuring obtained from livestock are the benefits of mixed farming. The farmer is able to raise draught animals on farm from milch cattle, for crop production and rural transport. The mixed farming reduces risk and uncertainty in farm business and act as hedge against famine and distress. The mixed farming is one of the useful measures for increasing productivity of both livestock and farm crops.

Farming system is used in a wider sense as compared to crop farming system, which is confined to crop production alone. It involves all-out integrated efforts for improvement of the farm resources such as land, labour and capital, etc through their efficient utilization for maximization of farm returns. This necessitates widening of farm activities by including, besides crop husbandry, other enterprise such as dairying, poultry, piggery, fishery, sericulture etc.

### **1.3 The Problem**

In India, several studies were undertaken in different states at macro and micro levels to provide empirical evidence that the resource production and resource use efficiencies of mixed farms vary from region to region and even among mixed farms. The regional variations are, however, brought about due to variations in the agro-climatic conditions and differentials in the past investment in developing infrastructure.

In Maharashtra, limited attempts have been made to study economics of mixed farming in various regions. The significant changes in biological and economic environment consequent upon the advent of improved new alternative, which in turn have brought up the need for various adjustments in efficient use of resources. However, no attempt was made for a comparative study of mixed farming in irrigated and rainfed regions.

The extent of crop and livestock production system in rainfed and irrigated agriculture varies from region to region. It has special role in rainfed areas. Therefore, empirical analysis of mixed farming in rainfed and irrigated farming is of special importance to know the sectoral composition. Scarcity zone in Maharashtra comprises 29.31 per cent area, where the farming community is more vulnerable than in assured rainfall zone. Under such

circumstances livestock production provides lifeline support to farming. In view of this, the study, viz, “**An economic analysis of mixed farming in the scarcity area of western Maharashtra**” was planned with the following objectives

#### **1.4 Objectives**

- 1 To study the resource use structure, costs and returns on the sample farm in irrigated and rainfed regions
- 2 To estimate and compare the resource productivities on the sample farms in both the regions
- 3 To determine resource-use efficiency in irrigated and rainfed regions
- 4 To study employment and income generated on the sample farms in the regions

#### **1.5 Hypotheses**

In the light of foregoing theoretical propositions the following hypotheses were proposed to be tested

- 1) The resource use structure and cost structure differ for rainfed and irrigated region
- 2) The resource productivities and resource use efficiencies of farms differ on different types of farms and regions
- 3) The employment and income generated on farms differ on different types of farms and regions

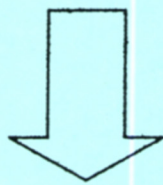
## 1.6 Scope and Utility of the Study

The information of productivities of different resources in the production of various crop and livestock activity in irrigated and rainfed regions as well as different sized farms may be used by policy makers to assess the possibilities of intensifying the resources in areas where specific resources command higher productivity. The significant differences in marginal value productivities of different resources in the production of the crops and livestock would indicate the possibility of increasing the production levels by reallocating limited funds. The results of the study will be useful to the farmers in both the regions in their endeavours to improve decisions in reallocation of limited resources in an optimal manner for maximizing returns from the crops and livestock activity.

The study will be of great importance to reorganize the farm business on profitable lines in the tract and explore the possibilities of increasing farm business income. The present study was carried out in the scarcity area encompassing rainfed and irrigated regions of the state for the year 1999-2000. Though there are variations in cropping patterns, cultivation practices, of irrigation practices, maintenance of livestock on the farm, results of this investigation will be indicative of the existing situations and the alternative options to make the resource allocations optimal so as to reap the better returns. The findings of the study will be useful for the similar farm situations for changing the pattern of returns, in favour of farm community.

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REVIEW OF LITERATURE

## **2. REVIEW OF LITERATURE**

In any systematic research, the review of literature on relevant aspects under study forms an integral part of the research work. The exercise would help in highlighting the methodology and results obtained by different research workers in similar fields and would serve as a guideline for the research to be carried out. It helps in proper understanding of the concept and methodological and analytical issues relating to problem under study. Many a times, it may be true that previous research work might have been carried out under different set of conditions. Nevertheless, such knowledge is always useful for improving efficiency and effectiveness of all acts relating to designing of research problem, adopting suitable methodology and interpreting research results.

This chapter deals with the presentation of reviews drawn by the author by studying the literature relevant to the problem under study. For the sake of convenience, the reviews collected from various source have been grouped under the following sub-headings

- 2.1 Importance of mixed farming
- 2.2 Resource use structure
- 2.3 Costs and returns
- 2.4 Resource productivity and efficiency
- 2.5 Employment and income

### **2.1 Importance of Mixed Farming**

Mixed farming is a type of farming under which crop production is combined with livestock raising. The livestock enterprise is complementary to crop production programme so as to provide balanced and productive system of

farming With the adoption of mixed farming, the cultivators and their families find an extra employment throughout the year

Talathi and Borude (1980) worked out the economics of mixed farming in Kulaba district of Maharashtra State They found that the farm business income on mixed farm was higher by 99.71 per cent than on arable farms As compared to the arable farms, the mixed farms could provide 109.18 per cent more employment to male family labour, 83.45 per cent more employment to female family labour and 79.69 per cent more employment to child labour The farm business income on mixed farms was 89.71 per cent greater than on arable farms The study distinctly showed that the mixed farms were superior to arable farms in respect of providing more income to the farm family

Patil (1980) revealed that the poor farmers in rainfed areas need subsidiary occupation like rearing of milch animals, which could provide them a continuous cash flow throughout the year

Kumar (1983) observed that the dairy animals could be maintained along with crop enterprises on holding of small, medium and large farmers of Siddloghatta Taluka of Kolhar district of Karnataka state Mixed farming is beneficial to the farmers over the arable farming Keeping dairy along with the crop enterprises based on scientific principles on the same farm was profitable to all the three groups of farmers It provided additional employment This results are in conformity with studies of Sharma et al (1984), Kadian et al (1992), Singh et al (1996) and Patil et al (1993) and Pagire and Shinde (2000)

Singh and Sharma (1989) conducted the study of farm production system with dairy enterprises operated at the existing technology in Hoshiarpur district of the Punjab State The farm production system included crop farming

(system A), crop plus goat farming (B), crop plus dairy (C) and crop plus goat plus dairy farming (D) The examination of the income generation and corresponding element of risk obtained from the farming system taken up for this enquiry brought out that dairy enterprise in combination with crop farming enhanced the income levels and reduced the quantum of risk considerably Again dairy farming in association of crop plus goat farming lowered the risk content appreciably They concluded that crop plus dairy farming was the most profitable and least risky choice among the existing system of farming, while crop farming system proved to be the least paying and most risky production alternative

While, studying the role of dairying as an adjunct to crop husbandry in Gwalior district of Madhya Pradesh, Singh et al (1995) reported that in aggregate terms the contribution of dairying was higher on irrigated farms but in relative terms, unirrigated farms fared better The contribution of milch animals was comparatively higher in unirrigated situation in both marginal and small size group farmers, which served as shock absorber and valuable asset during unfavorable conditions They concluded that dairying as a non-land augmenting enterprise and as adjunct to crop production played an important role in improving and propelling the farm economy of the farmer

## **2.2 Resource use structure**

The process of transformation of traditional agriculture into a modernized agriculture is characterized by the phenomena of replacement of old and out-dated inefficient methods of production by the new cultural practices, adoption of innovations such as improved seeds, chemical fertilizer and plant protection inputs and resultant changes in the composition and use levels of resources

Garg et al (1970) examined the changes in resource use structure due to adoption of improved cultural practices and high yielding varieties. The additional expenditure on labour and input material implied higher share of income from these inputs.

Patel (1971) stated that for the large number of small farmers dairy enterprises offered considerable scope for diversification of the farm economy and for increasing the net returns as well as employment and also. The extent of a labour utilization was higher in mixed farming i.e. about 53 per cent over that in the arable farming.

Patel and Jodha (1979) studied the economic relationship between crop farming and dairying and found that the number of animals kept on the farm increased with the farm size and with the increased use of purchased feeds also increased with farm size.

Singh et al (1981) investigated the labour absorption and factors influencing levels of employment in crop, dairy and Poultry enterprises under the Operational Research Project area of the National Dairy Research Institute, Karnal. They observed that the labour absorption in the dairy enterprise ranged from 224 man days on small farms to 423 man days on large farms. However, the human labour employment on the basis of per animal unit indicated an increasing relationship with the farm size.

Khan and Alam (1988) examined the resource use on a sample of marginal, small and medium size groups of progressive and non-progressive 209 farms in Jammu and Kashmir. The level of major input/acre showed an inverse relationship with farm size. Small farms were found to be fairly efficient in resource utilization, particularly in the case of human labour on progressive farms.

Diwakar (1989) studied the extent of use of bullock and human labour in relation to cropping pattern, its intensity and mechanization in Western Rajasthan. The modern water lifting devices extended the productive use of human labour employment on farms by inducing more labour intensive cropping pattern and by enhancing the water availability in comparison to indigenous water lifting devices. In the case of bullock labour, however, the employment opportunities declined due to their limited use in operations such as ploughing and sowing.

The level of technology and its impact on labour employment was studied by Sidhu and Grewal (1990). The proportion of hired labour to the total labour use was greater than that of family labour in the case of tractor operated farms. The farm size was found to have negative relationship with the labour use. The intensity of cropping as well as the use levels of manures and fertilizers, bullock labour and human labour increased due to adoption of new technology.

Kapse (1992) observed that per hectare use levels of crucial inputs viz, plant nutrients, human labour, quality seeds etc, were higher in the zones having assured and high rainfall.

Kumar et al (1994) studied comparative economics of dairy enterprise under mixed farming system in Haryana. They concluded that the mixed farming of crossed cows was more efficient for the utilization of land, capital, inputs and labour resources of the farmers.

Kodaskar (1995) studied economics of dairy enterprise at Ranjan village of Pune district in Maharashtra. He indicated that the average expenditure on green and dry fodder and concentrates per crossbred cow was Rs 4437 and Rs 1215, respectively. The average number of days worked in

dairying was 70 and 90 in the case of male and female adults, respectively during the year

Birari (1997) studied the resource use structure on farms in Western Maharashtra. He observed that use of all productive inputs was quite high in the irrigated region than in the rainfed region on different size groups of farms. The use of human labour, bullock labour and manure was relatively high in the irrigated region than in the rainfed region, whereas the use of seed was maximum in the rainfed region than in the irrigated region. The use level of fertilizer consumption was maximum in the crops grown under irrigated conditions.

Sharma and Sharma (1998) studied the resource use efficiency on various farms in Assam. They concluded that as the size of holdings increased, there was a decreasing usage of human labour per hectare in Ahu-Sali rice system. This indicated that small farms were labour intensive. The bullock power and F Y M use showed decreasing trend with increase in farm size.

Patil and Potekar (1999) studied employment pattern of owned draught animals in Maharashtra. They revealed that per farm bullock use was 118.13 days, it was the highest on large sized farms (149.79 days) and the lowest in small sized farms (54.38 days). The per pair annual cost of maintenance of bullock was Rs 8883 of that, share of variable and fixed cost worked to 85.06 and 14.94 per cent, respectively. Feed and fodder accounted for 57.48 per cent of the total cost of maintenance.

It can be noticed from the above reviews that the resource use intensity was higher on the small sized farms than on the large sized farms. Resource use levels were quite high in the irrigated region, than in the rainfed region. Use levels of inputs were influenced by the factors such as size of holding, crops and crop varieties to be grown and technological change etc.

### 2.3 Costs and returns

The quantum and proportions of out of pocket expense and imputed costs in total cost structure either increase or decrease depending upon changes in the use of different resource and substitution of one form of resource for another. The proportions of cash expenditure in the total cost of production of different crop enterprises also increase depending upon the process of transformation. The costs and returns structure of a farm business, in general, and crop enterprise, in particular, indicate the magnitude of profitability. It provides a guideline to intensity the resource use, resource substitution and reallocation of resource, in an attempt to maximize profit. It also helps in formulation of prices and development policies and adoption of yield increasing and cost effective technology.

Garg et al (1973) worked out the cost and returns per hectare for sugarcane in U P for five districts. They found that, on an average, sugarcane yielded a net income of Rs 1588.79 per hectare. The output input ratio was 1.94 and average cost of production for the state as a whole came to Rs 4.02 per quintal.

Singh and Bhal (1974) analysed the data collected under the comprehensive scheme in Punjab and found that sugarcane was the most profitable crop followed by cotton (American) and groundnut.

Rajput (1973) examined the economics of milk and crop production enterprise and found that milk accounted for the 40 per cent of the total net income and it indicated the complementary role of livestock production in the total net farm income. He concluded that the farmer it is economical to rear two milch animals on small farms along with adoption of new technology.

Saunders et al (1975) studied the economics of crop enterprises and dairying and the relative profitability of dairying, soyabean and cotton enterprises. They found that in spite of increasing costs of production, each of the enterprises showed a positive net return indicative of their profitability.

Reddy (1979) suggested that the small farmers in Bangalore district must keep one crossbred cow in order to attain the maximum possible returns. For the medium farmers and the large farmers, the optimum plans indicated that net farm returns could be maximized by the inclusion of crossbred cow, one local dairy cow and one local dairy buffalo in the farm plan.

Mehta et al (1980) proposed an analytical framework for comparing the efficiency of crop farming vis-à-vis mixed farming by employing variable resource programming technique. They inferred that inclusion of dairy activity, considerably improved the efficiency of small farms in Punjab.

Grewal and Rangt (1980) studied economics of dairying in Punjab. They revealed that the hired labour cost accounted for as much as 18.41 per cent of the paid out costs in the case of crops, against only 4.93 per cent for dairying of the total labour costs. They revealed that the gross returns, paid out costs and net returns per hectare from crop cultivation amounted Rs 4568, Rs 2385 and Rs 2182, respectively. The net returns from crop cultivation, Rs 2182 per hectare were almost of the same magnitude as the returns on per hectare basis from dairying (Rs 2293). However, the paid-out costs as a percentage of gross returns were much lower (47.8 per cent) in crop farming compared with dairying (77.4 per cent).

Manohar and Sudarshan (1982) in their study conducted in Dharmashala village at Warangal district of Andhra Pradesh, indicated that

dairying was a profitable enterprise. They also suggested that the farmers must be provided with credit to get maximum profit from dairying.

Pal and Pal (1983) studied the costs and returns from dairying with crossbred cows in relation to crop cultivation in Ludhiana district of Punjab. They observed that the net returns from crop cultivation were about 150 per cent more than from dairy enterprise, whereas per acre analysis of net returns from dairy enterprise were about 250 per cent more than that of crop cultivation. This showed that even on commercial dairy farm, crop husbandry is still a major enterprise. However, dairy which gives higher returns on acre basis is more profitable than crop cultivation and has large potential for increasing farm income.

Balishter and Singh (1989) worked out the economics of livestock enterprise in Bichpuri block of Agra district of Western U.P. They observed that the per hectare net income for crop was maximum on medium farms and minimum on large farms while for livestock farms, it was maximum on small farms and minimum on large farms. The highest net income from livestock on small farms was mainly due to the fact that the farmers in this group cared more for income from milk and milk products as compared to other farms. The output input ratio was higher for livestock enterprise as compared to crop enterprises. In the case of livestock enterprise this ratio was higher on small farms as compared to large farms, indicating a better scope for livestock enterprises as a subsidiary occupation on the farms.

Studies conducted by Panse et al (1963), Puri and Bhupal Singh (1964), Acharya et al (1973), Singh (1975), Reddy and Mathur (1980) and Ramaswamy et al (1981) revealed that a major share of the cost of milk production was accounted by feed cost.

Chauhan et al (1991) estimated the income of the weaker sections consequent upon financing by RRB in Etawah district of U P for the year 1985. They worked out total average net income for small and marginal farms together at Rs 8165 68, out of which Rs 2726 52 was from crop enterprise and Rs 1238 71 from dairy enterprise.

Kadian et al (1992) compared the profitability of arable farming with mixed farming rearing crossbred cows or buffaloes. The net returns were highest from mixed farming with buffaloes followed by mixed farming with cows and the least from arable farming.

Kumar et al (1994) studied comparative productivity and economics of dairy enterprises under mixed farming system in Haryana. They revealed that mixed farming of 3 crossbred cows on 1 ha of canal-irrigated land gave a higher return of Rs 21323, than Rs 9438 obtained from mixed farming of 3 Murrah buffaloes. The expenditure incurred on feed (40 per cent) was higher followed by expenditure on labour (30 per cent) among all the items. The study also revealed that 71 80 per cent and 59 30 per cent of income was obtained from the sale of cow milk and buffalo milk, respectively. The cost of milk production per litre was approximately double, Rs 5 29, in the buffalo unit as compared with Rs 2 74 in crossbred cows.

Raskar (1996) studied economics of dairy farming in Karjat Tahsil of Ahmednagar district. He found that the total cost of production of milk was Rs 27687 per family at the overall level. In the cost of milk production, the working cost contributed about 81 82 per cent and fixed cost 18 18 per cent. The structural composition of the total cost of milk production revealed that the feed and labour shared 65 89 and 10 54 per cent of the total cost of production, respectively. He also revealed that the per litre cost of production was Rs 4 63.

in the case of crossbred cows, while it was Rs 4 57 in local cows and 6 56 in the case of buffaloes

The per family gross returns from milk production activity was Rs 28,684, maximum (92 92 per cent) was contributed by the value of milk alone. The output-input ratio in respect of milk production activity ranged between 1 10 and 1 17 among different categories of sample families.

Kasar and Naikwadi (1998) studied the economies of milk production in dry region of Western Maharashtra. They revealed that the per animal productivity and net income were substantially higher in Holstein Friesians crossbred cow followed by Jersey crossbred cow and local cow. Net profit per animal accrued during lactation period worked out to Rs 6627 32, Rs 3441 33 and Rs 610 13 in the case of HF, Jersey crossbred and local cow, respectively. The study also revealed that the dairy enterprise contributed about 30 per cent and 27 54 per cent of the total annual income and employment of sample milk production in the dry region of Western Maharashtra. They concluded that the dairy enterprise has substantial importance in sustaining and improving economy of milk producers of dry region in rural Maharashtra.

Gadre (1998) examined the role of dairying as an accompaniment to crop husbandry in Vidharbha region of Maharashtra. He worked out cost of rearing crossbred cow and buffalo to Rs 10,733 and Rs 13,863, respectively. The gross returns computed to Rs 15,145 and Rs 15,058, respectively. As regards net returns from crop and dairy enterprises, positive net returns were noticed in all the categories of farmers in respect of crop enterprise, whereas negatives net returns were found in dairy enterprise on all the farms, except group first. He concluded that in order to increase the net returns from dairy enterprise, there is a need to reduce the ratio of dry to milch animals.

Alashi (1998) studied comparative economics of milk production from crossbred cow vis-à-vis local cow and buffalo in Akola district of Maharashtra. He revealed that the total cost of maintenance for local cow, crossbred cow and buffalo was Rs 5,576, Rs 14,243 and Rs 13,397, respectively. Feeds and fodder was accounted more than 90 per cent share to the total cost. Gross income from local cow, crossbred cow and buffaloes was Rs 5607, Rs 24301 and Rs 13,356 respectively. Net income was obtained to the tune of Rs 31 00, Rs 10018 and Rs.3559, respectively. The per litre cost of milk production was Rs.8 62, Rs 4 75 and Rs 7 47 for local cow, crossbred cow and buffalo, respectively.

Khemchand and Kumar (1998) studied economic analysis of milk production on commercial buffalo herds in Karnal city of Haryana for the year 1996-97. They found that the average investment per dairy herd was Rs 1,92,527. It was observed that the total investment per milch animal had inverse relationship with the size of herd. The total cost of milk production per milch buffalo per annum was estimated to Rs 22,444. Feed and fodder cost was the major component of cost of milk production, followed by labour cost, which accounted for 61 and 21 per cent of the total cost of milk production, respectively. The net returns per milch animal per annum were Rs 9304. The inverse relationship was observed between family labour income per buffalo and herd size.

Chand et al (1999) studied economics of milk production in Kurukshetra. The study revealed that the feed cost constituted the largest component (50-55 per cent) in the gross cost, irrespective of size categories and type of milch bovine. Expenses on concentrate feeds and green fodder constituted lions share in the feed costs. With a view of obtaining higher milk yields, farmers had been feeding higher level of concentrates and green fodder.

particularly to crossbred cows and buffaloes. The fixed cost component shared about 20 to 23 per cent of the gross cost. The average productivity of milch bovines was higher on small holdings. Excepting the local cows, the net income realized from milk production was positive in all other cases. The positive net returns, notwithstanding their lower values, have indicated that bovine rearing was a profitable subsidiary rural occupation. The study also revealed that the cost for milk production was the lowest for crossbred cows followed by buffaloes. This was due to the high milk production potential of crossbreds and good response to the strategic production inputs used. Further, it was indicated that the cost of milk production by the large farms, amply endorsing the operation of economics of scale in milk production.

Gattewar et al (1999) studied an economic viability of draught animals in Akola tahsil of Vidharbha region. They estimated the maintenance cost of bullock pair in a year at cost A was Rs 861.33 and it was Rs 9728.26 at cost B. Of the total cost, value of fodder and concentrates had a major share of 54.75 per cent. The per day maintenance cost of bullock pair worked out to Rs 40.09 at cost A and Rs 45.07 at cost B. The viable level of maintaining bullock pair was estimated to 86.24 days.

Patil et al (1999) studied employment pattern of owned draught animals in Marathwada region of Maharashtra. They revealed that per farm bullock use at was 118.13 days. It was the highest on large sized farms (149.79 days) and the lowest in small sized farms (54.38 days).

Marawar et al. (1999) studied the economics of crop and dairy enterprise in Nagpur district of Vidharbha region of Maharashtra. They studied economics of crop (I) and crop + dairy activity (II). They revealed that per hectare value of capital investment was Rs 73,014.04 and Rs 80,333.4 in I and II activity respectively. Total cost was higher in II activity (Rs 1187.10) than I

activity (Rs 8870 08) The investment of one rupee yielded a return of Rs 2 03 in II activity as against Rs 1 78 in I activity A comparison of net return in II activity over I activity showed an increase in net returns to the extent of 55 26 per cent They suggested that to avoid risks in farming, farmer should maintain milk animals on their farms

Inamdar et.al (2000) conducted a study on contribution of dairy enterprise in the economy of rural families in Solapur district of Maharashtra They revealed that per hectare cost of cultivation of farms was Rs 14,643 and per hectare net income was Rs 8725 The cost and returns from crop production activity increased as the size of farm increased The per farm total cost incurred in dairy enterprise was Rs.31,074 and the income received from it was Rs 38,722 The milk had the maximum share (90 per cent) in the total income from the dairy enterprise The net returns received from dairy enterprise were Rs 7674 The share of income from dairy enterprise in the total income was next to crop production activity Dairy enterprise provided maximum employment of 147 mandays and followed by crop production of 134 mandays

It appears from the above reviews that all the crops, by and large, grown by the farmers and livestock reared were rewarding The availability of irrigation facilities, size of farm and the level of technology adopted by the farmers influence the farm economy In the present study, the farm business analysis is carried out on the farms in irrigated and rainfed regions to know the economics of crop and livestock enterprises

#### **2.4 Resource productivities and efficiency**

The knowledge about difference in resource productivities in different regions and at different levels of technology in the same region is of greater importance for deciding policies for rational use of various resource

The significant difference in marginal value productivities of different resources on farms operated with different levels of technology would indicate the possibility of increasing agricultural production by shifting surplus resources and reallocating the same in an optimal manner

Azad and Garg (1974) studied productivity and optimization resource use in sugarcane in U P. The Cobb-Douglas production function was fitted. It was observed that the production elasticities of the individual resources were positive and less than unity. The highest elasticity of production was observed in the case of manures and fertilizers followed by irrigation both in planted and ratoon sugarcane. The marginal value product of manure and fertilizer was Rs 5.26 in planted sugarcane and Rs 5.60 in sugarcane ratoon, indicating thereby the possibility of higher returns from additional use of manures and fertilizers for ratoon sugarcane compared to planted sugarcane. Similar trend was observed in the case of irrigation. However, the use of these input was less than optimum in both the types of sugarcane. The use of bullock and human labour was in excess.

Rai and Gangwar (1976) used Cobb-Douglas type production to work out the cost of milk production and seasonwise resource use efficiency on different herd size. They found that the concentrates were the most significant factor influencing the milk yield. They also studied the use of human labour and suggested that the labour use could be reduced without affecting the milk yield, thus reducing the cost of milk production. They also asserted that milk yield could be substantially increased by feeding more concentrates, provided they are available in sufficient quantities and at a cheaper rates.

Das (1993) studied resource use efficiency over a cross-section of sample farmers in Aurangabad (Maharashtra) and Sabarkantha (Gujarat). The sample of 68 borrowers belonging to the local branches of State Bank of India

involved in three different minor irrigation schemes were selected. The Cobb-Douglas production function analysis showed that the total value of output was being determined by the amount of seeds sown, total expenditure on fertilizers and irrigation and the number of labour days. The inter-district and inter-factor comparison indicated that special attention should be given to water resource, off-farm rural employment opportunities and the provision and application of fertilizers.

Shah and Singh (1994) conducted study on resource productivity in milk production for crossbred cows in Bareilly district of U.P. The first order differentiation of the equation would indicate the marginal value product with respect of differentiated inputs. He concluded that expenses on green fodder, concentrate, dry fodder and housing expenses were observed to be the most important inputs, affecting milk production, positively.

Morankar (1995) studied the fertilizer use levels, resource productivities, use efficiencies, gap between recommended and existing levels of fertilizer use and constraints in the use of fertilizer in respect of principal crops grown on different size farms during the year 1991-92 and 1992-93. The production function analysis, indicated that human labour, fertilizer and other working capital were the major resource inputs influencing the output of all crops among the different size groups of farms. The marginal value of productivity analysis revealed that there was a higher level of efficiency in the use levels of fertilizers in production of principal crops on different size groups of farms. This indicated a scope for increasing production of individual crops through increased use levels of fertilizers.

Singh and Beena (1996) conducted study on resource use efficiency in cash crops of Pune district in Maharashtra. They used Cobb-Douglas production function for functional analysis. They inferred that the

important inputs, which made significant contribution to crop yield, were land and human labour in sugarcane crop. Land was found to be significantly contributing in large farms and human labour in small, medium farms and at the overall level in onion crop. They observed constant returns to scale. They revealed that MVP of land to factor cost ratio was more for sugarcane and onion, indicating sufficient scope for profit maximization by increasing of use of this resource for both the crops. As regards human labour, the MVP to its price was more for both the crops, indicating that labour can be increased to optimize the profit.

Thakur et al (1997) studied resource use efficiency on sheep and goat farming in different size groups in Himachal Pradesh using Cobb-Douglas type of production function for analysis. They revealed that flock size has significant impact on shepherds income on all size farms. The use of additional human labour was found to raise the shepherds income on medium and small farms. They also estimated marginal value products (MVPS) for all farm situations, by maintaining the inventory of farm flock and increasing the use of concentrates and decreasing the use of human labour.

Sharma and Sharma (1998) studied the resource use efficiency on various farms in Assam and revealed that on an average farm, the MVP was the highest for manure and for fertilizer followed by human labour. The values of marginal value products of human labour were higher on small farms than medium and large farms, which indicated that additional increase in the farm returns due to one unit of human labour at their geometric means level were more on small farms. The values of MVPs of manure and chemical fertilizers were higher on large farms followed by medium and small farms, respectively. Further, the importance of human labour in rice farming was demonstrated from the fact that MVP's in general, were more than unity.

Kumar (1999) studied economic efficiency of cow milk production in Villupuram district of Tamil Nadu. He applied Cobb-Douglas type production function. It gave the best fit to the input-output data in milk production. On dry fodder, concentrates and labour were found to be positively significant, which together with green fodder, explained 72 per cent of variation in returns from local cow milk production. However, in the case of milk production from crossbred cows, expenditure on dry fodder and concentrates were observed positively significant, which together with those on green fodder and labour explained about 70 per cent of variation in return from crossbred cows. These were surprisingly found positive but non-significant. In the case of milk production from local cows, dry fodder and concentrates were observed to be over utilized, while labour turned out to be underutilized.

Logamatha (2001) worked out an economic analysis of employment pattern and income generation by women in agricultural district of Tamil Nadu. A multilinear regression model employed to study the factors influencing gross income of farm indicated that use of farm women, use of other labourers and expenditure on other inputs had positive influence on gross income in crop based farming. In dairy based farming system, the expenditure on other inputs was found to have positive and significant influence on gross income and increased the gross income by Rs.2830 for every thousand increase in the expenditure and use of farm women labour also had positive influence on gross income of farm and increased gross income of Rs 187 for an hour increase in the farmwomen work.

Elamumgannans (2001) studied economics of mixed farming in rainfed agriculture in Erode district of Tamil Nadu. He used the linear programming analysis for different enterprise combinations in three size groups of farms and showed that the net income could be increased by recombination

of crop and livestock enterprises though the extent of increase was marginal in small and medium farms. He also revealed that scarcity of water, requirement of labour, capital and net returns influenced the crop decision behavior of the sample farmers in all the combinations of enterprises.

Khemchand et al (2001) studied economic efficiency of commercial dairy herds in arid Rajasthan and concluded that the capital investment on an average dairy herd was Rs 4.05 lakhs. The milch animals alone accounted for about 83 per cent of the total investment. The results of functional analysis revealed that the concentrates, feed and labour were the important inputs in the milk production process. The MVP analysis suggested that the higher feedings levels of concentrates and more labour use and better management would result in higher returns from dairy enterprise.

Kumar (2001) studied technological change and productivity in dairy farming in Tamil Nadu. He revealed that the regression coefficient for green fodder were negative and statistically non-significant for indigenous cows, buffaloes and crossbred cows. Similarly, the coefficient of dry fodder were negative for all the three species of milch animals, but it was statistically significant in the case of indigenous cows and crossbred cows and non-significant for buffaloes. The output elasticity of concentrates was found to be positive and significant for both the types of milch cattle, while it was negative and statistically non-significant for buffaloes. He also revealed that the regression coefficients of labour were found to be positive and statistically significant in the case of indigenous cows and buffaloes, while it was positive in the case of crossbred cows.

Above reviews have indicated that human labour, manures and fertilizer and other working capital were the major resource inputs influencing

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output of crops. While concentrate<sup>s</sup> feed and human labour were important inputs in livestock enterprise.

## **2.5 Income and employment**

While studying the economics of mixed farming, it is necessary to know the magnitudes of contribution made by crop and livestock enterprise to employment on the farm, being an ultimate aim of farm business.

Grewal and Rangı (1980) worked out economics of employment of dairying and crop farming for the year 1976-77 in Punjab. They revealed that although the relative share of labour input in dairying in the total cost is less, yet the absolute magnitude of labour employment turns out to be much higher. The per animal labour input worked out at 619 man hours per year, which mean a input of 1.7 hours per animal per day. Translated on per hectare basis, the labour employments work out at 457 mandays per hectare per annum. The labour input figures were worked out, for all-important crops grown in the Punjab. The average annual labour input per cropped hectare for the general field crops in the state is estimated at 138.25 mandays per hectare against 457 mandays per hectare per annum for dairying.

While, studying economics of livestock production in relation to its contribution to the gross farm income and employment in Farrukhabad district of Utter Pradesh, Singh et al (1980) revealed that the livestock production activity contributed 28.14 per cent of total employment of 231.01 days per hectare. The percentage contribution was higher on small farms as compared to the large sized farms. The livestock activity contributed 28.57 per cent to the total farm income of Rs 4991.22 per farm family. The proportion of income from livestock production in the total farm income was relatively high on small sized farms as compared to the large sized farms.

Joshi and Jha (1981) indicated that the earnings from the land holding of majority of the marginal, small and semi-medium farmers were not adequately sufficient for the household of the average size round the year. Livestock rearing provided a viable alternative to the small farmers as well as to those, whose income from operational holding was very much low.

Jachak and Borude (1983) calculated the business efficiency of some farms in Ratnagiri district of Maharashtra for the year 1975-76. They found that the total incomes which comprised of crop and dairy enterprises and other sources on marginal, small and medium size holding group were Rs 4376.57, Rs 3324.16 and Rs 2573.06 respectively, and Rs 2973.12 at overall the level. The farm business incomes in three groups were Rs 2204.85, Rs 1590.33, respectively and Rs 1710.99 at the overall level.

Sharma et al. (1984) conducted the study on economics of mixed farming in tribal area of Himachal Pradesh. They noticed that the major source of income for the farmers was sheep rearing. For the farms, which were without sheep, the off farm employment was the major source of income.

Thorve and Galgalikar (1985) concluded from the study in the Vidharbha region of Maharashtra that mixed farms with dairy enterprises have experienced the positive effect of income wise in all the size groups of farms. The study showed that the incorporation of dairy enterprises increase the efficiency of capital by 36 per cent. The investment of Rs 100 yielded a return of Rs 184 on mixed farms as against Rs.148 on the farm without milch animals. Arising trend was directly associated with the size of holding.

The study conducted by Kushwah et al (1986) in Ghazipur district of Uttar Pradesh revealed that the economy of small sized farms was influenced largely by the livestock production enterprise. The contribution made by the

livestock enterprise to the total farm income was of the order of 11.63 per cent and 27.65 per cent on small and marginal farms, respectively

Mehta and Sharma (1986) studied the farm structures, cropping pattern and resource use in Raya and Govardhan blocks of Mathura district, for the year 1982-83. They found that the main sources of income for the sample farms, were crop and milk production activities.

Singh and Sharma (1988) studied the income and employment potentials under different farming systems on small farms in mid-western region of U.P. for the year 1983-84. They found that the total income under crop plus dairy farming systems on the small farms was Rs. 7617 and showed that the main source of total income was crop enterprise but farmers could supplement it significantly by adopting suitable subsidiary occupation.

Nawadkar et al. (1988) studied the employment pattern of agricultural labour in Scarcity zone of Maharashtra for the year 1987-88. The average per family income during year was Rs. 10881.31. The major source of income was crop production contributing nearly 40 per cent to the total income against 60 per cent share from livestock, services and business etc.

Sharma and Mehta (1990) conducted a study in Himachal Pradesh to obtain optimum combination of milch cattle including buffaloes and crops and analysed its effect on farmers' income. Results showed that the percentage increase in income on small irrigated farms was greater than large irrigated farms, where modern crop and dairy technology was used. Other benefits included employment generation, reduced pressure on land and released scarce resource.

Deoghare et al. (1990) conducted a study on impact of mixed farming on income and employment in Karnal district. The results were obtained for four categories of mixed farming viz. crop, crop-dairy, crop-

poultry and crop-dairy-poultry as well as bullock operated and tractor operated farms. Crop-dairy-poultry farming, however appeared to be the most successful, raising per capita income upto 32 per cent on bullock operated farms, while tractor operated farms experienced a relatively lower level of employment generation of about 104 per cent.

Pawar and Kale (1990) studied the employment and income relationship of the marginal and small farm families in drought prone area of Maharashtra. The crop and livestock production activities together contributed 62.50 per cent and 84 per cent share in the total annual income of the marginal and small farm families, respectively. The contribution made by wage earning and income from services and business to the annual income was to the extent of 37 per cent and 14 per cent, in the case of the marginal and small farm families, respectively.

The study conducted by Dangat et al (1991) on a labour employment and income pattern under different farming systems in Scarcity zone of Maharashtra. They revealed that in the rainfed bajra base area, livestock production and wage earnings accounted for a major share of 33 per cent and 31.6 per cent, respectively, in the total income under the farming system with and without milch animals. While in the irrigated bajra base area the total family income was Rs.18,389 and Rs 11,164 in the farming system with and without milch animals, respectively. As regards the jowar base area, under rainfed conditions, the per family total income of the farming systems with and without milch animals was Rs 10,940 and Rs 8,737 respectively, while in the case of irrigated jowar base area, the corresponding figures were Rs 13,074 and Rs 9,808. The labour requirement in the case of farming system with animals was more than double to that in farming system without milch animals. The study

recommended to maintain the livestock which would help in generating employment opportunities and increasing the income of the farm families

A case study on economic rational of adopting dairy farming as a tool for income and employment generation for the weaker sections was conducted by Atibudhi (1995) in Pipili block of Puri district. The study revealed that the additional productive employment generated through the activity of dairying among the beneficiaries was 166, 169 and 171 mandays for small and marginal farmers and landless labourers, respectively, accounting for 43.45 to 53.27 per cent more labour employment compared to the non-beneficiaries. The study further revealed that the adoption of dairy enterprise raised the income levels of the beneficiaries by Rs 2527, Rs 2606 and Rs 2210 for small and marginal farmers and landless labourers, respectively, which were higher by 35 to 40 per cent than the non-beneficiaries.

Radha et al (1995) analysed income and employment potential of a dairy as a single and as an adjunct to crop husbandry in Karimnagar district of Andhra Pradesh. The results indicated that the farmers in the study area obtained a net return of Rs.10549 from agriculture. The analysis further revealed that by maintaining one milch animal as an adjunct to crop husbandry an additional expenditure of Rs 4485 has to be incurred with and obtained net returns of Rs.2195, besides generating additional employment of 76 days.

Deoghare (1997) conducted a study on sustainability of on farm income and employment through livestock production in Mathura district of Uttar Pradesh. He observed that the net income under crop farming increased as the size of land holding increased. On the farm of marginal, small, medium and large size, the maximum net income was through crop farming than other farming. On an average, the highest income was under crop farming (73.31 per cent) followed by buffalo (14.66 per cent), goat (11.63 per cent) and sheep

farming (0.40 per cent), livestock farming provides 26.69 per cent income to the farmers. He concluded that employment per household per year of female labour was comparatively higher than male and children labour on all the farms. The overall average labour employment per farm under crop, goat, sheep and buffalo farming was 312.03 days and constituted 41.53, 23.34, 1.96 and 33.17 per cent, respectively. On the whole, overall labour employment under livestock farming was 58.47 per cent.

Pagire et al (2000) studied the contribution of livestock in the generation of employment and income in the village, Pimpalgaon Wagha in Ahmednagar district of Maharashtra for the year 1998-99. They revealed that the annual employment for the male was 238 and 230 days for a female worker. The livestock was the major source of employment both for male and female worker with 30.28 and 41.92 per cent share in the total employment, respectively. The sale of milk was the prime source of income from livestock.

Pagire and Shinde (2000) studied the role of livestock in the economy of small farms in the Hivare Bazar watershed area in Ahmednagar district of Maharashtra. They revealed that sale of milk was the major source of income from livestock. Of the total income from all sources, the share of income from livestock was more than 32 per cent. Livestock component, constituted major role in the economy of small farmers in the watersheds area and provided sure source of regular income and employment.

Singh (2000) studied contribution of livestock and crop enterprises to the economy of tribal farmers in Kanke block of Ranchi district, Jharkhand. He revealed that per farm annual income from livestock was Rs 3384, milch animals contributed 53 per cent to this followed by goats (31 per cent) and pig (16 per cent). Livestock activities created an annual employment opportunity of 559 mandays/farm. Draught animals generated average employment of 168

mandays, goats and sheep 145 mandays, milch animals 137 mandays and pigs 126 mandays. He further revealed that livestock and crop enterprises were the main source of farm employment. The average annual employment per farm was 987 mandays, which varied 414 to 1347 mandays on the farms. Crops, livestock and farm forestry were prime source of farm income. The average annual gross income from these enterprises was Rs 26414 per farm. The contribution of crop, livestock and farm forestry was 76, 14.7 and 7.3 per cent, respectively.

Elamurugannan (2001) studied economics of mixed farming in Erode district of Tamil Nadu. A sample of 120 respondents were considered and distributed as i) farms with crop, dairy and sheep, ii) farms with crop and dairy, iii) farms with crop and sheep and iv) farms with only crop enterprise. He revealed that among the four enterprise combination, farms with crop, dairy and sheep rearing had the higher annual net income, conversely farms with only crop enterprises had lowest annual income per farm. As the size group increased from small to large, the contribution of crop to total annual income per farm increased.

Logamatha (2001) conducted a study on employment pattern and income generation by women in agriculture in Rasipuram tahsil of Namakkal district in Tamil Nadu. The results were obtained for three categories of mixed farming. The average annual employment generated for farm women were 1274.18, 1467.86 and 2253.25 man hours, respectively, in crop, crop, dairy and poultry based farming systems. Of which 26.8, 12.9 and 9.6 per cent were employed in crop activities and 31.1, 54.4 and 47.2 per cent were employed in dairy activities, while poultry activities formed 21.9 per cent, respectively and 42.1, 32.7 and 21.3 per cent were utilized in household activities in crop, dairy and poultry based farming systems.

Pant and Singh (2001) conducted a study on role of farm women in humid South Eastern plain of Rajasthan. They revealed that participation of women was high in interculturing, threshing, harvesting, milking of the animals and in the collection of inputs for animal husbandry. Female participation was more compared to male in marketing of livestock product while reverse picture was seen in the marketing of crop produce. Per worker employment of female was higher (257.02 days) compared to male worker (213.09 days) in a year. On farm and off farm per female worker, got employment of 224.55 days and 12.47 days respectively, in a year.

