ECONOMICS OF MAJOR CROPPING SEQUENCES IN PUNE DISTRICT OF MAHARASHTRA

A Thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI-413722, DIST. AHMEDNAGAR
MAHARASHTRA, INDIA

In partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE [AGRICULTURE]

in

AGRICULTURAL ECONOMICS

By

MR. GAIKWAD TEJAS BAPU
(Reg. No. 13/124)

DEPARTMENT OF AGRICUTURAL ECONOMICS
POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH,
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Approved by

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2016

CANDIDATE'S DECLARATION

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

Place : M.P.K.V., Rahuri **(Gaikwad T. B.)**

Date :

Dr. Y. C. Sale
Assistant professor of
Agril. Economics,
College of Agriculture, Pune

C E R T I F I C A T E

This is to certify that the thesis entitled **"ECONOMICS OF MAJOR CROPPING SEQUENCES IN PUNE DISTRICT OF MAHARASHTRA",** submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra (India) in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE) in AGRICULTURAL ECONOMICS,** embodies the results of a piece of bonafide research work carried out by **Mr. GAIKWAD TEJAS BAPU,** under my guidance and supervision and that no part of this thesis has been submitted for any other degree or diploma.

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Date :

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

Date : / / 2016 *(Gaikwad T.B.)*

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List of Abbreviations

%	-	Per cent
/	-	Per
Agril.	-	Agriculture
Cl/ha	-	Cartload/hectare
e.g.	-	Exampli gratia (For example)
CS	-	Cropping Sequence
Econ.	-	Economics
et al.	-	*et alia* (and others)
etc.	-	Etcetera
Fig.	-	Figure
FYM	-	Farm Yard Manure
Ha	-	Hectare
i.e.	-	That is
J.	-	Journal
kg	-	Kilogram
MH	-	Maharashtra
Qtl.	-	Quintals
Qty.	-	Quantity
Res.	-	Research
₹	-	Rupees
Univ.	-	University
Viz.,	-	Videlicet (namely)
@	-	at the rate

NI	-	Net Income
FC	-	Fixed cost
Ind	-	Indian
Asso	-	Association
Vol	-	Volume
PP	-	Page Number
Co-op	-	Co-operative
Situ	-	Situation
Teh	-	Tehsil
Dist	-	District
ha	-	Hectare

ABSTRACT

ECONOMICS OF MAJOR CROPPING SEQUENCES IN PUNE DISTRICT OF MAHARASHTRA

By

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DEPARTMENT OF AGRICULTURAL ECONOMICS,
MPKV, RAHURI-413722

Research Guide : **Dr. Y. C. Sale**

Department : Agricultural Economics

The study "Economics of major cropping sequences in Pune district of Maharashtra" was conducted in six villages of Indapur, Shirur and Junnar tahsils of Pune district. The objectives of the study were to identify different cropping sequences, to estimate the resource use structure of major cropping sequences. Besides this, employment, income and expenditure pattern of sample farmers adopting major cropping sequences were studied. The constraints in adoption of major cropping sequences in Pune districts were also examined.

Contd…

The study was based on the primary data of 90 cultivators for the year 2013-14 spread over the six randomly selected villages of three tahsils. From each selected village, 15 cultivators, 5 from each size group *viz.,* small, medium and large were randomly selected. Thus, total sample consisted of 30 farmers each of small, medium and large size groups.

Out of existing sixteen cropping sequences three major cropping sequences *viz.,* Pearl millet-Coriander-*Rabi* Onion cropping sequence (CS-I) is the dominant cropping sequence which is adopted by 21 farmers (23.33 per cent) followed by Pearl millet-*Rabi* Sorghum (CS-II) by 20 farmers (22.22 per cent) and Cauliflower-*Rabi* Potato-Fenugreek (CS-III) by 18 farmers (20.00 per cent), were selected for present study.

The average per hectare utilization of resources *viz.,* machine power, planting material, manures and fertilizers *etc.* were more used in cropping sequence III compared to remaining two cropping sequences. The per hectare labour utilization indicated that the utilization of human labour was maximum in cropping sequence I which was followed by cropping sequence III. Cropping sequence III observed per hectare utilization of machine power was more than cropping sequence I and II. The farmers adopted cropping sequence III had used more fertilizers than cropping sequence I and II.