Studies by Singh et al. (1996), Kumar (1983), Singh and Sharma (1998), Deoghare (1990), Talathi and Borude (1980), Pagire (2000) revealed that the dairy enterprise in combination with crop farming offered considerable scope for increasing the net returns as well as employment potential for farmers.

In mixed farming, on an average highest net income were obtained from crop farming while labour employment under the livestock farming was the highest. Economy of small farmers was primarily influenced by the livestock enterprise. Keeping dairy animals along with the crop enterprises based on scientific management principles provided additional income and employment to the farmer throughout the year (Talathi and Borude 1980, Kumar 1983, Patil et al. 1993 and Singh et al. 1995). Resource use levels per hectare showed an inverse relationship with the farm size (Khan and Alam 1988, Sharma and Sharma 1998). Use levels of inputs were more in the irrigated region than in the rainfed region (Birari 1997). Input use was increased due to adoption of new technology on farm (Sidhu and Grewal 1990).

It is economical to rear two milch animals on small farms adopting new technology (Rajput 1973). Inclusion of dairy activity improved the efficiency of small farms (Mehta et al. 1980). Per acre basis dairy was more

profitable than crop cultivation (Pal and Pal, 1983) Net returns from dairy enterprise were higher than crop enterprise (Balishter and Singh 1989) on the contrary it was observed that net returns from crop enterprise were the highest (Inamdar et al 2000).

It is seen that human labour fertilizer and other working capital were major inputs influencing output of crops (Morankar 1995) Important inputs in sugarcane yield were land and human labour (Singh and Beena 1996)

Marginal value products of manures and fertilizer were more than that of irrigation (Azad and Garg 1974) Concentrates were the most significant in influencing milk yield while human labour have negative effect on milk yield (Rai and Gangwar 1976) Expenses on green fodder, concentrate, dry fodder and housing expenses were most important inputs affecting milk production (Shah et al 1994) Concentrate, feed and labour were important inputs in milk production (Khem Chand et al 2001) Dry fodder has negative effect on local cow and crossbred cow (Kumar 2001) MVP analysis suggested that higher feeding of concentrates and more labour use would result in higher returns from dairy enterprise (Khemchand et al 2001)

The potential far average annual labour input per hectare basis was more in dairying than crop cultivation (Grewal and Rangr 1980) Opportunities for employment in dairying increased due to use of new technology The economy of small farmers was influenced mainly by the livestock enterprise (Kushwah et al 1986) The net income was highest under crop farming while labour employment was highest under livestock farming (Deoghare 1997)

The studies in respect of importance of mixed farming, resource use structure, costs and returns of crop and dairy enterprise and income an employment potential of sample farms were related to one aspect or two and subjected to one or more limitations Most of the studies analysed the farm

business in irrigated region and few in rainfed region and not with all the aspects at a time. Present study is a modest attempt to explore the areas of research in two districts namely Pune and Solapur of Western Maharashtra. The study analyses the resource use structure, costs and returns of different types of farms in irrigated and rainfed region. The study also measures the resource productivities and resource use efficiency on different types of farms. An attempt is made to study the income and employment generated on different types of farms in irrigated and rainfed regions.

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# Rainfed Farm



# Irrigated Farm



Chapter Opener Page



**METHODOLOGY**

### **3. METHODOLOGY**

This chapter discusses the methodology adopted for the study. It provides an insight into the source of data, data collection, variables of the study and analytical approach deployed in the analysis of data for obtaining estimates of different variables and establishing relationships between output and inputs on farms in order to meet the requirements of the objectives of the study.

#### **3.1 Data requirement**

The investigation contemplates the study of resource use structure, costs and returns structure, resource productivities and resource use efficiencies of different types of farms for crop production activity and livestock activity in the region. The detailed data were required on the following aspects.

- a) Structure of sample farms
- b) Quantities of different inputs used and output of the farms
- c) Production cost and value of output

#### **a) Structure of sample farms**

In order to know the structural organisation and background information of the sample farms, the farm level data were required in respect of land use pattern, cropping pattern, investment in different capital assets, and composition of selection of sample families.

**b) Physical quantities of inputs and output**

The data on physical inputs such as human labour (both hired and family), bullock labour (owned and hired), quantities of seed, manure, fertilizers, plant protection chemicals and other inventory expenditure as well as the data on physical quantities of output comprising of main and by-products of crop and livestock activities

**c) Production costs and value of output**

The information on various aspects such as wages of hired human and bullock labour, irrigation charges, expenditure on seed manures, fertilizers, insecticides and fungicides, repairs and maintenance of implements and machinery etc and maintenance of livestock by the selected sample families. In addition to this for computing the value of output from crop and livestock activities, farm harvest price, prices of animal product were also required

### **3.2 Sources of data**

For the completion of present study both types of data i.e. primary as well as secondary were required. Macro level data were obtained from the office records of Government departments such as agriculture, animals husbandry, dairy co-operatives, etc. The micro level data were obtained by personal interview method from the selected 180 sample families of both the region for the agricultural year 1999-2000

### **3.3 Selection of the study area**

The state of Maharashtra is divided into nine Agro-climatic zones. The Scarcity zone comprises parts of seven districts from Western

Maharashtra For the present study, two districts namely Pune and Solapur were selected purposively from the Scarcity zone of Western Maharashtra These two districts cover more than 35 per cent area of Scarcity zone of Western Maharashtra and have more or less similar agro-climatic conditions, crop complex and soil type As in this area, dairy, poultry, goat and sheep enterprises are complementary to crop production activity and the practice of undertaking one or more than one activities alongwith the crop production activity is followed by the most of the farming communities of this region

### **3.3.1 Sampling design**

The sampling design adopted for the present study was three stage stratified random sampling design with tahsil as a primary sampling unit, village as a secondary sampling unit and farm household as the ultimate unit of sampling

### **3.3.2 Selection of tahsils**

The primary unit of sample was tahsil and the record of revenue as well as department of agriculture was referred for the same The tahsils falling under Scarcity zone, which receive 500 to 700 mm rainfall, were arranged in ascending manner for each district separately on the basis of irrigated area under tahsils Two tahsils i.e. one irrigated and one rainfed from each district were selected purposively on the basis of the highest and lowest irrigated area in tahsils Thus, two tahsils of irrigated area and two tahsils of rainfed area were selected The two tahsils, one irrigated and one rainfed namely Indapur and Shirur from Pune district and Pandharpur and Madha from Solapur district were selected, respectively

### **3.3.3 Selection of villages**

The village, being the secondary unit of sample, randomly three villages were selected from each tahsil by listing them in ascending order having maximum cropped area as well as number of livestock. From the irrigated region, villages viz, Lasurne, Kalthan 2 and Wadapuri from Indapur tahsil of Pune district and Bhandishegaon, Gursale and Kauthali from Pandharpur tahsil of Solapur district were selected, and from rainfed region, villages namely Karade, Karandi and Nhavara from Shirur tahsil of Pune district and Madha, Modnimb and Uplai from Madha tahsil of Solapur district were selected.

### **3.3.4 Selection of sample farmers**

The tertiary and ultimate unit of sample was the farmer. The list of the farmers having the milch animals were prepared from revenue record of villages and were categorized into three size groups on the basis of the operational holdings viz, holding size upto 2.00 ha, holding size 2.01 ha to 4.00 ha and holding size 4.01 ha and above were designated as small, medium and large size groups, respectively. Then, five cultivators were selected randomly from each size groups. The sample comprised of 90 farms in each rainfed and irrigated region consisting 30 farms from each size groups. Thus, the total sample consisted of 180 farms.

## **3.4 Collection of data**

### **3.4.1 Primary data**

The information regarding the expenditure incurred on account of crop and livestock activities and returns from these enterprises were collected by the survey method for the agricultural year 1999-2000 with

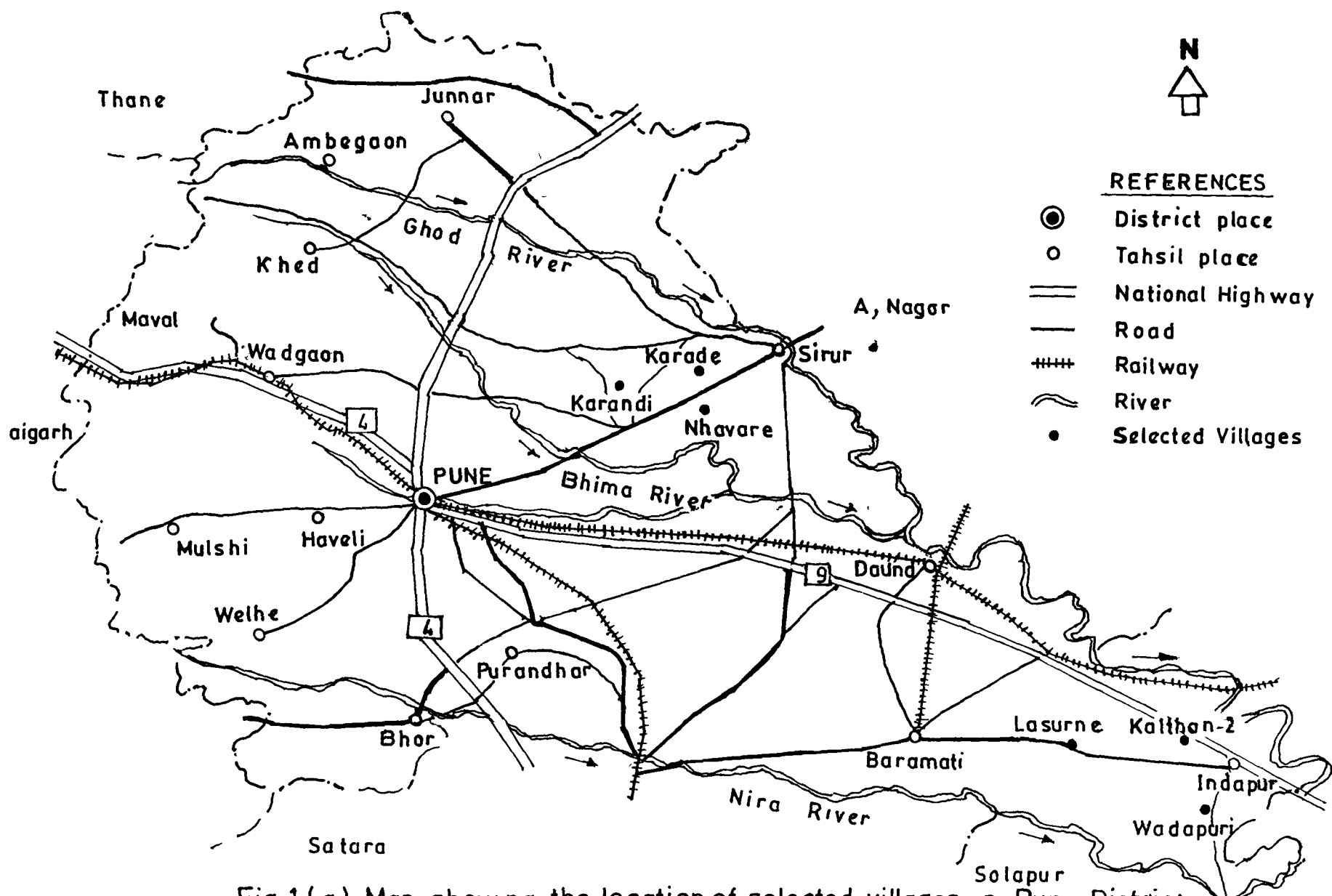


Fig.1(a) Map showing the location of selected villages in Pune District.

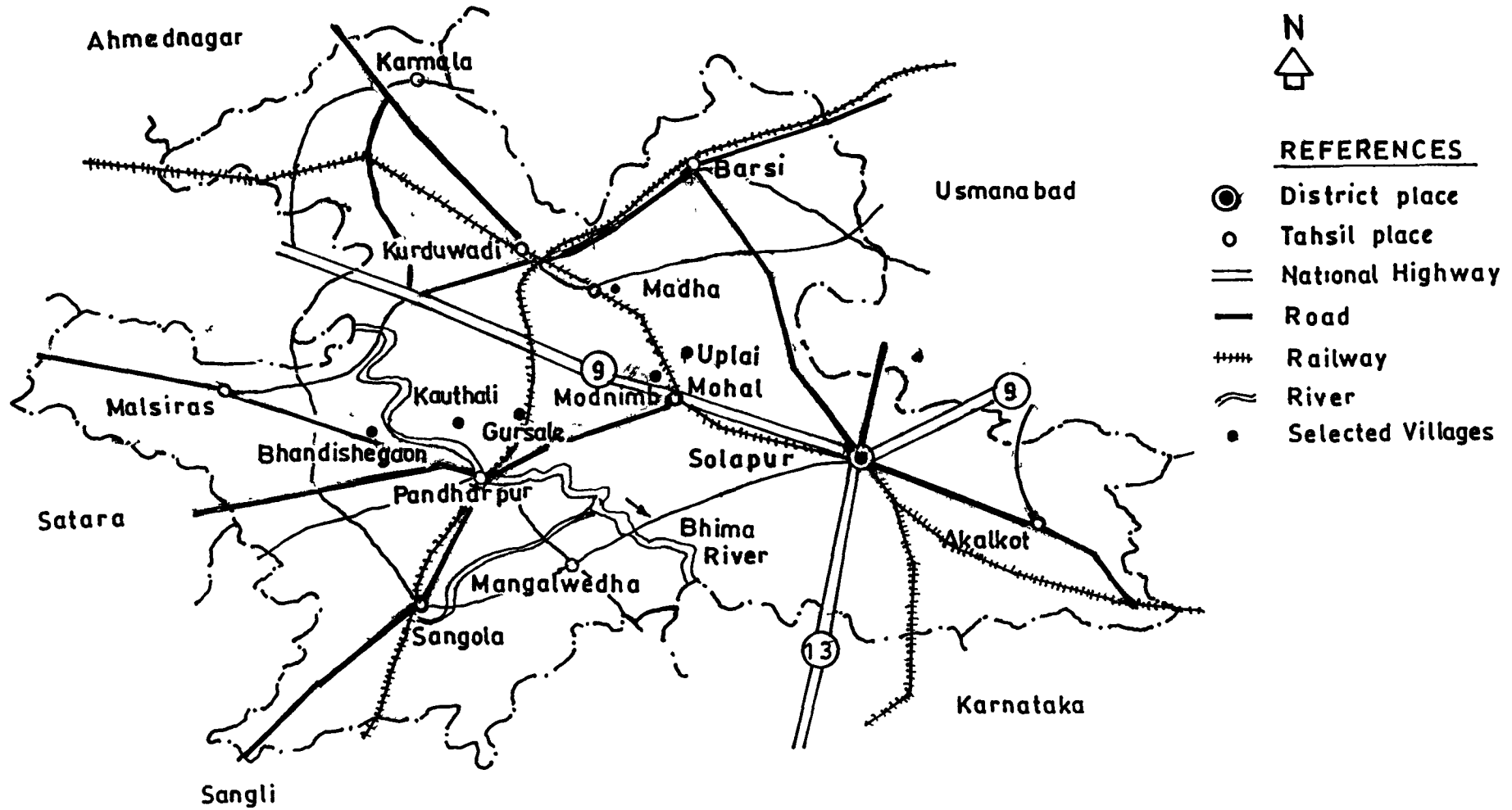


Fig.1 (b) Map showing the location of selected villages in Solapur district.

the help of pretested questionnaires specially designed for the purpose by conducting personal interview with the selected sample families of the regions

#### **3.4.2 Secondary data**

Secondary information regarding the tahsil wise area under different crops and number of livestock during the year 1999-2000 was collected from the office records of the Divisional Agriculture Officer and Animal husbandry officer. The information regarding population, land use pattern, cropping pattern, irrigation and capital assets were collected from the socio-economic reports of the respective districts for the period under reference.

### **3.5 Method of data analysis**

The data collected from sample families were compiled according to individual sample categories. The data were further analysed to obtain sample means relative to different aspects of crop and livestock production activities. A simple tabular method and production function analysis were the two tools used for the present study. The relative contribution of individual variable to total income and labour employment of the families were studied by multiple regression analysis.

#### **3.5.1 Estimation of input requirements**

The requirement of inputs for crop production activities and livestock enterprises were estimated by a tabular system of analysis with simple averages. The input requirements were calculated separately for each enterprise on per family and per unit basis. The inputs requirements for crop enterprise included human labour (hired + family), bullock

labour, seeds, manures and fertilizers, plant protection chemicals, irrigation etc. In the case of livestock enterprise, the inputs required were human labour, green fodder, dry fodder, concentrates and veterinary aids. The input requirements were estimated for each of the sample categories for both the regions.

### **3.5.2 Estimation of costs and returns**

The data were analysed to find out the unit production costs and returns of crop and livestock enterprises separately. A cross-sectional (i.e. size groupwise) comparison of costs and returns of both the activities as well as mixed farms as a whole was done separately in order to find out the extent of profitability in each farm enterprise in both the regions.

### **3.5.3 Output-input relationships**

The output-input ratio is the ratio of gross income to the total cost. This ratio is calculated as the ratio of gross income to the total production cost for both enterprises separately as well as for the mixed farm as a whole.

## **3.6 Concepts and their meanings**

### **3.6.1 Cost concepts used for crop enterprises**

The primary data which was collected at farmer's level were processed, compiled and the total input costs of different crops have been distributed by using standard cost concepts.

**Cost 'A'** : Cost 'A' includes the cost on account of hired human labour, hired plus owned bullock labour and machine labour, seeds (purchased plus owned), manures (purchased plus owned), fertilizers, irrigation, plant protection, land revenue and cesses,

depreciation on implements and machinery, interest on working capital etc

**Cost 'B'** It comprises of Cost 'A' plus interest on value of owned fixed capital assets (excluding land) and rental value of own land (net of land revenue) and rent paid for leased in land

**Cost 'C'** It comprises of Cost 'B' plus imputed value of family labour

**Cost concepts i.e. cost 'A', cost 'B' and cost 'C'** has been utilized for working out per hectare costs and returns of crops indifferent size groups

The methodology adopted for valuation of different items of cost in estimation of cost of cultivation is discussed in the subsequent paragraph

**1 Human Labour** It includes both hired and family labour. Most of the labour force engaged in crop production comes from cultivators own family. However, the cultivators have to engage hired labour from time to time for certain operations. It includes labour required for following different operations. Ploughing, harrowing, weeding, planting, earthing up, manuring, fertilizer application, plant protection, irrigation, harvesting, winnowing and incidental (includes actual labour required for organization of inputs, watching, etc )

**Human labour cost comprises of**

- a) Wages actually paid to the hired labour as also those paid to the labour hired on contract for the whole year or part thereof for various operations
- b) Imputed value of labour put in by the family members for various operations

c) Wages paid to the attached farm servants for different operations

The wages of male and female members of the family were calculated on the basis of wages rates in force from time to time of the casual labours for different operations

However, for converting the female labour in to the mandays following formula has been used

$$\text{Mandays} = \text{Female labour days} \times 0.75$$

**2 Bullock labour** In the case of hired bullock labour, the prevailing rates of bullock labour for particular operations in the village were considered Charges on account of owned bullock labour were accounted on the basis of the charges paid to the hired bullock pair including the labour required for the operations like ploughing, harrowing, manuring and organization of inputs

**3 Machine labour** In the case of hired machine labour, the prevailing rates of machine labour (i e tractor, threshing machine)) for particular operations in the village were considered Charges on account of owned machine labour were accounted on the basis of the charges paid to the hired machine

**4 Seed :** The cost on account of seed purchased was worked out at the actual price paid by the cultivators The cost of own seed was evaluated on the basis of rates prevailed in the village

**5 Manure** The cost of farm yard manures or composts produced on the farm was evaluated on the basis of rates prevailed in the village The cost of manures purchased was accounted for by considering to the actual prices paid by the cultivators

**6. Fertilizer** The cost on account of fertilizers was worked out at the actual prices by the cultivators

7. **Insecticides and pesticides** The insecticides and pesticides were charged at the actual prices paid by the cultivators

8. **Irrigation charges** Irrigation was mostly through wells, bore wells, canal The details regarding estimation of irrigation charges is given below

$$\text{Irrigation charges for sample crops (Rs)} = \left[ \left( I_h \times M_e \right) + \left( \frac{F_1}{IGCA} \right) P A \right]$$

Where,

$I_h$  = Total number of working hours of electric motor for the crop

$M_e$  = Per hour maintenance cost of electric motor

$F_1$  = Interest on fixed capital of irrigation structure

$IGCA$  = Irrigated gross cropped area

$PA$  = Area of the crop

$$\text{Per hour Maintenance cost of Electric motor} = \frac{M_c}{W_h}$$

Where,

$M_e$  =Maintenance of cost of electric motor includes electric bill for the year plus repairs charges

$W_h$  =Total number of working hours of electric motor for one year

Irrigated cropping pattern of individual sample farmer was taken into consideration Then the information on number of irrigation applied for individual crop, horse power of the electric motor, soil, canal charges

were worked out as the charges paid by the cultivators for irrigating the crop

**9 Land revenue, cesses and taxes** This item of cost includes land revenue, additional land revenue, cess by the Zilla Parishad, taxes on account of Employment Guarantee Scheme and educational taxes, which were actually paid by the cultivators

**10 Depreciation on implements and machinery and repairs** Farm assets like farm buildings (whole or its part used for agricultural business purpose), implements, equipments, machinery, bore wells and other irrigation structure were evaluated at the prevailing market prices taking into consideration the conditions of the assets. Depreciation of these assets for current year was calculated using straight line method. For the purpose, the present value and remaining useful life of assets were considered and worked out with the following formula

$$D = \frac{(PV) - (10\% \text{ of } PV)}{RL}$$

Where,

D = Depreciation of asset for one year in rupees

PV = Present value of the asset in rupees

RL = Expected remaining life of the asset in years

**11. Interest on fixed capital** Interest on present value of fixed assets (excluding land, animals and traditional old wells) such as farm buildings, implements, equipment, machinery, bore wells, irrigation structure was charged at the rate of 10 per cent of the present value

**12. Interest on working capital** Interest on working capital was charged at the rate of 13 per cent per annum for full of period of crop

**13. Rental value of land** . Rental value of land is calculated as one-sixth of gross value of produce (main + bye produce) minus total land revenue paid

### **Concept of Income in crop production**

**Gross Income** Value of main produce and bye-produce at the rate prevailing at the time of harvest of crop

**Farm Business Income** = Gross income – Cost A

**Family Labour Income** = Gross income – Cost B

**Net Income** = Gross income – Cost C

**Farm Investment Income** = Net income + rental value of land + Interest on fixed capital

It is the same as Farm business income – Imputed value of family labour

### **3 6 2 Cost concept used for livestock enterprises**

The livestock enterprises in the present investigation included draught, milk and other animals such as sheep and goat. The costs and returns from all these animals put together were estimated on per farm and per livestock unit. For this purpose, the animals maintained by each of the sample units were converted into animal units with the help of norms adopted in Government of India's cost of Cultivation Scheme. The norms followed are as under

Animal maintained during the year	Animal unit
Animal of the age above two year	1 00
Animals in between the age of 1 to 2 years	0 50
Calves below one year	0 25
Goat and sheep	0 20

In order to work out the costs and returns of livestock enterprise, various items of costs were categories into two main groups such as (a) working costs and (b) fixed costs

Working costs in livestock rearing are those costs which are paid directly and include costs of feed, cost on account of hired labour and family labour, veterinary charges, cost on miscellaneous items and interest on working capital for the year

Fixed costs are those costs which are not paid directly but they are to be considered while estimating the cost of livestock rearing. They included interest on fixed capital comprising of investment on a animal, byre, utensils, depreciation of animal, byre and utensils

### **a) Items of Costs**

In various items of cost considered in working out the cost of livestock rearing are as under

#### **i) Fodder**

In the case of purchased fodder, the actual purchase price was taken into account while in the case of fodder raised on own farm, prevailing market prices were taken into consideration for evaluation

### **ii) Concentrate**

The cost on account of concentrate was worked out at the actual purchase price paid by the farmer

### **iii) Labour**

The labour is required for various activities in livestock enterprise such as grazing, tending, feeding, cleaning of byre, milking etc. The valuation of labour was done on the basis of total wages paid to him both in kind and cash while that of family labour was done at the prevailing wage rates for the labour

### **iv) Veterinary expenses**

The expenses incurred on purchase of medicines and other veterinary requisites

### **b) Maintenance cost of livestock**

Net maintenance cost of animal is equal to gross maintenance cost less value of dung

### **c) Per hour maintenance cost of bullock**

Net maintenance cost divided by total productive work hours (work for crop production) on own farms and other's farm as well as non-crop production work on own and others farms

### **d) Source of returns from livestock**

The returns from livestock included income from various items viz, milk and milk products, manure, sale of animals, appreciation in the value of animals and imputed value of bullock labour for crop production, hiring out charges and appreciation in the value of animals

The net returns from livestock were examined at working cost and total cost of maintenance of animals

### 3.7 Production function analysis

#### (a) Choice of function

Number of production studies have been conducted with the major objectives of determining the productivities of resources and allocation efficiency of farm inputs for a crop or livestock or for the farm business as a whole. These studies have used Cobb-Douglas type of production function for estimation and finally pointed out inefficiencies in the resource use and indicated improvements in input mix to increase yields [Sam and Bagchi (1977), Kasar (1992), Birari (1997) etc]. By now, the choice of Cobb-Douglas form has become a convention in production function analysis mainly because of its theoretical fitness to agriculture and its computational manageability.

It is in this context, the Cobb-Douglas production function has been fitted to the farm level data of both the regions of farms for studying resource productivities and resource use efficiency in crop production, livestock production and for the farm as whole.

#### 3.7.1 Crop production function

The Cobb-Douglas production function of the following type was used to estimate production elasticities of resource variables in crop production activity

$$Y = a \cdot X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} e^u$$

Where,

Y = Gross returns (Rs )

a = Constant

$b_1$  = Regression coefficients of respective variables

$X_1$  = Human labour (mandays)

$X_2$  = Manures and fertilizers (Rs )

$X_3$  = Other working capital (Rs )

$X_4$  = Gross cropped area (ha )

$X_5$  = Area under cash crops (ha )

$X_6$  = Area under fruit crops (ha )

$e^u$  = Error term

### 3.7.2 Livestock production function

The livestock production was estimated for all animals together. For this purpose, the Cobb-Douglass production function of the following type was used

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} e^u$$

Where,

$Y$  = Gross returns (Rs )

$a$  = Constant

$b_1$  = Regression coefficients of respective variables

$X_1$  = Dry fodder (qtls )

$X_2$  = Green fodder (qtls.)

$X_3$  = Concentrates (Kg )

$X_4$  = Human labour (mandays)

$X_5$  = Livestock unit (No )

$e^u$  = Error term

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### 3.7.3 Production functions for the mixed farm :

An attempt was also made to estimate production elasticities of individual resource variables in farm production as whole by using Cobb-Douglass production function of following type

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e^u$$

Where,

Y = Gross returns of the farm (Rs )

a = Constant

b<sub>1</sub> = Regression coefficients of respective variables

X<sub>1</sub> = Human labour (mandays)

X<sub>2</sub> = Cash expenses on crop production (Rs )

X<sub>3</sub> = Cash expenses on livestock production (Rs )

X<sub>4</sub> = Area under cash crops (ha )

X<sub>5</sub> = Area under fruit crops (ha )

X<sub>6</sub> = Gross cropped area (ha )

e<sup>u</sup> = Error term

Thus the productivity of individual resources for crop production, livestock enterprises and farm as whole were worked out for different size groups of holding. The significant test for individual resources was carried out by student's 't' test, while, the significance of the model was tested by 'F' value test. R<sup>2</sup> were also worked out in total production by the explanatory variables.

### 3.7.4 Specification of variables

#### i) Land

The most important variable used in production function is area. This input has been used as explanatory variables in the production function analysis and it has been used as gross cropped area in hectares.

**ii) Human labour**

This inputs has been expressed in terms of mandays of eight hours It included all human labour (including operator's labour, hired labour-permanent and temporary and other family labour) utilized for performing different farm operations right from preparing of land to threshing The difference in the efficiency of labour have ben taken into account by converting female labour into mandays

(Mandays = Female labour X 0.75)

**iii) Mannures and fertilizers**

This input variable included the use of plant nutrient in the form of manures (*organic*) and fertilizers (*inorganic*) In view of the difficulties involved in finding out exact quantities of different nutrients at the farm level, only three major nutrients viz, N, P and K have been considered in the present study The input variable including manures and fertilizers has, therefore, been defined in the forms of the total nutrients (NPK) applied through chemical fertilizers as well as through FYM (manure) in kilogram

**iv) Other working capital**

This variable has been defined as expenditure on other inputs These inputs are seeds, irrigation, insecticides and fungicides, repairs (minor) and maintenance of implements and machinery etc All these inputs were aggregated into only one variable for the reason that each of these items individually may have a small association with production and inclusion of all these items as separate variables would greatly reduce degree of freedom

**v) Area under cash crop**

This input has been measured in terms of hectares. This includes area under cash crops such as sugarcane, cotton, summer groundnut and onion.

**vi) Area under fruit crop**

This input has been measured in terms of hectares. This variable includes area under fruit crops grown by the cultivators such as pomegranate, custard apple, ber etc. on the farms.

**vii) Gross returns**

The gross returns obtained on each farm from crop enterprise has been used as dependent variable in monetary terms.

An attempt has been made to estimate the production function for livestock production on different size groups of farms in the irrigated and rainfed regions. Explanatory variables included were

**i) Dry fodder :**

It includes dry fodder purchased as well as farm produced fed to the animals on the farm and was measured in quintals.

**ii) Green fodder:**

This variable includes green fodder purchased as well as farm produce fed to the animals on the farm and was measured in quintals.

**iii) Concentrates:**

This variable includes the feeding of concentrate like oil cake to the animals on the farm in kilogram.

**iv) Human labour:**

The human labour used for maintenance of livestock i.e. for cleaning of byre, feeding, rearing milking of livestock etc. This input has expressed in terms of mandays

**v) Livestock unit**

This variable includes the number of livestock unit on the farm

In addition to this, an attempt has also been made to estimate the production function for mixed farm as a whole on the different size groups of sample farms in the irrigated and rainfed regions. A set of explanatory variables used is as below.

**i) Land**

It has been used as gross cropped area in hectares

**ii) Human labour**

The human labour input has been expressed in terms of mandays and evaluated as explained earlier.

**iii) Cash expenditure on crop production excluding human labour**

This variable included the expenditure on seed, manure, fertilizer, irrigation, crop protection and repairs and hiring charges of implements and machines used in crop production in value terms

**iv) Cash expenditure on livestock activity**

This variable included the maintenance cost of animals excluding the wages of human labour

**v) Area under cash crop**

This variable includes the area under cash crops like sugarcane, cotton, summer groundnut and onion and measured in hectares

**vi) Area under fruit crop**

This variable includes area under fruit crops mentioned earlier in hectare

**vii) Gross returns**

The gross returns obtained on each farm from both crop and livestock enterprise has been used as dependent variable in monetary terms

**3.8 Economic analysis**

The estimated production function coefficients were used for economic analysis with regards to estimation of returns to scale and marginal productivities of individual resource factors. The differences in the values of these estimated coefficients gives an idea about the variations in the productivities of resources of the farms in different regions as well as groups of farms

**-a) Estimation of marginal value products**

In order to compare the marginal value productivities with the marginal cost of the individual variables, the analysis was extended to work out marginal physical products (MPPs) and marginal value products (MVPs) of the selected variables of the present study

The marginal physical product (MPP) of individual input used in the crop, livestock and farm as a whole production of enterprises was worked out with the help of following equation

$$MPP_{X_1} = b_1 \frac{\overline{Y}}{\overline{X_1}}$$

Where,

$b_1$  = Elasticity of production for  $X_1$

$\overline{Y}$  = Geometric mean of output

$\overline{X_1}$  = Geometric mean of input

The MPP of individual input were then converted into MVPs with the help of unit price of output

$$MVP_{X_1} = b_1 \frac{\overline{Y}}{\overline{X_1}} P_y$$

$P_y$  = Per unit price of output

The efficiency of resource use was studied through the comparison of MVP of resource with its respective acquisition cost. The difference between MVP of the individual resource and its acquisition cost was tested by computing 't' value

#### **b. Estimation of returns to scale**

In the Cobb-Douglas type of production function, the returns to scale are measured by adding elasticities of all the input as given below

$$Y = a X_1^{b_1} X_2^{b_2} \dots X_n^{b_n}$$

$b_1, b_2, \dots, b_n$  are the regression co-efficient or elasticities of production and the returns to scale is

$$\sum b_i = b_1 + b_2 + \dots + b_n$$

Depending upon the sum of regression co-efficients as less than, equal to or greater than unity, the prevailing returns to scale are considered as decreasing, constant or increasing, respectively. Since the elasticity coefficients are constant in the Cobb-Douglas production function, the scale of returns so indicated represent the average condition for the sample farm. The sums of regression coefficients were further tested for their deviation from unity. The details of test used are given in Appendix I.

#### **b) Statistical test for comparing production function relationship**

In order to know whether the irrigated and rainfed farms belonging to different production relationships, Chow's test of equality has been applied (Gujarathi, 1978 and Kasar 1987). The test involved the following steps

**Step I**        Combine all  $N_1$  and  $N_2$  observations of two sample and run the single "Pooled" regression. From the regression, obtain the residual sum of squares (RSS),

say  $S_1$  with  $df = N_1 + N_2 - K$  where  $K$  is the number of parameters estimated

Step II Run the two individual regression (1) and (2) to obtain their RSS say  $S_2$  and  $S_3$  with  $df = N_1 - K$  and  $N_2 - K$  respectively

Add these two SS, say  $S_4 = S_2 + S_3$  with  $df = N_1 + N_2 - 2K$

Step III Obtain  $S_5 = S_1 - S_4$

Step IV Apply the 'F' test as follow

$$'F' = \frac{S_5/K}{S_4/(N_1+N_2-2K)}$$

With  $df = K, N_1 + N_2 - 2K$

If the computed 'F' exceeds the critical 'F' the hypothesis that the two regressions are the same can be rejected. In other words, such regression differ, either in the intercept or slopes or both

### 3.9 Estimation of family income

Per farm family income was worked out by simple tabular method considering the means for the different sized farms. The income from crop production, livestock activity, wages earned and income from service and business have been worked out for both the regions

### 3.10 Estimation of employment function

The following form of multiple linear regression equation was used for estimating the employment

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u_t$$

Where,

Y	=	Total farm employment (mandays)
a	=	Constant
X <sub>1</sub>	=	Gross cropped area (ha )
X <sub>2</sub>	=	Milch animals (No )
X <sub>3</sub>	=	Working capital (Rs )
X <sub>4</sub>	=	Cropping intensity (%)
X <sub>5</sub>	=	Off- farm employment (mandays)
b <sub>i</sub> 's	=	Regression coefficients
u <sub>t</sub>	=	Error term

### 3 11 Estimation of income function

The annual family income function has also been estimated on the lines of employment function. The form of function used was as under

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u_t$$

Where,

Y	=	Total farm family income (Rs )
a	=	Constant
X <sub>1</sub>	=	Gross cropped area (ha )
X <sub>2</sub>	=	Milch animals (No )
X <sub>3</sub>	=	Total crop and livestock expenditure (Rs )
X <sub>4</sub>	=	On-farm labour employment (mandays)
X <sub>5</sub>	=	Off-farm labour employment (mandays)
b <sub>i</sub> 's	=	Regression co-efficients
u <sub>t</sub>	=	Error term

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Chapter Opener Page



**SOCIO-ECONOMIC FEATURES OF  
THE STUDY AREA  
AND THE SAMPLE FARMS**

## **4. SOCIO-ECONOMIC FEATURES OF THE STUDY AREA AND SAMPLE FARMS**

### **4.1 Socio-economic features of the study area**

The Knowledge about the physical features and economic background of the study area facilitates better understanding of the problem under investigation. Agro-climatic conditions play major role in the agricultural production. Apart from the agro-climatic factors, there are some factors, which are minor but play important role in the production. The factors are topography, soil types, irrigation, communication, education, credit, marketing, infrastructural development and entrepreneurship. The study of these factors, in addition to land use pattern, crop pattern and importance of crop and livestock, would help in understanding the salient features of the area. As mentioned earlier, Indapur and Shirur tahsils of the Pune district and Pandharpur and Madha tahsils of Solapur districts were selected for the present study.

#### **4.1.1 Location**

Pune district is a part of deccan plateau. The district lies between  $17^{\circ}50'$  and  $19^{\circ}24'$  North latitudes and  $73^{\circ}19'$  and  $75^{\circ}10'$  East longitudes. Pune district is surrounded by Ahmednagar district in North and East, Satara district in the South, Raigad district in the West, Solapur district in the South East and Thane district in the North-West. The part of the district are more or less broken type due to the Sahyadri mountains spread from North to West. It lies in the basin of Bhima, Ghod, Indrayani, Mula-Mutha, Nira, Karha, Kukadi. For administrative

purpose, the district is divided into 13 tahsils. The district has a total geographical area of about 15642 sq km.

Indapur tahsil is situated at east side of the district headquarter on the Pune-Solapur highway and tahsil headquarter is at a distance of 135 kms from Pune. Indapur tahsil is surrounded by Baramati tahsil at West, Daund at North, Malshiras at South and Madha at east side. Nira left canal flows in the direction of west to east.

Shirur tahsil is situated at North-east side of the district headquarter on the Pune-Ahmednagar Road at a distance of 60 kms from Pune. Shirur tahsil is surrounded by Haveli and Rajgurunagar tahsils at West, Parner tahsil of Ahmednagar at North, Daund tahsil at East and Purandhar and Baramati tahsils at South. It lies in the basin of Bhima river.

Solapur district is one of the five districts of Pune Revenue Division, situated on the South-East fringe of Maharashtra state and situated between 17°-10' to 18°-32' North latitude and 74°-42' to 76°-15' East longitude. Solapur district is surrounded by Ahmednagar district in the North, Osmanabad in the North and East. Sangli and Karnatka state are to the South and Sangli, Satara and Pune districts towards the West. There is no important hill system in the district. However, towards North-East fringe, sparse of Balaghat ranges and towards western fringe sparse of Mahadeo ranges and towards South-western fringe sparse of Shukracharya ranges exist in the district. It lies in the basin of Bhima, Nira, Sina and Man rivers. For administrative purpose, the district is divided into 11 tahsils. The district has a <sup>geo</sup>graphical area at about 14895 sq kms.

Pandharpur tahsils is situated at West side of the district headquarter on the Solapur-Kolhapur road and at a distance of 70 kms from Solapur. Pandharpur tahsil is surrounded by Mohol tahsil at East, Madha at North, Malshiras at West, Sangola and Mangal Wedha at South side. Bhima is the main river which flows in the direction from North-West to South-East.

Madha tahsil is situated on West side of the district head quarter on north side of Solapur-Pune highway, at a distance of 65 kms from Solapur. Madha tahsil is surrounded by Mohol tahsil at East, Karmala at North, Pandharpur at South and Indapur tahsil of Pune district at West side. It lies in the basin of Sina river.

#### **4.1.2 Population**

The information relating to population and distribution of workers according to different categories is shown in Table 4.

According to the 2001 census, the population of Pune district is 7224000 in which 41.92 and 58.08 per cent were the rural and urban population, respectively. The population of Solapur district is 3855380 in which 68.20 and 31.80 per cent were the rural and urban population, respectively. The population density of Pune district is 462 and that of Solapur district is 259.

The percentage of total workers in the total population was 42.21 per cent in Pune district, while it was 45.83 per cent in Solapur district. It is observed that out of total workers, percentage of workers engaged in agriculture and related field for the Pune district was 40.66 per cent and

**Table 4.1-Demographic features of the study area**

('000')

Sr No	Particulars	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Geo area sq Km	14878	1194	1526	15621	1468	1557
2	Population Density	259	278	194	462	238	200
3	No of villages	1233	101	127	4563	141	113
4	No of houses	861	67	57	1433 4	54	42
5	No of families	865	69	57	1541	54	43
6	Total population	3855 38	402 68	292 15	7224	348 37	310 57
	a Male	1990 66 (51 63)	210 12 (52 18)	151 77 (51 95)	3768 (52 16)	180 64 (51 85)	160 64 (51 72)
	b Female	1864 72 (48 37)	192 56 (47 82)	140 38 (48 05)	3456 (47 84)	167 73 (48 15)	149 94 (48 28)
7	Rural population	2629 55 (68 20)	371 30 (77 31)	269 38 (92 21)	3029 (41 92)	326 78 (93 81)	283 57 (91 31)
8	Urban population	1225 82 (31 80)	91 38 (22 69)	22 77 (7 79)	4196 (58 08)	21 58 (6 19)	27 00 (8 69)
9	Workers	17669	1821	1577	30492	1545	1620
	a Agril & related	11166 (63 19)	1237 (67 93)	1194 (75 71)	12399 (40 68)	119 (77 60)	1164 (71 85)
	b Non agril	6503 (36 81)	584 (32 07)	383 (24 29)	18093 (59 34)	346 (22 40)	456 (28 15)
10	Rural workers	13527	1561	1508	16073	1483	1529
	a Agril & related	10845 (80 17)	1220 (78 15)	1188 (78 78)	11961 (74 42)	1192 (80 38)	1160 (75 87)
	b Non agril	2682 (19 83)	341 (21 85)	320 (21 22)	4112 (25 58)	291 (19 62)	369 (24 13)
11	Urban workers	4142	260	69	14419	62	91
	a Agril & related	320 (7 73)	16 (6 15)	8 (11 59)	438 (3 04)	7 (11 29)	4 (4 40)
	b Non agril	3822 (92 27)	244 (93 85)	61 (88 41)	13981 (96 96)	55 (88 71)	87 (95 60)
12	Literate persons	2757 (71 50)	276 (68 65)	194 (66 40)	5835 (80 78)	248 (71 45)	228 (73 53)
	a Male	1637 (82 28)	165 (78 83)	115 (76 04)	3336 (88 55)	147 (81 66)	135 (84 03)
	b Female	1120 (60 07)	111 (58 09)	79 (57 13)	2499 (72 32)	101 (60 07)	93 (62 37)

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts, 2001-2002

63.19 per cent for the Solapur district. Out of total rural workers, 74.42 per cent and 80.17 per cent were engaged in agriculture and related fields, respectively in the Pune and Solapur districts. The literacy percentage was more in Pune district (80.78 per cent) than the Solapur district (71.50 per cent).