Contd…

Abstract contd..... **Gaikwad T.B.**

The average per hectare cost of cultivation was highest in cropping sequence III (₹236774.42), followed by cropping sequence I (₹179574.88) and cropping sequence II (₹ 63398.97). The average per hectare yield and gross income were less in cropping sequence II (37.47 qtl and ₹66622.58) as compared to cropping sequence I and III (320.81 and 433.47 qtl and ₹292129.08 and ₹410648.64), respectively. This has resulted into higher B:C ratio (1.73) in cropping sequence III as compared to cropping sequence I (1.63) and cropping sequence II (1.05).

Total employment generated was 390.93, 351.72 and 325.10 man days in cropping sequence I, II and III, respectively. Of the total employment generated in cropping sequence III, 20.25 per cent employment was generated through crop production activity and 42.25 per cent through livestock activity. In cropping sequence II, 16.31 per cent employment generated through crop production activity and 43.78 per cent through livestock activity. While more employment generated through crop production 28.19 per cent in cropping sequence I. The employments generated were more in cropping sequence I, includes crop such as Pearl millet, Coriander and *Rabi* Onion required more labours.

Contd…

The results of employment function of three cropping sequences indicate that the variables included in the model were number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in employment function have jointly explained 78.00 per cent, 70.00 per cent and 69.00 per cent variation for cropping sequence I, II and III, respectively. The highest contribution came from number of milch animal (X_2) for cropping sequence I and II and earners (X_1) for cropping sequence II and III.

Highest annual income produced in crop production by cropping sequences I was ₹179450.72 followed by income produced by cropping sequences II and III in crop production were ₹52465.28 and ₹171105.68, respectively. The results of income function of three cropping sequences indicate that the variables included in the model were number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in income function have jointly explained 76.00 per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively. The variables *viz.,* number of earners (X_1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in

Contd…

cropping sequence I and III, but it was non-significant in cropping sequence II. Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III.

Highest annual expenditure spends on cropping sequences III was ₹315695.60 per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 per cent share, respectively). Expenditure spends on cropping sequences I and II are ₹298761.18 and ₹241850.69, respectively.

The scarcity of water in summer, irregular supply of electricity with low voltage, high wage rate and non- availability of input (*i.e.* planting material, manures, chemical fertilizer and pesticides *etc.*) are the major problem faced by farmer in adoption of major cropping sequences. During marketing, the problem faced by the farmer high transportation cost, high price fluctuation, high marketing cost and lack of market intelligence.

The technical know-how, the availability of inputs, diversification of crops efficient use of irrigation and better marketing *etc.*, will help the farmers to have sustainable income consistently.

1. INTRODUCTION

1.1 General.

The agricultural sector occupies the place, prime importance in the Indian economy. This is because 61 per cent Indian population still depends on agriculture for its livelihood. Besides, the agriculture sector contributes 12.00 per cent of gross domestic products and provide, sizeable export earnings (₹ 28,657 crore *i.e.* 1 per cent of total export earnings during 2010-11). 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).

It is being increasingly realized that the land are limited and the wide use of the same is imperative. This is especially true in the case of countries like India where the population pressure is continuously increasing.

Indian agriculture is characterising by 70 per cent rain fed crop. In other words only 30 per cent of the total cultivable land is brought under irrigation. However, the proportion of irrigation is only to the tune of 13 per cent for the state of Maharashtra. With the increase in area under irrigation and the availability of shorter duration varieties of different crops, the scope for increasing the cropping intensity through cropping sequence is continuously increasing.

Farmers wish that the crop should be grown with minimum risk and should have high returns. On the other side, farmer also desire that their family member should gate full employment throughout the year on their own farms. If these two objectives are to be attained simultaneously, it is rather difficult task. Because past studies and experiences indicated that mono or sole cropping like sugarcane, cotton crop may not provide adequate employment to the family member, while it may yield high returns to the farmer. On the contrary, the other crop sequences may not fetch high returns to farmers but may supply adequate employment to the family members.