Among the tahsils, the population of Indapur and Shirur are 348370 and 310570, respectively while it was 402000 and 292000 in Pandharpur and Madha tahsils. The population density is 238 and 200 in Indapur and Shirur, respectively, while that of Pandharpur and Madha tahsils, it is 278 and 194, respectively. Out of total population, the percentage of rural and urban population is 93.80 and 6.20 in Indapur, 91.31 and 8.69 in Shirur, 77.31 and 22.39 per cent in Pandharpur and 92.21 and 7.79 per cent in Madha tahsils, respectively. It is observed that out of total workers, percentage of workers engaged in agriculture and related field for the Indapur, Shirur, Phandarpur and Madha tahsils is 77.60, 71.85, 67.93 and 75.71 per cent, respectively. The out of total rural workers, 80.38, 75.87, 78.15 and 78.78 per cent are engaged in agriculture and related field in the tahsils respectively. The literacy percentage was more in Shirur tahsil (73.53 per cent) and least in Madha tahsil (65.81 per cent).

#### **4.1.3 Climate**

In Solapur and Pune district and selected tahsils, rainy season starts from the middle of June and lasts at the end of October. The South-West monsoon is the main rainy season, during which different parts of the districts get major portion of the annual precipitation. It is followed by

winter season from November to February and hot weather from March to mid-June. The average rainfall of this area is in the range 50 to 60cms

During winter the atmosphere remains generally bright and clear with moderate to less humidity (i.e. dry winter). While it remains clear with bright and scorching sunshine with less humidity and occasionally mild-dust storms and hot winds may occur during summer season in the selected districts and tahsils. Within the districts, in the canal irrigated areas, the temperature during winter, some times falls below 10 degree Celsius with moderate to high humidity and in such area temperature during summer rarely increases beyond 40 degree Celsius.

The information pertaining to monthwise rainfall for the year 1999-2000 in the selected district and tahsils is presented in Table 4.2

**Table 4.2 – Rainfall pattern in the study area (1999-2000) (mm.)**

Sr No	Particulars	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	June, 99	115.6	102.2	92.7	159.6	93.4	87.3
2	July, 99	124.4	77.8	94.2	194.9	89.7	91.2
3	August, 99	112.3	53.1	90.7	153.2	81.9	97.4
4	Sept, 99	190.3	172.7	172.6	233.8	178.3	201.0
5	October, 99	75.1	77.2	68.8	135.1	71.4	63.7
6	Nov, 99	26.7	28.1	29.3	57.3	21.3	23.1
7	December, 99	8.0	7.2	6.7	11.3	5.2	3.2
8	January, 2000	5.0	4.0	5.6	2.0	3.9	1.8
9	Feb., 2000	3.4	2.0	2.5	2.1	1.8	1.0
10	March, 2000	5.1	3.8	2.9	0.0	0.0	0.0
11	April, 2000	12.8	12.7	10.0	3.9	2.9	1.0
12	May, 2000	28.2	21.8	22.7	12.1	8.9	5.2
	Total	707	562.6	598.7	985.3	567.7	575.9

Source: Socio-economic Reports of Solapur and Pune districts 2001-2002

It could be seen from the table that in the both the districts and selected tahsils, the annual total rainfall ranges between 500 to 900 mm and nearly 60 per cent rainfall is received during the period of August to October

Agro-climatically, the entire Pune district except western parts of Bhor, Velhe, Ambegaon and Junnar tahsils and entire Solapur district except Akkalkot tahsils and eastern parts of Barshi tahsils falls under Scarcity zone

#### **4.1.4 Soils**

The geographical foundation of soil prevailing in Solapur and Pune districts are mainly of deccan trap of volcanic origin. The solum is underlined by partially decomposed basaltic rock. The lime reserve is fairly high (3.5 to 10.00 per cent). The soils in the districts can be classified into four main categories on the basis of depth and structure

- i) Very shallow soils with depth below 7.5 cm
- ii) Shallow soils with depth between 7.5 to 22.5 cm
- iii) Medium deep soils with depth between 22.5 to 90 cm
- iv) Deep soils with depth more than 90 cm

It is broadly estimated that out of the total cultivated area, very shallow soils occupy about 10 per cent of the area, shallow soils 20 per cent, medium soils 45 per cent and deep soils 25 per cent. The shallow soils in the selected district and tahsils are light brown or grayish black, while medium to deep soils are black.

#### 4.1.5 Land Use Pattern

Land use pattern of the study area gives an idea about proportion of land under different uses. Information relating to land use pattern in the selected districts and tahsils is given in Table 4.3

It can be revealed from the table that the total geographical area of Solapur and Pune district is 1487843 and 1562100 hectares, respectively, while that of Indapur, Shirur, Pandharpur and Madha tahsils, it is 146800, 155700, 129437 and 152600 hectares, respectively. The share of area under the forest was 10.93 per cent in Pune district and 2.15 per cent in Solapur district. Among tahsils percentage of area under forest was maximum in Pandharpur tahsil (5.84 per cent) and least in Madha tahsil (1.69 per cent). Percentage share of land not available for cultivation was more in Pune district (10.70) than in Solapur district (5.31).

The share of land not under cultivation in Pune district was 7.88 per cent and in the Solapur district 5.14 per cent. Among tahsils, it was maximum in Indapur tahsil (15.46 per cent) and least in Pandharpur tahsil (2.43 per cent).

Percentage of fallow land was more in Solapur district (16.45 per cent) than in Pune district (6.27 per cent). However, percentage of net area sown was higher in Solapur district (70.96 per cent) than in Pune (64.15 per cent), among tahsils it was the highest in Madha (82.62 per cent) and least in Pandharpur (68.24 per cent). The percentage of area sown more than once to the net sown area was much higher in Pune district (36.35 per cent) than Solapur district (7.17 per cent). In the case of the percentage total cultivable land it was more in Solapur district (90 per cent) than in Pune district (74.10 per cent).

**Table 4.3 – Land utilization in the study area (1997-98)**

( ha )

Sr No	Particulars	Solapur			Pune		
		Dist	Pandharpur	Madha	Dist	Indapur	Shirur
1	Total Geo area	1487843	129437	152600	1562100	146800	155700
2	Area under Forest	31947 (2 15)	7556 (5 84)	2584 (1 69)	170700 (10 95)	7800 (5 31)	6000 (3 85)
3	Land not available for cultivation	78897 (5 31)	7325 (5 66)	4464 (2 93)	167100 (10 70)	8700 (5 93)	15100 (9 70)
	a Land under non-agril	15486 (1 04)	1277 (0 99)	2180 (1 42)	62900 (4 03)	5800 (3 95)	6100 (3 92)
	b Barren and uncultivable land	63411 (4 26)	6048 (4 67)	2284 (1 50)	104200 (6 67)	2900 (1 98)	9000 (5 78)
4	Land not under cultivation (Other than Permanent fallow)	76430 (5 13)	3142 (2 42)	7299 (4 78)	123100 (7 88)	22700 (15 46)	9400 (6 04)
	a Cultivable but not in use	3359 (2 26)	3142 (2 43)	1380 (0 90)	32900 (2 11)	2700 (1 84)	5600 (3 60)
	b Permanent pasture & grazing land	37864 (2 54)	-	5710 (3 74)	65600 (4 20)	1500 (1 02)	2200 (1 41)
	c Land under trees shrubs etc	4971 (0 33)	-	209 (0 14)	24600 (1 57)	18500 (12 60)	1600 (1 03)
5	Fallow land (current & other)	244714 (16 45)	23057 (17 84)	12180 (7 98)	97900 (6 27)	5200 (3 54)	5600 (3 60)
6	Net Sown Area	1055825 (70 96)	88327 (68 24)	126073 (82 62)	1002100 (64 20)	102400 (69 76)	119700 (76 81)
7	Area sown more than once	75697	5354	915	364300	73000	67800
8	Gross Cropped Area	1131522	93681	126988	1366400	175300	187500
9	Total cultivable land	139105 (90 00)	114556 (88 50)	139842 (91 64)	1157500 (74 10)	128800 (87 74)	132400 (85 03)

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts 2001-2002

#### 4.1.6 Cropping Pattern

The details of cropping pattern of Pune and Solapur districts and selected tahsils for the year 1997-98 are presented in Table 4.4

From the table it is revealed that in Solapur and Pune districts, cropping pattern was dominated by cereals with the share of 70 and 65 per cent in gross cropped area, respectively in the districts. Within the cereals, *rabi jowar* has maximum share of 59.69 per cent in Solapur district and 40.82 per cent in Pune district. The share of oilseeds was more in Solapur (11.54 per cent) than that of Pune district (6.40 per cent). The share of pulses was also more in Solapur district (8.81 per cent) than Pune (6.07 per cent). The share of fruits and vegetables was more in Pune district (4.72 per cent) than Solapur (2.84 per cent). The share of sugarcane was more or less the same in both the districts. The percentage share of fodder crops was much higher in Pune district (12.30 per cent) than Solapur district (0.78 per cent). Since the total livestock share of crossbred cattle was more in Pune district.

The cropping intensity was relatively higher in Pune district (136.37 per cent) than the Solapur district (107.17 per cent). Since the percentage of gross irrigated area to gross cropped area was more in Pune district.

Among the tahsils, cropping pattern was dominated by cereals, with a maximum share in Indapur tahsil (77.23 per cent) and minimum in Madha tahsil (68.45 per cent). The share of pulses was highest in Shirur tahsil (11.12 per cent) and least in Indapur tahsil (3.23 per cent). The sugarcane crop had a better share of 12.81 and 11.52 per cent, respectively in Pandharpur and Indapur tahsils and this is due to better

**Table 4.4 – Cropping pattern of the study area (1997-98)****(ha.)**

Sr No	Crop(s)	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Jowar (Rabi)	675396 (59 69)	49073 (52 38)	83848 (66 03)	557813 (40 82)	117176 (66 84)	86572 (46 17)
2	Wheat	52216 (4 61)	5144 (5 49)	1648 (1 30)	55405 (4 05)	6116 (3 49)	2000 (1 06)
3	Bajra	23382 (2 07)	780 (0 83)	730 (0 57)	177012 (12 95)	7433 (4 24)	45950 (24 51)
4	Maize	16705 (1 48)	2485 (2 66)	425 (0 34)	15120 (1 11)	4670 (2 66)	730 (0 39)
5	Other cereals	28279 (2 49)	3244 (3 46)	271 (0 21)	82783 (6 06)	62 (0 04)	0 (0 00)
6	Total cereals	795978 (70 34)	60726 (64 82)	86922 (68 45)	888123 (64 99)	135457 (77 27)	135252 (72 13)
7	Gram	32897 (2 91)	3972 (4 24)	3725 (2 93)	42334 (3 09)	1445 (0 82)	5775 (3 08)
8	Tur	34117 (3 01)	1065 (1 14)	1657 (1 30)	5845 (0 43)	1369 (0 78)	595 (0 32)
9	Other pulses	32697 (2 89)	2067 (2 20)	3817 (3 01)	34826 (2 55)	2847 (1 62)	14425 (7 69)
10	Total pulses	99708 (8 81)	71 04 (7 58)	9199 (7 24)	83005 (6 07)	5661 (3 23)	20845 (11 12)
11	Groundnut	43014 (3 80)	2523 (2 69)	13625 (10 73)	48758 (3 57)	871 (0 50)	5300 (2 83)
12	Safflower	25376 (2 24)	265 (0 28)	5832 (4 59)	25305 (1 85)	3912 (2 23)	10850 (5 78)
13	Sunflower	58701 (5 19)	2364 (2 52)	4638 (3 65)	6408 (0 47)	1716 (0 98)	779 (0 41)
14	Other oilseeds	3554 (0 31)	190 (0 21)	33 (0 02)	6992 (0 51)	206 (0 12)	353 (0 19)
15	Total oilseeds	130645 (11 54)	5342 (5 70)	24128 (19 00)	87463 (6 40)	6705 (3 83)	17282 (9 22)
16	Fibre crops	6222 (0 55)	1283 (1 37)	1073 (0 84)	587 (0 04)	26 (0 01)	0 (0 00)
17	Fruits and vegetables	32105 (2 83)	5865 (6 26)	3070 (2 42)	64480 (4 72)	5103 (2 91)	5850 (3 12)
18	Sugarcane	53495 (4 75)	12000 (12 81)	1000 (0 79)	63760 (4 67)	20200 (11 52)	7758 (4 74)
19	Spices and condiments	4188 (0 37)	456 (0 49)	323 (0 25)	8934 (0 65)	244 (0 14)	80 (0 04)

Table contd-----

Sr No	Crops	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
20	Medicinal and aromatic plants	160 (0 01)	0 (0 00)	33 (0 02)	77 (0 01)	62 (0 03)	0 (0 00)
21	Fodder crops	8805 (0 78)	905 (0 97)	1140 (0 90)	168057 (12 30)	1804 (1 03)	430 (0 23)
22	Miscellaneous non-food crops	216 (0 02)	0 (0 00)	100 (0 08)	2001 (0 15)	38 (0 02)	0 (0 00)
23	Net Sown area	1055825	88327	126073	1002014	102342	119700
24	Area sown more than once	75697	5354	915	364386	72958	67831
25	Gross cropped area	1131522 (100 00)	93681 (100 00)	126988 (100 00)	1366487 (100 00)	175300 (100 00)	187497 (100 00)
26	Cropping intensity	107 17	106 06	100 72	136 37	171 29	156 63

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts, 2001-2002

availability of irrigation water by wells, canal and small irrigation projects constructed on the river in the tahsils. The cropping intensity was observed highest in Indapur tahsil and least in Madha tahsil.

#### 4.1.7 Irrigation

The information pertaining to the availability of irrigation water resources in the study area is presented in Table 4.5.

In both Pune and Solapur district as well as in the selected tahsils the dominance of well irrigation is there. Out of total irrigated area, percentage share of area irrigated by surface and well was 39.91 and 60.09 in Pune respectively, and it was 27.40 and 72.60 in Solapur respectively. The maximum area irrigated by well was more in Madha tahsil (80.10 per cent) and minimum area irrigated by well was in

**Table 4.5 –Sourcewise area irrigated in the study area (1997-98) (ha.)**

Sr No	Particulars	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Total area irrigated	216655 (100 00)	34474 (100 00)	26588 (100 00)	253187 (100 00)	43100 (100 00)	22890 (100 00)
	a Surface	59363 (27 40)	7967 (23 11)	5251 (19 90)	101036 (39 91)	19903 (46 18)	6288 (27 47)
	b well	157292 (72 60)	26507 (76 89)	21297 (80 10)	152151 (60 09)	23197 (53 82)	16602 (72 53)
2	Net sown area (NSA)	1055825	88327	126073	1002014	102342	119700
3	Gross irrigated area (GIA)	267300	40337	31386	304980	47935	28210
4	Gross cropped area (GCA)	1131522	93681	126988	1366487	175300	187497
5	% of NIA to NSA	20 52	39 03	21 09	25 27	42 11	19 12
6	% of GIA to GCA	23 62	43 06	24 72	22 32	27 34	15 05

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts, 2001-2002

Indapur tahsil(53 82 per cent) The percentage of net irrigated area to net sown area was more in Pune district (25 27 per cent) than in Solapur district (20 52 per cent) But in the case of percentage of gross irrigated area to gross cropped area was more in Solapur district (23 62 percent)

Among the tahsils, percentage of net irrigated area to net sown area was maximum in Indapur tahsil (42 11 per cent) and minimum, in Shirur tahsil (19 12 per cent) The percentage of gross irrigated area to gross cropped area, was maximum in Pandharpur tahsil (43 06 per cent) and least in Shirur tahsil (15 05 per cent)

The cropwise irrigated area in the selected district and tahsils is depicted in Table 4 6

**Table 4.6- Cropwise irrigated area in selected district and tahsil (1997-98 ha )**

Sr No	Crops	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Jowar (rabi)	67400 (25 21)	9959 (24 69)	9887 (31 50)	64103 (21 02)	8067 (16 83)	6613 (23 44)
2	Wheat	39100 (14 63)	3444 (8 54)	2510 (8 00)	40399 (13 25)	5243 (10 94)	2000 (7 09)
3	Maize	7800 (2 92)	2821 (6 99)	440 (1 40)	9013 (2 95)	3553 (7 47)	391 (1 39)
4	Other cereals	8600 (3 22)	452 (1 12)	62 (0 17)	12781 (4 19)	630 (1 31)	1990 (7 05)
5	Total cereals	122900 (45 98)	16676 (41 34)	12889 (41 07)	126296 (41 41)	17493 (36 49)	10994 (38 97)
6	Gram	12200 (4 56)	435 (1 08)	1162 (3 70)	17773 (5 83)	728 (1 52)	2295 (8 14)
7	Other pulses	2200 (0 82)	343 (0 85)	15 (0 05)	4381 (1 44)	103 (0 21)	350 (1 24)
8	Total pulses	14400 (5 39)	778 (1 93)	1337 (4 26)	22154 (7 27)	831 (1 73)	2645 (9 38)
9	Groundnut	22500 (8 42)	2516 (6 24)	9524 (3034)	5436 (1 78)	576 (1 20)	1242 (4 40)
10	Other oilseeds	12100 (4 53)	436 (1 08)	955 (3 84)	1061 (0 35)	90 (0 19)	5 (0 02)
11	Total oilseeds	34600 (12 95)	2952 (7 32)	10479 (33 39)	6497 (2 13)	666 (1 39)	1247 (4 42)
12	Fibre crops	4200 (1 57)	582 (1 45)	1063 (3 38)	352 (0 12)	26 (0 06)	0 (0 00)
13	Fruits	14500 (5 42)	4277 (10 60)	307 (0 99)	13311 (4 37)	4144 (8 65)	529 (1 88)
14	Vegetables	14600 (5 46)	1845 (4 58)	2767 (8 81)	50363 (16 51)	2435 (5 08)	4827 (17 11)
15	Sugarcane	53500 (20 01)	12000 (29 75)	1000 (3 18)	63707 (20 91)	20200 (42 14)	7758 (27 50)
16	Spices and condiments	4700 (1 76)	320 (0 79)	791 (2 52)	8491 (2 78)	244 (0 51)	80 (0 28)
17	Medicinal & aromatic plants	100 (0 04)	10 (0 02)	13 (0 04)	77 (0 02)	62 (0 13)	0 (0 00)
18	Fodder crops	3600 (1 35)	897 (2 22)	640 (2 04)	11678 (3 83)	1804 (3 76)	130 (0 46)
19	Miscellaneous non-food crops	200 (0 07)	0 (0 00)	100 (0 32)	2001 (0 65)	30 (0 06)	0 (0 00)
20	Gross irrigated area	267300 (100 00)	40337 (100 00)	31386 (100 00)	304980 (100 00)	47935 (100 00)	28210 (100 00)

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts, 2001-2002

It can be predicted from the table that out of gross irrigated area in the Pune district 41.41 per cent was dominated by cereals followed by sugarcane (20.91 per cent), vegetables (16.51 per cent), Pulses (7.26 per cent) and fruits (4.36 per cent). In Solapur district also, maximum share was contributed by cereals (45.98 per cent) followed by sugarcane (20.01 per cent), oilseeds (12.94 per cent), vegetables (5.46 per cent), fruits (5.42 per cent) and pulses (5.39 per cent).

Among the tahsils, except Indapur tahsil, out of the gross irrigated area, cereals dominated in Pandharpur tahsil (41.34 per cent), Madha (41.07 per cent) and Shirur (35.42 per cent). In Indapur tahsil proportionately maximum share was of sugarcane (42.14 per cent) followed by cereals (36.49 per cent), fruits (8.64 per cent), vegetables (5.08 per cent). In Pandharpur tahsil, 41.34 per cent area was dominated by cereals (41.34 per cent) followed by sugarcane (29.75 per cent), fruits (10.60 per cent) and oilseeds (7.32 per cent).

In Shirur tahsils, maximum share was contributed by cereals (35.42 per cent) followed by sugarcane (27.50 per cent), Pulses (9.37 per cent). In Madha tahsil, the highest share of by cereals (41.07 per cent) followed by oilseeds (33.39 per cent), vegetables (8.81 per cent) and pulses (4.26 per cent). It may be further revealed that though the share of cereals was maximum in the selected districts and tahsils, the irrigation was only of protective type for the rabi jowar and kharif crops and rabi jowar.

#### **4.1.8 Implements and machinery**

The information of agricultural implements and machinery in the study area and it is given in Table 4.7

**Table 4.7 –Agricultural implements and machinery in the study area (1997) (No.)**

Sr No	Particulars	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Wooden plough	15037	1611 (10.71)	1169 (7.77)	50120	684 (1.36)	6242 (12.45)
2	Iron plough	38532	3388 (8.79)	2763 (7.17)	31823	1553 (4.59)	6612 (19.55)
3	Bullock-cart	35485	2435 (6.86)	2546 (7.17)	33918	3397 (10.01)	3867 (11.40)
4	Sugarcane crusher	1781	450 (25.27)	149 (8.37)	704	14 (1.99)	7 (0.01)
5	Oil engine	7464	1122 (15.03)	600 (8.04)	8925	421 (4.72)	960 (10.76)
6	Electric motor	62366	4896 (7.86)	7598 (12.18)	51026	6269 (12.29)	5293 (10.37)
7	Tractor	3745	636 (16.98)	190 (5.07)	8092	1319 (16.30)	1167 (14.42)
8	Oil extractor	259	114 (44.01)	1 (1.39)	148	9 (6.08)	2 (1.35)
9	Total	164969	14652 (8.88)	15016 (9.18)	186756	13666 (7.32)	24150 (12.93)

(Figures in parentheses are percentages to the respective totals)

Source Socio-economic Reports of Solapur and Pune districts 2001-2002

From the table it is revealed that number of ploughs, oil engines and tractors are more in Pune district than Solapur district, while the number of bullock cart, sugarcane crusher, electric motor and oil extractor are more in Solapur district. In Pune district, wooden plough are more than iron ploughs, while in Solapur district reverse is the case. In Pune district, the number of ploughs, bullock carts and oil engines was more in Shirur tahsil than Indapur tahsil. The percentage share of sugarcane crushers, electric motors, tractors and oil extractors was observed more in Indapur tahsil. In solapur district number of bullock cart and electric motor was more in Madha tahsil, while the number of

sugarcane crushers, oil engines, tractors and oil extractors was observed more in Pandharpur tahsil than in Madha tahsil

#### **4.1.9 Livestock**

Information regarding the livestock population in the districts and related tahsils according to 1997 census is presented in Table 4.8

It may be revealed from the table that out of total bovine population, the share of indigenous cattle was higher in Solapur district (47.85 per cent) than in Pune district (42.96 per cent), while percentage share of crossbred cattle was higher in Pune district (32.65 per cent) compared to Solapur district (18.77 per cent). The share of buffaloes was more in Solapur district (33.43 per cent) than Pune district (24.19 per cent). In the case of total population of goats and sheeps, the proportion of was 72.63 and 27.37 per cent in Solapur district, respectively while in the Pune district, it was 60.97 and 39.03 per cent, respectively. The percentage share of poultry was more in Pune district

The percentage share of indigenous cattle was maximum in Madha tahsil (48.81 per cent) and minimum in Indapur tahsil (33.10 per cent). The population of crossbred cows was the highest in Indapur tahsil (45.31 per cent), while least in Pandharpur tahsil (17.45 per cent). The percentage share of buffaloes was maximum in Pandharpur tahsil (43.81 per cent), while minimum in Shirur tahsil (15.41 per cent). The population of goats was more in Pandharpur, Madha tahsils than in Indapur and Shirur tahsils

**Table 4.8 – Livestock population in the study area (1997)****(Number)**

Sr No	Particulars	Solapur			Pune		
		District	Pandharpur	Madha	District	Indapur	Shirur
1	Crossbred cows	90865 (9 35)	10939 (8 35)	13813 (17 60)	216102 (18 28)	29905 (24 63)	21872 (23 35)
2	Crossbred bullock	13395 (1 38)	2093 (1 60)	2655 (3 38)	22478 (1 90)	2298 (1 89)	2484 (2 65)
3	Crossbred calves	77575 (7 99)	9823 (7 5)	12972 (16 53)	149805 (12 67)	22814 (18 79)	12970 (13 85)
4	Crossbred cattle	181835 (18 72)	22838 (17 45)	29440 (37 51)	388385 (32 85)	55017 (45 31)	37316 (39 84)
5	Indigenous cows	155311 (15 99)	19059 (14 56)	8867 (11 30)	147048 (12 44)	14194 (11 69)	10163 (10 85)
6	Indigenous bullock	163356 (16 82)	13705 (10 47)	12141 (15 47)	229584 (19 42)	13715 (11 30)	21047 (22 47)
7	Indigenous calves	146123 (15 04)	17938 (13 71)	10557 (13 45)	131221 (11 10)	12272 (10 11)	10719 (11 44)
8	Total indig- enous cattle	464790 (47 85)	50702 (38 74)	31565 (40 22)	507853 (42 96)	40181 (33 10)	41939 (44 77)
9	Total cattle	646625 (65 57)	73537 (56 19)	61005 (77 73)	896238 (75 81)	95198 (78 41)	79255 (84 61)
10	Buffaloes-he	8755 (0 90)	1856 (1 42)	1540 (1 96)	5257 (0 44)	662 (0 54)	114 (0 12)
11	Buffaloes-she	179232 (18 45)	29127 (22 25)	8034 (10 23)	186709 (15 80)	15307 (12 61)	8117 (8 67)
12	Buffaloe-calves	136763 (14 08)	26356 (20 14)	7909 (10 08)	94015 (7 95)	10244 (8 44)	6185 (6 60)
13	Total Buffaloes	324750 (33 43)	57339 (43 81)	17483 (22 27)	285951 (24 19)	26213 (21 59)	14416 (15 39)
14	Total bovines	971375 (100 00)	130876 (100 00)	78488 (100 00)	1182189 (100 00)	121411 (100 00)	93671 (100 00)
15	Goat*	890516 (72 63)	106868 (85 05)	75599 (82 93)	644826 (60 97)	102731 (76 49)	55988 (50 12)
16	Sheep*	335655 (27 37)	18807 (14 96)	15564 (17 07)	412737 (39 03)	31575 (23 51)	55715 (48 88)
17	Other livestock	28076	6307	7650	49239	5659	3439
18	Total livestock	2225622	262858	156603	2288991	261373	208813
19	Poultry	2084242	217663	135846	3941985	366861	214898

(Figures in parentheses are percentages to the respective totals and \* Sheep + Goat )  
Source : Socio-economic Reports of Solapur and Pune districts 2001-2002

## 4.2 Socio-economic features of the sample farmers

Some important socio-economic features such as, family size, land use and cropping pattern and various capital assets of the sample farmers have been discussed under the following sub-heads

### 4.2.1 Average family size and its composition

Average family size and its composition of sample farmers is depicted in Table 4.9

**Table - 4.9 Family size and its composition of sample farmers**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Family size (No.)</b>								
Adult male	1 67	2 13	2 37	2 01	1 57	2 37	2 20	2 04
Per cent	30 87	32 62	28 80	29 91	29 96	31 56	27 85	29 73
Adult female	1 47	1 87	2 40	1 82	1 47	2 13	2 23	1 94
Per cent	27 17	28 64	29 16	27 08	28 05	28 44	28 27	26 27
Children	2 27	2 53	3 46	2 89	2 20	3 00	3 47	2 89
Per cent	41 96	38 74	42 04	43 01	41 98	40 00	43 88	42 00
<b>Total</b>	<b>5.41</b>	<b>6.53</b>	<b>8.23</b>	<b>6.72</b>	<b>5.24</b>	<b>7.50</b>	<b>7.90</b>	<b>6.88</b>
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00
<b>Workers (No.)</b>								
Male	1 51	1 90	2 40	1 95	1 47	2 27	2 27	2 00
Per cent	58 53	55 88	58 11	57 69	53 65	55 37	54 83	54 64
Female	1 07	1 50	1 73	1 43	1 27	1 83	1 87	1 66
Per cent	41 47	44 12	41 89	42 31	46 35	44 63	45 17	45 36
Total	2 58	3 40	4 13	3 38	2 74	4 10	4 14	3 66
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

It may be revealed from the table that the average size of family was 6 72 and 6 88 members in irrigated and rainfed region, respectively at the overall level. The family size showed an increasing trend with

increasing farm size in both the regions. The percentage of adult male, adult female and children in the family size was 29.91, 27.08 and 43.01 at the overall level, respectively, in the irrigated region, while in rainfed it was 29.73, 26.27 and 42.00, respectively.

The number of workers at the overall level was 3.38 in irrigated region and 3.66 in rainfed region comprising 57.69 and 54.64 per cent male working on farm, respectively, while the female working on farm were 42.31 per cent in irrigated region and 45.36 per cent in rainfed region. The percentage total workers including both male and female was maximum in medium size group and minimum in large size group in both the regions.

#### **4.2.2 Education status and occupation**

Education status and occupational pattern of selected farmers is presented in table 4.10.

It may be revealed from table that the literacy percentage of farmer was 92.22 per cent in irrigated region and 90 per cent in rainfed region. The literacy percentage was the highest (93.33 per cent) in large size groups in both the regions.

In irrigated region, 43.37 per cent farmers had taken education up to secondary followed by up to higher secondary (32.53 per cent), up to primary (19.28 per cent) and very few farmers (4.82 per cent) up to graduation, at the overall level in the irrigated region, while in rainfed region 44.44 per cent farmers had taken education up to secondary followed by higher secondary (24.44 per cent), up to primary (17.78 per cent) and up to graduation (3.33 per cent).

**Table - 4.10 Educational status and occupational pattern of the sample farmers**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Literacy</b>								
Primary	6 00	5 00	5 00	16 00	7 00	4 00	5 00	16 00
Per cent	20 00	16 67	16 67	17 78	23 33	13 33	16 67	17 78
Secondary	12 00	13 00	11 00	36 00	13 00	14 00	13 00	40 00
Per cent	40 00	43 33	36 67	40 00	43 33	46 67	43 33	44 44
Higher Secondary	8 00	9 00	10 00	27 00	7 00	7 00	8 00	22 00
Per cent	26 67	30 00	33 33	30 00	23 34	23 34	26 67	24 45
College	1 00	1 00	2 00	4 00	0 00	1 00	2 00	3 00
Per cent	3 33	3 33	6 66	4 44	0 00	3 33	6 66	3 33
<b>Total Literate</b>	<b>27.00</b>	<b>28.00</b>	<b>28.00</b>	<b>83.00</b>	<b>27.00</b>	<b>26.00</b>	<b>28.00</b>	<b>81.00</b>
Per cent	90 00	93 33	93 33	92 22	90 00	86 67	93 33	90 00
Illiterates Adult	3 00	2 00	2 00	7 00	3 00	4 00	2 00	9 00
Per cent	10 00	6 67	6 67	7 78	10 00	13 33	6 67	10 00
<b>Type of Business</b>								
Farming	26 00	28 00	22 00	76 00	28 00	24 00	22 00	74 00
Per cent	86 66	93 33	73 33	84 44	93 33	80 00	73 33	82 22
Farming + Service	2 00	2 00	5 00	9 00	2 00	2 00	5 00	9 00
Per cent	6 67	6 67	16 67	10 00	6 67	6 67	16 67	10 00
Farming + Business	2 00	0 00	3 00	5 00	0 00	4 00	3 00	7 00
Per cent	6 67	0 00	10 00	5 56	0 00	13 33	10 00	7 78
<b>Total</b>	<b>30.00</b>	<b>30.00</b>	<b>30.00</b>	<b>90.00</b>	<b>30.00</b>	<b>30.00</b>	<b>30.00</b>	<b>90.00</b>
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

Majority of the sample farmers were engaged in only farming and few were engaged in farming as well as service or business. At the overall level, 84.44 per cent in irrigated region and 82.22 per cent in rainfed region, sample farmers had only farming as a main source of occupation, while 10 per cent were engaged in farming plus service in both the regions and 6.67 per cent in irrigated and 7.78 per cent in rainfed region had farming plus business as a source of income.

Percentage of families having farming as only one source of occupation was maximum in medium size group of irrigated region, while it was in small size group in rainfed region.

#### 4.2.3 Land use pattern

The details of the land use pattern of the sample farms according to size groups of holding are given in Table 4.11 for the irrigated and rainfed regions of the area under study

It can be revealed from the table that at the overall level, the average size of holdings was 2.97 and 3.53 hectares in the irrigated and rainfed regions, respectively. The proportion of uncultivable and current fallow land in the total land holding was 5.05 and 4.38 per cent, respectively in the irrigated region, while it was 6.80 and 9.92 per cent in the rainfed region. The proportion of cultivatable land was 90.57 per cent and 83.28 per cent, respectively in the regions. The proportion of irrigated area was maximum (83.50 per cent) in the irrigated region. Even in the rainfed region, irrigated area was 19.26 per cent owing to created irrigation facilities. The area sown more than once was to the extent of 0.69 hectare per farm in the irrigated region and 0.59 hectare per farm in the rainfed region, which accounted for 26.65 and 20.07 per cent of the net cropped area of the irrigated and rainfed regions, respectively. The cropping intensity was 125.65 and 120.07 per cent in the irrigated and rainfed regions, respectively, at the overall level.

Among the different size groups of farms, barren and uncultivable land increased proportionately along with the size groups of farms in both the regions. The proportion of the irrigated area was the highest (88.24 per cent) in the case of small size groups of farms in the irrigated

**Table 4.11 Land use pattern of sample farms** (ha.)

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Total holding	1 19	2 83	4 90	2 97	1 45	3 02	6 11	3 53
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00
Barren and Uncultivable	0 02	0 10	0 34	0 15	0 07	0 15	0 50	0 24
Per cent	1 68	3 53	6 94	5 05	4 83	4 97	8 18	6 80
Fallow land	0 04	0 15	0 19	0 13	0 13	0 23	0 68	0 35
Per cent	3 36	5 30	3 88	4 38	8 97	7 62	11 13	9 92
<b>Cultivated area</b>								
Irrigated area	1 05	2 36	4 02	2 48	0 26	0 60	1 18	0 68
Per cent	88 24	83 39	82 04	83 50	17 93	19 87	19 31	19 26
Rainfed area	0 08	0 22	0 35	0 21	0 99	2 04	3 75	2 26
Per cent	6 72	7 77	7 14	7 07	68 28	67 55	61 37	64 02
Net sown area	1 13	2 58	4 37	2 69	1 25	2 64	4 93	2 94
Per cent	94 96	91 17	89 18	90 57	86 21	87 42	80 69	83 29
Double sown area	0 33	0 71	1 04	0 71	0 37	0 67	0 73	0 59
Per cent	27 73	25 09	21 22	23 91	25 52	22 19	11 95	16 71
Gross cropped area	1 46	3 29	5 41	3 40	1 62	3 31	5 66	3 53
Gross Irrn Area	1 36	3 04	4 97	3 12	0 52	1 16	2 15	1 28
Per cent of GIA to GCA	93 45	92 40	91 87	92 03	32 09	35 04	37 98	36 26
Cropping intensity	129 20	127 52	123 80	125 65	129 60	125 38	114 81	120 07

region. The proportion of the cultivable area was the highest (94.96 per cent) in small size group of farms in the irrigated region. The share of area cropped more than once in the gross cropped area ranged between 12.90 to 22.83 per cent in the rainfed region and between 19.22 to 22.60 per cent in the irrigated region. The percentage of gross irrigated area of gross cropped area was maximum (94.52 per cent) in small size groups of farms in the

irrigated region and it was maximum (36.40 per cent) in large size groups of farms in the rainfed region. The cropping intensity showed decreasing trend with the farm size in both the regions.

#### 4.2.4 Cropping Pattern

The details of area allocation to different crops on sample farms in irrigated and rainfed regions are presented in Table 4.12.

At the overall level, total cropped area was 3.40 hectare in the irrigated region and 3.53 hectare in the rainfed region. The hecterage under total cereals, total pulses and total oilseeds and fruit crops was maximum in the rainfed region than in the irrigated region, while the area under sugarcane and other cash crops was maximum in the irrigated region.

At the overall level, the highest area allocation to the cereals was to the extent of 57.22 per cent of the gross cropped area in the rainfed region in which 17.85 and 30.03 per cent area was under bajra and rabi jowar. While, the area under total pulses (23.51 per cent) and total oilseeds (4.25 per cent) and fruit crops (2.83 per cent) which was relatively high as compared to the irrigated region. In the irrigated region, sugarcane occupied 42.06 per cent of gross cropped area followed by total cereals (40.00 per cent) consisting of rabi jowar (13.82 per cent), Wheat (12.06 per cent), bajra (7.35 per cent) and maize (6.76 per cent). The proportionate area under irrigated crops such as sugarcane, wheat, maize was more, which is obvious in the irrigated region compared to the rainfed region.

Among the different size groups of farms, the proportionate area allocation under total cereals was maximum (61.11 per cent) in small

**Table - 4.12 Cropping pattern of sample farmers (ha.)**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Bajra ( I )	0 08	0 23	0 43	0 25	0 00	0 00	0 00	0 00
Per cent	5 48	6 99	7 95	7 35	0 00	0 00	0 00	0 00
Bajra (R))	0 00	0 00	0 00	0 00	0 30	0 60	1 00	0 63
Per cent	0 00	0 00	0 00	0 00	18 52	18 13	17 67	17 85
Rabi Jowar ( I )	0 15	0 41	0 49	0 35	0 08	0 21	0 60	0 30
Per cent	10 27	12 46	9 06	10 29	4 94	6 34	10 60	8 50
Rabi Jowar ( R )	0 00	0 12	0 24	0 12	0 44	0 81	1 04	0 76
Per cent	0 00	3 65	4 44	3 53	27 16	24 47	18 37	21 53
Maize ( I )	0 10	0 14	0 44	0 23	0 07	0 15	0 26	0 16
Per cent	6 85	4 26	8 13	6 76	4 32	4 53	4 59	4 53
Wheat ( I )	0 21	0 45	0 58	0 41	0 10	0 20	0 21	0 17
Per cent	14 38	13 68	10 72	12 06	6 17	6 04	3 71	4 82
<b>Total Cereals</b>	<b>0.54</b>	<b>1.35</b>	<b>2.18</b>	<b>1.36</b>	<b>0.99</b>	<b>1.97</b>	<b>3.11</b>	<b>2.02</b>
Per cent	36 99	41 03	40 30	40 00	61 11	59 52	54 95	57 22
Tur ( R )	0 01	0 06	0 08	0 05	0 01	0 1	0 15	0 09
Per cent	0 68	1 82	1 48	1 47	0 62	3 02	2 65	2 55
Mung	0 00	0 00	0 02	0 01	0 17	0 40	0 75	0 44
Per cent	0 00	0 00	0 37	0 29	10 49	12 08	13 25	12 46
Gram ( I )	0 00	0 02	0 07	0 03	0 00	0 00	0 00	0 00
Per cent	0 00	0 61	1 29	0 88	0 00	0 00	0 00	0 00
Gram(R )	0 02	0 01	0 00	0 01	0 07	0 08	0 24	0 13
Per cent	0 00	0 61	1 29	0 88	0 00	0 00	0 00	0 00
Other pulses	0 00	0 00	0 00	0 00	0 06	0 17	0 30	0 17
Per cent	0 00	0 00	0 00	0 00	3 70	5 14	5 30	4 82
<b>Total Pulses</b>	<b>0.03</b>	<b>0.09</b>	<b>0.17</b>	<b>0.10</b>	<b>0.31</b>	<b>0.75</b>	<b>1.44</b>	<b>0.83</b>
Per cent	2 05	2 74	3 14	2 94	19 14	22 66	25 44	23 51
Groundnut ( I )	0 00	0 05	0 07	0 04	0 04	0 10	0 07	0 07
Per cent	0 00	1 52	1 29	1 18	2 47	3 02	1 24	1 98

Table Contd-

Groundnut (R )	0 05	0 03	0 01	0 03	0 00	0 00	0 00	0 00
Per cent	3 42	0 91	0 18	0 88	0 00	0 00	0 00	0 00
Other oilseeds	0 00	0 00	0 00	0 00	0 00	0 02	0 12	0 05
Per cent	0 00	0 00	0 00	0 00	0 00	0 60	2 12	1 42
<b>Total Oil seeds</b>	<b>0.05</b>	<b>0.08</b>	<b>0.08</b>	<b>0.07</b>	<b>0.04</b>	<b>0.12</b>	<b>0.19</b>	<b>0.12</b>
Per cent	3 42	2 43	1 48	2 06	2 47	3 63	3 36	3 40
Cotton (I )	0 04	0 01	0 07	0 04	0 00	0 00	0 02	0 01
Per cent	2 74	0 30	1 29	1 18	0 00	0 00	0 35	0 28
S cane	0 57	1 34	2 39	1 43	0 01	0 05	0 15	0 07
Per cent	39 04	40 73	44 18	42 06	0 62	1 51	2 65	1 98
Onion	0 01	0 01	0 01	0 01	0 13	0 13	0 26	0 17
Per cent	0 68	0 30	0 18	0 29	8 02	3 93	4 59	4 82
Groundnut (s )	0 03	0 09	0 06	0 06	0 03	0 00	0 07	0 03
Per cent	2 05	2 74	1 11	1 76	1 85	0 00	1 24	0 85
Vegetable	0 01	0 01	0 01	0 01	0 01	0 00	0 01	0 01
Per cent	0 68	0 30	0 18	0 29	0 62	0 00	0 18	0 28
<b>Cash crops</b>	<b>0.66</b>	<b>1.46</b>	<b>2.54</b>	<b>1.55</b>	<b>0.18</b>	<b>0.18</b>	<b>0.51</b>	<b>0.29</b>
Per cent	45 21	44 38	46 95	45 59	11 11	5 44	9 01	8 22
Pomegranate	0 03	0 02	0 06	0 04	0 04	0 09	0 08	0 07
Per cent	2 05	0 61	1 11	1 18	2 47	2 72	1 41	1 98
Other Fruits	0 00	0 04	0 01	0 02	0 00	0 04	0 04	0 03
Per cent	0 00	1 22	0 18	0 59	0 00	1 21	0 71	0 85
Fodder	0 15	0 25	0 37	0 26	0 06	0 16	0 29	0 17
Per cent	10 27	7 60	6 84	7 65	3 70	4 83	5 12	4 82
<b>Gross cropped area</b>	<b>1.46</b>	<b>3.29</b>	<b>5.41</b>	<b>3.40</b>	<b>1.62</b>	<b>3.31</b>	<b>5.66</b>	<b>3.53</b>
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

(I -Irrigated, R. -Rainfed, S -Summer )

size groups and showed declining trend along the farm size in the rainfed region. The proportionate area allocated to bajra crop and rabu jowar also

Fig. 2 (a)- Composition of capital assets on sample farms in irrigated region

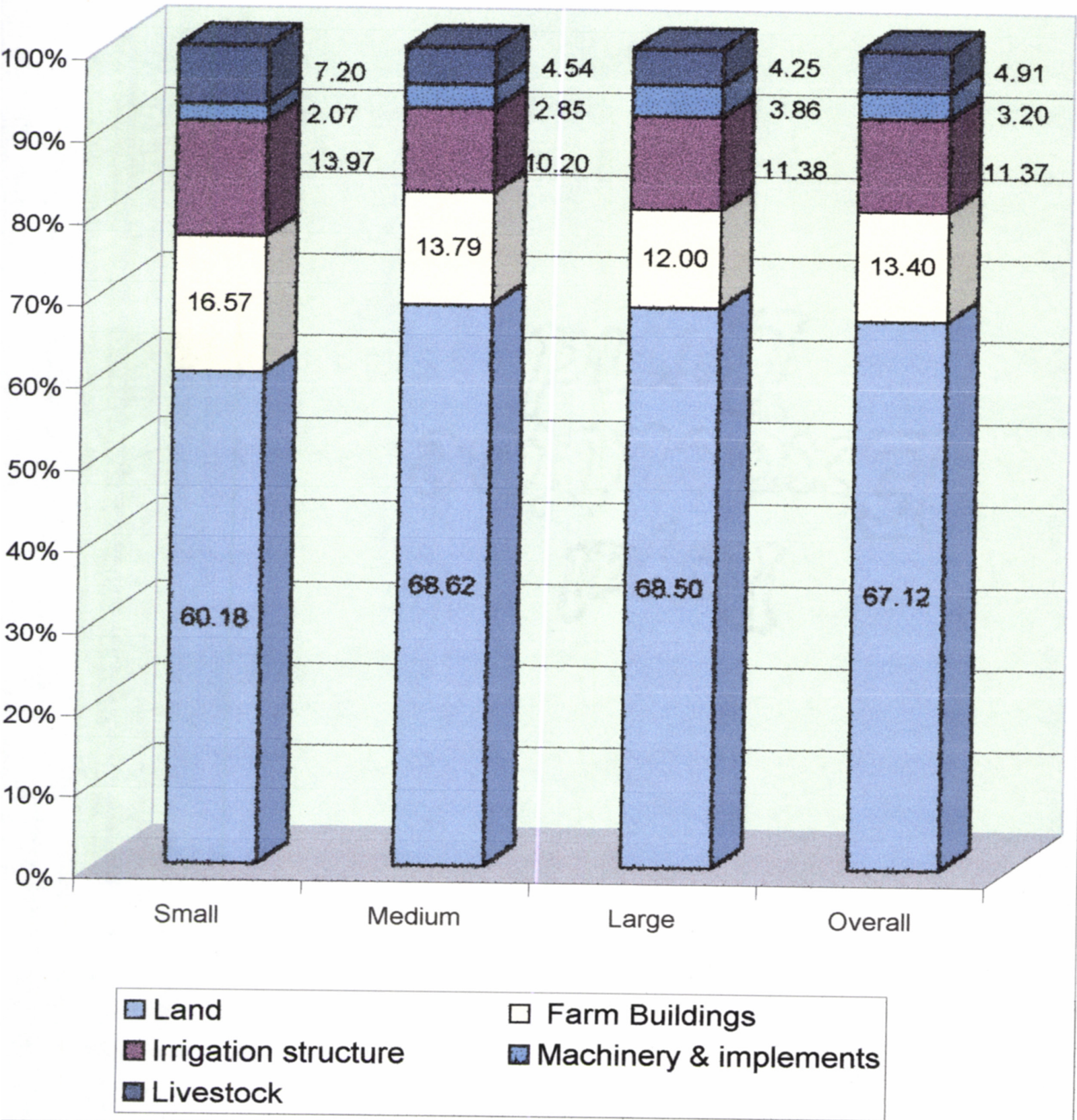
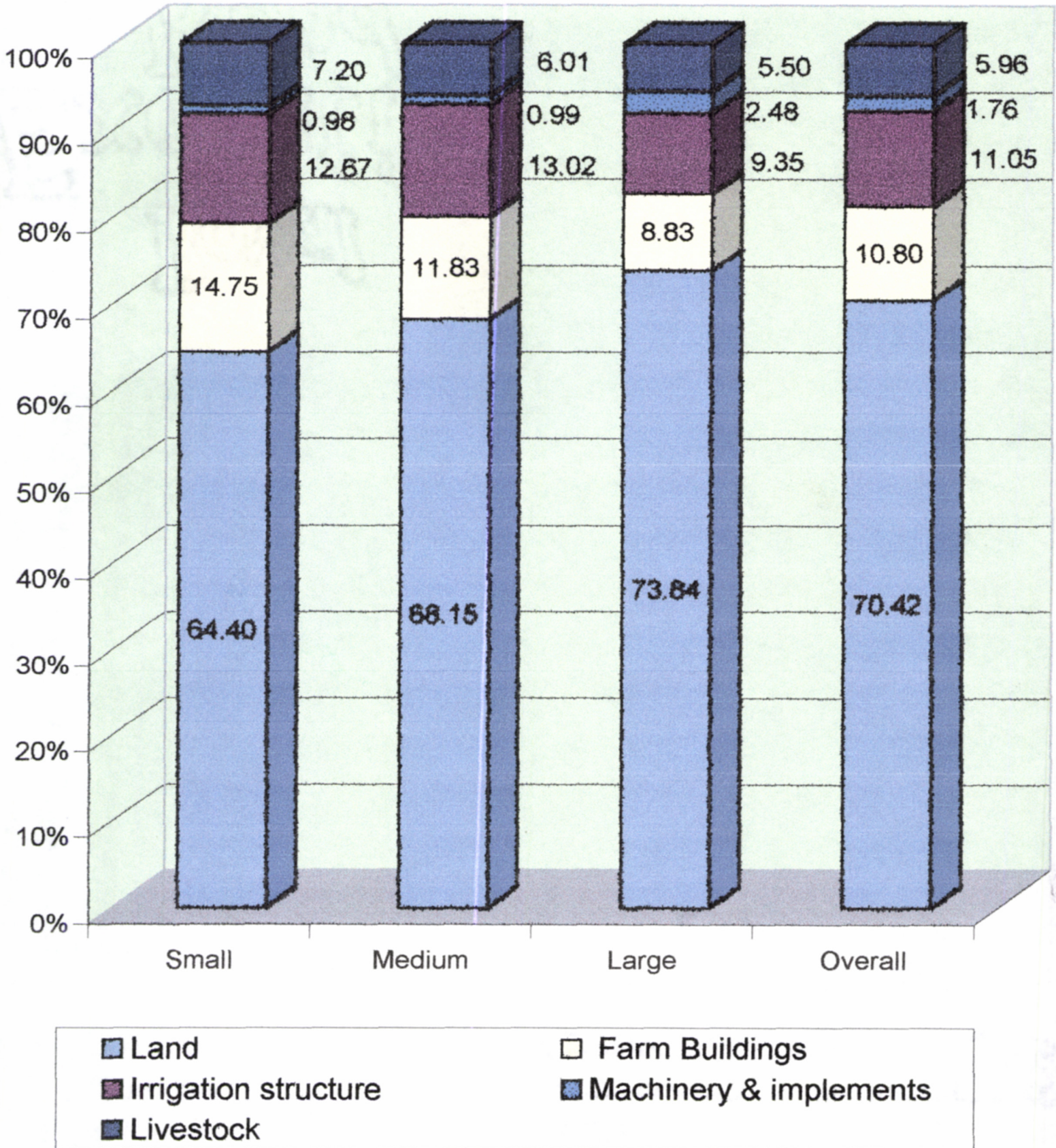


Fig. 2(b)-Composition of capital assets on sample farms in rainfed region



showed decreasing trend. The proportionate area under total cereals ranged between 36.99 to 41.03 per cent in the irrigated region.

Rabi jowar, bajra, wheat and maize were the prominent cereals grown in the irrigated region. Their area allocation ranged between 4.26 to 16.11 per cent. The proportionate area allocation was relatively higher for total pulses and oilseeds in the rainfed region than in the irrigated region. It was the highest to the extent of 25.44 per cent for pulses and 4.59 per cent for oilseeds on large size group of farms in the rainfed region. However, it was the lowest (2.05 per cent) in the case of pulses on small size group of farms in the irrigated region. The proportionate area allocation under high value crops was observed to be maximum to the extent of 44.18 per cent in the case of sugarcane on large size groups of farms and 10.27 per cent in the case of fodder crops on small size groups of farms in the irrigated region, whereas, the proportion of area under fruit crops was maximum (3.93 per cent) on medium size groups of farms and under onion was maximum (8.02 per cent) on small sized farms in the rainfed region.

#### **4.2.5 Capital assets**

The information on per farm investment in different capital assets such as land, irrigation structure, farm building, implements and machinery and livestock is given in Table 4.13.

As usual, the value of land happened to be the major items of the total value of fixed assets (including investment in capital assets) owned by the sample farmers, it would, therefore, be more appropriate if we consider the value of capital assets excluding land for the purpose of

**Table - 4.13 Investment in capital assets by sample farmers**

(Rs)

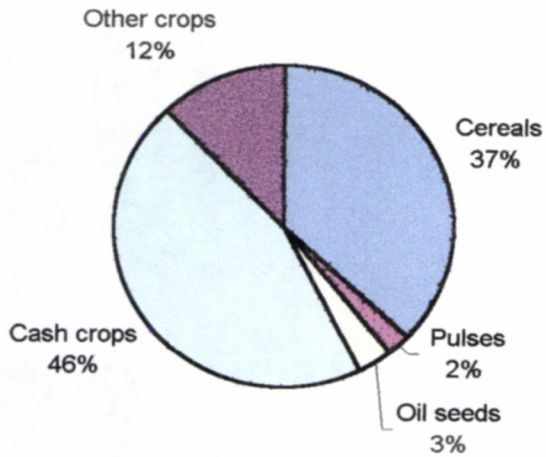
Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Land	198866 67	498850 00	644766 67	447494 45	149716 67	268136 67	496066 67	304640 00
Per cent	60 18	68 62	68 50	67 12	64 40	68 15	73 84	70 42
Farm Buildings	54775 00	100226 67	113000 00	89333 89	34288 33	46540 00	59355 00	46727 78
Per cent	16 58	13 79	12 00	13 40	14 75	11 83	8 83	10 80
Irrigation structure	46181 67	74156 67	107166 67	75835 00	29448 30	51220 00	62796 67	47821 66
Per cent	13 97	10 20	11 39	11 37	12 67	13 02	9 35	11 06
Machine-implements	6843 50	20717 67	36370 17	21310 45	2273 33	3910 67	16650 00	7611 33
Per cent	2 07	2 85	3 86	3 20	0 98	0 99	2 48	1 76
Livestock	23804 00	33031 40	40002 00	32745 33	16747 00	23634 00	36959 00	25780 00
Per cent	7 20	4 54	4 25	4 91	7 20	6 01	5 50	5 96
Total	330470 84	726982 41	941305 51	666719 12	232473 63	393441 34	671827 34	432580 77
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

comparing relative capital endowments of the sample farms across the regions and size groups

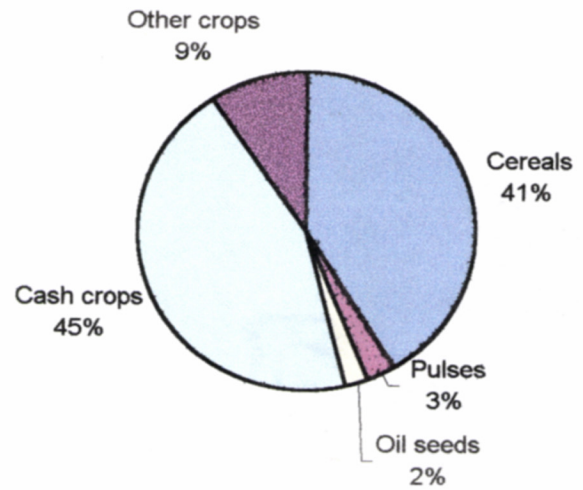
The structural composition of capital assets of the sample farms varied greatly among the size groups of farms. In the total value of assets, the share of land was as high as 67.12 and 70.42 per cent in the irrigated and rainfed regions, respectively, at the overall level. The level of total investment varied significantly between the irrigated and rainfed farms. On an average, the total investment on irrigated farms was found to be about 54.13 per cent higher than that on the rainfed farms. This clearly indicated that irrigated farms in the study area were better in resource position than that of the rainfed region. As far as the size

Fig. 3 (a). Cropping pattern of sample farms in irrigated region

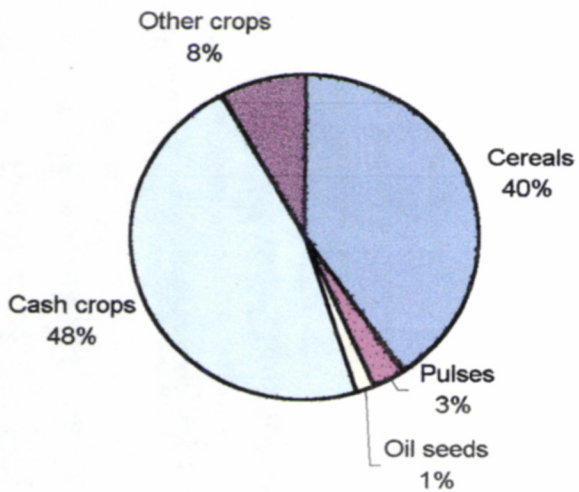
Small



Medium



Large



Overall

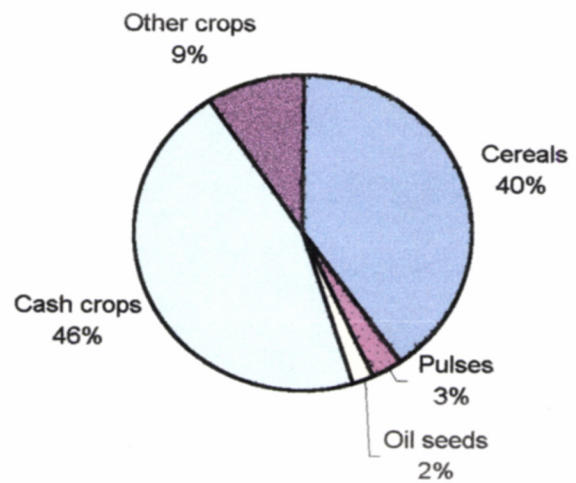
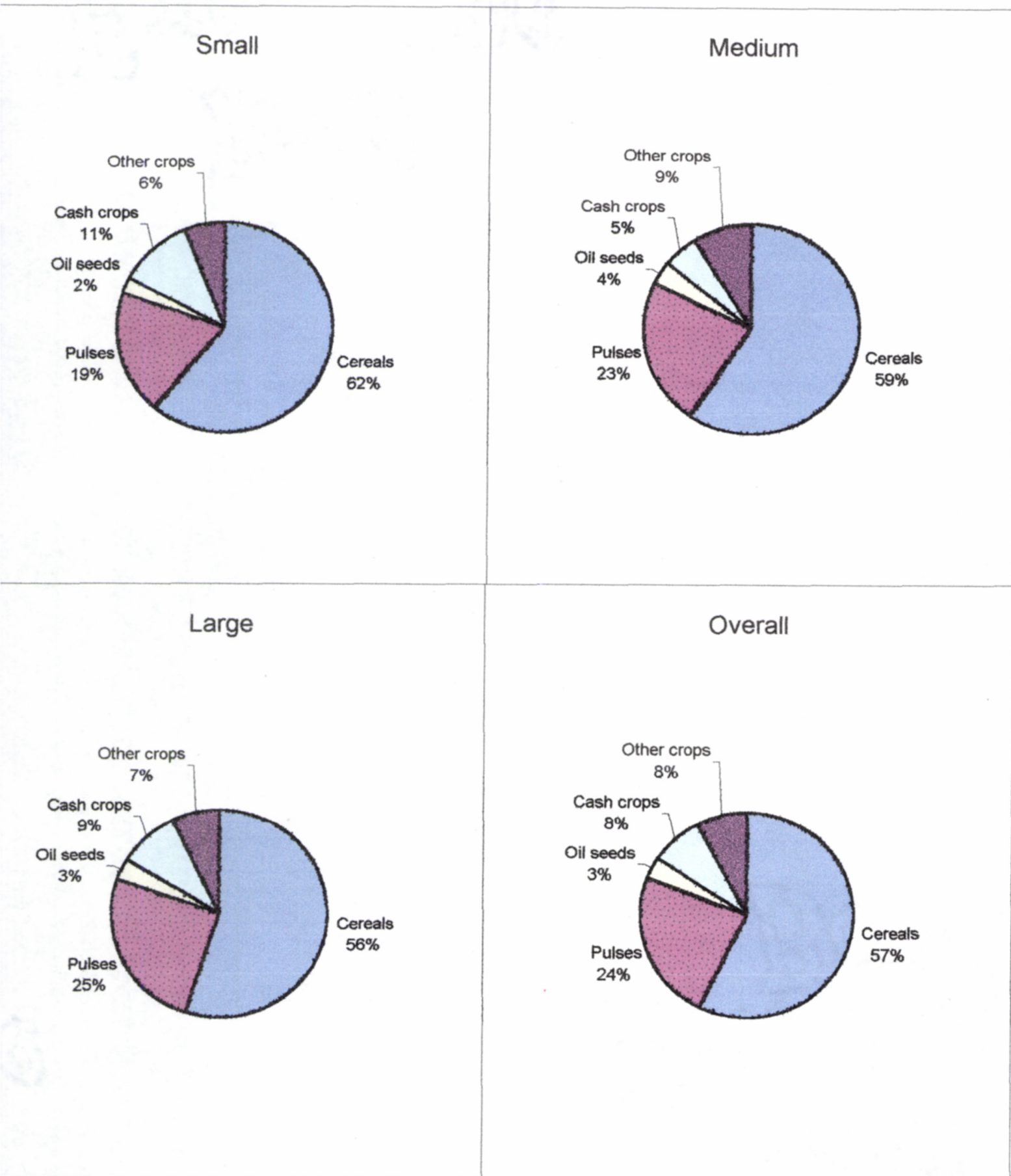


Fig. 3 (b). Cropping pattern of sample farms in rainfed region



groups are concerned, there was positive relationship between the size groups of holding and the total value of the assets

At the overall level, proportionate share of investment in farm buildings (13.40 per cent), irrigation structure (11.37 per cent) and implements and machinery (3.20 per cent) was maximum in irrigated region, whereas, the proportionate share of investment in livestock was maximum (5.96 per cent) in rainfed region. Among the different size groups, the proportion of value of land in the total investment ranged between 60.35 to 73.84 per cent in both the regions. The relative share of farm building and irrigation structure in the total investment was more in the small size group of farms in the irrigated region. The proportion of investment in livestock ranged between 4.25 to 7.20 per cent, whereas, in implements and machinery it was in the range of 0.98 to 3.86 per cent in both the regions.

#### **4.2.6 Irrigation**

Average per farm and per hectare investment in irrigation structure is presented in Table 4.14

From the table it may be revealed that at the overall level per farm investment in irrigation structure, was Rs 75,835 and Rs 47,821.65 in the irrigated and rainfed region, respectively. The proportionate share of investment in well (76.76 per cent) and electric motor (12.71 per cent) was maximum in rainfed region, whereas, the proportionate share of investment in pipe line and drip set was maximum in irrigated region.

Size groupwise analysis revealed that per farm irrigation investment showed positive relationship with the farm size. The per hectare investment was more than double in rainfed region than irrigated

region for all farm size groups. In the case of pipeline per hectare investment in large size group was the highest in both the regions. In the case of drip set, per hectare investment was maximum in small size group in both the regions.

**Table - 4.14 Per farm and per hectare investment in irrigation structure**

Items	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Well	29950 00	49833 33	62500 00	47427 78	24012 77	40300 00	45816 67	36709 81
per ha	28523 81	21115 82	15547 26	19124 10	92356 81	67166 67	39497 13	55620 92
Per cent	64 85	67 20	58 32	62 54	81 54	78 68	72 96	76 76
Ele Motor	5826 66	9506 67	12333 33	9222 22	3562 20	6393 33	8283 33	6079 62
per ha	5549 20	4028 25	3067 99	3718 64	13700 77	10655 55	7140 80	9211 55
Per cent	12 62	12 82	11 51	12 16	12 10	12 48	13 19	12 71
Pipe line	6905 00	12016 67	27166 67	15362 78	873 33	3026 67	6630 00	3510 00
per ha	6576 19	5091 81	6757 88	6194 67	3358 96	5044 45	5715 52	5318 18
Per cent	14 95	16 20	25 35	20 26	2 97	5 91	10 56	7 34
Drip set	3500 00	2800 00	5166 67	3822 22	1000 00	1500 00	2066 67	1522 22
per ha	3333 33	1186 44	1285 24	1541 22	3846 15	2500 00	1781 61	2306 39
Per cent	7 58	3 78	4 82	5 04	3 40	2 93	3 29	3 18
<b>Total</b>	46181 66	74156 67	107166 60	75835 00	29448 30	51220 00	62796 67	47821 65
per ha	43982 53	31422 32	26658 38	30578 63	113262 60	85366 67	54135 06	72457 05
Per cent	100 00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

Further, within the three size groups, per farm investment for exploitation of ground water was maximum in large size group and it was less in the small size group. The per hectare investment was more in



From the table it may be concluded that at the overall level, investment in total farm implements and machinery was Rs 21310 45 and Rs 7611 33 in the irrigated and rainfed regions, respectively. The percentage share was maximum in tractor (47.97 per cent) followed by tractor drawn (16.73 per cent), spray pump (11.07 per cent), bullock cart (9.91 per cent), other implements (6.45 per cent), iron plough (3.26 per cent), seed drill (2.08 per cent), harrow (1.87 per cent) and least in hoe (0.66 per cent) in the irrigated region, while in the rainfed region it was maximum in tractor (39.67 per cent) followed by bullock cart (18.86 per cent), tractor drawn implements (14.33 per cent), other implements (6.56 per cent), spray pump (6.51 per cent), iron plough (6.02 per cent), seed drill (3.79 per cent), harrow (3.24 per cent) and least in hoe (1.02 per cent). Among the size groups, tractor and tractor drawn implements showed the increasing trends with size groups of farms, while all other items except other implements and spray pump showed decreasing trend along the farm size in both the regions.

### 4.3.3 Livestock

Average per farm livestock and investment in livestock is depicted in Table 4.16

From the table revealed that at overall level per farm investment in livestock was Rs 32,745.33 and Rs 25,780.00 in the irrigated and rainfed region, respectively, whereas number of livestock per farm was 4.56 and 4.07, respectively. The proportionate share of buffaloes was more in irrigated region (38.45 per cent) than in rainfed region (17.81 per cent). The proportionate share of crossbred cows was more in rainfed region (42.84 per cent) than in irrigated region (29.50 per cent), share of bullocks was maximum in rainfed region (21.48 per cent) than in

irrigated region (15.10 per cent) This was due to higher use of machine power in irrigated region, while share of indigenous cow was more in rainfed region (7.87 per cent) than in the irrigated region (4.15 per cent) Per farm investment in livestock was maximum in large sized farms, followed by medium and small sized farms in both the regions However, within the size groups, there was variation in the per cent share of

**Table - 4.16** Composition and value of livestock of sample farmers (Rs)

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Livestock (No)								
Bullock	0.37	0.80	1.00	0.72	0.43	1.00	1.20	0.88
Value	2250.00	5600.00	6983.33	4944.44	2383.33	6050.00	8183.33	5538.89
Cow local	0.27	0.33	0.43	0.34	0.37	0.53	0.63	0.51
Value	1110.67	1170.00	1798.33	1359.67	1370.00	1951.67	2766.67	2029.44
Calves	0.27	0.27	0.30	0.28	0.37	0.50	0.57	0.48
Value	243.33	100.00	200.00	181.11	158.33	208.33	290.00	218.89
Cow crossbreed	0.77	1.13	0.80	0.90	0.67	1.07	1.23	0.99
Value	8700.00	12866.67	8470.00	10012.22	6553.33	11183.33	15400.00	11045.56
Calves	0.67	0.90	0.73	0.77	0.57	1.00	1.10	0.89
Value	843.33	990.00	743.33	858.89	433.33	770.00	1390.00	864.44
He buffalo	0.03	0.03	0.07	0.04	0.00	0.00	0.06	0.02
Value	250.68	258.46	642.22	352.14	0.00	0.00	514.46	180.08
Buffaloe	1	1.3	2.10	1.47	0.50	0.27	0.83	0.53
Value	8105.99	10941.54	18624.45	12588.97	5133.33	2066.67	6602.21	4592.14
Calves	0.87	0.97	1.60	1.14	0.37	0.23	0.73	0.44
Value	793.33	723.33	1335.00	950.56	336.67	140.00	551.67	342.78
<b>Total bovine</b>	<b>4.25</b>	<b>5.73</b>	<b>7.03</b>	<b>5.66</b>	<b>3.28</b>	<b>4.60</b>	<b>6.35</b>	<b>4.74</b>
Value	22297.33	32650.00	38796.66	31248.00	16368.32	22370.00	35698.34	24812.22
Goat	1.10	1.40	0.90	1.13	1.30	1.20	0.97	1.16
Value	1223.33	1400.00	890.00	1171.11	293.33	1146.67	1013.33	817.78
<b>Total livestock</b>	<b>5.35</b>	<b>7.13</b>	<b>7.93</b>	<b>6.79</b>	<b>4.58</b>	<b>5.80</b>	<b>7.32</b>	<b>5.90</b>
Value	23520.66	34050.00	39686.66	32419.11	16661.65	23516.67	36711.67	25530.00
Poultry	3.27	4.50	3.90	3.89	1.00	1.43	2.93	1.79
Value	283.33	380.00	315.33	326.22	85.33	117.33	247.33	150.00
<b>Total Value</b>	<b>23803.99</b>	<b>34430.00</b>	<b>40001.99</b>	<b>32745.33</b>	<b>16746.98</b>	<b>23634.00</b>	<b>36959.00</b>	<b>25780.00</b>

different animals. Proportional share of bullocks showed increasing trend with size groups of holding in the irrigated region while its share was maximum in medium size group and the minimum in small sized farms in the rainfed region. Share of crossbred cows was maximum in medium sized farms and minimum in large sized farms, while share of buffalo was maximum in large sized farms and minimum in medium sized farms in the irrigated region. Share of crossbred cows was maximum in medium sized farms and minimum in small sized farms, while share of buffalo was maximum in small sized farms and minimum in medium sized farms in the rainfed region.

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Chapter Opener Page



# RESULTS AND DISCUSSION

## **5. RESULTS AND DISCUSSION**

In the previous chapter, the resource base of the sample farmers in different size categories of farms in the irrigated and rainfed regions have been presented and discussed. The sample farms used these resources for production of crops and livestock, which influence farm productivity and finally the levels of income. The net returns from the farm business depends on the pattern of response of output to the application of inputs and price per unit of output. It would be useful to examine the farm business economy and resource productivities of crop production and livestock enterprises, differences in resource use pattern, cost and return structure of farm enterprises, profitability and the resource use efficiency on sample farms in irrigated and rainfed region. This analysis would be helpful to have a further probe into the employment and income structure of the sample farms. With this present chapter presents the utilization of farm resources such as human labour, manure and fertilizers, cash expenditure for crop production and livestock production activities, farm productivity, cost and return structure of crop and livestock enterprises, farm profitability, resource productivities and resource use efficiency of crop and livestock production activities for both the regions.

### **5.1 Resource use structure**

The profitability of farm business can be ascertained from the relationship between costs in running the business and the returns accrued from it. The cost structure of the business depends up on the type of resources employed, the resource-mix and the extent of application. The primary focus of this section is, therefore, on the resource use structure for crop production

activity and livestock production activity on the selected farms in each of the three sample categories of farms of the irrigated and rainfed regions

### 5.1.1 Resource use structure of crop production

The information on utilization of different resources on per farm and per cropped hectare basis for all the three size groups of farms in the irrigated and rainfed regions has been presented in table 5 1

**Table 5.1 Resource use structure of crop production activity**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Human labour (mandays)</b>								
Per farm	188 30	367 07	624 52	436 30	116 29	190 67	334 36	223 01
Per hectare	128 97	111 57	115 44	128 32	71 78	57 60	59 07	63 17
<b>Bullock labour (pairdays)</b>								
Per farm	8 30	16 76	23 87	16 31	12 99	23 99	38 40	25 12
Per hectare	5 68	5 09	4 41	4 80	8 02	7 25	6 78	7 12
<b>Machine (hrs.)</b>								
Per farm	6 93	17 40	33 71	19 35	0 96	1 45	2 13	1 52
Per hectare	4 75	5 29	6 23	5 69	0 59	0 44	0 38	0 43
<b>Manure (qtl.)</b>								
Per farm	35 37	55 36	85 70	58 81	8 37	16 83	25 00	16 73
Per hectare	24 23	16 83	15 84	17 30	5 17	5 08	4 42	4 74
<b>Fertilizer (Kg.)</b>								
<b>N</b>								
Per farm	247 20	484 97	915 69	549 29	59 24	110 77	154 93	108 32
Per hectare	169 32	147 41	169 26	161 56	36 57	33 47	27 37	30 69
<b>P</b>								
Per farm	104 80	178 57	361 53	214 97	20 35	52 60	61 42	44 79
Per hectare	71 78	54 28	66 83	63 23	12 56	15 89	10 85	12 69
<b>K</b>								
Per farm	60 38	146 30	322 47	178 39	7 88	23 03	25 55	18 82
Per hectare	41 36	44 47	59 61	52 47	4 86	6 96	4 51	5 33

Fig. 4(a)-Resource use structure of crop production activity in irrigated region

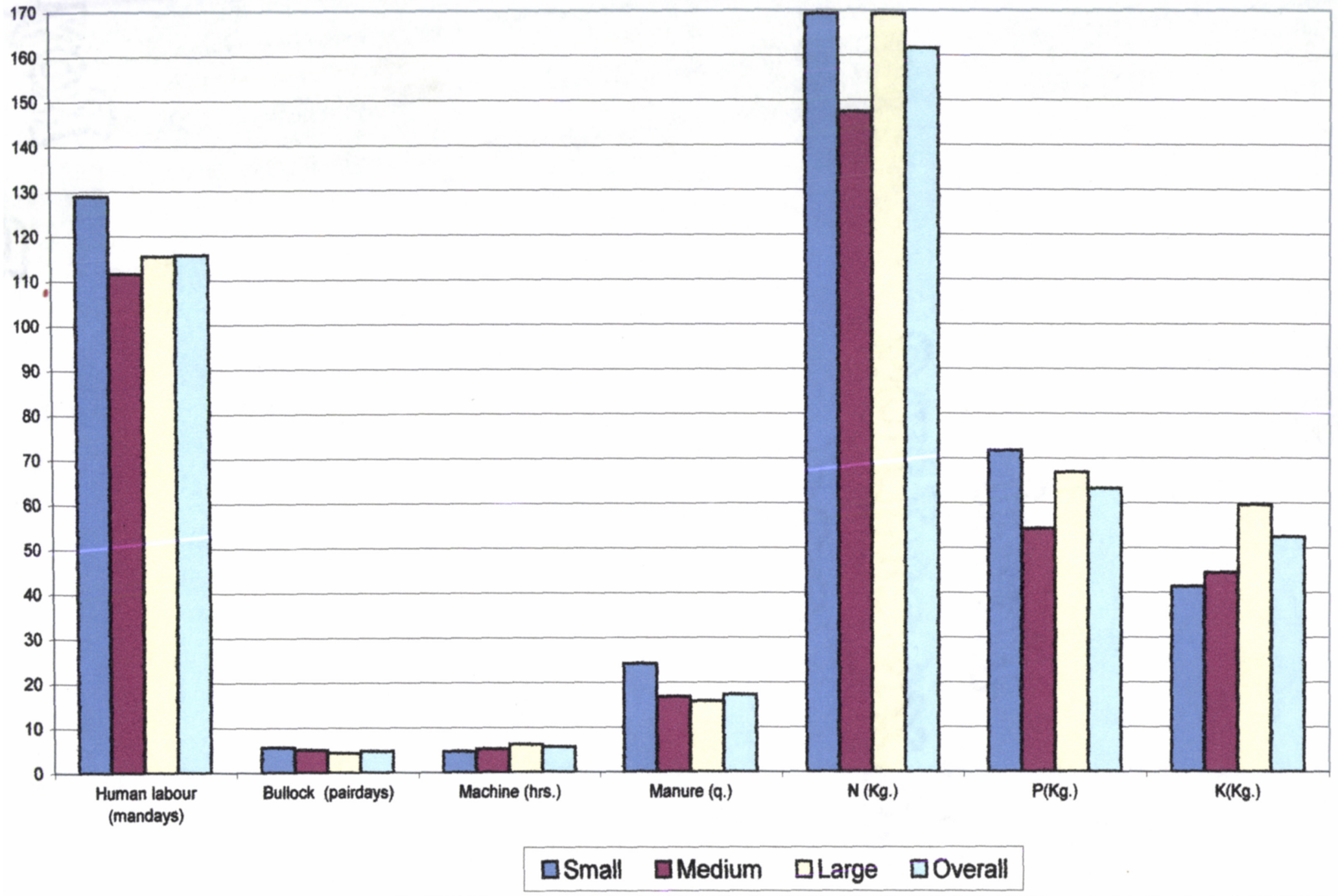
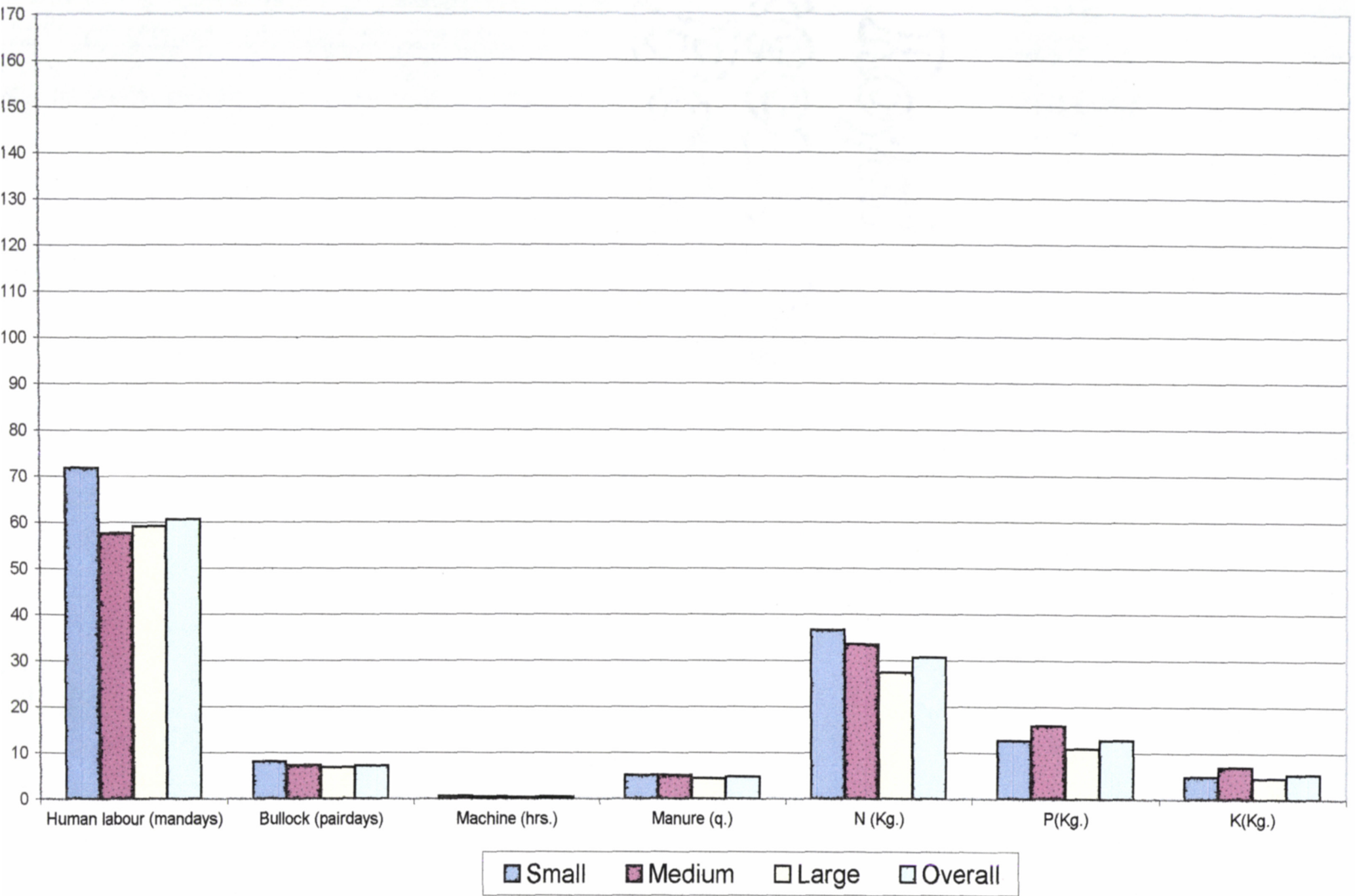


Fig. 4(b)-Resource use structure of crop production activity in rainfed region



It could be revealed from the table that at the overall level, the per farm human labour use was 436 30 and 223 01 mandays in irrigated and rainfed regions, respectively. The per hectare use level of human labour was 128 32 mandays for the irrigated region and 63 17 mandays in the rainfed region. The variations in the utilization of human labour on per farm as well as per hectare basis was only because of the differences in farm size, cropping pattern adopted, cultivation practices and techniques adopted on the farms in the irrigated and rainfed areas. Among the different size groups of farms, as compared to the rainfed region, more use of the human labour on per hectare basis was noticed in the irrigated region.

At the overall level, per hectare bullock labour use was relatively more in the rainfed region (7 12 pair days) than that in the irrigated region (4 80 pair days). This was due to more use of machine power in irrigated region than the rainfed region and due to the variability in cropping pattern and the package of practices followed in the irrigated and rainfed regions. Among the different size groups, the highest use of bullock labour was noticed on small size groups of farms of both the regions.