There is the way to increase agriculture production on the small or marginal unit of the farming is to increase the productivity per unit and area. This may be achieved by breeding efficient crop varieties and by improving management practices like fertilizer use, weed and paste control, irrigation application *etc.*

Cropping Sequence can be defined as growing of two or more crops in sequence on the same piece of land in an Agricultural year (Reddy, 2000). Depending on the number of

crops grown in the year, it is called as double, triple and quadruple cropping involves two, three and four crops, respectively. In addition to these systems, relay cropping, ratoon cropping is also in vogue. Relay cropping refers to planting of the succeeding crop before harvesting the previous crop, Ratoon cropping or rationing refers to raising a crop with regrowth coming out of root or stalks after harvest of the crop

History of cropping sequence is very old. In the past, agricultural scientists tried to be familiar with the tradition based technology. Gradually, new concepts on cropping sequence have started coming in and now there has been some accumulations of useful scientific information based on growth analytical work on different crop sequential growth of crops.

The cropping sequence is important from the point of view the individual farmer as well as the nation as a whole. In the case of individual farmer, it is the question of the sequence of crops to be grown on the limited area in a period of one year with the given quantities of labour, capital and management. From the national point of view, it is the problem of evolving cropping patterns 'plan priorities'. Thus, the cropping sequence is concerned with the important issues both at micro and macro levels. At the micro level, the maximisation of farm profits in a given year with the available resources and at the macro level, the most efficient utilization of the nation's productive resources from the important objectives of appropriate cropping sequences in intensive agriculture.

Cropping sequences are important in the farm economy. An endeavour to attain optimum use of resources towards the most profitable cropping sequence would become a guideline to prescribe the direction in which the shift of resources as well as cropping sequence should take place in a selected area. Such shift of area to the highly profitable cropping sequence and optimum level of resources use would not only strengthen the economic position of the cultivators but will also have a considerable impact on the state's economy.

The problem before the farmer is thus, the selection of crop to be grown in different seasons which will fit in the sequence to form an appropriate cropping sequence in farm business. Now, technological progress in different aspects have given many farmers a greater freedom of choice among rotations of crop *viz.,* monoculture, double cropping, triple cropping or perhaps four crops during a year. There is a gradual shift from subsistence farming. In which farmer grows only those crops needed for his consumption to commercialized farming in which only those crops are grown which have the highest comparative advantages. In this technological context, farmers are trying to adopt profitable cropping sequences.

Availability of new technology does ensure adoption of profitable cropping sequence by farmers. There are various factors responsible for it among which resources structure, managerial ability, risk bearing capacity, presence of infrastructure like credit facilities, availability of irrigation, marketing facilities and remunerative prices are the important

ones. Efforts are, therefore, needed to examine economical cropping sequence in the context of the existing resources structure and increasing farm income and employment of farmers and his family members. In view of this, the job of production economist is to provide new knowledge to cultivars on a continual basis such that resources use efficiency can be increased and profits maximised. This situation induced that there should be a study on economics of cropping sequence systems in Pune district as per given objectives.

1.2 The problem.

The problem of 'Economics of cropping sequence' is important from view point of individual farmer. To the individual; farmer, it will give an indication of the optimum combination of different resources like labour, fertilizer, working capital, irrigation *etc.*, to be used for growing the crop on his farm.

It has been observed that during resent year large area has been brought under highly commercial crops like pulses, groundnut, vegetables (onion, tomato, and chillies), fruit crop as well as high yielding variety of and cereals such as *kharif* sorghum, pearl millet, paddy *etc.*, besides sole cropping.

In this study the cropping sequence adopted a sample farm are compare with each other. An attempt to find out optimum use of resources toward the most profitable cropping sequence would become guideline to prescribe the direction in which the shift of recourses as well as cropping sequences should take place in the selected area. Such shift of area to the highly profitable cropping sequence and the

optimum level of recourse use would not only strengthen the economic position of the farmers but will also have a considerable impact on the economics of the state.