At the overall level, the per hectare use of machine power was more in irrigated region (5 69 hrs) than in the rainfed region (0 43 hrs). The differential in the use of machine power in the irrigated and rainfed region was mainly due to the more area under irrigated crops in irrigated region (93 45 per cent of G.C.A.) than rainfed region (35 18 per cent to G.C.A.). The highest use of machine was noticed on large sized farms in the irrigated region while it was on small sized farms in the rainfed region.

The per hectare use levels of manure at the overall level was 17 30 quintals in the irrigated region and it was more than three and half fold higher

than the use level of manure in the rainfed region. This is because the farms operated under irrigated conditions are having more livestock which, provide more manure and they are more profitable due to the cultivation of high value crops, which require a higher level of inputs and the farmers have capability to invest more for obtaining higher returns. The size groupwise use of manure indicates that the highest use level of manure was in small size groups of farms in both the regions. It ranged between 24.23 to 15.84 quintals in irrigated region and 5.17 to 4.42 quintals in rainfed region.

At the overall level, per hectare use of plant nutrient, in the form of fertilizers were 161.56 kg. of N, 63.23 kg. of P and 52.47 kg. of K in the irrigated region and in rainfed region it was 30.69 kg. of N, 12.69 kg. of P and 5.33 kg. of K. These use of fertilizers in irrigated region were much higher than the use levels of plant nutrients in the rainfed region. The application of fertilizers, such a costly input, is associated with the availability of moisture in the soils. The use of fertilizers coupled with irrigation responds well in boosting the production. Because of this reason, the consumption of fertilizers was more in the irrigated region than the rainfed region. Among the size group of farms, the per hectare use of all the plant nutrients were higher on small size groups of farms in the respective regions excepting the use of K, which was relatively high on large size group of farms in irrigated region and P and K which was higher on medium size groups of farms in the rainfed region. As the area under fruit crop is relatively more in medium size group of rainfed region.

Among the different size groups of farms, the per farm use of different resources, in general, increased with the increase in farm size in both the regions. When compared on per hectare basis, it was observed that the use of most of the resources was relatively high on the small sized farms as compared to the medium and large sized farms in both the regions under study.

### 5.1.2 Resource use structure for livestock production.

The utilization of different resources for livestock production activity per annum on per farm and per animal basis for all the three size groups of farms in the irrigated and rainfed regions, has been presented in Table 5 2

**Table 5.2 Resource use structure of livestock production activity**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Dry fodder (qtl.)</b>								
Per farm	81 63	127 16	145 10	117 96	56 16	95 05	110 97	90 73
Per animal	22 86	25 53	24 72	24 52	20 87	23 58	22 65	22 57
<b>Green fodder (qtl.)</b>								
Per farm	102 70	152 33	155 77	136 93	71 55	102 90	135 17	103 21
Per animal	28 77	30 59	26 53	28 47	26 58	25 53	25 31	25 67
<b>Concentrates (qtl.)</b>								
Per farm	6 14	7 06	7 83	7 01	4 77	5 92	7 38	6 03
Per animal	1 72	1 42	1 33	1 45	1 77	1 47	1 38	1 50
<b>Human labour (man days)</b>								
Per farm	173 20	230 47	261 58	221 75	142 85	224 26	267 32	211 48
Per animal	48 45	46 25	44 56	46 09	53 07	55 60	50 04	52 61
<b>Veterinary expenses (Rs.)</b>								
Per farm	309 33	412 67	571 20	431 33	231 73	388 17	505 87	375 25
Per animal	86 65	82 86	97 30	89 67	86 14	96 32	94 73	93 34

It is revealed from the table that, at the overall level, the per farm use of dry fodder was 117.96 quintals and 90.73 quintals in the irrigated and rainfed regions, respectively. Per animal dry fodder use was 24.52 quintal in irrigated region and 22.57 quintals in rainfed region. Per farm green fodder use was relatively more in irrigated region (136.93 q.) than that of rainfed region (103.21 q.). However, per animal green fodder use was more in irrigated region (28.47q) than rainfed region (25.67 q.) as the grazing of livestock is generally followed in the rainfed region.

Per farm use level of concentrate was more in irrigated region (7.01 q) but per animal use of concentrate was higher in the rainfed region.

The per farm human labour use for livestock production was 221.75 mandays in the irrigated region while, it was 211.48 mandays in the rainfed region. Per animal human labour use was more in the rainfed region (52.58 mandays) than the irrigated region (46.09), since there is use of human labour for grazing of animals in the rainfed region.

The annual per farm veterinary expenditure was relatively more in irrigated region (Rs.431.33) than the rainfed region (Rs.375.25) and per animal it was relatively more in rainfed region (Rs.93.30), as the crossbred cows are relatively more in the rainfed region.

Among the different size group of farms, the per farm use of different resources in livestock production, in general, increased with the increase in farm size in both the regions. When compared on per animal basis, it was observed that use of green fodder and concentrate was relatively high on small sized farms in both the regions.

While the use of human labour in small sized farm and use of dry fodder in medium sized farms were relatively higher in the irrigated region.

## 5.2 Cost structure on the sample farms.

The structural adjustments in the use of resource bring about the changes in the total cost structure. The quantum and proportions of out of pocket expenses and imputed costs in the total costs structure either increase or decrease depending upon changes in the use of different resources and substitution of one form of resource for another. The proportions of cash expenditure in the total cost of production of crop enterprise and livestock enterprise also increase as, in the process of transformation, farms depend more on purchased resources and less on owned or farm produced resources. This section examines in detail the economic impact of the structural difference of resource use on the cost structure of the farm for the crop enterprise, livestock enterprise as well as for mixed farm as whole.

### 5.2.1 Cost structure of crop production

Table 5.3 presents the average per farm and per hectare cost of cultivation at different cost level (i.e. cost A, cost B, and cost C) together for all the crops grown on the sample farms in irrigated and rainfed regions under study.

At the overall level, the per farm total cost of cultivation incurred for all the crops (cost C) was Rs 94,883.93 in the irrigated region. It was more than two and half fold higher than the per farm total cost of cultivation of crops (Rs 35,781.85) in the rainfed region. On per cropped hectare basis, the total cost of cultivation for all crops was Rs 27,907.04 at the overall level, in the irrigated region. In the same region, the share of cost A (Rs 17,454.38) and cost B (Rs 25,468.20) accounted for 62.54 per cent and 91.53 per cent, respectively in the total cost of cultivation of all the crops. The per hectare total cost of cultivation of all crops in the rainfed region was Rs 10,136.50 at the overall

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**Table -5.3 Cost of cultivation of crop production on sample farms (Rs )**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Cost A</b>								
Per farm	29022 92	54604 66	94407 12	59344 9	11485 29	19763 24	32408 87	21219 13
Per hectare	22882 73	19026 01	18824 95	17454 38	7082 4	6053 06	5811 51	6011 08
	{62 44}	{62 17}	{62 40}	{62 54}	{56 93}	{56 31}	{62 23}	{59 30}
<b>Cost B</b>								
Per farm	41352 88	79781 09	138641 6	86591 87	16586 84	29178 68	44884 92	30216 81
Per hectare	32604 11	27798 29	27645 39	25468 20	10228 27	8936 81	8048 7	8560 00
	{88 96}	{90 83}	{92 22}	{91 53}	{82 22}	{83 13}	{86 19}	{84 44}
<b>Cost C</b>								
Per farm	46484 38	87833 96	150333 5	94883 93	20173 11	35097 88	52074 55	35781 85
Per hectare	36649 97	30604 17	29976 76	27907 04	12439 74	16749 73	9337 93	10136 50
	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}

{Figures in parathenses are percentages to the total}

level, in which proportionate share of cost A (Rs 6,011 08) and cost B (Rs.8,560.00) was 59.30 per cent and 84.44 per cent, respectively. The overall share of cost A and cost B in the total cost of cultivation was relatively higher in the irrigated region.

In the case of individual size classes, the per farm cost of cultivation for the all crops increased with the increase in farm size at all levels of costs in both the regions. The comparison of cost of cultivation for all crops on per hectare basis, however, gives a different picture. In that, the per hectare total cost of cultivation declined continuously as the farm size increased in the rainfed region, indicating thereby certain economics of scale. In irrigated region, it was maximum in small sized farm (Rs.31,838.62) and minimum in medium sized farms (Rs.26,697.25). This similar pattern was also observed at the level of cost A and cost B in both the regions. The cost of cultivation of crops in the irrigated region was much higher than that of rainfed region at all the levels of costs. The

per hectare share of cost A and cost B in the total cost of cultivation of all crops ranged between 56.31 per cent to 62.44 per cent and 82.22 per cent to 92.22 per cent respectively, in both the regions.

The proportion of cash expenditure in the total cost was more in the irrigated region than in the rainfed region. This was due to lack of irrigation facilities, the lower level resource use and the inability of the farmers to invest more, resulted in lower of cash expenditure in the total cost of cultivation in the rainfed region than in the irrigated region.

### **5.2.2 Cost structure of livestock production**

Table 5.4 depicts the information relating per farm and per animal annual cost of maintenance of livestock for all the categories of sample farms in both the regions under study.

At the overall level, per farm working cost incurred for livestock production in irrigated region was Rs 32,239.54 and that in rainfed region, it was Rs.25,607.92. The share of working cost in the total cost at the overall was 80.23 per cent in the irrigated region while, it was 81.52 per cent in the rainfed region. At the overall level, the per farm fixed cost was Rs 7,943.32 and Rs.5,803.57 in the irrigated and rainfed regions, respectively. The share of fixed cost in the total cost was 19.77 per cent and 18.48 per cent, respectively in the irrigated and rainfed regions. At the overall level, total cost per farm was worked out to Rs.40,182.86 and Rs 31,411.49, respectively in the irrigated and rainfed regions. Per livestock unit total cost of maintenance was Rs 8,352.09 and Rs 7,809.49, respectively in the irrigated and rainfed regions. The overall share of working cost in the total maintenance cost of livestock was relatively high in the rainfed region whereas the share of fixed cost in the total cost was comparatively high in the irrigated region.

Fig 5(a)-Resource use structure of livestock production activity in irrigated region

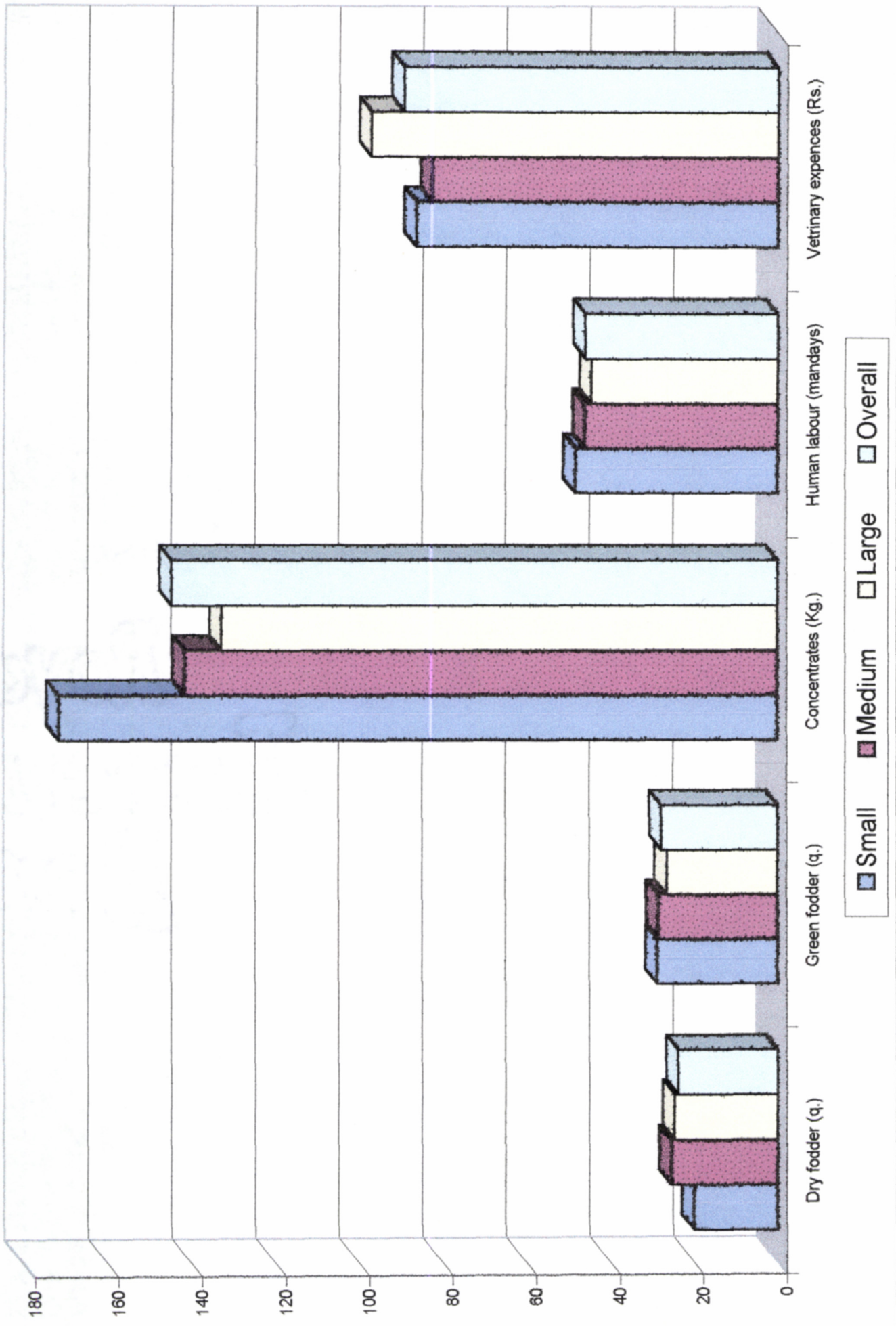


Fig. 5(b)-Resourceuse structuer of livestock production activity in rainfed region

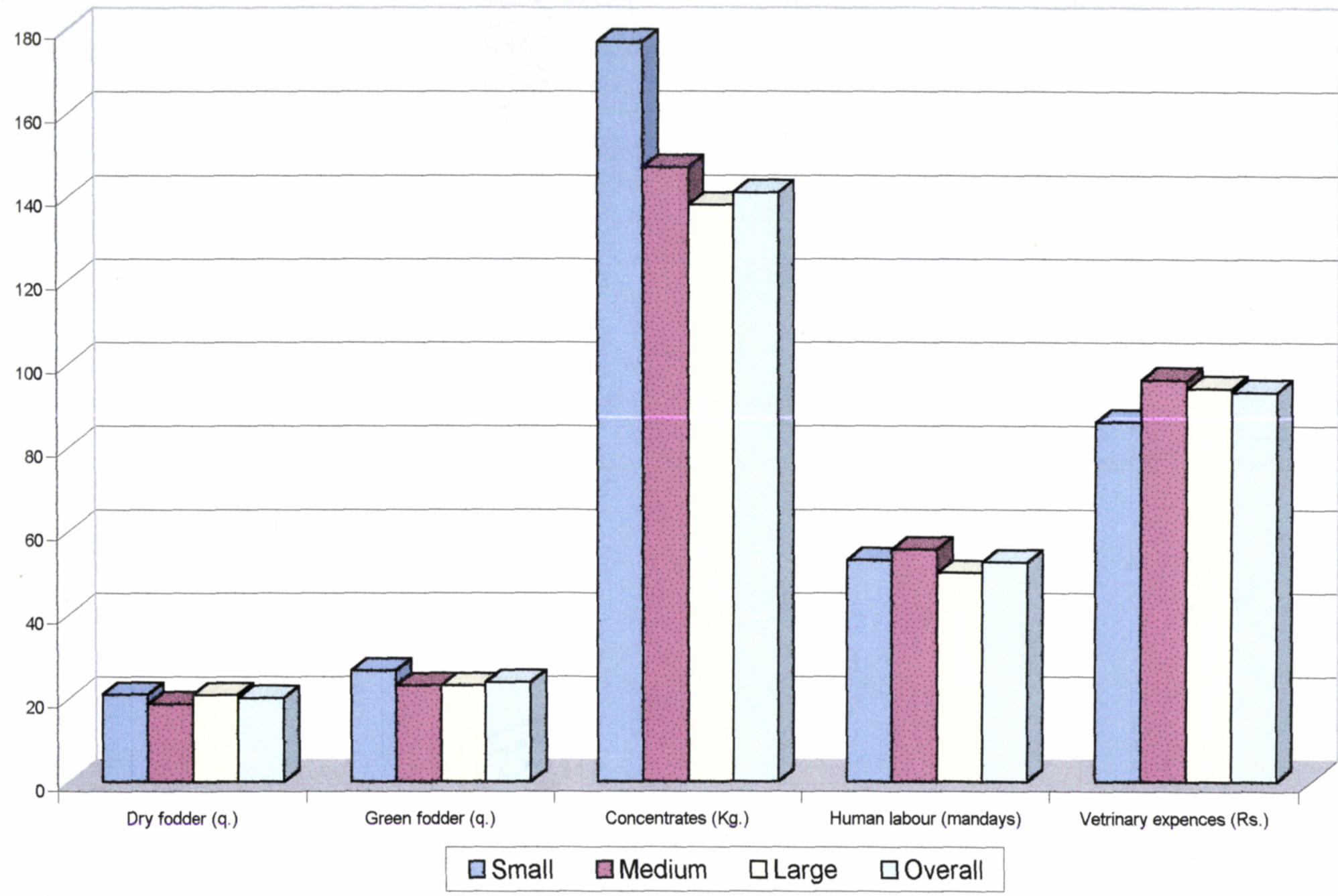
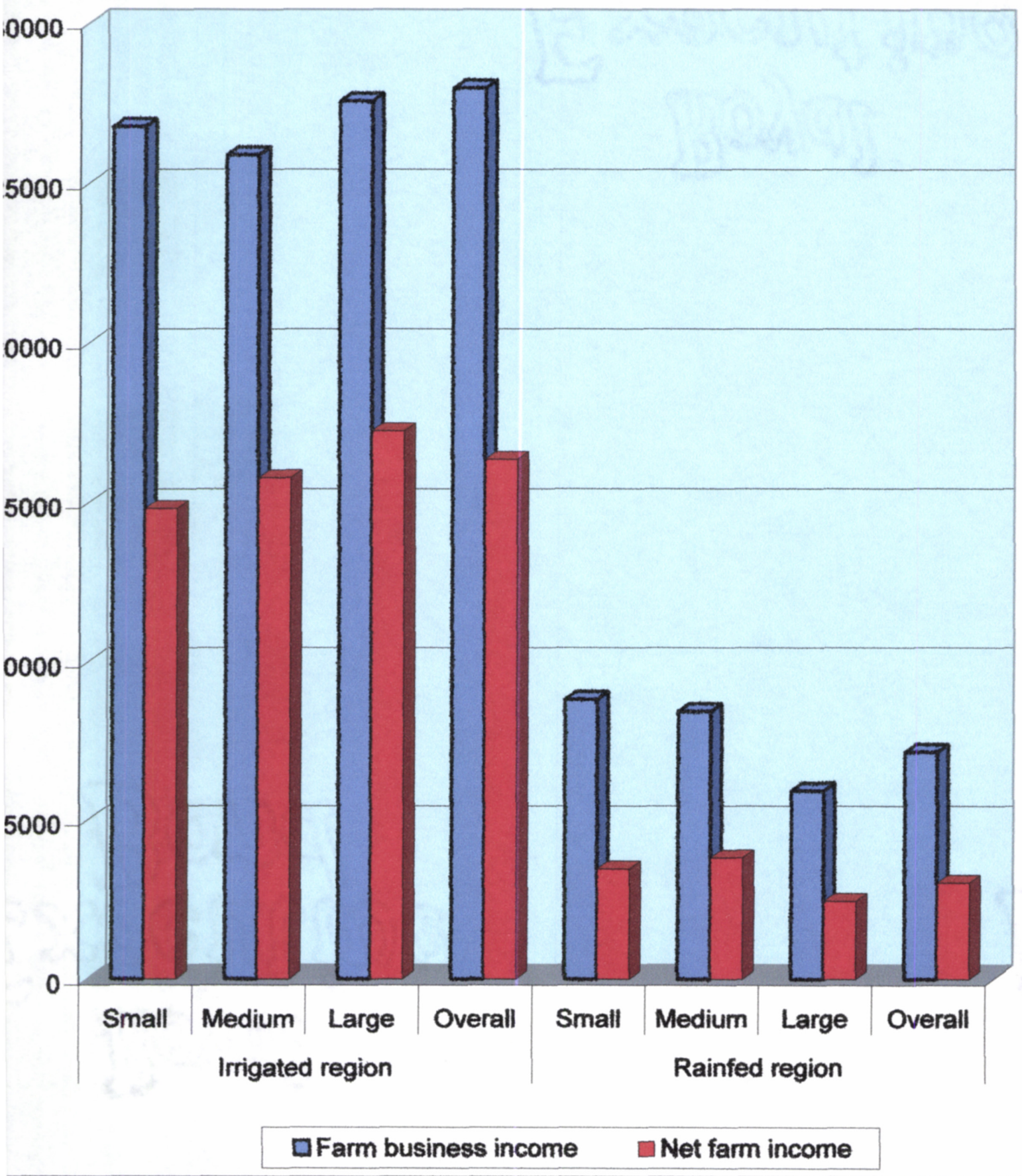


Fig. 6 Farm size groupwise returns ( farm business and net ) from crop production (Rs/ha.)



**Table - 5.4 Cost structure of livestock production on sample farms (Rs )**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Working cost</b>								
Per farm	23759 25	34486	38473 37	32239 54	18417 23	25546 67	32859 87	25607 92
Per animal	6645 94 {80 76}	6920 27 {79 76}	6548 66 {79 23}	6701 06 {80 23}	6842 32 {82 80}	6333 88 {81 74}	6151 61 {84 66}	6366 61 {81 52}
<b>Fixed cost</b>								
Per farm	5654 35	8644 91	10082 61	7943 32	3828 86	5706 84	7878 14	5803 57
Per animal	1581 64 {19 26}	1734 77 {20 04}	1716 19 {20 76}	1651 04 {19 77}	1421 48 {17 20}	1414 92 {18 26}	1474 77 {19 34}	1442 88 {18 48}
<b>Total cost</b>								
Per farm	29413 6	43130 91	48555 97	40182 86	22246 09	31253 51	40738 01	31411 49
Per animal	8227 58 {100 00}	8655 03 {100 00}	8264 85 {100 00}	8352 09 {100 00}	8263 8 {100 00}	7748 8 {100 00}	76262 38 {100 00}	7809 49 {100 00}
<b>Per farm cost (Crop + Livestock)</b>								
<b>Cost A</b>	52782 17 {69 54}	89090 66 {68 03}	132880 5 {66 81}	91584 44 {67 81}	29902 52 {70 49}	45309 91 {68 29}	65268 74 {70 32}	46827 05 {69 69}
<b>Cost C</b>	75897 98 {100 00}	130964 9 {100 00}	198889 4 {100 00}	135066 8 {100 00}	42419 2 {100 00}	66351 39 {100 00}	92812 56 {100 00}	67193 34 {100 00}

{Figures in parathenses are percentages to the total }

Among the different size farms, the per farm maintenance cost of livestock increased with the increase in farm size at all the levels of cost in both the irrigated and rainfed regions. The comparison of cost of maintenance of livestock on per animal basis, however, gives a different picture. In that, per animal total cost of maintenance was maximum (Rs 8,655 03) in medium size group and minimum (Rs 8,227 58) in small size of group of farms in the irrigated region, while it was maximum (Rs.8,263 80) in small sized farms and declined as the farm size increased in rainfed region, indicating thereby certain economies of scale. The cost of maintenance of livestock in the irrigated region

was comparatively higher than that of the rainfed region at all the levels of costs. The per animal proportionate share of working cost and fixed cost in the total cost of maintenance of livestock ranged from 79.23 per cent to 84.66 per cent and from 17.20 per cent to 20.76 per cent, respectively, in both the regions.

### **5.2.3 Cost structure of farm production**

Table 5.4 presents per farm total costs incurred for crop cultivation and maintenance of livestock at different cost levels together on sample farms in both the irrigated and rainfed regions under study.

At the overall level, the per farm total costs (both for crop production and livestock production) incurred was Rs 1,35,066.79 in the irrigated region. It was more than two-fold the per farm total cost (Rs 67,193.84) in the rainfed region. Per farm working cost in farm production was Rs 91,584.44 in irrigated region and Rs.46,827.05 in rainfed region. This confirms the validity of hypothesis that resource use and cost structure differs for the rainfed and irrigated regions. The percentage of working cost to the total cost at the overall level was 67.81 per cent in irrigated region while it was 69.69 per cent in the rainfed region.

Among the different size classes, the per farm total cost of production increased with the increase in farm size at both the levels of costs in the irrigated and rainfed regions.

### **5.3 Returns on the sample farms**

The structural adjustments in the use of resources not only result into the differences in the cost structure but also the output and gross returns of crop enterprises and livestock enterprises are equally influenced to the extent to which such adjustments take place at the farm level. Moreover, the process of

Fig. 7 Per animal returns from livestock production at different cost levels (Rs.)

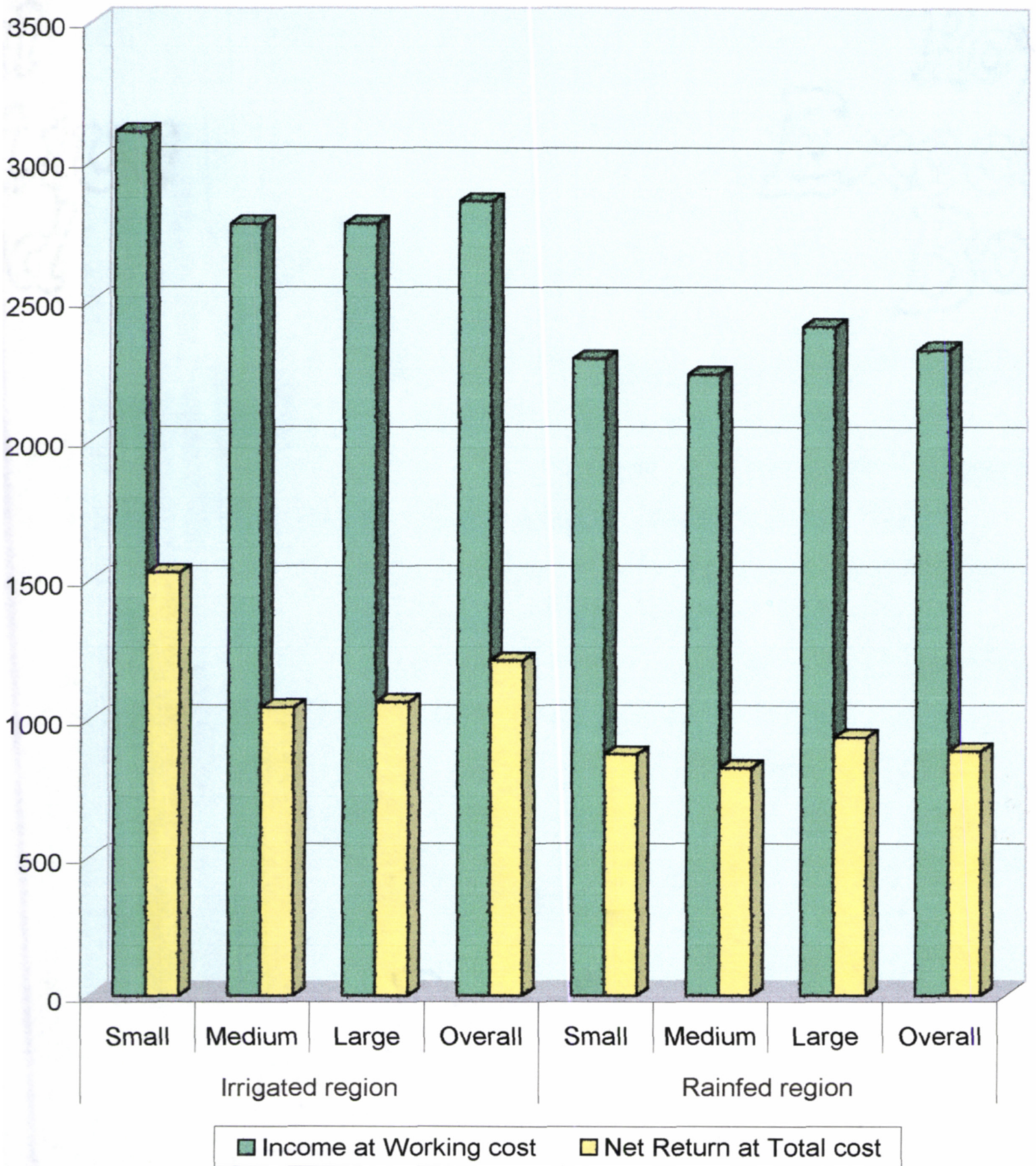
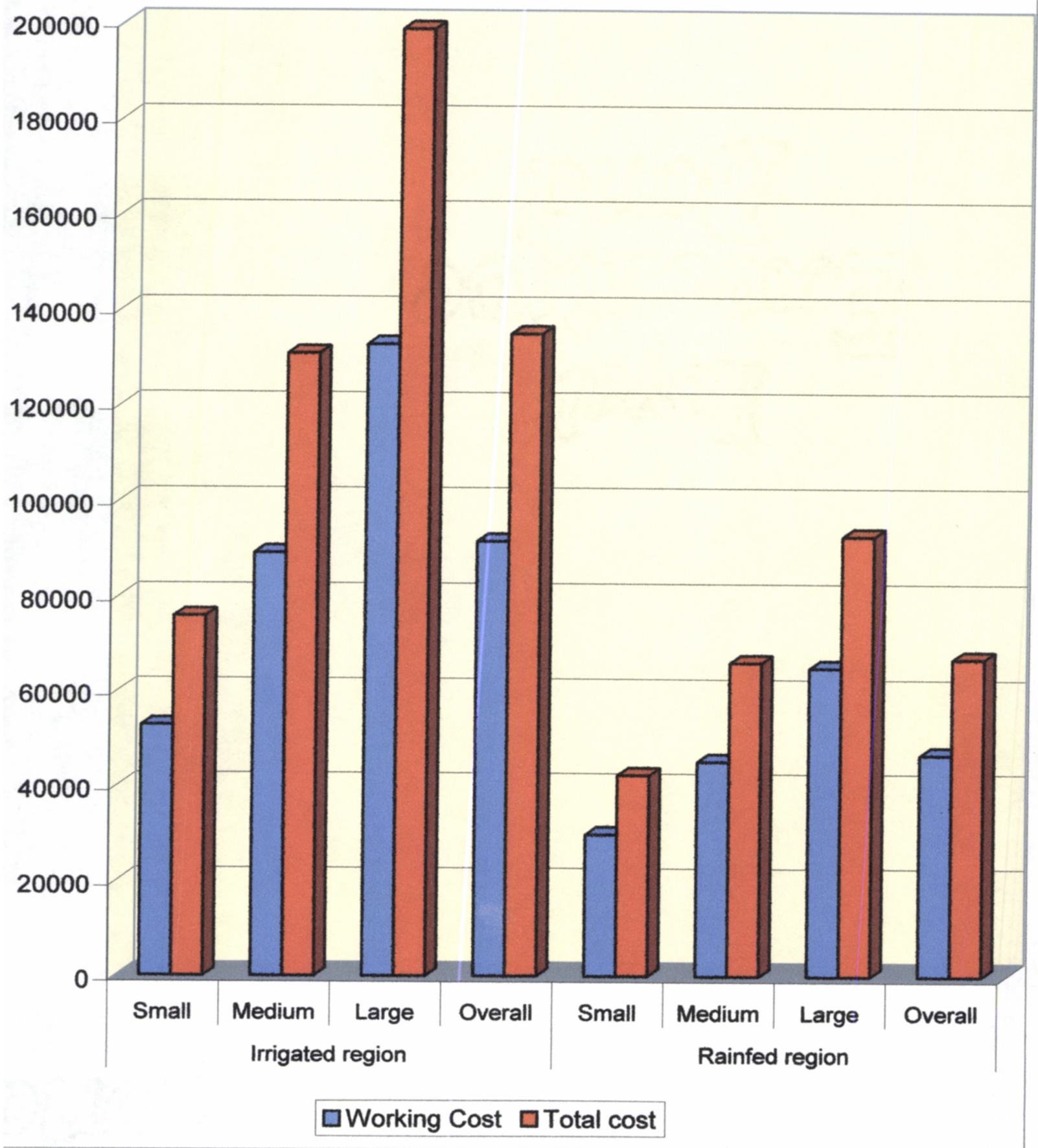


Fig. 8 Per farm costs for mixed farm (Rs.)



structural adjustments in the use of resources is based, among other factors, on the changing nature of productivities of individual resources, since the latter call for further improvements in the allocation of resources leading to increased output and gross returns on the farm

Table 5.5 represents the per farm and per unit gross returns from crop production activity and livestock activity for all the three categories of sample farms in both the irrigated and rainfed regions

**Table -5.5 Average per farm and per unit gross returns on sample farms (Rs.)**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Crop production</b>								
Per farm	68118 92	139774	243594 4	150495 77	25784 5	47734 5	65945	46488 05
Per hectare	46656 79	42484 5	45026 69	44263 46	15916 36	14421 3	11651 06	13169 42
	{66 14}	{74 31}	{81 63}	{76 59}	{51 18}	{58 00}	{59 05}	{57 08}
<b>Livestock production</b>								
Per farm	34869 8	48328 4	54801 27	45999 82	24590 3	34567 77	45725	34961 02
Per unit	9753 79	9698 01	9327 88	9561 16	9135 72	8570 52	8078 62	8691 97
	{33 86}	{25 69}	{18 37}	{23 51}	{48 82}	{42 00}	{40 95}	{42 92}
<b>Total (Per farm)</b>	102988 72	188102 4	298395 7	196495 59	50374 8	82302 27	111670	81449 07
	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}	{100 00}

{Figures in parathenses are percentages to the total}

At the overall level, for the mixed farm as whole, gross returns from both crop production and livestock activity together were Rs.1,96,495 59 in the irrigated region and Rs 81,449 07 in the rainfed region. Thus, the gross returns in the irrigated region were 141 25 per cent higher than the gross returns obtained in the rainfed region. Among the different size groups of farms, per

farm gross returns increased with the increase in the size of farm in both the irrigated and rainfed regions. This confirms the validity of hypothesis that the returns on the farms differs for irrigated and rainfed regions

Per farm total returns from the crop production activity amounted to Rs 1,50,495.77 in the irrigated region and Rs 46,488 05 in the rainfed region. Among the different size group of farms, the per farm total returns increased with increase in the size of farms in both the regions. On per cropped hectare basis, the total returns from the crop production activity was Rs.44,263 46 in the irrigated region and Rs.13,169.42 in the rainfed region, at the overall level. Thus the total return per hectare in the irrigated region was three and half fold higher than the total returns obtained in the rainfed region. The per hectare returns were maximum for small sized farms and declined with increasing farm size in the rainfed region, while in irrigated region it was more in small sized farms and less in medium sized farms.

On an average total returns per farm from livestock activity realized were to the tune of Rs.45,999 82 in the irrigated region and Rs.34,961 02 in the rainfed region. Per livestock unit total returns in irrigated region were Rs.9,561.16, which were higher than that of rainfed region (Rs 8,691 97). With the increase in farm size the total returns increase with farm size but per livestock unit it declined in both the regions.

## **5.4 Net returns on the sample farms**

### **5.4.1 Net returns from crop production**

Table 5.6 shows the per farm and per hectare net returns from crop production activity on the different size categories of farms in the irrigated and rainfed regions. The net returns are of four types; i.e (i) farm business income, (ii) family labour income, (iii) net income and (iv) farm investment income. At

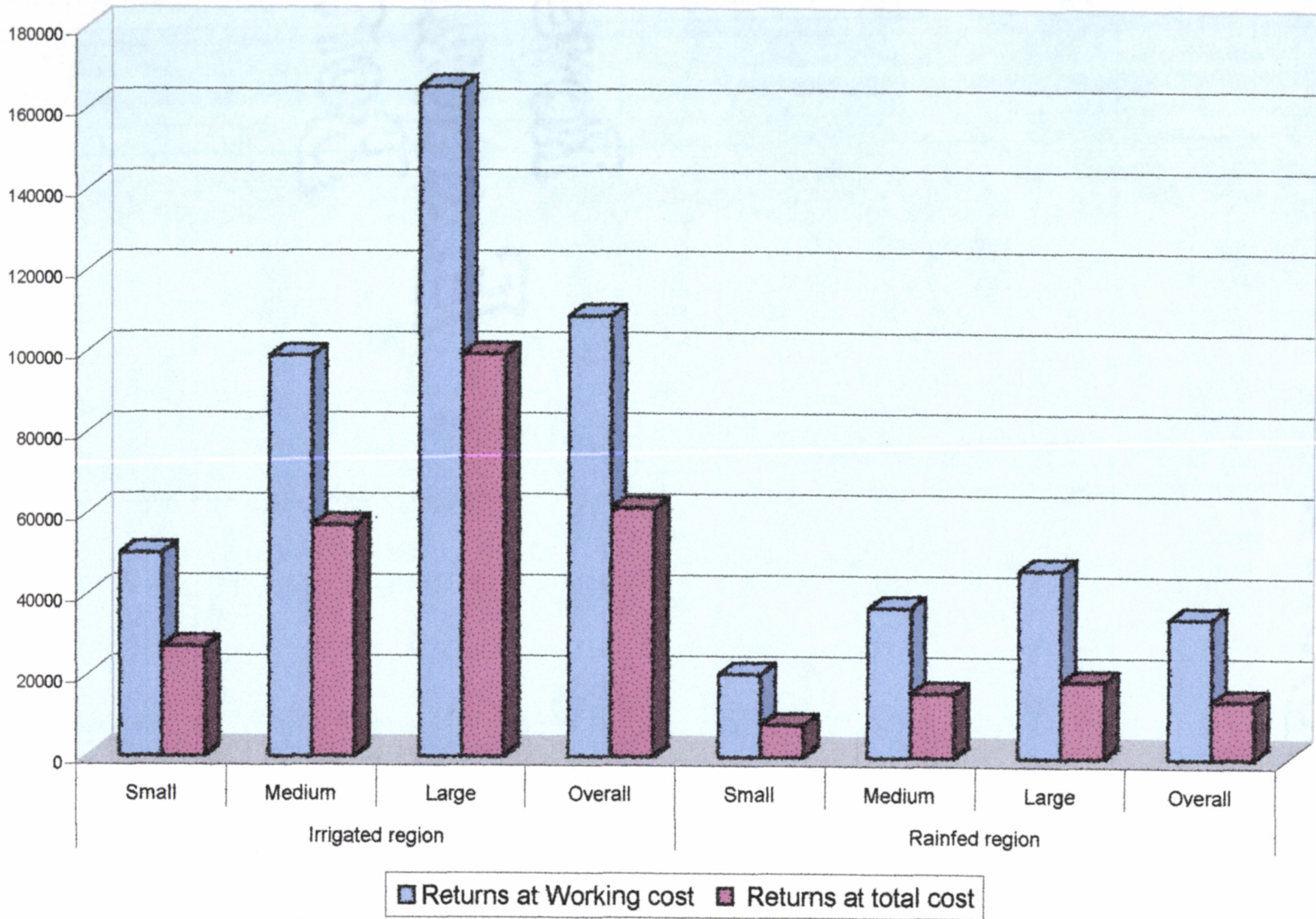
**Table -5.6 Average per farm and per unit net returns on sample farms**  
(Rs)

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Crop production</b>								
<b>Farm business income</b>								
Per farm	39095 99	85169 34	149187 7	91150 87	14299 21	27971 26	33536 29	25268 92
Per hectare	26778 08	25887 34	27576 29	26809 08	8826 67	8450 53	5925 14	7158 33
<b>Family labour income</b>								
Per farm	26766 03	59992 91	104952 8	63903 9	9197 66	18555 82	21060 24	16271 24
Per hectare	18332 90	18234 93	19399 77	18795 26	5677 57	5605 99	3720 89	4609 42
<b>Net income</b>								
Per farm	21634 53	51940 04	93260 95	55611 84	5611 39	12636 62	13870 61	10706 20
Per hectare	14818 17	15787 25	17238 62	16356 42	3463 82	3817 71	2450 64	3032 92
<b>Farm investment income</b>								
Per farm	33964 49	77116 47	139699 4	87593 29	10712 94	22052 06	26346 67	18704 89
Per hectare	23263 35	23439 66	25822 43	25762 73	6612 93	6662 25	4654 89	5298 84
<b>Livestock production</b>								
<b>Net Returns at Working cost</b>								
Per farm	11110 55	13842 4	16327 9	13760 28	6173 07	9021 1	12865 13	9353 1
Per animal	3107 85	2777 74	2779 22	2860 11	2293 4	2236 64	2408 45	2325 36
<b>Net Returns at Total cost</b>								
Per farm	5456 2	5197 49	6245 29	5816 97	2344 21	3314 26	4986 99	3549 53
Per animal	1526 21	1042 97	1063 03	1209 07	871 92	821 72	933 68	882 48
<b>Net Returns of farm</b>								
At Working cost	50206 54	99011 74	165515 6	104911 15	20472 28	36992 36	46401 26	34622 02
At Total cost	27090 73	57137 53	99506 24	61428 81	7955 6	15950 88	18857 44	14255 73

the overall level, the per farm, farm business income, family labour income, net income and farm investment income were worked out to Rs 91,150 87, Rs 63,903 90, Rs 55,611.84 and Rs.87,593.29, respectively, in the irrigated and in rainfed region, which were Rs 25,268 92, Rs 16,271 24, Rs.10,706 20 and Rs 18,704 89, respectively On the per hectare basis, the farm business income, family labour income, net income and farm investment income were of the

Fig. 9 Per farm returns at different costs for mixed farm

(Rs.)



order of Rs.26,809.08 Rs.17,454.38, Rs.16,356.42 and Rs.25,762.73, respectively, in the irrigated region at the overall level, while they were far lower in the rainfed region than those of the irrigated region

Among the different size categories of farms, the per farm net returns of all the four types showed increasing trend over the size groups of farms. On the per hectare basis, the farm business income (Rs 26,778.08) and family labour income (Rs.18,332.30) was maximum on small size group of farms while net income Rs (17,238.62) and farm investment income (Rs 25,762.73) were maximum on the large size group of farms in the irrigated region. In the rainfed region, however, the per hectare farm business income (Rs 8,826.67) on small size group of farms and family labour income (Rs 5,605.99), net income (Rs.3,817.71) and farm investment income (Rs 6,662.25) on medium size group of farms were found to be maximum.