This study tries to examine the adoption of the different cropping sequences in the context of the exiting recourses structure that will have high resulting farm income and employment to the farmer. The specific objectives of the present study are

1.3 Objectives:

a) To identify the different cropping sequences
b) To study the resource use structure of major cropping sequences
c) To study the employment, income and expenditure pattern of sample farmers adopting major cropping sequences
d) To study the constraints in adoption in major cropping sequences

1.4 Scope and utility of the study

The present investigation is carried out in specific area *i.e.* Pune district of Maharashtra. However, the result of this study will have waste scope. Actually there could be large number of cropping sequences can be followed by the farmers. The present study cover major cropping sequence, the economic analysis of which would be guideline to those who adopt it and do not adopt it. Besides the finding of the study may be useful for other area where similar type of agro-ecological situation prevail.

The main aim of this study is to find out the most suitable and highly profitable cropping sequence which will

help in increasing production and improve the condition of farmer and ultimately help in improving the economic status of people. The results will be of great help in formulation of production oriented policies.

1.5 limitation of the study

The present study is mainly relied on the data collected through interview using schedules. Therefore, some amount of recall bias is bound to be associated with the collected data since the farmers did not maintain any records about the cultivation expenses, application of inputs and returns especially for subsidiary enterprises. However, efforts were made to minimize them through cross checks at time of data collection. Since, the information was collected from farmers who practiced various cropping sequences in Pune district of Maharashtra, generalization of the results to other areas should be made carefully. The suggested model considered optimal solutions from economists' point of view, using the prices of inputs and output that prevailed at the time of enquiry and not for ecology and environment consideration.

2. REVIEW OF LITERATURE

India is facing a very serious problem of fast increasing population, creating continuous heavy demand for food grains. The area under food grain crops cannot be increased as it has limitation. Cropping sequence is one of the important solution for increasing food grain production. This will also help in improving farmer's economy, maintaining soil fertility and developing employment potential.

Several research worker studies cropping sequence of 2-3 crops including either cereals, pulses, oilseeds and fibre crops grown according to local preferences. The literature closely related to the present investigation is grouped and briefly presented on the following aspect.

2.1 Identification of cropping sequences
2.2 Resource use structure
2.3 Cost of production, gross and net returns
2.4 Employment potentiality
2.5 Constraints adopting cropping sequence

2.1 Identification of cropping sequences

Varshney (1993) observed that the lowest biomass of nutgrass was recorded in sesame-wheat (63 g/m^2), followed by sesame-wheat-green gram (83 g/m^2) compared with 598 g/m^2 in pigeonpea-wheat-greengram sequence. It was inferred that growing of greengram in summer increased nutgrass infestation.

Gangwar (1995) observed that alley cropping with *Leucaena leucocephala* in upland rice-wheat sequence is not only economical but also beneficial in improving soil

productivity. The system was identified as a potential alternate cropping system for best utilization of salt-affected lands.

Chand (1996) concluded that the cropping pattern changes have occurred mainly from crops with declining demand and lower value addition potential to crops with an increasing demand and higher value addition potential.

Behera and Jha (1999) concluded that order to avoid the risk, provide better returns to the farmers. It is needed to diversify the cropping programme of rainfed uplands with non-rice crops, which are drought tolerant, less moisture-requiring and deep-rooted such as pulses and oilseeds.

2.2 Resource use structure

Scatena and Walker (1996) suggested that a major factor in selecting a fallow length is the relationship between land clearance costs and the age of vegetation. In particular, since clearing costs are dramatically reduced for young secondary vegetation, the reduction in site preparation costs over several short rotations compensates for the lost production caused by using short fallows instead of long fallows.

Lu *et al.* (2003) suggested a range of crop rotations that satisfy food production, soil and water conservation and economic objectives to different extent. The results of this study can serve two purposes. First, they may help setting an agenda for empirical and experimental research aimed at the testing and improving of cropping systems and second, the cropping systems can be input for an integrated land use study that weighs objectives at regional scale and reveals

potential and strategic land use options.

Dogliotti *et al.* (2003) concluded that the sound procedure to evaluate the performance of large number of rotations 'a priori', ROTAT can reduce the risk of ignoring promising options and the arbitrariness present in previous studies dealing with design of rotations. The usefulness of ROTAT for designing production activities in explorative land use studies based on linear programming is discussed.