#### **5.4.2 Net returns from livestock production**

In livestock production activity, the per farm returns over working cost and total cost worked out (at the overall level) to Rs.13,760.28 and Rs 5,816.97 in the irrigated region and the same amounted to Rs.9,353.10 and Rs 3,449.53 respectively, in the rainfed region, respectively. The per livestock unit net returns over total cost were higher (Rs.1,209.07) in the irrigated region than that in the rainfed region (Rs 882.48).

The net returns over total cost per unit livestock was maximum for small farms (Rs 1,526.21), followed by large sized farms (Rs 1,063.03) and medium sized farm (Rs.1,042.97) in the irrigated region. In the rainfed region, they were highest in the large group (Rs 933.68) and the lowest in the medium size group of farms (Rs.821.72).

### 5.4.3 Net returns on mixed farms

On the farm as whole i.e for mixed farm, the net returns over working cost at the overall level were Rs.1,08,911.15 in the irrigated region and Rs 34,622.02 in the rainfed region. The net returns over total cost (cost C) were Rs 61,428.81 which were more than four fold of rainfed region (Rs 14,255.73) in the irrigated region.

The net returns at the both the cost levels showed an increasing trend with an increase in the size groups of farms in both the regions. In the irrigated region, the net returns at cost A and cost C were higher than those of the rainfed region.

## 5.5 Output- input ratio

The efficiency operating the crop enterprise, livestock enterprise and farm as a whole has been examined by comparing the output-input ratio in different size groups of farms at different cost levels. The ratios are given in Table 5.7

### 5.5.1 Output : input ratio for crop production activity

At the overall level, the relative efficiency of crop production activity i.e. output input ratio of crop production at cost A was higher in the irrigated region (2.56) than in the rainfed region (2.19). At cost B it was higher in the irrigated region (1.76) than in the rainfed region (1.54). The output-input ratio at cost C was also relatively higher in the irrigated region than in the rainfed region and it worked out to 1.62 and 1.30, respectively, indicating the cultivation of various crops is economically viable entity in both the regions. Among the size groups of farms, it shows increasing trend in the irrigated farms. The output-input ratio was higher for crop production activity as compared to livestock activity.

**Table -5.7 Output-input ratios on the farms**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Crop production activity</b>								
Cost A	2 35	2 56	2 62	2 56	2 24	2 41	2 03	2 19
Cost B	1 65	1 75	1 79	1 76	1 55	1 64	1 47	1 54
Cost C	1 47	1 59	1 68	1 62	1 28	1 36	1 27	1 30
<b>Livestock activity</b>								
Working cost	1 47	1 4	1 42	1 43	1 34	1 33	1 34	1 34
Total cost	1 19	1 12	1 13	1 14	1 11	1 09	1 09	1 09
<b>At farm level</b>								
Cost A	1 95	2 11	2 24	2 15	1 68	1 82	1 71	1 74
Cost C	1 36	1 44	1 50	1 45	1 21	1 24	1 20	1 21

### 5.5.2 Output : input ratio for livestock activity

At the overall level, in the irrigated region, output-input ratio, estimated at working cost and total cost were 1.43 and 1.14, respectively, while the ratios were 1.34 and 1.09 in the rainfed region. It indicated that relative efficiency of livestock production was higher in the irrigated region. Among the size groups of farms similar pattern was observed.

### 5.5.3 Output : input ratio for mixed farm as whole

At the overall level, output-input ratio at cost A was 2.15 and 1.74 in the irrigated and rainfed regions, respectively. At cost C it was 1.45 and 1.21 in the two regions, respectively. This indicates that the mixed farms were operating more efficiently in irrigated region than in the rainfed region.

## **5.6 Resource productivities and resource use efficiencies of farms**

The resource use structure, costs and returns from crop production activity and livestock activity on the sample farms in different size categories of farms in the irrigated and rainfed regions under study have been presented and discussed in the preceding section. The analysis relied mostly on sample means and proportions of individual items in the total of respective varieties. The type of analysis employed for the purpose, however, had certain limitations of its own, as it could not measure the relative contribution of individual resource in combination with others in influencing production costs and output levels of the farms. The discussion on resource use structure, costs and returns obtained, however, provided certain indications useful for devising and adopting measures to effect improvements in resource allocation efficiency of the farms.

This section discusses the resource productivities and resource use efficiency in respect of crop production activity, livestock activity and mixed farm as whole in the irrigated and rainfed regions. The production function estimates are deployed to estimate resource productivities and resource use efficiencies and returns to scale underlying the farm production process in both the regions

### **5.6.1 The production function model**

The resource productivities and resource use efficiency in crop production, livestock activity and mixed farm as a whole have been analysed within the Cobb-Dougllass type of production function framework

The production functions analysis was estimated from the sample data of both activities for different size categories of farms at the overall level in both

the irrigated and rainfed regions to ascertain the problem of multi-collinearity, a zero order correlation matrix for all the explanatory variables was obtained for each function. The following rule was applied to visualize the magnitude of multi-collinearity.

The correlation coefficient between a pair of explanatory variables was considered serious if it was greater than 0.8 (Heady and Dillon, 1961). In majority of the pairs of explanatory variables, the correlation coefficient was less than 0.8. In the case where correlation coefficient was greater than 0.8, the multi-collinearity was not a problem, as the corresponding correlation coefficient was not high relative to the overall degree of multiple correlation among all the variables simultaneously (Klein, 1953). Thus satisfying non-seriousness of the problem of the multi-collinearity, the analysis was carried out.

Different statistical tests of significance were used to judge the efficiency of individual regression coefficients and coefficient of multiple correlation in respect of all the production functions. A zero order correlation matrix to individual production functions is given in Appendix- I I-VII.

### 5.6.2 Resource productivity on farms

The coefficient of multiple determination ( $R^2$ ) indicates the proportion of total variation in the dependent variable (output) explained by the independent variables jointly. At the same time, the regression coefficients of individual resource variables are the production elasticities of respective resources in the Cobb-Douglass production function, which indicate the percentage change in farm output associated with a percentage change in concerned input at its geometric mean level. On the whole, these results are of paramount importance.

as they readily provide the information relative to probable effects of resource use changes on farm output.

#### **5.6.2.1 Resource productivity of crop production activity**

The estimated parameters of the production functions of the crop production activity as a whole are presented in Table 5.8 for the sample farms in the irrigated and rainfed regions.

The F ratios obtained from the analysis of variance in respect of the production functions for crop production activity at the overall level in the irrigated and rainfed region has turned out to be highly significant, indicating thereby overall significance of the estimated production functions. The six resource variables included in the production function analysis have explained jointly more than 72 per cent of the total variations in the gross value of crop output, at the overall level in the irrigated region. Among the size groups of farms, the proportion of total variation explained by the concerned resource variables ranged between 79.05 per cent and 81.51 per cent, the lowest and the highest proportions being in the large and medium size groups of farms, respectively

The regression coefficient of all the resource variables except other working capital and area under fruit crops have turned out to be positive and significant, in irrigated region. The other working capital and fruit crop area were positive and non-significant in the case of production estimated at the overall level in the irrigated region.

The regression coefficient of human labour, manures and fertilizers, area under cash crop were highly significant at 1 per cent level which indicate that these are the important inputs to which the output was highly responsive. It

**Table -5.8 Results of Cobb-Douglas crop production function analysis**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Constant	2 4099	2 0343	2 5456	2 3835	3 2831	0 9948	2 2525	2 0498
X <sub>1</sub> Hu Labor (mandays) Std Error	*** 0 7860 0 2034	NS 0 0022 0 2388	*** 0 8130 0 2853	*** 0 6704 0 1263	NS 0 2071 0 2006	* 0 3525 0 1894	NS 0 3395 0 2698	*** 0 5845 0 1302
X <sub>2</sub> Manures -Fert (Rs ) Std Error	*** 0 3102 0 1091	*** 0 3790 0 1314	* 0 1290 0 0718	*** 0 2030 0 0644	NS 0 0262 0 0284	NS 0 0758 0 0636	** 0 0523 0 0202	* 0 0201 0 0112
X <sub>3</sub> Other W C (Rs ) Std Error	NS 0 1425 0 1639	** 0 3428 0 1479	NS 0 0417 0 1873	NS 0 0342 0 0923	** 0 4359 0 2082	*** 0 6961 0 1725	* 0 3105 0 1802	*** 0 3355 0 1146
X <sub>4</sub> G C A ( ha ) Std Error	** 0 2174 0 1014	* 0 1549 0 0901	NS 0 0201 0 1417	* 0 0864 0 0501	** 0 4504 0 1952	NS 0 1475 0 1844	* 0 3965 0 2058	NS 0 0658 0 0956
X <sub>5</sub> Cash crops ( ha ) Std Error	** 0 0692 0 0336	** 0 1029 0 0501	* 0 0986 0 0561	*** 0 0902 0 0284	*** 0 1576 0 0403	NS 0 0293 0 0292	** 0 0859 0 0399	** 0 0591 0 0227
X <sub>6</sub> Fruit crops (ha ) Std Error	NS 0 0145 0 0385	NS 0 0288 0 0278	NS 0 0256 0 0327	NS 0 0266 0 0172	*** 0 4694 0 0952	*** 0 1240 0 0441	NS 0 0173 0 0595	*** 0 1126 0 0334
R <sup>2</sup>	0 7126	0 8151	0 7905	0 7254	0 8121	0 7051	0 8187	0 7122
F value	9 57 ***	16 34 ***	15 04 ***	36 00 ***	16 34 ***	11 38 ***	18 08 ***	34 27 ***

\*\*\*, \*\* and \* indicates significance at 1, 5 and 10 per cent level of significance  
NS - Non significant

indicated that if we increase the human labour by one per cent, the gross returns will be increased by 0 6704 per cent, provided that other variables remaining constant. The variable land (gross cropped area) was significant at 10 per cent. The finding relating to the significance of the regression coefficients of human labour, manures and fertilizers and land confirm the results of Singh and Beena

(1996) and Birari(1997). The results of on production elasticity of fertilizers and the number of human labour days confirm with the results of Das (1993)

The significant and positive coefficients of all the input variables except other working capital and area under fruit crop clearly indicated that land, human labour, manures and fertilizers and area under cash crop exert significant influence on the gross value of crop output in the irrigated region. At the same time, none of the variables had production elasticity exceeding unity showing decreasing marginal productivity of factor-inputs. This means, if other inputs are fixed at a specified level and only one input is increased, the gross returns will increase at a diminishing rate.

Among the size groups of farms, the regression coefficient of land was positive and significant at 5 per cent level on small sized farms and 10 per cent on the medium sized farms and positive but non-significant on large sized farms in the irrigated region. In the case of manures and fertilizers and area under cash crop the regression coefficients were positive and significant in all the three categories of farms in the irrigated region, whereas the regression coefficients of human labour was positive and significant on small and large sized farms, and positive but non-significant on medium sized farm. The regression coefficient for other working capital was positive and significant on medium sized farms and positive but non-significant on small and large sized farms in the irrigated region.

The production elasticities of individual variables such as human labour on small and large size group of farms and manures and fertilizers on small and medium size groups of farms reveal that these were the important variables to which output was highly responsive in the respective size groups of farms in the irrigated region.

The highly significant value of  $R^2$  (coefficient of multiple determination) in the production function estimate of crop production activity at the overall level of the rainfed region indicated that the included variables have jointly explained 71.22 per cent variation in the gross value of crop output. Among the size groups of farms, the proportion of total variation explained by the resource variables was maximum (81.87 per cent) on large size group of farms followed by small (81.21 per cent) and medium (70.51 per cent) size groups of farms in the rainfed region.

The regression coefficients of human labour, manures and fertilizers, other working capital, area under cash crop and area under fruit crop were positive and significant, whereas the positive and non-significant coefficient was obtained in the case of land, at the overall level, in the rainfed region. The high significance of variables like human labour, other working capital and area under fruit crop proved to be important inputs to which output was highly responsive. The area under cash crop was significant at 5 per cent and manures and fertilizers was significant at 10 per cent level, at the overall level.

Among the different size categories of farms, the production estimates showed that the regression coefficients of other working capital on medium size groups of farm, area under cash crops in small size groups and area under fruit crop on small and medium size groups of farms was highly significant at 1 per cent level in the rainfed region, whereas the regression coefficients of human labour on medium, manures and fertilizers on large, other working capital and land (G.C.A) on small and large farms and area under cash crop on large size groups of farms also turned out to be positive and significant in the rainfed region.

On the whole, the resource variables such as human labour, manures and fertilizers and area under cash crop have shown significant influence on the

gross value of crop output in both the irrigated and rainfed regions. The high significance of human labour in both the regions and manures and fertilizers an area under cash crop showed a highly significant influence on the gross value of crop output in the irrigated region, while other working capital and area under fruit crop showed highly significant influence on the gross value of crop output in the rainfed region.

### **5.6.2.2 Resource productivity of livestock activity**

The results of estimated production function of livestock production activity are presented in Table 5.9 which gives the elasticities of production, standard errors of regression coefficients, their significance and coefficients of multiple determination ( $R^2$ ) along with 'F' statistic

The five resource variables included in the livestock production analysis have jointly explained 76.25 per cent and 81.12 per cent of total variation in the gross value of livestock output in the irrigated and rainfed regions, respectively, at the overall level. The 'F' ratios obtained from the analysis of variance in respect of production function for livestock production activity at the overall level, in the irrigated and rainfed region turned out to be highly significant, indicating thereby overall significance of the estimated production function

The regression coefficients of all the resource variables have turned out to be positive and significant at the overall level in the irrigated region. All resource variables viz, dry fodder, green fodder, concentrate, human labour and livestock unit were highly significant at 1 per cent level which indicates that these were the important inputs to which output was highly responsive in the irrigated region, at the overall level. This indicates that if we increase the dry fodder by one per cent the gross value of livestock production will increase by 0.1715 per cent, provided that other variables remaining constant at the overall

**Table 5.9 Results of Cobb-Douglas livestock production function analysis**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Constant</b>	2 6520	2 4660	2 9075	2 6456	1 9064	2 6744	2 4334	2 4066
<b>X<sub>1</sub></b>	***	**	NS	***	**	***	***	***
Dry fodder( q )	0 3064	0 2300	0 1579	0 1715	0 1779	0 4174	0 4279	0 3064
Std Error	0 0952	0 9190	0 1273	0 0527	0 0826	0 0856	0 1385	0 0555
<b>X<sub>2</sub></b>								
Green fodder (q)	***	*	***	***	***	***	*	***
Std Error	0 3179	0 1445	0 1794	0 2303	0 2716	0 3401	0 2446	0 3033
Std Error	0 0862	0 0843	0 0636	0 0400	0 0763	0 0835	0 1401	0 0544
<b>X<sub>3</sub></b>								
Concentrate (Kg )	***	***	**	***	***	**	*	***
Std Error	0 1863	0 1262	0 1489	0 1586	0 3451	0 1458	0 1599	0 1995
Std Error	0 0657	0 0347	0 0629	0 0266	0 0835	0 062	0 0924	0 0485
<b>X<sub>4</sub></b>								
Human Labor (mandays )	NS	***	NS	***	**	NS	NS	**
Std Error	0 0435	0 3890	0 1869	0 2510	0 3665	0 0532	1548	0 1720
Std Error	0 1254	0 1474	0 1731	0 0782	0 1325	0 0942	0 1635	0 0738
<b>X<sub>5</sub></b>								
Livestock unit	*	NS	**	***	NS	NS	NS	NS
Std Error	0 1445	0 1993	0 2810	0 2028	0 0472	0 0567	0 0428	0 0266
Std Error	0 0825	0 1361	0 1345	0 0602	0 1565	0 1140	0 2063	0 0904
<b>R<sup>2</sup></b>	0 7895	0 7600	0 8215	0 7625	0 7541	0 8102	0 8293	0 8112
<b>F value</b>	17 94 ***	15 20***	21 86***	53 20***	14 40 ***	20 46***	81 03***	20 46 ***

\*\*\* , \*\* and \* indicates significance at 1 , 5 and 10 per cent level of significance

NS - Non significant

level, in the irrigated region. These findings confirm the results of Khemchand et al. (2001)

The regression coefficients of all variables were positive and significant in all the categories of the farms except dry fodder on large sized farms, human labour on large and livestock unit on medium sized farms in the irrigated

region. The regression coefficient of dry fodder on small farms, green fodder on small and medium sized farms and human labour on medium sized farms were highly significant at 1 per cent level, which indicated that these were the important inputs in respective size groups of farms influencing the gross value of livestock output in the irrigated region.

The regression coefficients of all the resource variables except livestock unit have turned out to be positive and significant whereas that of livestock unit were positively non-significant in the case of production function estimated at the overall level in the rainfed region. The regression coefficient of dry fodder, green fodder and concentrate were highly significant at 1 per cent level indicating influence on output. Human labour was positive and moderately significant at 5 per cent level, at the overall level, in the rainfed region.

Among the different size groups of farms, the production estimates showed that the regression coefficients of livestock unit in all the three size groups of farms and human labour in medium and large size groups of farms were positive but non-significant in the rainfed region. The regression coefficients of dry fodder, green fodder and concentrates on all the three size groups of farms and human labour on the small size groups of farms were positive and significant, whereas the regression coefficients of dry fodder on medium and large size farms, green fodder on small and medium sized farms and concentrate on small sized farms turned out to be highly significant at 1 per cent level indicating these are important variables in respective size groups of farms to which output was highly responsive in the rainfed region.

### **5.6.2.3 Resource productivity on farm as a whole**

In addition to the production function relationship pertaining to the data for crop production activity and livestock activity, the production function

estimates were also worked out for the mixed farm as whole separately for the two regions

The estimated parameters of the production functions of farm as whole are presented in Table 5.10 for the sample farms in the irrigated and rainfed regions

**Table 5.10 Results of Cobb-Douglas farm production function analysis**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Constant	2 2787	1 6104	2 1745	1 6739	3 0344	1 5973	1 3306	1 8765
X <sub>1</sub> Hu Labor mandays	*** 0 7951	*** 0 3984	*** 0 8291	*** 0 7195	NS 0 0114	NS 0 1357	*	NS 0 1613
Standard Error	0 1542	0 1407	0 1824	0 1543**	0 1553	0 1483	0 2342	0 0972
X <sub>2</sub> Cash expenses on crop	NS 0 1099	*** 0 3742	** 0 1727	*** 0 1543	*** 0 1342	*** 0 3290	*** 0 2761	*** 0 2136
Standard Error	0 1478	0 1176	0 0824	0 0571	0 0456	0 0724	0 0804	0 0362
X <sub>3</sub> Cash expenses on livestock	** 0 1568	*** 0 2099	NS 0 0189	* 0 0688	*** 0 4161	*** 0 4404	** 0 3007	*** 0 3542
Standard Error	0 0728	0 0493	0 0600	0 0400	0 0601	0 1114	0 1230	0 0474
X <sub>4</sub> Area under cash crop	NS 0 0512	* 0 0667	** 0 0796	** 0 0543	*** 0 1029	NS 0 0205	NS 0 0025	** 0 0330
Standard Error	0 0536	0 0375	0 0381	0 0250	0 0245	0 0216	0 0271	0 0142
X <sub>5</sub> Area under fruit crop	NS 0 0192	NS 0 0191	NS 0 0229	NS 0 0160	*** 0 2479	*** 0 1348	NS 0 0174	*** 0 0957
Standard Error	0 0474	0 0251	0 0231	0 0174	0 0531	0 0260	0 0390	0 0217
X <sub>6</sub> G C A	* 0 0972	NS 0 0300	NS 0 0276	NS 0 0148	*** 0 2687	NS 0 0496	NS 0 0979	** 0 1979
Standard Error	0 0568	0 0921	0 1207	0 0469	0 0855	0 1098	0 1436	0 0768
R <sup>2</sup>	0 7255	0 7435	0 8512	0 7511	0 7914	0 8276	0 8152	0 8144
F value	10 16 ***	11 16 ***	22 15 ***	39 10 ***	14 65 ***	18 41 ***	16 91 ***	57 50 ***

\*\*\* , \*\* and \* indicates significance at 1 , 5 and 10 per cent level of significance

NS - Non significant

The 'F' ratios obtained from the analysis of variance in respect of the production functions for the farm production as whole at the overall level in both the regions have turned out to be highly significant, indicating thereby overall significance of the estimated production functions. The six resource variables included in the production function analysis have explained jointly 75 per cent of the total variation in the gross value of farm output, at the overall level, in the irrigated region. Among the size groups of farms, the proportion of total variation explained by the concerned resource variables ranged between 72.55 and 85.12 per cent, the lowest and the highest proportions being on small and large size groups of farms, respectively.

The regression coefficients of all the resource variables except land (G.C.A.) and fruit crop area have turned out to be positive and significant, whereas that of the land (G.C.A.) and fruit crop area were positive and non-significant in the case of total farm production function estimated at the overall level in the irrigated region. The regression coefficients of human labour and cash expenses on crop production were highly significant at 1 per cent level, which indicated that these are the important inputs influencing the gross value of farm output. The regression coefficients of cash crop area was positive and significant at 5 per cent level, while cash expenses on livestock were positive and significant at 10 per cent level.

The significant and positive coefficients of input variables viz, human labour and cash expenses on crop production exert significant influence on the gross value of farm output. At the same time, it may be seen that, none of the variables had production elasticity exceeding unity. This showed that each input was denoting diminishing marginal productivity.

Among the size groups of farms, the regression coefficient of land (G C A.) was positive and significant at 10 per cent level only on small sized farms and positive but non-significant on medium and large sized farms in the irrigated region. The regression coefficients of human labour was positive and significant at 1 per cent level in all the three categories of farms, which indicates that if we increase human labour by one per cent in all size groups of farms, the gross value of output will be increased by 0.7951, 0.3984 and 0.8291 per cent, respectively, in small, medium and large size groups of farms provided that other variables remaining constant. The regression coefficient of cash expenses on crop production and cash expenses on livestock activity on medium size groups of farms were positive and highly significant at 1 per cent level in the irrigated region. The regression coefficient of area under fruit crop was non-significant in all the size group of farms in irrigated region.

The highly significant value of  $R^2$  (coefficient of multiple determination) in the production function estimate of the total farm production at the overall level in the rainfed region indicated that the included variables have jointly explained 81.44 per cent variation in the gross value of farm output. Among the size groups of farms, the proportion of total variation explained by the resource variables was maximum (82.76 per cent) on medium size group of farm followed by large (81.52 per cent) and small (79.11 per cent) size groups of farms in the rainfed region.

The regression coefficients of all the resource variables except human labour turned out to be positive and significant, whereas the coefficient of the human labour was positive but non-significant in the case of production function estimated at the overall level in the rainfed region. The regression coefficients of cash expenses on crop production, cash expenses on livestock activity and area under fruit crop were highly significant at 1 per cent level.

which indicated that these are the important resource variables to which total farm output was highly responsive. The land (gross cropped area) and area under cash crop were positive and significant at 5 per cent level

The significant and positive coefficients of all the resource variables except human labour indicate that land, cash expenses on crop activity, cash expenses on livestock, area under fruit crop and area under cash crop exert significant influence on the gross value of farm output. It may be seen that the regression coefficient was less than unity for all the resource variables (inputs). This showed that each input was signifying diminishing marginal productivity.

Among the different size categories of farms, in the rainfed region, the production estimates showed that the regression coefficients of land (gross cropped area) and area under cash crop on medium and large sized farms, area under fruit crop only on large sized farms were positive and non-significant while human labour was negatively non-significant on small sized farms and positive but non-significant on medium sized farms. It indicated that human labour use was excess on respective size groups of farms. The regression coefficient of cash expenses on livestock was positive and significant at 5 per cent level while human labour was significant at 10 per cent level on large sized farms.

The regression coefficients of cash expenses on crop activity in all size groups of farms, cash expenses on livestock and fruit crop area on small and medium size groups of farms, land and cash crop area on small size groups of farms were highly significant at 1 per cent level in the respective size groups of farms in the rainfed region. This reveals that these were the important variables to which output was highly responsive in the respective size groups of farms in the rainfed region.

The pooled analysis of the entire sample farm was carried out with a view to apply 'Chow's test of equality'. The significance of difference between the farm production functions of irrigated and rainfed farms was tested by using 'Chow's test'. At the overall level it is seen that 'F' ratio, 10.19 which is significant at probability level of 1 per cent indicated that the two regressions are not equal but differ significantly in their production relationships (Appendix-X). Among the size groups of farms, 'F' ratio was highly significant at 1 per cent level in small and large size groups of farms, while significant at 5 per cent level in medium size groups of farms. This indicated that two regressions are also not equal and differ significantly in their production relationship among all size groups of farms. This is also corroborated in the discussion made earlier in this chapter about resource use, costs and returns structure in crop production and livestock production of farms in both the regions.

### **5.7 Returns to scale**

As mentioned earlier, the regression coefficients in the Cobb-Douglas production function framework are production elasticities of the respective resource variables and their sum indicates the type of returns to scale. The returns to scale are increasing, constant and decreasing according to the sum of regression coefficients is greater than, equal or less than unity.

Table 5.11 gives the sum of regression coefficients derived from the regression equations estimated for individual size groups in the crop production activity, livestock activity and farm as whole on the sample mixed farms of the respective regions.

At the overall, the sum of regression coefficients, in crop production activity was 1.1108 and 1.0650 for the irrigated and rainfed regions,

respectively Over the size groups of the farms, the regression coefficients ranged between 1 0062 and 1 5398 in the irrigated region and between 1 2020 and 1 7466 in the rainfed region

**Table 5.11 Returns to scale on the farms**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Crop production activity</b>								
Sum of regression Coefficient	1 5398	1 0062	1 128	1 1108	1 7466	1 4252	1 202	1 065
Returns to scale indicated by t test	Const	Const	Const	Const	Const	Const	Const	Const
<b>Livestock activity</b>								
Sum of regression Coefficient	0 9987	1 089	0 9541	1 0142	1 2083	1 0132	1 0300	1 0078
Returns to scale indicated by t test	Const	Const	Const	Const	Const	Const	Const	Const
<b>Farm as a whole</b>								
Sum of regression Coefficient	1 2294	1 0983	1 1508	1 0277	1 1583	1 1100	1 1144	1 0557
Returns to scale indicated by t test	Const	Const	Const	Const	Const	Const	Const	Const

Const -Constant

The sum of regression coefficients in livestock activity, at the overall level, was 1 0142 and 1 0078 for the irrigated and rainfed regions, respectively Among the size groups of farms, it ranged between 0 9541 and 1 0890 in the irrigated region and between 1 0132 to 1 2083 in the rainfed region

At the overall level, the sums of regression coefficients at the farm as whole were 1 0277 and 1 0557 in the irrigated and the rainfed region, respectively Over the size groups of farms, it ranged between 1 0983 to 1 2294 in the irrigated region and 1 1100 to 1 1583 in the rainfed region The sums of regression coefficients were further tested statistically for their derivation from

unity. The test indicated constant returns to scale in all the cases. These findings confirm the results of Pawar(1978), Birari (1997)

### **5.8 Resource use efficiency on the farms**

The estimated production function enables us to evaluate the efficiency of prevalent factor proportions in agriculture in the region. The production function analysis has been generally used to determine economic efficiency of resource use, which requires estimation of marginal value products of different resources. A resource or input is considered to be used more efficiently if its marginal value product just offsets its unit cost. Equality of marginal value product with factor cost is, therefore, the basic condition that must be satisfied to obtain efficient resource use.

The marginal value products of the resources so obtained from the estimated production functions at the geometric mean level of their use in the crop production activity, livestock activity and mixed farm as whole in the irrigated and rainfed regions are presented in Table 5.12, 5.13 and 5.14 along with per unit acquisition costs of the respective resources. The geometric means of individual resources and gross returns are given in Appendix-~~XI~~

#### **5.8.1 Resource use efficiency of crop production activity**

It is revealed from the Table 5.12 that at the overall level, the marginal value products of human labour, manures and fertilizers and area under cash crop were greater than the per unit acquisition cost of the respective variables indicated that on an average the use of these inputs was at their optimal level in the irrigated region. The marginal value products of land was less than its imputed rental value. This shows that the use of land was inefficient. The marginal value products of other working capital and area under fruit crop were

also less than their unit prices indicating inefficient effect of other working capital as well as area under fruit crop at the overall level in the irrigated region

**Table 5.12 Comparison of MVP of farm resources with prices in crop Production (Rs.)**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Land (G.C.A.) (ha.)</b>								
M V P	11119 88	7029 74	982 00	4176 82	5524 66	1687 72	1830 21	748 22
Price	8839 16	8012 27	7979 85	8109 73	2594 15	2385 66	1909 86	2162 47
Difference	2280 72	-982 53	-6997 85	-3932 91	2930 51	-697 94	-79 65	-1414 25
<b>Human labor (mandays)</b>								
M V P	280 48	15 68	330 69	253 30	38 80	74 30	42 67	119 09
Price	51 18	51 53	52 07	51 59	47 15	47 80	48 11	47 87
Difference	229 30	-35 85	278 62	201 71	-8 35	26 50	-5 44	71 22
<b>Manure - fertilizers (Rs.)</b>								
M V P	3 28	4 50	1 49	2 30	0 78	0 93	2 31	1 09
Price	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Difference	2 28	3 50	0 49	1 30	-0 22	-0 07	1 31	0 09
<b>Other working capital (Rs.)</b>								
M V P	0 52	1 33	0 17	0 13	1 18	1 93	0 84	1 27
Price	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Difference	-0 48	0 33	-0 83	-0 87	0 18	0 93	-0 16	0 27
<b>Area under cash crop (ha.)</b>								
M V P	14409 40	17219 58	14489 00	14918 30	69102 42	7797 00	44451 42	32798 14
Price	13810 10	13289 00	13019 00	13210 60	8827 00	8324 00	7009 00	8435 22
Difference	599 30	3930 58	1470 00	1707 70	60275 42	-527 00	37442 42	24362 92
<b>Area under fruit crop (ha.)</b>								
M V P	29388 00	31670 80	26792 00	28767 80	94238 60	82171 70	24709 53	84538 00
Price	31271 20	33320 00	34788 10	33890 20	33858 80	34157 10	27857 55	31428 00
Difference	-1883 20	-1649 20	-7996 10	-5122 40	60379 80	48014 60	-3148 02	53110 00

Among the size groups of farms, the marginal value products of land was less than its imputed rental value in medium and large size groups of farms and greater than its rental value in small size group of farms in the irrigated region. This indicated the inefficient use of land in medium and large size group of farms, while efficient use of land in small size groups of farms in the irrigated region. The marginal value product of human labour was less than its per unit cost on the medium sized farms, while it was greater than its cost on small and large sized farms. This showed a efficient effect of the human labour on the small and large sized farms. This indicated the farmer may receive marginal return of Rs 280 48 and Rs 278 62 on small and large sized farms, respectively by increasing one unit of human labour in respective groups, keeping other factors constant.

The marginal value product of the manures and fertilizers was greater than its unit cost in all size groups of farms. The use of this input was found to more efficient on all the size groups of farms in the irrigated region. The M V P of area under cash crop was also greater than its unit cost (rental value) indicating efficient use of this resource on all the size groups of farms. The MVP of other working capital was greater than its unit cost only in medium sized farms, indicating its positive effect only on medium size group of farms. The MVP of area under fruit crop was less than its unit cost (rental value), indicating inefficient use of this resource in all size groups of farms in the irrigated area.

At the overall level, the marginal value products of human labour, manures and fertilizers, other working capital, area under cash crop and area under fruit crop are greater than the per unit acquisition prices of these inputs in the rainfed region. This indicated, the use of these resources was at optimal

level. The marginal value product of land was less than its imputed rental value, which shows that the use of land was inefficient.

Among the different size classes of farms in the rainfed region, the difference between the marginal value product of land and its imputed rental value was positive on small sized farms indicating efficient use of land while difference was negative on medium and large sized farms indicating inefficient use of land on these farms in the rainfed region.

The marginal value product of human labour was greater than its per unit acquisition cost on medium sized farms indicating efficient use of human labour on medium size group of farms, while it was less than per unit acquisition cost on small and large sized farms indicating uneconomic use of human labour on these groups in the rainfed region. The marginal value product of manure and fertilizer was less than per unit price on small and medium size groups of farms indicating inefficient use of these inputs, while it was greater than unit price on large sized groups of farms indicating that the use of fertilizer input was efficient and can be increased to obtain higher gross returns from crop activity. The MVP of other working capital was more than its per unit price on small and medium sized farms. This indicated the efficient use of other working capital on these farms. The expenditure on seeds, plant protection measures, irrigation and upkeep of implements and machinery should be increased to increase the gross returns on these farms in the rainfed region.

The marginal value product of area under cash crop on small and large sized farms and area under fruit crop on small and medium sized farms was greater than its unit price indicating the efficient use of these resource variables in respective size groups of farms. The magnitude of marginal value product of area under fruit crop was greater than area under cash crop in respective size

groups indicates that growing of area under fruit crop was more efficient than that of cash crops in the rainfed region

### 5.8.2 Resource use efficiency on livestock activity

The marginal value products of resources obtained from the estimated production function at the geometric mean level, marginal cost of resource and their difference in livestock activity both in the irrigated and rainfed region are presented in Table 5 13

**Table -5.13 Comparison of MVP of farm resources with prices in livestock Production (Rs )**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Dry fodder(q)</b>								
M V P	145 79	120 06	61 07	118 30	85 44	195 86	197 02	139 77
Price	103 00	103 00	103 00	103 00	105 00	105 00	105 00	105 00
Difference	42 79	17 06	-41 93	15 30	-19 56	90 86	92 02	34 77
<b>Green fodder(q)</b>								
M V P	115 49	48 13	83 98	74 07	104 74	131 19	103 85	120 81
Price	70 00	70 00	70 00	70 00	71 00	71 00	71 00	71 00
Difference	45 49	-21 87	13 98	4 07	33 74	60 19	32 85	49 81
<b>Concentrates (q)</b>								
M V P	11 66	9 99	11 18	11 40	18 13	8 84	10 63	11 89
Price	5 60	5 62	5 65	5 62	5 50	5 52	5 55	5 52
Difference	6 06	4 37	5 53	5 78	12 63	3 32	5 08	6 37
<b>Human labor (mandays)</b>								
M V P	8 43	77 07	37 58	49 62	60 08	8 50	25 16	27 87
Price	40 22	40 95	40 81	40 50	35 00	35 40	35 60	35 33
Difference	-31 79	36 12	-3 23	9 12	25 08	-26 90	-10 44	-7 46
<b>Livestock unit</b>								
M V P	3288 00	1819 00	3633 55	3480 21	390 12	499 33	359 23	226 62
Price	3175 00	3103 00	3480 00	3121 00	2672 10	2751 00	2657 18	2748 11
Difference	113 00	-1284 00	153 55	359 21	-2281 98	-2251 67	-2297 95	-2521 49

At the overall level, the marginal value products of all resources viz, dry fodder, green fodder, concentrates, human labour and livestock unit were greater than the per unit acquisition cost of these inputs in the irrigated region. This indicated the use of these inputs was at their optimal level in the irrigated region. This suggested that fodder along with concentrates and more use of human labour as well as increase in size of herd would result in higher returns from livestock enterprise at the overall level in the irrigated region.

Among the different size categories of farms, the marginal value products of dry fodder on large sized farms and green fodder on medium sized farms was less than its unit price indicated that over utilization of these inputs in respective size groups of farms in the irrigated region. The marginal value products of dry fodder on small and medium sized farms and green fodder on small and large sized farms were greater than unit price indicating efficient use of these resources. The marginal value product of concentrates was more than its per unit price on all three size classes of farms. It indicates concentrates are used more efficiently on all the size groups of farms. It was maximum (Rs 11 66) on small sized farms followed by large (Rs 11 18) and medium (Rs 9 99) sized farms in the irrigated region.

The MVP of human labour was less than its unit prices on small and large sized farms, showed over utilization of human labour on small and large sized farms for livestock activity in the irrigated region. The MVP of livestock unit was greater than its unit price on small and large sized farms indicating efficient use of livestock unit on small and large sized farms.

At the overall level, in the rainfed region, marginal value products of dry fodder, green fodder and concentrates were greater than the per unit acquisition cost of these inputs. This indicates that, use of these inputs was at their optimal

level in the rainfed region. The marginal value product of human labour and livestock unit were less than the per unit acquisition prices showed over utilization of these inputs.

Among the different size groups of farms, the marginal value products of dry fodder were less than its unit price on small size groups of farms indicates over utilization of dry fodder on small farms in the rainfed region. The MVP of dry fodder on medium and large size group of farms was greater than its unit price, which indicates efficient use of dry fodder on these farm groups. The marginal value product of green fodder and concentrates was greater than per unit acquisition cost of these inputs in all the size groups of farms in rainfed region. This indicated that the green fodder and concentrates were more efficiently used in all size groups of farms in the rainfed region. The ratio of MVP to marginal cost in the case of concentrate was more as compared to other inputs indicating enough scope for profit maximization by increasing the use of concentrates in all size groups of farms.

The marginal returns may be increased by Rs 104 74, Rs 131 19 and Rs 103 85 by increasing the feeding of green fodder by one quintal to the livestock in small, medium and large size groups of farms, respectively.

The marginal value products of human labour was more than its unit price indicating efficient use of human labour on small sized farms, whereas it was less than unit price on medium and large sized farms indicating excess use of human labour on both the farms in the rainfed region.

The marginal value product of livestock unit was less than its unit price indicating inefficiency on gross income of livestock activity in all size groups of farms. This suggested the need to reducing the unproductive livestock in all size groups of farms in the rainfed region.

### **5.8.3 Resource use efficiency for mixed farm as a whole**

The marginal value products of resources at the geometric mean level, marginal cost and their difference for the farm as a whole both in irrigated and rainfed region are presented in Table 5 14

At the overall level, marginal value products of human labour, cash expenses on crop production and area under cash crops were greater than the per unit acquisition prices of respective resources, indicates that the use of these inputs was at their optimal level in the irrigated region. The marginal value products of land, cash expenses on livestock activity and area under fruit crop were less than their unit prices indicating the inefficient effect of land, cash expenses on livestock and area under fruit crop at the overall level, in the irrigated region. This suggests that higher utilization of human labour, cash expenses on crop production and area under cash crop would result in higher returns from the mixed farm as a whole in the irrigated region.

Among the size groups of farms, the marginal value of land was less than its imputed rental value in all three size groups of farms in the irrigated region. This indicates the inefficient use of land in all three size groups of farms in the irrigated region. The marginal value product of human labour was greater than its unit price in all size categories of farms indicating more efficient use of human labour in all size groups of farms. This suggests that the human labour can be increased to maximize the profit on the farms in the irrigated region. The marginal value product of cash expenses on crop production was greater than its unit price on medium and large size groups of farms indicating optimal use of this resource on medium and large size groups of farms.

The MVP of cash expenses on livestock activity was greater than its unit price on small and medium size groups of farms indicating the efficient use of

**Table -5.14 Comparison of MVP of farm resources with prices in farm Production (Rs )**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
<b>Land (G.C.A.) (ha.)</b>								
M V P	6228 85	1720 30	1541 00	889 15	7959 00	1138 88	1830 44	46118 86
Price	8839 16	8012 27	7979 85	8109 73	2594 15	2385 66	1909 86	2162 47
Difference	-2610 31	-6291 97	-6438 85	-7220 58	5364 85	-1246 78	-79 42	43956 39
<b>Human labor (mandays)</b>								
M V P	227 25	133 37	299 37	238 68	-1 20	19 62	78 05	22 86
Price	51 18	51 53	52 07	51 59	47 15	47 80	48 11	47 87
Difference	176 07	81 84	247 30	187 09	-48 35	-28 18	29 94	-25 01
<b>Cash expenses on crop production (Rs )</b>								
M V P	0 50	2 02	1 09	1 07	1 09	2 22	1 94	1 56
Price	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Difference	-0 50	1 02	0 09	0 07	0 09	1 22	0 94	0 56
<b>Cash expenses on livestock production (Rs )</b>								
M V P	1 08	1 52	0 28	0 56	1 60	1 95	1 55	1 57
Price	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Difference	0 08	0 52	-0.72	-0 44	0 60	0 95	0 55	0 57
<b>Area under cash crop (ha )</b>								
M V P	12385 60	15736 00	15010 80	14630 87	87812 39	7992 00	1227 72	32368 72
Price	13810 10	13289 00	13019 20	13210 60	8827 00	8324.00	7009 00	8835 22
Difference	-1424 50	2447 00	1991 60	1420 27	78985 39	-332 00	-5781 28	23533 50
<b>Area under fruit crop (ha )</b>								
M.V P	24160 70	28579 00	31897 00	31980 00	950795 0	524793 0	26013 82	431676 7
Price	31271 20	33320 00	34788 10	33890 00	33858 70	34157 10	27857 55	31428 00
Difference	-7110 50	-4741 00	-2891 10	-1910 00	916936.3	490635 9	-1843 73	400248 7

expenses on livestock activity on the small and medium size group farms. The marginal value products of area under cash crop was less than its unit price on small sized farms indicated inefficient use of this resource whereas marginal

value products of area under cash crop was greater than its unit price on medium and large size groups of farms. This showed that efficient use of this resource on medium and large sized farms in the irrigated region, indicating scope to increase the area under cash crops to increase gross returns on medium and large size groups of farms. The marginal value products of area under fruit crop was less than its factor cost in all three size groups of farms in the irrigated region indicating inefficient and negative effect on the gross value of farm output.

At the overall level, marginal value products of land, cash expenses on crop production, cash expenses on livestock activity, area under cash crop and area under fruit crop were greater than the per unit acquisition prices of respective resources, indicated that, the use of these inputs was at their optimal level in the rainfed region. The marginal value product of human labour was less than per unit wage rate, indicates the excess use of human labour at the overall level, in the rainfed region. This suggest that increase in the use of land, expenses on crop and livestock activity, area under cash crops and are under fruit crops would result in higher returns from mixed farming in rainfed region.

The marginal value product of cash expenses on crop production and cash expenses on livestock production was greater than its unit price on all the size group of farms. This indicates the optimal use of cash expenses on crop production and livestock production in the rainfed region. The marginal value product of area under cash crop was greater than its unit price on small sized farms, only, indicating effective use of area under cash crop on small sized farms. The marginal value product of area under fruit crops was greater than its unit price on small and medium sized farms in the rainfed region. This showed that effective use of this resources on small and medium size group farms, indicating scope to increase area under fruit crops to increase gross returns on

small and medium sized farms in the rainfed region. These findings confirm the reality of the hypothesis that the resource productivities and resource use efficiencies of farms differ on different types of farms and regions.

### **5.9 Employment pattern of family workers of sample farms**

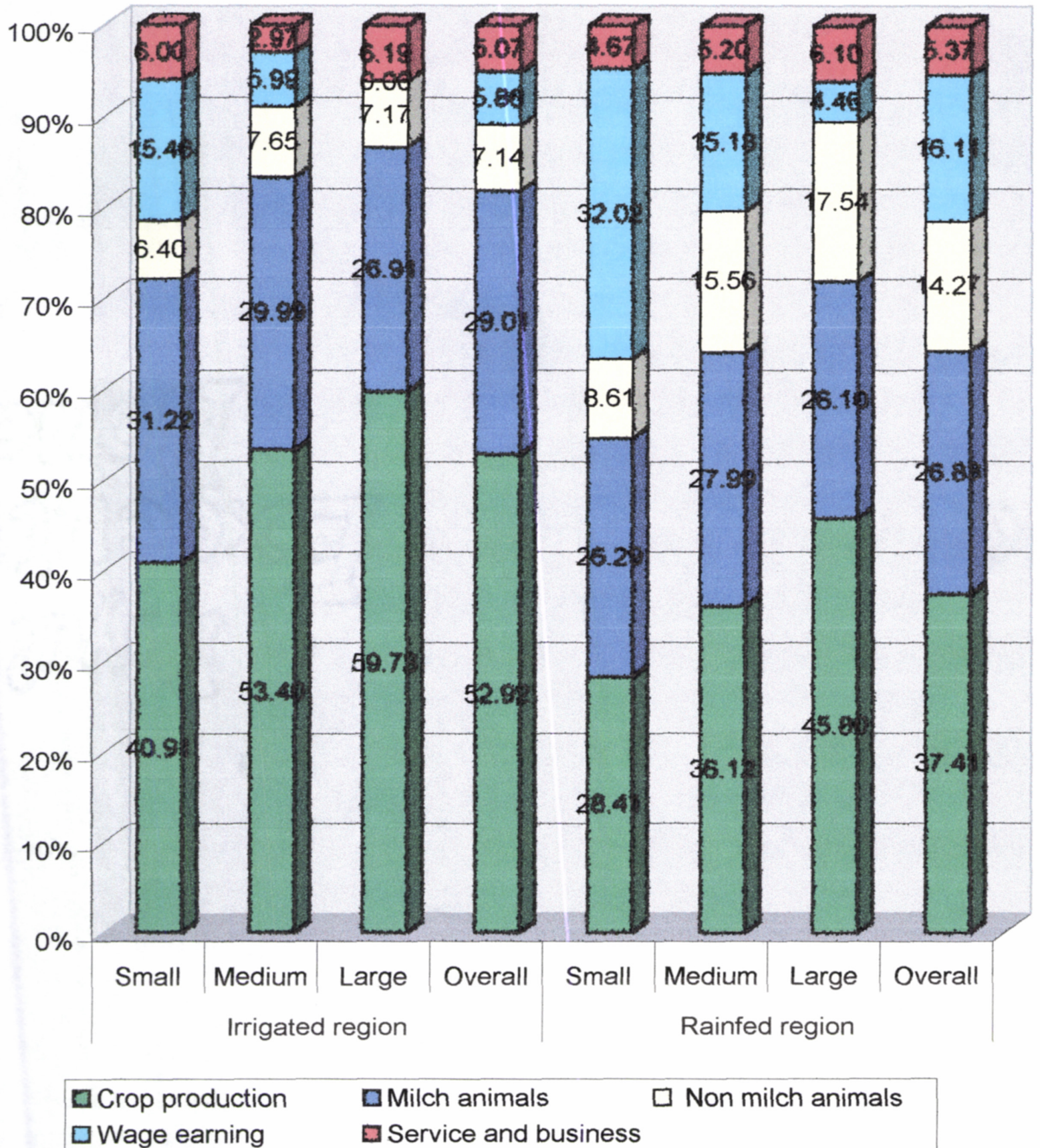
The main activity of the farmer is to cultivate land and grow crops in such a way as to make the efficient use of labour to secure the maximum income. However, owing to limitations on size of holding and irrigation, all the family members do not find adequate employment in crop production activity throughout the year. They are therefore, required to find employment in alternative activities in order to earn additional income. Table 5.15 presents the details of sourcewise employment pattern of the average male and female working members in different size groups of the sample families.

The employment pattern of the family workers revealed that at the overall level, per family total annual employment generated in the irrigated region was 613.40 mandays, whereas, in the rainfed region it was 470.72 mandays. In the total employment, the share of employment generated from crop production activity was the highest (52.92 per cent) in the irrigated region, while the share of employment generated from livestock production activity was the highest (41.40 per cent) in the rainfed region. Employment generated from milch animal was more under livestock activity contributing 29.01 per cent and 26.83 per cent to the total employment in the irrigated and rainfed regions, respectively. The share of employment from wage earning was more in the rainfed region (16.11 per cent) than irrigated region (5.86 per cent).

Among the size groups, employment generated from crop production showed increasing trend in both the regions. Share of employment from crop production was 40.91 per cent on the small farm to 59.73 per cent on the large



Fig. 10-Sourcewise employment pattern of sample farms (mandays)



farms in the irrigated region. It was 28.41 per cent on the small farms and 45.80 per cent on the large farms in the rainfed region.

The percentage share of employment from livestock activity was more in the rainfed region (41.10 per cent) than in the irrigated region (36.15 per cent) at the overall level. The share of employment from livestock activity was 34.08 per cent on the large farm to 37.64 per cent on the medium farms in the irrigated region. It was 34.90 per cent on the small farms and increased to 43.64 per cent on the large farms in rainfed region.

The share of employment from milch animals was the highest on the small farms (31.23 per cent) and lowest on the large farms (26.91 per cent) in irrigated region, while it was 27.99 per cent on the medium farm and 26.10 per cent on the large farm in the rainfed region.

The share of employment from wage earning was higher on the small farm i.e. 32.02 per cent and it was only 4.46 per cent on large farms in the rainfed region. It was 15.46 per cent on the small farms and 5.99 per cent on the medium farms in the irrigated region. This confirms the part of hypothesis that employment on farms differ on different types farms and regions.

### **5.10 Farm employment function**

The employment pattern of family workers indicated that crop and livestock production activities were the major source for employment on the farms. In order to find out the extent of influence exerted by the factors viz; land (gross cropped area), number of milch animals, working capital, cropping intensity and off-farm employment. On the farms labour employment, the linear regression model of the following form was fitted to the sample data

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u_t$$

Where,

Y	=	Total farm employment (mandays)
a	=	Constant
X <sub>1</sub>	=	Gross cropped area (ha )
X <sub>2</sub>	=	Milch animals (No )
X <sub>3</sub>	=	Working capital (Rs )
X <sub>4</sub>	=	Cropping intensity (%)
X <sub>5</sub>	=	Off-farm employment (mandays)
X <sub>6</sub>	=	Gross income (Rs )
b <sub>i</sub> 's	=	Regression coefficient
u <sub>t</sub>	=	Error term

The details of the regression coefficients of individual variables, standard errors and the estimated values of coefficient of multiple determination are given in the Table 5 16 for employment functions of farms for both the regions.

At the overall level, the coefficients of multiple determination ( $R^2$ ) were estimated at 0.6381 and 0.7921 in the irrigated and rainfed regions, respectively. The five independent variables have jointly explained 64 per cent and 79 per cent variations in the total employment in the irrigated and rainfed regions, respectively. The value of 'F' ratio was observed to be highly significant at the overall level in both the regions indicating, the overall significance of fitted multiple linear regression equations.

At the overall level, the regression coefficients of land (gross cropped area) and number of milch animals on the farms were found highly significant at 1 per cent level in the irrigated region. This indicates that these are the most important variables to increase employment on the farms in the irrigated region. The regression coefficient of working capital and off-farm employment were

positive and significant at 10 per cent level, while the cropping intensity was found to be non-significant but positive at the overall level in the region. It is

**Table 5.16 Results of employment function of sample farms**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Constant	120.41	93.5936	-83.1682	122.381	-118.87	12.1600	123.3785	13.3972
	NS	*	*	***	**	NS	**	***
Gross cropped area (X <sub>1</sub> )	17.859	39.8651	24.0862	42.168	27.2363	-3.0193	18.4156	9.7866
Standard error	36.2733	22.6319	13.6507	8.8121	11.6499	17.1729	8.0541	3.0690
	***	***	***	***	***	***	***	***
No. of milch animal (X <sub>2</sub> )	46.7776	55.5352	54.9735	36.5872	38.2356	31.5718	30.9971	21.1706
Standard error	14.3131	13.8955	15.7789	8.1021	9.1115	9.6945	5.9810	5.6971
	***	*	NS	*	***	***	***	***
Working capital (X <sub>3</sub> )	0.047	0.0251	0.0119	0.0205	0.0337	0.0428	0.0196	0.023
Standard error	0.0162	0.0127	0.0089	0.0103	0.0120	0.0135	0.0061	0.0067
	NS	NS	**	NS	NS	NS	NS	NS
Cropping intensity (X <sub>4</sub> )	0.4804	0.6539	3.5658	0.4442	0.4307	0.1819	-0.9583	0.0345
Standard error	0.5691	1.0312	1.5147	0.4250	0.2912	0.5818	0.5939	0.1842
	***	*	**	*	***	***	NS	***
Off-farm employment (X <sub>5</sub> )	0.7012	1.0122	4.1593	0.1979	1.0113	0.8327	0.0125	0.4651
Standard error	0.2419	0.5251	1.8181	0.5067	0.2909	0.1646	0.6555	0.2198
R <sup>2</sup>	0.6638	0.6293	0.6799	0.6381	0.8191	0.7884	0.8641	0.7921
	***	***	***	***	***	***	***	***
F value	9.36	8.17	10.09	29.68	20.51	17.14	29.65	63.20

seen that an addition of one hectare of gross cropped area, other things remaining the same, would create additional employment of 42.17 mandays to the working members of the families at the overall level.

Among the size groups, the regression coefficients of number of milch animals and off-farm employment were significant in all the size groups. The land was significant on medium and large sized farms, while working capital

was significant on small and medium sized farms the regression coefficient of cropping intensity was significant only on large sized farms

In the rainfed region, at the overall level, the independent variables viz, land, (G C A ), number of milch animals and working capital were highly significant at 1 per cent level, this means, with addition of one unit of milch animal, the employment of farm families would increase by 21 17 mandays The off-farm employment was positive and significant at 5 per cent level The regression coefficient of cropping intensity was positive but non-significant on the farms

Among the size groups, the regression coefficient of number of milch animals and working capital were highly significant at 1 per cent level in all the size groups of farms indicating that these are the most important variables to increase the employment on farms in the rainfed region. This means that if the milch animals increased by one unit on the small farms, ceteris paribus, the employment would increase by 38 24 mandays on the small farms in the rainfed region The land was positive and significant on small and large farms while negative and non-significant on the large sized farms. The regression coefficient of cropping intensity was found to be non-significant and positive on the small and medium farms but negative on large farms

The total employment of the farm family workers depended largely on the factors viz; cropped area, number of milch animals and working capital in the rainfed region

### **5.11 Annual gross income of the sample farms**

An important economic measurement, which is applied to measure the standard of living of the people is the income The average annual gross income

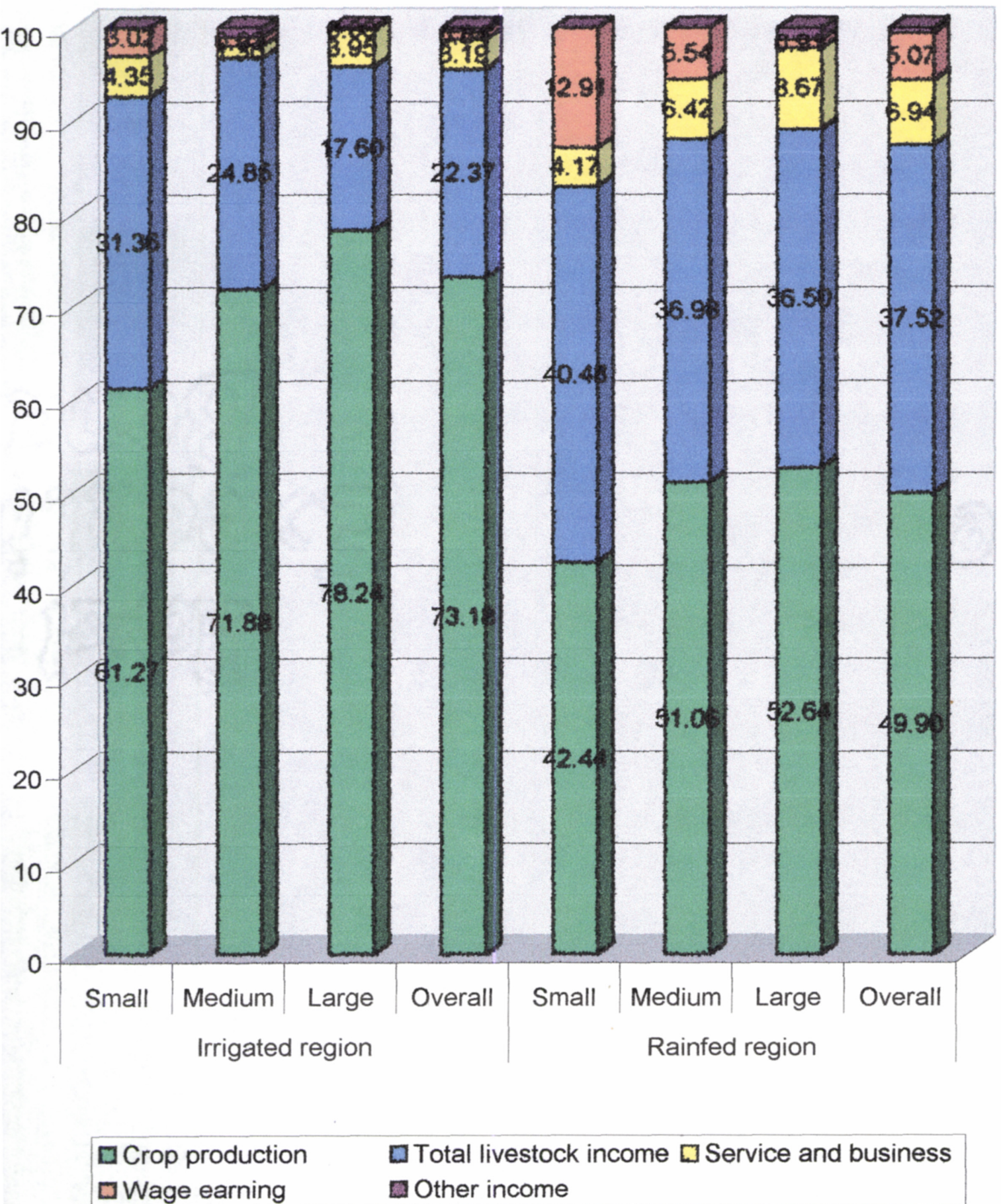
per farm was estimated by adding total income received from crop enterprise, livestock enterprise and from other sources are presented in Table 5 17

**Table -5.17 Sourcewise income of farm families (Rs )**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Crop production	68118 27	139774 00	243594 39	150495 77	25784 50	47734 50	65945 16	46488 05
Per cent	61 27	71 88	78 24	73 18	42 44	51 06	52 64	49 90
Milch animals	30659 45	39993 40	45572 94	38741 93	20903 79	26053 43	35429 33	27462 19
Per cent	27 58	20 57	14 64	18 84	34 41	27 87	28 28	29 48
Other animals	2561 02	5591 00	8022 33	5391 45	1516 51	4426 34	7211 00	4384 61
Per cent	2 30	2 88	2 58	2 62	2 50	4 74	5 76	4 71
Bullock hiring	1649 33	2744 00	1206 00	1866 44	2170 00	4088 00	3084 67	3114 22
Per cent	1 48	1 41	0 39	0 91	3 57	4 37	2 46	3 34
Total livestock income	34869 80	48328 40	54801 27	45999 82	24590 30	34567 77	45725 00	34961 02
Per cent	31 36	24 85	17 60	22 36	40 48	36 98	36 50	37 52
Wage earning	3358 33	1801 67	0 00	1720 00	7843 33	5178 33	1141 67	4721 11
Per cent	3 02	0 93	0 00	0 84	12 91	5 54	0 91	5 07
Machinery hiring	0 00	2010 00	666 67	892 22	0 00	0 00	1600 00	533 33
Per cent	0 00	1 03	0 21	0 43	0 00	0 00	1 28	0 57
Service and business	4833 33	2533 33	12300 00	6555 33	2533 33	6000 00	10866 66	6466 67
Per cent	4 35	1 30	3 95	3 19	4.17	6 42	8 67	6 94
<b>Total income</b>	<b>111179 73</b>	<b>194447 40</b>	<b>311362 33</b>	<b>205663 14</b>	<b>60751 46</b>	<b>93480 60</b>	<b>125278 49</b>	<b>93170 18</b>
Per cent	100.00	100 00	100 00	100 00	100 00	100 00	100 00	100 00

It was observed that at the overall level, total average annual gross income of a family in the irrigated region was Rs 2,05,663.14 whereas that of rainfed region was Rs.93,170 18, which was more than double the income of farms of the rainfed region. Obviously, per family annual gross income was more on the large farm and it increased with the size group of holding in both the regions.

Fig. 11- Sourcewise income of sample farm families (Rs.)



The share of income from crop production in the gross income was 73.18 per cent and 49.90 per cent in the irrigated and rainfed region, respectively. The livestock production activity has share of 23.37 per cent and 37.52 per cent in the gross income in the irrigated and rainfed regions, respectively. The share of income from crop production increased with the size groups of holding in both the regions while the share of income from livestock production showed reverse trend.

The income from milch animals was to the extent of 18.84 per cent of the gross income on farms in the irrigated region and it was 29.48 per cent in the rainfed region. The share of income from milch animals showed a decreasing trend with the size groups of holding in the irrigated region and it was 27.58 per cent on the small farms and 14.64 per cent on the large farms. The share of income from milch animals in the gross income was the highest on small farms (34.41 per cent) and lowest on the medium farms (27.87 per cent) in the rainfed region. The income from other animals (dry bovines, calves and goats) contributed 2.62 per cent in the rainfed region to the gross family income at the overall level. The share of income from bullock hiring out was more in the rainfed region (3.34 per cent) than in the irrigated region (0.91). The share of income from bullock hiring out decreased as the size group increased in the irrigated region, while in the rainfed region it was highest on medium farms (4.37 per cent) and lowest on the large farms (2.46 per cent). The share of income from wage earning obviously was more in the rainfed region (5.07 per cent) than in the irrigated region (0.84 per cent). It was the highest on small farms, 12.91 per cent in the rainfed region and 3.02 per cent in the irrigated region and showed decreasing trend in accordance with the size groups of farms in both the regions.

The proportionate share of income from machine hiring out (tractor, threshing machine etc ) was less than one percent in both the regions under study. Income from service and business was more in the rainfed region (6.94 per cent) than that in the irrigated region (3.19 per cent). It showed increasing trend among the size groups of farms in the rainfed region, while in the irrigated region, it was maximum on small size group (4.35 per cent) and maximum on the medium farms (1.30 per cent). This confirms the part of hypothesis i.e. income generated on farms differs on different types of farms and regions.

### 5.12 Farm family income function

An attempt was made to estimate the family income function for the individual categories of the sample farm families. The model employed was a multiple linear regression equation of the following form

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u_t$$

Where,

Y	=	Total farm income (Rs )
a	=	Constant
X <sub>1</sub>	=	Gross cropped area (ha )
X <sub>2</sub>	=	Milch animals (No )
X <sub>3</sub>	=	Working capital (Rs.)
X <sub>4</sub>	=	On-farm employment (mandays)
X <sub>5</sub>	=	Off -farm employment (mandays)
b <sub>i</sub> 's	=	Regression coefficients
u <sub>t</sub>	=	Error term

On examination of correlation matrix given in Appendix-VIII it was found that there was no problem of multi-collinearity and hence the regression analysis results indicated in Table 5.16 were accepted for interpretation.

The estimated value of the regression coefficients and their standard error are given in Table 5.18.

**Table 5.18 Results of income function of sample farms**

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Constant	-5744.97	4956.91	3952.86	-24531.03	-140.96	-4609.48	-13805.40	-6776.68
	***	NS	NS	**	NS	*	NS	NS
Gross cropped area (X <sub>1</sub> )	25578.23	5885.37	5096.23	5584.20	2140.15	7125.20	759.20	1202.20
Standard error	9412.20	6883.11	7741.64	2650.22	3366.47	3936.20	2120.00	1802.39
	NS	NS	NS	*	***	**	NS	***
No. of milch animal (X <sub>2</sub> )	6869.32	4585.17	13960.14	9500.00	6506.20	405.20	7309.62	8720.93
Standard error	3970.70	6131.71	8950.08	5397.71	2305.15	160.30	5888.56	3215.61
	NS	***	***	***	***	***	***	***
Working capital (X <sub>3</sub> )	0.3068	2.5097	2.7861	1.6592	3.056	3.2111	0.8912	1.1215
Standard error	0.6887	0.3755	0.2844	0.1712	0.4792	0.5931	0.2981	0.2172
	***	**	***	***	NS	*	**	**
On-farm employment (X <sub>4</sub> )	277.58	92.69	195.36	89.25	-128.90	142.2	196.2	65.25
Standard error	94.73	41.2500	71.0200	32.5200	96.3000	77.8400	86.4202	26.9500
	NS	NS	NS	NS	***	NS	NS	*
Off-farm employment (X <sub>5</sub> )	-43.24	28.84	396.84	-2.0554	65.84	4.49	158.20	48.10
Standard error	59.75	140.52	850.26	74.86	23.21	61.3130	253.44	26.20
R <sup>2</sup>	0.5845	0.8305	0.8435	0.7635	0.8692	0.7926	0.8105	0.7733
	***	***	***	***	***	***	***	***
F value	11.60	23.71	25.45	54.28	29.65	18.16	20.51	57.03

At the overall level, the coefficient of multiple determination ( $R^2$ ) were 0.7535 and 0.7736 for the irrigated and rained regions, respectively. This showed that the five independent variables have jointly explained nearly 75 and 77 per cent of the variations in the farm family total income under the irrigated and rained regions, respectively.

The value of F ratio from the analysis of variance in respect of family income function at the overall level in both the regressions have turned out to be highly significant, indicating the overall significance of fitted multiple linear regression equations.

It is observed that at the overall level, the regression coefficients of all the independent variables except, off-farm employment, were found to be positive and significant in the irrigated region. The regression coefficients of working capital and on-farm employment were found highly significant at 1 per cent level. The regression coefficient of land was positive and significant at 5 per cent level for the number of milch animals it was positive and significant at 10 per cent level and for off-farm employment, it was negative and non-significant.

Among the size groups on irrigated farms, the regression coefficients of land (gross cropped area) and number of milch animals were found positive and significant on small farms. The on-farm employment was found positive and significant, while, working capital, barring small farms, was significant in all the size groups of farms. The magnitude of regression coefficient, for land (gross cropped area) was the highest (Rs 25578.23) in small irrigated farms followed by medium and large groups. It means that an addition of 1 hectare of land, *ceteris paribus*, would have resulted into increase in the family income by Rs 25578.23 in small sized farms in irrigated region. The regression coefficient

of off farm employment was non-significant in all the size groups of farms in the irrigated region.

At the overall level, in the rainfed region, the independent variables viz, number of milch animals and working capital (cash expenses on crop and livestock production) were highly significant at 1 per cent level, while on-farm employment was significant at 5 per cent level and off farm employment was significant at 10 per cent level. The variable land (G C A ) was positive but non-significant.

Among the size groups, the crucial variable, working capital was highly significant in all the size groups, indicating its role in increasing annual gross farm income of farm families by increasing the cash expenses on crop and livestock production, in all the size groups of farms in the rainfed region.

The regression coefficient of number of milch animals was significant on small and medium farms, while the off-farm employment was positive and highly significant on small farms only in the rainfed region. The on-farm employment was negative and non-significant on small farms, while it was positive and significant on medium and large farms. The land (gross cropped area) was positive and significant on medium sized farm only.

Finally, it may be concluded that there is scope for increasing income levels of sample farm families by way of spending more on additional quantities of various non-human resources viz; number of milch animals, working capital for crop production and livestock production activities and on-farm employment used for crop and livestock production activities in both the regions.

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Chapter Opener Page



**SUMMARY**

**AND**

**CONCLUSIONS**

## **6 SUMMARY AND CONCLUSIONS**

The agricultural sector occupies a place of prime importance in the Indian economy because of a majority of population still depends on agriculture for its livelihood besides sharing sizeable contribution to the gross domestic product and the export earnings. In a predominantly agricultural dependent country like India, economic development largely depends on growth in agricultural production. Since the scope to bring additional land under cultivation is limited, significant increase in agricultural production is possible through raising productivities of different crops per unit of land, labour and capital.

The resources of the farmer being meager, it is difficult for him to sustain himself and his family on crop component only. Mixed farming, which comprises the crop and animal components together, creates a natural chain between the crop production and livestock raising which gives more sustainability to the farm business. In Maharashtra, where the famines are of common occurrence and majority of area is dry, mixed farming offers special advantages such as balanced farming providing more employment, income and covering risk of complete failure of mono-cropped farming. The mixed farming reduces risk and uncertainty in farm business and acts as hedge against famine and distress. The mixed farming is one of the useful measures for increasing productivity of both livestock and farm crops.

The extent of crop and livestock production system in rainfed and irrigated agriculture varies from region to region. Therefore empirical analysis of mixed farming in rainfed and irrigated farming is of special

importance to know the sectoral composition. In view of this, the study viz, “An economic analysis of mixed farming in the scarcity area of Western Maharashtra”, was undertaken with the following specific objectives

- 1 To study the resource use structure, costs and returns on the sample farms in irrigated and rainfed regions
- 2 To estimate and compare the resource productivities on the sample farms in both the regions
- 3 To determine the resource use efficiency in irrigated and rainfed regions
- 4 To study employment and income generated on the sample farms in the regions.

The sampling design for the present study was a three stage stratified random sampling with tahsil as the primary sampling unit, village as the secondary sampling unit and the farm house hold as an ultimate unit of sampling.

The scarcity zone consisting of parts of seven districts of Western Maharashtra, two districts viz; Pune and Solapur were selected purposely for the study. These two districts cover more than 35 per cent area of the scarcity zone of Western Maharashtra and have similar agro-climatic conditions. From these districts, two tahsils falling under scarcity zone, i.e. one irrigated and one unirrigated from each district were selected randomly on the basis of the highest and lowest irrigated areas in the tahsils. From each tahsil, 3 villages were selected randomly. From each village, 15 sample farms i.e. 5 each from the small (up to 2ha), Medium (2.01 to 4.00 ha) and large (4.01 and above) size groups of holdings were selected randomly. The total sample comprised of 90 irrigated and 90

unirrigated mixed farms. The total sample of 180 farms this comprised of 60 each of small, medium and large size closing farms. The primary data on relevant aspects of study were collected by personal interview with the farmers for the agricultural year 1999-2000.

To fulfil the requirements of the objectives of the study, the estimates of resource use structure, costs and returns and profitability, resource productivities, resource use efficiency, employment and income have been worked out for different size groups of holdings and the regions for crop activity, livestock activity and for farm as a whole.

Primarily, tabular analysis based on simple means and percentages has been used in this study. The Cobb-Douglas type production functions were deployed to estimate resource productivities and resource use efficiencies, from crop production activity, livestock activity and farm as a whole in both the regions. To estimate employment and income functions, the multiple linear regression was carried out. To know whether the irrigated and rainfed mixed farms belong to different production relationships, Chow's test of equality was applied.

The findings of the present study are briefly summarized as below.

## 6.1 Summary

1. The average family size of sample farms was 6.72 and 6.88 members in irrigated and rainfed regions, respectively. The family size showed an increasing trend with an increase in farm size in both the regions. The literacy percentage of farmers was 92.22 in the irrigated region and 90 in the rainfed region. The literacy percentage was the highest (93.33 per cent) in large size group in both the regions. The number of workers, at the overall level, was 3.38 in the irrigated region and 3.66 in the rainfed

region, comprising of 52.66 and 60 percent male workers on sample farms, respectively. The proportion of the female workers on farms was 42.31 per cent in the irrigated region and 45.36 per cent in the rainfed region.

2. The average size of holding in the rainfed region was higher (3.53 ha) than in the irrigated region (2.97 ha). The average size of holding of small, medium and large size farms in rainfed region was 1.45, 3.02 and 6.11 hectares, respectively, while in the irrigated region was 1.19, 2.83 and 4.90 hectares, respectively. The proportion of irrigated area in the total land holding was 83.50 per cent in irrigated region and 19.26 per cent in the rainfed region. The proportion of irrigated area in the total holding ranged from 17.93 per cent on small sized farms to 19.87 per cent on medium sized farms in the rainfed region. In the case of irrigated region, it was 82.04 per cent on large sized farms to 88.24 per cent on small sized farms. Among the different farm size groups, the cropping intensity was highest on small farms followed by medium and large farms in both the regions with an average intensity of 125.65 in the irrigated region and 120.07 in the rainfed region.
3. The average cropping pattern indicated that the average per farm gross cropped area was 3.40 hectares in the irrigated region. In the irrigated region, sugarcane occupied 42.06 per cent of the gross cropped area followed by cereals (40.00 per cent) comprising of rabi jowar (13.82 per cent), wheat (12.06 per cent), bajra (7.35 per cent) and maize (6.76 per cent). In the case of rainfed region, cereals occupied 57.22 per cent of the gross cropped area comprising of 30.03 per cent by rabi jowar and 17.85 per cent by bajra. The area under fruit crops was relatively more in the rainfed region.

- 4 The per farm average investment in capital assets was Rs 6,66,719.12 in the irrigated region and Rs.4,32,580.77 in the rainfed region at the overall level. The land holdings shared major proportion (67.12 per cent) in the capital assets, followed by farm building 13.40 per cent and irrigation structure 11.37 per cent in irrigated region. In the case of rainfed region, the land constituted 70 per cent of the total assets. The irrigation structure investment was more by one and half time in the irrigated region than in the rainfed region.
- 5 The average investment on livestock was Rs.32,745.33 in irrigated region which was higher than that in the rainfed region (Rs 25780.00) at the overall level. The number of livestock was 4.56 in irrigated region and 4.07 in the rainfed region. Among the bovines, crossbred cows shared the largest proportion (42.84 per cent) in the rainfed region than in the irrigated region (29.50 per cent), while the proportionate share of buffaloes was more in the irrigated region (38.45 per cent) than in the rainfed region (17.81 per cent).
- 6 There existed wide variations in the resource use structure in the irrigated and in the rainfed regions. The use of all productive inputs was quite high in the irrigated region than in the rainfed region both at the overall level and on the different size groups of farms. This variability was due to the difference in cropping pattern and crop production practices followed in these regions. The level of the resource use increased with an increase in farm size on per farm basis. However, this phenomenon was not observed on per cropped hectare basis. On per cropped hectare basis, the use of human labour, bullock labour and manure was maximum on the small sized farms in the irrigated region, whereas, mixed trend was observed in the use of these resources in the rainfed region and application

of fertilizers in the irrigated region. The per hectare input use level except bullock labour was higher in the irrigated region than in the rainfed region. The per farm use level of dry fodder, green fodder, concentrate and human labour was more in the irrigated region than in the rainfed region. Also per animal use level of dry and green fodder, concentrates was more in the irrigated region, while the human labour was more in the rainfed region.

- 7 The structural adjustments in the use of farm resources have had an economic impact on costs and returns of crop production activity and livestock activity of the sample farms

a) At the overall level, the per farm total cost of cultivation of crops was Rs 94,883.93 in the irrigated region, which was two and half times more than that of rainfed region (Rs 35,781.85). On per cropped hectare basis, the total cost of cultivation of crops was Rs 31,099.03, in the irrigated region consisting of 32.54 and 91.53 per cent share of cost A and cost B, in the total cost of cultivation, respectively. The per cropped hectare total cost of cultivation of crops in the rainfed region was Rs 10,259.21, which comprised of 59.30 per cent share of cost A and 84.44 per cent share of cost B. Similar trend was observed for farm groups in both the regions. The per farm total cost of cultivation increased with an increase in farm size at all the levels of costs.

The per farm gross returns from crop production business amounted to Rs 1,50,459.77 in the irrigated region and Rs 46,488.05 in the rainfed region at the overall level. Among the size groups of farms, the per farm gross returns increased with an increase in the size of farms in both the regions. On per hectare

basis, the gross returns from the crop production business were Rs.49,326.70 and Rs.13,328.85 in the irrigated and rainfed regions, respectively. The per cropped hectare gross returns were maximum on the small farms and declined among the size groups of farms in both the regions. The per farm, farm business income, family labour income, net income and farm investment income worked out to Rs.95,150.87, Rs.59,344.90, Rs.55,611.84 and Rs.87,593.29 in the irrigated region, respectively. All these incomes were quite higher than those of the rainfed region, which were Rs.25,268.92, Rs.16,271.21, Rs.10,706.20 and Rs.18,704.89, respectively.

- b) At the overall level, per farm total cost of livestock production, worked out to Rs.40,182.86 and Rs.31,411.49, in the irrigated and rainfed region, respectively. The total cost per livestock unit was Rs.8,352.09 and Rs.7,809.49 in the regions. The percentage of working cost to the total cost was 80.23 per cent and 81.52 per cent, respectively, in the regions, while share of fixed cost was 19.77 per cent and 18.48 per cent, respectively.

The gross returns from livestock production per farm were to the tune of Rs.45,999.82 in the irrigated region and Rs.34,961.02 in the rainfed region, at the overall level. Per livestock unit it was Rs.9,561.16 in the irrigated region, which was more than that of rainfed region (Rs.8,691.87). With the increase in farm size, the gross returns per livestock unit showed a decline.

The per farm returns over working cost and total cost worked out to Rs.13,760.28 and Rs.5,816.97 respectively, in the irrigated region and it was Rs.9,353.10 and Rs.3,449.53 in the rainfed

region. The per livestock unit net return over total cost were higher in the irrigated region (Rs 1209.07) than the rainfed region (Rs 882.48). The net returns per livestock unit were maximum on small farms in the irrigated region, while, the same were highest in the large sized farms in the rainfed region.

- c) At the overall level, per farm total cost (both crop and livestock production) incurred was Rs 1,35,066.79 in the irrigated region, which was more than twice than the rainfed region (Rs 67,193.34). The gross returns for the farm as a whole were Rs 1,96,495.59 and Rs 81,449.07 in the irrigated and rainfed region, respectively, at the overall level. The returns from crop production activity were more (76.59 per cent) than the livestock activity (23.51 per cent) in the irrigated region and in the rainfed region, the same were 57.08 per cent and 42.92 per cent, respectively, at the overall level. The share of crop production increased with an increase in the size groups of farms in both the regions, while the share of livestock production in gross returns declined with an increase in the size groups of farms in the rainfed region. The net return at total cost (Cost C) were Rs.61,428.81 which were more by four times than in the rainfed region (Rs.14,255.73).

- 8 The output . input ratio of crop production activity at cost C was more in the irrigated region (1.62 per cent) than that in the rainfed region (1.30 per cent). In livestock activity output-input ratio at total cost was also more in irrigated region (1.13 per cent) than in the rainfed region (1.09 per cent). The output-input ratio on farm as whole at cost C level was 1.45 and 1.21 in the irrigated and dry regions, respectively.

9 a) The critical examination of production function for the crop production activity of the sample farms revealed that land, human labour, manures and fertilizers and area under cash crops were important inputs influencing the gross value of crop output, at the overall level, in the irrigated region. The use of human labour, manures and fertilizers and area under cash crop were the important variables to which output was highly responsive, whereas the highly significant production elasticities of human labour, other working capital and area under fruit crops indicated the importance of these inputs to which output was highly responsive, at the overall level, in the rainfed region. The gross value of crop output was influenced by all the included variables excepting land. None of the variables had the production elasticity exceeding unity, showing thereby decreasing marginal productivity of factor inputs, in both the regions. The highly significant value of  $R^2$  indicated that the included variables have jointly explained about 73 and 71 per cent of the total variation in the gross value of crop output, at the overall level, respectively, in the irrigated and rainfed regions.

b) In the livestock production functional analysis, five resource variables have jointly explained about 76 and 81 per cent of total variation in the gross value of output in irrigated and rainfed region respectively, at the overall level. The regression coefficients of all the resource variables viz, dry fodder, green fodder, concentrates, human labour and livestock unit were positive and highly significant indicating that these are the important inputs to which output was highly responsive in the irrigated region. In the rainfed region, the highly significant regression coefficients of dry fodder, green fodder and concentrates

indicated the importance of these inputs in influencing the output of the overall level.

c) The critical examination of production functions for whole mixed farm revealed that human labour, cash expenses in livestock production and area under cash crops were the important inputs influencing the gross value of farm output, at the overall level, in the irrigated region. The use of human labour and cash expenses on crop production were the important variables influencing the gross value of farm output while, highly significant production elasticities of cash expenses on crop production, cash expenses on livestock production and area under fruit crops indicated the positive and significant association with the total farm income in the rainfed region. The gross value of farm output was influenced by all the variables included in the model excepting human labour.

- 10 The significant difference between the farm production functions of irrigated and rainfed farms was tested by using Chow's test. The 'F' ratio was highly significant indicating that the two regressions are not equal but differ significantly in their production relationship.
- 11 The analysis further indicated that there existed a constant returns to scale for crop production activity, livestock activity and mixed farm as a whole in all the size groups of farms in both the regions.
- 12 The marginal value products of different farm resources have been estimated (at geometric mean level) and compared with their per unit prices in order to know the resource use efficiency of the farms.
  - a. At the overall level, in crop production activity human labour, manures and fertilizers and area under cash crops were uses at their optimum use levels in the irrigated region. The significantly lower marginal value

products of land shows inefficient use of land, whereas inefficient utilization of other working capital as well as area under fruit crops was noticed, at the overall level, in the irrigated region. The higher marginal value products of human labour, manures and fertilizers, other working capital, area under cash crop and area under fruit crops indicated the use of these inputs was at optimal level, in the rainfed region. The marginal value product of land was less than its imputed rental value which has indicated its inefficient use.