Shrivastava *et al.* (2003) found that the application of 5 ton FYM ha^{-1} resulted in significantly higher yield of black gram (599 kg ha^{-1}) and wheat (1,347kg ha^{-1}) than without application. Phosphorus level 17.2 kg ha^{-1} resulted in significantly higher yield, comparable yield in without application

David (2004) search for systems that use more water to reduce drainage through the soil and lower saline water tables. A major contribution is the much restricted use of fallow but summer active plants are also required to provide a soil water storage buffer to retain autumn–winter rainfall. New systems under evaluation include herbaceous perennials such as Lucerne that are readily integrated into a crop-livestock system and agroforestry combinations with various trees.

Gupta and Seth (2007) Field results show that the resource conserving technologies, an exponent of conservation agriculture, improve yields, reduce water consumption and reduce negative impacts on the environmental quality.

Olaf and Vijayalaxmi (2008) reviews and synthesizes the experience ZT wheat is particularly appropriate for rice–wheat systems in the IGP by alleviating system constraints by allowing earlier wheat planting, helping control the weed *Phalaris minor,* reducing production costs and saving water. These benefits explain the widespread interest of farmers and the rapidity of the diffusion across the Indian IGP, further aided by the wide applicability of this mechanical innovation.

Singh *et al.* (2009) studied integrated nutrient management in pearl millet-wheat cropping sequence in semi arid condition of India. They concluded that the combination application of organic manures and fertilizers had significant and positive effect on productivity of the system. The quality of both the crops in respect of protein, nitrogen and phosphorus and potash utilization increased significantly with combined use of organic manure and inorganic fertilizer.

Aglave *et al.* (2009) concluded that the 60 kg N/ha gave significantly higher gross and net monetary returns in the cropping sequence of mungbean-sunflower compared to all other sequences and nitrogen level.

Roger and Michael (2010) concluded that in Western Australia, cereal crops are being grown with increasing frequency at the expense of less profitable break crops and developed a land use sequence optimiser (LUSO) to analyse strategic break crop decisions across as unite of price, yield, nitrogen fertiliser cost, soil borne disease incedent and weed thresholds.

Yadav *et al.* (2013) found that the highest effect of inorganic nutrient, organic manure and bio-fertilizer on rice-potato-onion cropping sequence.

Gullani *et al.* (2013) found that the a positive effect of organic farming on productivity, B:C ratio of soybean and sedimentation value of wheat flour.

Bhat *et al.* (2013) on the basis of two years study lead to the conclusion that for realizing higher grain yield of maize based cropping system under Kashmir valley conditions rates and frequency of FYM for maize-oats cropping system must centre around 10 ton FYM ha^{-1} to be applied in *kharif* and *rabi* along with recommended package of NPK for both maize and oats.

2.3 Cost of production, gross and net returns

Palada *et al.* (1981) found that the returns on a dollar/acre basis in Florida state were the highest in the onion-bean-collar cropping pattern.

Bhore (1985) studies cropping systems of various vegetables under Pune region and concluded that the cropping system *viz.*, Cauliflower-Coriander-Bottle gourd and Cucumber-Frenchbean-radish gave higher net return of ₹ 47,574 ha^{-1} $year^{-1}$ while the cropping system *viz.*, onion-Cucumber-Bottle gourd gave the lower net returns ₹ 11,652 ha^{-1} $year^{-1}$.

Radha *et al.* (1989) studied the two rice based farming system in Divi taluka, Krishna district of A.P. It was observed that total cost of cultivation was ₹ 7290 and ₹ 5140 on rice-rice and rice-pulses farming system, respectively. Net

returns were slightly higher in rice-pulse cropping system than rice-rice cropping system.

Padhi (1993) a field experiment was conducted during 1987-90 to find out the most suitable rice (*Oryza sativa* L.) based cropping sequence on sandy loam soil of north eastern ghat zone of odisha under irrigated medium land situation. Amongst different rice based cropping sequences, rice-potato-cowpea recorded the highest output with maximum input: output ratio.

Chaudhary and Chaudhary (1994) observed that higher returns were realised from Basmati rice with wheat (₹ 42760) or with sunflower (₹ 44960) registered higher returns over sugarcane ratoon (₹ 34168).

Ray *et al.* (1999) studied the productivity and profitability of low land rainfed rice-based cropping sequences in Andaman. The net returns and benefit cost ratio were highest for the okra sequences followed by the cowpea sequences.