- b. At the overall level, in livestock activity, use of dry fodder, green fodder, concentrates, human labour and livestock unit was at their optimum use levels in the irrigated region. The marginal value product of dry fodder, green fodder and concentrates were greater than the per unit acquisition cost of these inputs indicating that the use of these inputs was at their optimal levels in the rainfed region. The marginal value products of human labour and livestock were less than the per unit acquisition cost which depicted over utilization of these inputs in the rainfed region.
- c. At the overall level, on the farm as whole, marginal value products of human labour, cash expenses on crop production and area under cash crops were greater than the per unit acquisition prices of respective resources, which depicted that the use of these inputs was at their optimal level, in the irrigated region. The significantly lower marginal value products of land showed inefficient use, whereas low contribution of the factors viz, cash expenses on livestock and area under fruit crops was noticed in the irrigated region. The higher marginal value products of land, cash expenses on crop production, cash expenses on livestock production, area under cash crops and area under fruit crops indicates the use these inputs was at optimal level, at the overall level in the rainfed

region. The marginal value product of human labour was less than per unit wage rate indicates the excess use of human labour in the rainfed region.

- 13 Per family total employment generated was 613.40 mandays and 470.72 mandays in the irrigated and rainfed regions respectively, at the overall level. In the total employment, the share of crop production activity was highest (52.92 per cent) in the irrigated region, while the share of livestock production activity was highest (41.40 per cent) in the rainfed region. Employment generated from milch animal was 29.01 per cent and 26.83 per cent in the irrigated and rainfed regions, respectively.

On critical examination of employment function, it is noted that land, number of milch animals, working capital and off-farm employment were important variables to increase employment on the farms in the irrigated region at the overall level. The land (gross cropped area) and number of milch animals on the farms were highly significant indicating that these are the most important variables to increase employment on the farms in the irrigated region. In the rainfed region, land, number of milch animals, working capital and off-farm employment were important variables to increase employment on the farm in the rainfed region at the overall level. The land (G.C.A.), number of milch animals and working capital were highly significant showing that these are the most important variables to increase employment on the farms in the rainfed region.

- 14 At the overall level, average annual gross income of the sample farm family was Rs 2,05,663.14 in the irrigated region while in the rainfed region it was Rs 93,170.18. The share of income from crop production in the total income was 73.18 per cent and 49.90 per cent in the irrigated and rainfed regions, respectively. The livestock production activity

accounted for 22.37 per cent and 37.52 per cent in the total farm income in the regions, respectively. The income from milch animals amounted to 18.84 per cent and 29.48 per cent in the gross income of the irrigated and rainfed regions, respectively.

On critical examination of income function, it is revealed that land, working capital, on farm employment and number of milch animals were important variables to increase income on the farms in irrigated region at the overall level.

The working capital and on-farm employment were highly significant depicting that these are the most important variables to increase the income on the farms in the irrigated region. In rainfed region, variables viz, number of milch animals, working capital, on farm employment and off-farm employment were the important variables to boost the income on farms at the overall level. The number of animals and working capital were highly significant showing that these are the most important variables to enhance the income on the farms in the rainfed region.

## 6.2 Conclusions

From the empirical evidences of the study, the following conclusions have been drawn

1. The family size, number of farm workers, level of education and per farm investment in capital assets showed a positive relationship with the size of farms. There exists a positive relationship between gross cropped area and size of holding, literacy percentage as well as percentage of families depending on farming as only one source of income was more common in the irrigated region.

2. There was a positive relationship between average size of holding, irrigated area and size of farm. As the size increases, the percentage of area under cereals decreases. The area under pulses, oilseeds, fodder increased in the rainfed region, while, area under pulses and fodder crops showed the decline in the case of irrigated region. The cropping intensity was maximum in the irrigated region than in the rainfed region. It showed decreasing trend along the farm size groups in both the regions
3. The per hectare use of crucial inputs viz; human labour, machine power, manures and fertilizers were relatively high in the irrigated region, whereas the use of seed and bullock labour was more in the rainfed region. Per animal fodder use was more in the irrigated region, while, human labour use was more in the rainfed region. The agro-climatic differences among the regions led to wide variations in the resource use levels, production costs and returns of the farms
4. The farms of the irrigated region were more profitable than the farms of the rainfed region both in the crop and livestock production activity. The small sized farms were characterised by intensive agricultural practices since the intensities of resource use were relatively high
5. There was great variations in the production elasticities of different inputs for crop production among the regions as well as amongst group of farms which suggest the scope for increasing returns from crop production by way of intensifying the use of potential inputs (human labour, manures and fertilizers, area under cash crops) in the irrigated region, while in rainfed region, there existed a scope to increase area under fruit crops, other working capital and human labour. The productivity of livestock could be increased by way of higher input use in both the regions. There existed a scope for increasing farm

production by way of intensifying the use of potential inputs (human labour and cash expenses on crop production) in the irrigated region, while in the case of rainfed region, there existed a scope to increase area under fruit crops, cash expenses on crop production and cash expenses on livestock

- 6 The significant difference between the farm production functions of irrigated and rainfed farms were tested by using 'Chow's test' 'F' ratio, which was highly significant, indicating that two regression differed significantly in their production relationships.
- 7 The constant returns to scale were in operation in the production of crops, livestock and mixed farm as a whole on the sample farms in both the regions under the existing technological conditions
- 8
  - a The extent of resource use efficiency was high in the crop production activity on the different types of farms in both the regions. The marginal value product of human labour, manures and fertilizers and area under cash crops were greater than their prices. The use of these inputs was at optimal level in both the regions. The optimum level use of area under fruit crops and other working capital was noticed, at the overall level in the rainfed region. The inefficiencies in the resource use were more for land in both the regions and other working capital and area under fruit crops in the irrigated region
  - b The comparison of marginal value products of resource inputs with their per unit prices in livestock activity indicated the optimum use of green fodder, dry fodder, concentrates in both regions while inefficiencies in resource use were more in respect of human labour and livestock unit in the rainfed region, showed over utilization of inputs

- c. In the farm production, efficiency of resource use was more for area under fruit crops in the rainfed region, while it was more for the area under cash crops in the irrigated region. The higher utilization of human labour, cash expenses on crop production and area under cash crops would result in higher returns from the mixed farm as whole in the irrigated region. In the rainfed region, the increased use of land, expenses on crop and livestock enterprise, area under fruit crops and area under cash crops would result in higher returns from mixed type of farming in the rainfed region.
- 9 The relative share of employment from crop production in the total family employment was more in the irrigated region, while the livestock activity contributed more in the rainfed region. The proportionate share of employment from milch animals was higher in the livestock activity in both the regions. The total employment of farm family workers depended largely on cropped area and number of milch animals on the farm in both the regions.
- 10 The per family annual income was directly related to the farm size. The share of income from crop production increased with the size groups of holding in both the regions, while the share of income from livestock production showed reverse trend. There scope to increase the income levels of farm families by increased investment in farms of number of milch animals, working capital for crop and livestock production and on-farm employment on additional quantities of various non-human resources used for crop and livestock production activities in both the regions.

### 6.3 Policy implications

Maharashtra is in the process of impressive economic transformation especially in agricultural sector. Study of the state agriculture showed substantial growth in the production and considerable changes in various factors contributing for the growth. The crux of the problem of profitability of agricultural enterprises has been associated with the limitations on availability of capital resource, inadequate irrigation, lack of incentives to produce more, availability of suitable technologies and their adoption besides many other limitations.

The policy implications based on the inferences of the study, if considered and implemented (with practical considerations) with full involvement of policy makers, planners, implementing agencies (Govt & Non Govt) having active participation of entire spectrum of farm community, will go a long way in improving the farm economy. The WTO being accepted its implications are of prime concern to one and all, who are directly or indirectly involved with the prime sector of Indian economy i.e. Agriculture, which is the mainstay of majority of the Indian population and of the economy.

The policy implications are summarized as below.

1. Efforts are needed to activate extension education programme for the spread of improved production technologies of food grain crops among the farmers of the respective regions. Research efforts aiming at evolution of low cost technologies of food grain crops suitable for rainfed conditions will contribute for the increased production of food grains.

2. The cash expenses on crop production and area under cash crops are the important resource variables. The high marginal value product of these resources indicate the scope to increase area under cash crops and expenditure on working capital. This includes the expenditure on quality seeds, proper and timely adoption of preventive and protective plant protection measures, irrigation facilities and upkeep and use of improved implements and machinery to increase the farm returns
3. The marginal value productivity analysis of farm production indicated that there existed a scope for expansion of area under fruit crops in the rainfed, while area under cash crops in the irrigated region. In the rainfed region, area under dry land fruit crops should be increased, with the adoption of drip irrigation system to enhance the returns, with available irrigation resources. In the irrigated region, area under cash crops need be increased with the substitution of high yielding varieties for local varieties of the cash crops, will, however result improving the productivity of land resource as well as production of cash crops. The development of high yielding varieties suitable to the regions, therefore, becomes a major concern
4. Research and development strategies have to focus on exploiting the inter-regional and inter farm gaps. The research funds need to be augmented to venture successfully into new promising technology to raise productivity levels and resource use efficiency to a more productive and sustainable plateau.

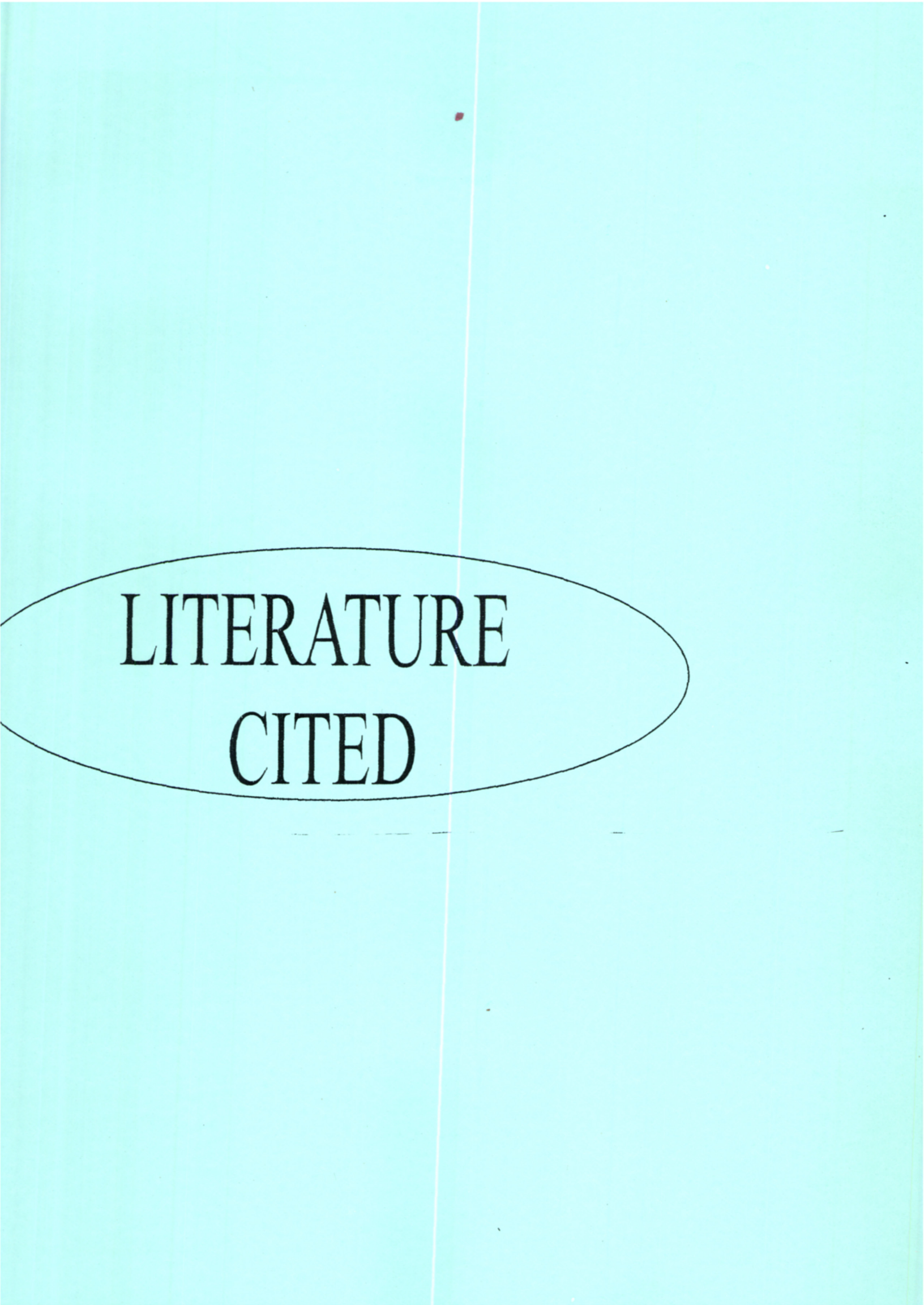
- 5 Mixed farming ensures utilization of existing resources and as such, there is a need for adopting mixed farming, which further demands more capital, credit facility, veterinary aids, which are required to be ensured in time and in required quantities
- 6 The milk yield per animal can be possibly increased through efficient dairy management, milk collection, its efficient transportation and distribution in order to have better returns
- 7 Farmers are required to be given reasonable price assurance for their milk and agricultural produce, so that mixed farming which, is there since ages could be continued on profitable and sustained basis
- 8 The productivity of local cows and buffaloes is quite low and cost of production of milk is more, which leads to low returns and therefore, it is necessary to have proper mix of local cows, buffaloes, crossbred cows and high yielding breeds of buffaloes
9. Availability of farm inputs including technological components and advances in time, their purchase/ distribution/adoption by the farmers and ensuring the proper and balanced marketing mechanism favouring all and disfavours none, is a must for the healthy competition in the global markets (s).
10. The success of the on going horticultural development in the state will depend on the efficient and effective functioning of the marketing system and processing industries for fruits and vegetables Since livestock production activity has been found to be the important activity in influencing the family's income and employment on small

and medium farms in the rainfed region, efforts for the development of these enterprises need to be intensified

All in all, it goes without saying that when we say “Annadata sukhi bhav”, it is, we, all the consumers of food, that receivers have to give major thought that at least little bit of contribution in making the farm community happy, in their efforts to feed the population, especially so in the regime of WTO

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LITERATURE  
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# **APPENDICES**

## 8. APPENDICES

### Appendix -I

Test of significance of Deviation of sum of elasticities ( $\sum b_i$ ) from unity

$$t = \frac{\sum b_i - 1}{S.E. \text{ of } (\sum b_i)}$$
$$= \frac{\sum b_i - 1}{\sqrt{S (C_{11} + C_{22} + C_{33} + 2C_{12} + 2C_{12} + 2C_{12})}}$$

Where, S = Sum of squares of due to errors /No of d f

= Variance estimate

(Note  $C_{11}$ ,  $C_{12}$  are the variance)

(elements of the Covariance inverse matrix)

The of significance of the difference of marginal values of products (MVP) of the input with its price

$$t = \frac{MVPX_I - \text{Price } X_I}{S.E. \text{ of } MVPX_I}$$

Where, S.E. of  $MVPX_I = \sqrt{AVPX_I^2 - V(b_i)}$

AVP refers to average value product

## Appendix - II

A) Zero order correlation matrix for crop production activity on small sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manure & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0.9280	1					
X <sub>2</sub>	0.8410	0.77610	1				
X <sub>3</sub>	0.8434	0.8084	0.8377	1			
X <sub>4</sub>	0.5266	0.6116	0.2989	0.5503	1		
X <sub>5</sub>	0.7474	0.6834	0.5080	0.5366	0.2495	1	
X <sub>6</sub>	0.0851	0.0470	0.4162	0.2924	0.1182	0.0155	1

B) Zero order correlation matrix for crop production activity on medium sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manure & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0.8956	1					
X <sub>2</sub>	0.9277	0.7864	1				
X <sub>3</sub>	0.9237	0.7276	0.8600	1			
X <sub>4</sub>	0.6133	0.7333	0.5348	0.6984	1		
X <sub>5</sub>	0.6896	0.5514	0.6623	0.5993	0.1310	1	
X <sub>6</sub>	0.3720	0.4128	0.2681	0.4266	0.3886	0.0266	1

C) Zero order correlation matrix for crop production activity on large sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manures & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8979	1					
X <sub>2</sub>	0 8523	0 8472	1				
X <sub>3</sub>	0 8792	0 7231	0 7489	1			
X <sub>4</sub>	0 2885	0 3807	0 1913	0 2558	1		
X <sub>5</sub>	0 8807	0 7476	0 7318	0 8077	0 1097	1	
X <sub>6</sub>	0 2534	0 4367	0 3064	0 2696	0 4034	0 0877	1

D) Zero order correlation matrix for crop production activity on overall sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manures & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 9508	1					
X <sub>2</sub>	0 9322	0 7219	1				
X <sub>3</sub>	0 9404	0 7573	0 7210	1			
X <sub>4</sub>	0 7329	0 7752	0 6722	0 7058	1		
X <sub>5</sub>	0 9033	0 7303	0 7317	0 8594	0 5537	1	
X <sub>6</sub>	0 3714	0 3576	0 3093	0 3030	0 3044	0 0368	1

### Appendix III

A) Zero order correlation matrix for crop production activity on small sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manure & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 7679	1					
X <sub>2</sub>	0 9024	0 7144	1				
X <sub>3</sub>	0 8836	0 8158	0 8227	1			
X <sub>4</sub>	0 3323	0 7172	0 2729	0 5508	1		
X <sub>5</sub>	0 4832	0 7303	0 3495	0 6390	0 4572	1	
X <sub>6</sub>	0 7990	0 1907	0 6397	0 4344	0 2211	0 1407	1

B) Zero order correlation matrix for crop production activity on medium sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manures & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha ) X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8345	1					
X <sub>2</sub>	0 9249	0 8070	1				
X <sub>3</sub>	0 8482	0 8179	0 8105	1			
X <sub>4</sub>	0 1977	0 5209	0 2368	0 5023	1		
X <sub>5</sub>	0 4007	0 4949	0 4234	0 5685	0 2583	1	
X <sub>6</sub>	0 8886	0 6691	0 7543	0 6156	0 0307	0 0568	1

C) Zero order correlation matrix for crop production activity on large sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manures & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 7661	1					
X <sub>2</sub>	0 8954	0 6610	1				
X <sub>3</sub>	0 6209	0 6221	0 6186	1			
X <sub>4</sub>	0 1985	0 3723	0 5480	0 0981	1		
X <sub>5</sub>	0 7190	0 5456	0 6081	0 3730	0 1406	1	
X <sub>6</sub>	0 4010	0 3068	0 4758	0 6076	0 6627	0 1337	1

D) Zero order correlation matrix for crop production activity on overall sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Manures & Fertilisers (Rs ) X <sub>2</sub>	Other working capital (Rs ) X <sub>3</sub>	Gross cropped area (ha ) X <sub>4</sub>	Area under cash crop (ha ) X <sub>5</sub>	Area under fruit crop (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8283	1					
X <sub>2</sub>	0 9134	0 7578	1				
X <sub>3</sub>	0 6965	0 7242	0 6949	1			
X <sub>4</sub>	0 4409	0 6700	0 3204	0 4323	1		
X <sub>5</sub>	0 6146	0 5983	0 5724	0 5087	0 2704	1	
X <sub>6</sub>	0 6560	0 4088	0 5815	0 4404	0 0272	0 0594	1

### Appendix IV

A) Zero order correlation matrix for livestock production activity on small sample farms in the irrigated region

Variable	Gross returns (Rs) Y	Dry fodder (qtl) X <sub>1</sub>	Green fodder (qtl) X <sub>2</sub>	Concentrates (Rs) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 8628	1				
X <sub>2</sub>	0 8929	0 7067	1			
X <sub>3</sub>	0 8413	0 6555	0 8303	1		
X <sub>4</sub>	0 8943	0 8785	0 7688	0 6441	1	
X <sub>5</sub>	0 8570	0 8883	0 6532	0 6475	0 8688	1

B) Zero order correlation matrix for livestock production activity on medium sample farms in the irrigated region

Variable	Gross returns (Rs) Y	Dry fodder (qtl) X <sub>1</sub>	Green fodder (qtl) X <sub>2</sub>	Concentrates (Rs) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 6356	1				
X <sub>2</sub>	0 9523	0 4816	1			
X <sub>3</sub>	0 8770	0 3447	0 9318	1		
X <sub>4</sub>	0 8142	0 8385	0 7399	0 6495	1	
X <sub>5</sub>	0 6960	0 8214	0 5232	0 4676	0 7712	1

C) Zero order correlation matrix for livestock production activity on large sample farms in the irrigated region

Variable	Gross returns (Rs) Y	Dry fodder (qtl) X <sub>1</sub>	Green fodder (qtl) X <sub>2</sub>	Concentrates (Rs) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.9326	1				
X <sub>2</sub>	0.9150	0.8796	1			
X <sub>3</sub>	0.8602	0.7924	0.8702	1		
X <sub>4</sub>	0.9204	0.8006	0.8144	0.6398	1	
X <sub>5</sub>	0.9098	0.8791	0.7540	0.6732	0.9480	1

D) Zero order correlation matrix for livestock production activity on overall sample farms in the irrigated region

Variable	Gross returns (Rs) Y	Dry fodder (qtl) X <sub>1</sub>	Green fodder (qtl) X <sub>2</sub>	Concentrates (Rs) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.8962	1				
X <sub>2</sub>	0.7857	0.5975	1			
X <sub>3</sub>	0.8396	0.7947	0.6611	1		
X <sub>4</sub>	0.8808	0.8231	0.6725	0.6967	1	
X <sub>5</sub>	0.8715	0.7177	0.5790	0.8120	0.8140	1

### Appendix - V

A) Zero order correlation matrix for livestock production activity on small sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Dry fodder (qtl ) X <sub>1</sub>	Green fodder (qtl ) X <sub>2</sub>	Concentrates (Rs ) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No ) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 7152	1				
X <sub>2</sub>	0 8359	0 4589	1			
X <sub>3</sub>	0 8822	0 5080	0 7483	1		
X <sub>4</sub>	0 7336	0 7322	0 5492	0 5333	1	
X <sub>5</sub>	0 8768	0 7649	0 6495	0 8005	0 7016	1

B) Zero order correlation matrix for livestock production activity on medium sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Dry fodder (qtl ) X <sub>1</sub>	Green fodder (qtl ) X <sub>2</sub>	Concentrates (Rs ) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No ) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 8270	1				
X <sub>2</sub>	0 8643	0 6174	1			
X <sub>3</sub>	0 7465	0 4304	0 7949	1		
X <sub>4</sub>	0 7681	0 7762	0 5804	0 6087	1	
X <sub>5</sub>	0 8793	0 8308	0 7215	0 6111	0 8509	1

C) Zero order correlation matrix for livestock production activity on large sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Dry fodder (qtl ) X <sub>1</sub>	Green fodder (qtl ) X <sub>2</sub>	Concentrates (Rs ) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No ) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.9357	1				
X <sub>2</sub>	0.9528	0.8524	1			
X <sub>3</sub>	0.9187	0.8039	0.7505	1		
X <sub>4</sub>	0.8815	0.8984	0.8315	0.7931	1	
X <sub>5</sub>	0.9508	0.8299	0.8177	0.8609	0.8404	1

D) Zero order correlation matrix for livestock production activity on overall sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Dry fodder (qtl ) X <sub>1</sub>	Green fodder (qtl ) X <sub>2</sub>	Concentrates (Rs ) X <sub>3</sub>	Human labour (mandays) X <sub>4</sub>	Livestock unit (No ) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.8967	1				
X <sub>2</sub>	0.9256	0.7653	1			
X <sub>3</sub>	0.8809	0.6971	0.8972	1		
X <sub>4</sub>	0.8433	0.8548	0.7399	0.6832	1	
X <sub>5</sub>	0.9336	0.8208	0.8457	0.8099	0.8961	1

### Appendix - VI

A) Zero order correlation matrix for mixed farm as a whole on small sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses on crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8961	1					
X <sub>2</sub>	0 7839	0 7220	1				
X <sub>3</sub>	0 5713	0 6370	0 1314	1			
X <sub>4</sub>	0 1560	0 0600	0 2279	0 1972	1		
X <sub>5</sub>	0 1858	0 2450	0 2837	0 0572	0 0156	1	
X <sub>6</sub>	0 4429	0 4300	0 4252	0 0375	0 2496	0 1182	1

B) Zero order correlation matrix for mixed farm as a whole of medium sample farms in irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses on crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8406	1					
X <sub>2</sub>	0 8317	0 7660	1				
X <sub>3</sub>	0 3249	0 3060	0 1552	1			
X <sub>4</sub>	0 5380	0 3440	0 6326	0 2742	1		
X <sub>5</sub>	0 3443	0 3200	0 3966	0 0453	0 0267	1	
X <sub>6</sub>	0 6459	0 7600	0 6746	0 1433	0 1311	0 3886	1

C) Zero order correlation matrix for mixed farm as a whole on large sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 9106	1					
X <sub>2</sub>	0 8978	0 7860	1				
X <sub>3</sub>	0 1747	0 2730	0 0352	1			
X <sub>4</sub>	0 8602	0 7070	0 8120	0 0186	1		
X <sub>5</sub>	0 2678	0 4610	0 2876	0 1319	0 0877	1	
X <sub>6</sub>	0 3486	0 4610	0 2464	0 3443	0 1098	0 4034	1

D) Zero order correlation matrix for mixed farm as a whole on overall sample farms in the irrigated region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 9555	1					
X <sub>2</sub>	0 9453	0 8300	1				
X <sub>3</sub>	0 4082	0 4490	0 2373	1			
X <sub>4</sub>	0 8546	0 7670	0 8066	0 1180	1		
X <sub>5</sub>	0 2449	0 3100	0 2662	0 0636	0 0369	1	
X <sub>6</sub>	0 7756	0 8150	0 7301	0 3906	0 5538	0 3044	1

### Appendix - VII

A) Zero order correlation matrix for mixed farm as a whole on small sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses on crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 4544	1					
X <sub>2</sub>	0 6942	0 3755	1				
X <sub>3</sub>	0 5915	0 1231	0 0405	1			
X <sub>4</sub>	0 4579	0 5985	0 4638	0 0449	1		
X <sub>5</sub>	0 6140	0 0602	0 5713	0 2106	0 1408	1	
X <sub>6</sub>	0 2855	0 4457	0 2884	0 0783	0 4662	0 2300	1

B) Zero order correlation matrix for mixed farm as a whole on medium sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 6198	1					
X <sub>2</sub>	0.8730	0 5874	1				
X <sub>3</sub>	0 5094	0 6558	0 3046	1			
X <sub>4</sub>	0 3644	0 4335	0 5326	0 0855	1		
X <sub>5</sub>	0 8510	0 3062	0 6683	0 2128	0 0568	1	
X <sub>6</sub>	0 2923	0 4690	0 4088	0 3174	0 2262	0 0694	1

C) Zero order correlation matrix for mixed farm as a whole on large sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses on crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 8419	1					
X <sub>2</sub>	0 4731	0 4105	1				
X <sub>3</sub>	0 7997	0 7696	0 1417	1			
X <sub>4</sub>	0 4754	0 3090	0 4061	0 1718	1		
X <sub>5</sub>	0 3504	0 2821	0 5724	0 1661	0 1337	1	
X <sub>6</sub>	0 0830	0 3050	0 0275	0 0562	0 1269	0 0183	1

D) Zero order correlation matrix for mixed farm as a whole on overall sample farms in the rainfed region

Variable	Gross returns (Rs ) Y	Human labour (mandays) X <sub>1</sub>	Expenses on crop production (Rs ) X <sub>2</sub>	Expenses on livestock (Rs ) X <sub>3</sub>	Area under cash crop (ha ) X <sub>4</sub>	Area under fruit crop (ha ) X <sub>5</sub>	Gross cropped area (ha )X <sub>6</sub>
Y	1						
X <sub>1</sub>	0 7451	1					
X <sub>2</sub>	0 6296	0 4878	1				
X <sub>3</sub>	0 7381	0 6640	0 2670	1			
X <sub>4</sub>	0 5179	0 4292	0 4980	0 2547	1		
X <sub>5</sub>	0 5504	0 382	0 4807	0 1777	0 0594	1	
X <sub>6</sub>	0 4779	0 4695	0 3355	0 3042	0 2733	0 0570	1

### Appendix - VIII

A) Zero order correlation matrix for income on small sample farms in irrigated the region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (mandays) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.4629	1				
X <sub>2</sub>	0.5056	0.2502	1			
X <sub>3</sub>	0.5977	0.3706	0.7790	1		
X <sub>4</sub>	0.7068	0.3002	0.6048	0.7745	1	
X <sub>5</sub>	-0.2045	0.0690	-0.2457	-0.3354	-0.2134	1

B) Zero order correlation matrix for income on medium sample farms in the irrigated region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (mandays) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.6433	1				
X <sub>2</sub>	0.3994	0.1308	1			
X <sub>3</sub>	0.8897	0.6242	0.6022	1		
X <sub>4</sub>	0.4942	0.4280	0.7080	0.6757	1	
X <sub>5</sub>	-0.2220	-0.2452	-0.2288	-0.2655	-0.1677	1

C) Zero order correlation matrix for income on large sample farms in the irrigated region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (mandays) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.3483	1				
X <sub>2</sub>	0.2455	0.2000	1			
X <sub>3</sub>	0.8841	0.3517	0.4582	1		
X <sub>4</sub>	0.7070	0.5040	0.5085	0.04260	1	
X <sub>5</sub>	-0.02683	-0.0483	-0.1669	-0.1444	0.1213	1

D) Zero order correlation matrix for income on overall sample farms in the irrigated region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (mandays) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.4483	1				
X <sub>2</sub>	0.3455	0.2100	1			
X <sub>3</sub>	0.7841	0.3017	0.4182	1		
X <sub>4</sub>	0.6070	0.5540	0.5185	0.04260	1	
X <sub>5</sub>	-0.01683	-0.1483	-0.1669	-0.1644	0.0213	1

### Appendix -IX

A) Zero order correlation matrix for income on small sample farms in the rainfed region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (per cent) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 4051	1				
X <sub>2</sub>	0 8597	0 7125	1			
X <sub>3</sub>	0 8687	0 8101	0 7611	1		
X <sub>4</sub>	0 0918	0 7109	0 7829	0 6230	1	
X <sub>5</sub>	0 8271	0 4221	0 3919	0 1108	0 0131	1

B) Zero order correlation matrix for income on medium sample farms in the rainfed region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (per cent) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0 5230	1				
X <sub>2</sub>	0 6533	0 6021	1			
X <sub>3</sub>	0 8390	0 7231	0 7516	1		
X <sub>4</sub>	0 6122	0 8070	0 7289	0 5849	1	
X <sub>5</sub>	0 1209	0 2912	0 3143	0 1091	-0 0231	1

C) Zero order correlation matrix for income on large sample farms in the rainfed region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (per cent) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.3464	1				
X <sub>2</sub>	0.3102	0.5022	1			
X <sub>3</sub>	0.8380	0.7351	0.5831	1		
X <sub>4</sub>	0.7801	0.7902	0.6137	0.6802	1	
X <sub>5</sub>	0.3131	-0.0980	0.2028	-0.1230	-0.0453	1

D) Zero order correlation matrix for income on overall sample farms in the rainfed region

Variable	Farm income (mandays) Y	Gross cropped area (ha) X <sub>1</sub>	Milch animals (No) X <sub>2</sub>	Working capital (Rs) X <sub>3</sub>	On farm employment (per cent) X <sub>4</sub>	Off farm employment (mandays) X <sub>5</sub>
Y	1					
X <sub>1</sub>	0.3429	1				
X <sub>2</sub>	0.8231	0.4951	1			
X <sub>3</sub>	0.8701	0.6829	0.4125	1		
X <sub>4</sub>	0.6121	0.5831	0.5595	0.3480	1	
X <sub>5</sub>	0.3335	0.0918	0.2410	0.0131	0.0112	1

**Appendix - X**

Results of Chow test on the sample farms

Farm size group	Degrees of freedom	F Value
Small	46	5.20***
Medium	46	2.69**
Large	46	11.69***
Overall	166	10.19***

\*\*\* Significant at one per cent level

\*\* Significant at five per cent level

### Appendix - XI

#### A) Geometric mean of inputs and gross returns of crop production

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Human labour $X_1$	168 85	339 00	572 93	320 03	96 16	166 10	388 60	159 81
Manures & fertilizers $X_2$	5689 63	10558 60	20150 29	10665 96	476 93	2708 19	1237 61	842 36
Working capital $X_3$	16523 10	32260 94	56732 86	31153 00	6602 36	12597 19	20280 58	8605 76
Gross cropped area $X_4$	1 17	2 77	4 78	2 50	1 47	0 06	5 23	2 86
Area under cash crop $X_5$	0 34	0 75	1 54	0 73	0 04	0 05	0 11	0 06
Area under fruit crop $X_6$	0 02	0 01	0 02	0 01	0 01	0 02	0 02	0 02
Gross return $Y$	60254 30	125959 50	233045	120920 51	18021 39	35013 60	54801 00	32576 16

#### B) Geometric mean of inputs and gross returns of livestock production

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Dry fodder $X_1$	65 44	114 63	129 61	58 74	44 57	68 50	91 52	65 37
Green fodder $X_2$	85 71	125 78	121 57	114 81	55 51	83 33	90 77	74 86
Concentrate $X_3$	497 24	529 64	667 50	560 14	407 45	529 96	579 88	500 26
Human labour $X_4$	160 55	211 46	249 33	203 79	130 58	201 24	237 05	183 99
Livestock unit $X_5$	3 12	4 51	5 35	4 22	2 59	3 65	4 60	3 50
Gross return $Y$	31138 58	41895 34	50134 95	40290 25	21407 19	32143 65	38537 18	29819 17

## C) Geometric mean of inputs and gross returns of farm production

Particulars	Irrigated region				Rainfed region			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Human labour $X_1$	284 61	530 49	805 84	495 45	412 50	492 82	535 00	477 33
Expenses on crop prod $X_2$	17885 97	32774 48	58863 49	27136 25	5346 73	10549 30	14152 52	9274 70
Expenses on livestock $X_3$	16442 47	24417 08	27772 77	22335 72	11375 03	16082	19266 53	15215 98
Area under cash crop $X_4$	0 34	0 75	1 54	0 73	0 04	0 04	0 11	0 06
Area under fruit crop $X_5$	0 02	0 01	0 02	0 04	0 01	0 02	0 02	0 02
Gross cropped area $X_6$	1 27	3 10	5 21	2 74	1 48	3 10	5 32	2 90
Gross return $Y$	81348 75	177589 4	290976	164361 5	43723 53	71244 18	99468 59	68660 93



## 3 Information about farm assets, machinery, implements etc

## A) Farm implements and machinery

Particulars	Number	Year of Purchase	Value (Rs )		If shared, share of cultivator	Remaining life (Yr )	Maintenance Charges (Rs )
			Present	At the time of purchase			
<b>Bullock drawn Implements</b>							
1	Wooden plough						
2	Iron plough						
3	Harrow						
4	Seed drill						
5	Hoes						
6	Bullock cart						
7	Other						
<b>Machinery</b>							
1	Tractor						
2	Tractor drawn accessories						
3	Oil Engine						
4	Elec Motor						
5	Thresher						
6	Crusher						
7	Spray pump						
8	Duster						
9	Others						
<b>Tools</b>							
1	Pick axe						
2	Spade						
3	Sickle						
4	Weeding hooks						
5	Crow bar						
6	Axe						
7	Others						

B) Information about farm buildings :

Type	Area (l x w)	Type of Construction	Year of Construction	Value (Rs )		Part of house if used as animal shed / godown			
				Present	At the time of construction	Area	Value	Remaining Life (yr )	Maintenance charges during the year (Rs )

C) Information about wells, tube wells and other sources of irrigation

Type	Type of construction (in case of wells)	Year of construction	Remaining life (yr )	Digging and construction charges(Rs )	If shared % share	Area Irrigated (ha )	Whether water Is adequate?	Expenditure During the year
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6 Production and value of various crops

Crop	Dry/ irrigated	Variety	Main produce			By-produce			Total Value (Rs)	Reasonwise justification for high/low crop production
			Quantity (qt)	Rate (Rs/qt)	Value (Rs)	Quantity (qt)	Rate (Rs/qt)	Value (Rs)		



## 8 Expenditure on livestock

Animals/ birds	Number	Labour		Green fodder				Dry fodder			Concentrates			Vet & other Charges (Rs )	Total Expe- nditure (Rs )
		Family	Hired	Home produced		Purchased		Home Produced		Pur- ased	Home Produced		Pur- hased		
		F M C	F M C	Qty.	Value (Rs )	Qty	Value (Rs )	Qty	Value (Rs )		Qty	Value (Rs )			
Draught animals															
Milch Cow/s															
Dry cow/s															
Milch buffalo															
Dry buffalo															
Calves															
Other															
1 Poultry															
2 Goat															
3 Sheep															

9 Details regarding production from livestock

Live-Stock type	Total Milk Production (lit)	Sold out to co-op Dairy society			Retained for home consumption			Sale of milk Products		Total (Rs)	Eggs			Wool			F Y M			Total Prodn Rs	Rem-ark
		Qty (lit)	Rate Rs / Lit	Value (Rs)	Qty (lit.)	Rate (Rs./ lit.)	Value (Rs)	Qty	Value (Rs)		Total	Sale		Total	Qty sold	Val-ue (Rs)	Pro-duction	Sold Qty	Vale (Rs)		
												No	Val (Rs)								

10 Income from purchased and sale of livestock

Livestock Type	Purchase		Sale		Reason for Purchase/sale	Remarks
	Number	Value (Rs)	Number	Value (Rs)		

### 11 Activitywise labour employment of family and permanent labourers

Month	Engaged in crop production			Livestock maintenance		Working on others farms			Service/ business social & family work			Illness			Unemployment days			Total Working days			
	Male	Female	Children	Milch Animals M F C	Other Animal M F C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	

### 12 Income from crop production and other activities

Month	Sale of agril produce			Wages (Rs )	Other business (Rs )	Service (Rs )	Income from hiring out bullocks (Rs )	Income from hiring out machinery implements (Rs )	Milk & other products (Rs )	Govt assistance (Rs )	Total income Rs
	Qty Qtl	Rate Rs	Total (Rs )								

### 13 General questions

- 1 Since when you have undertaken the following occupations?
    - a) Agriculture / farming -
    - b) Animal Husbandry -
  - 2 Difficulties faced in crop production
    - a) Shortage of funds
    - b) Are you informed about the modern varieties of crops?
    - c) Lack of knowledge of improved crop production practices
    - d) Do you face shortage of irrigation? If yes, When?
    - e) Whether the fertilizers are available?
    - f) Whether the loan disbursement is timely?
    - g) Whether the fuel/electricity supply is adequate?
    - h) Whether the crops fetch adequate price in market?
    - i) Other difficulties
  - 3 Difficulties faced in milk production/dairy activities
    - a) Shortage of funds
    - b) Are you informed about the modern dairying techniques?
    - c) Availability of crossbred cows
    - d) Whether the co-operative milk society is near to your place?
    - e) Whether the veterinary center is near to your place?
    - f) Green fodder/Hay availability · Adequate/ Inadequate
    - g) Whether the prices of fodder are adequate?
    - h) Availability of concentrates : Yes/No
    - i) Price of concentrates : High/Optimum
    - j) Availability of AI center · Yes/No
    - k) Other
3. Labour
- a) Whether the work is of permanent nature?
  - b) Whether the wages are sufficient/adequate
  - c) Place of work : Near/Far
  - d) Other

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**VITA**

## 9.VITA

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Scarcity Area of Western Maharashtra”**

Major field	Agricultural Economics
Personal Bio-data	Born at Bori, Tahsil – Indapur, District – Pune on 1 <sup>st</sup> June, 1963 Son of Shri Narahari Eknath Waghmare Married with Lalita on 8 <sup>th</sup> May, 1989 Having daughter - Monica and son – Pratik
Educational	Attended primary education at Bori, Secondary in Shri Chhatrapati high school, Bhavaninagar Tal Indapur Dist - Pune Higher Secondary in T C College, Baramati (Pune) Obtained the Bachelor of Science (Agriculture) in June 1985 with first class Master of Science in Agricultural Economics in January, 1989 obtained first class with distinction from MPKV, Rahuri Completed Ph D Course work in Agril Economics P G I , M P K V , Rahuri in 2000
Professional Experience	Worked as Agriculture Supervisor in the Department of Agriculture, Govt of Maharashtra during 1985-86 Appointed as a Junior Research Assistant in May 1988 in CPMCC Scheme, Department of Agricultural Economics, M P K V Rahuri Promoted as a Senior Research Assistant in August 2004 and appointed as Assistant Statistician in the Comprehensive Scheme, Department of Agricultural Economics, M P K V Rahuri till date
Publications	Published 11 research papers and popular articles in various reputed journals

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