Kausarkar (2003) reported that sorghum-cotton cropping sequence was most profitable followed by sorghum-soybean cropping sequence.

Nimje (2003) observed that the Pigeon pea-Wheat sequence gave significantly highest gross return, followed by the soybean-gram. However, the highest net monetary returns and benefit cost ratio were found under soybean-gram sequence followed by soybean-wheat sequence.

Gan *et al.* (2003) founded that the relationship was stronger when durum was preceded by oilseeds compared with pulses. Broadleaf crops in no-till cropping systems provide

significant rotational benefits to durum wheat in the semi-arid northern Great Plains.

Gangwar *et al.* (2003) founded that the among 12 crop sequence evaluated at Akola district Cotton-groundnut cropping sequence gave highest productivity of 43.82 kg day^{-1} ha^{-1} followed by Sorghum-Indian mustard-groundnut with production efficiency of 25.59 kg day^{-1} ha^{-1}. The best cropping sequence was Sorghum-Chickpea + wheat with productivity of 33.14 kg day^{-1} ha^{-1}. And reported that at M.P.K.V. rahuri 8 cropping sequences tired sorghum-chickpea-cowpea (fodder) cropping system was found distinctly better than other cropping sequence gaves maximum productivity 94.19 kg day^{-1} ha^{-1}, followed by Groundnut-wheat cropping sequence with productivity 39.23 kg day^{-1} ha^{-1}and single crop of sugarcane giving productivity of 33.46 kg day^{-1} ha^{-1}.

Sinha *et al.* (2009) suggested that growing sunhemp as green manuring crops in *kharif* rice in jute-rice-potato, jute-rice-lentil and jute-rice-mustard cropping sequences at West Bengal resulted in an additional return of ₹ 2,944, ₹ 1,555 and ₹ 2,662 ha^{-1}, respectively.

Rathod *et al.* (2009) founded that amongst rainfed cropping sequences Cotton-fallow was the best sequence with more net return, output-input ratio and was the most profitable cropping sequence followed by soybean-gram cropping sequence.

Aglave *et al.* (2009) reported that the cropping sequence of mungbean-sunflower and urd-sunflower gave higher gross and net monetary returns compared to fallow-sunflower.

Chitale *et al.* (2011) found that the Rice–potato-cowpea cropping sequence was the most appropriate system in terms of profit as well as sustainability over the years.

Sale (2011) studied for cropping sequences in the year 2009-10. The result revealed that the maximum net monetary returns ₹ 78139 ha^{-1} was obtained from soybean-onion cropping sequence with highest B:C ratio of 2.46 followed by soybean-chilli cropping sequences in respect of net returns ₹ 27,124 ha^{-1} and B:C ratio 1.55.

Kumar *et al.* (2011) found that among different cropping sequences rice-maize-moong recorded higher mean yield than rice-wheat-moong cropping sequences. Further, rice-maize-moong registered higher average productivity with recycled pond silt + poultry manure (50+50 %).

Tuti *et al.* (2013) found that Pigeon pea–lentil cropping system proved to be the best in terms of monetary returns, net return and soil productivity and hence, could be adopted in the north-west Himalayas under rainfed conditions.

Anthony *et al.* (2015) concluded that the intensification of sesame-based cropping system could help farmers adapt to the changing climate with greater net productivity and enhanced income through crop(s) diversification. One that emphasizes a climate-smart agriculture strategy for food security, mitigation and adaptation.

2.4 Employment potentiality

Shrinji (1991) studied that economic impact of market yards in Rajasthan: an analysis of the effects on income, employment and cropping pattern. The study suggest to policy makers that attempts to improve the economic condition of farmers will not succeed without transforming the old cropping pattern in Indian agriculture. The development market has encouraged the farmer not only to increase the income of farmers but also increases the level of employment.

Joshi (1995) reported that the Paddy-Wheat cropping sequences provided more employment than other cropping sequences in Western Maharashtra.

Vyas (1996) reported that the farmers on their own have tried to arrive at such a product mix by introducing crops or engaging in enterprises which enable them to spread out the risks and ensure a steady flow of income over the year.

Ray *et al.* (1999) studied that productivity and profitability of low land rainfed rice-based cropping sequences in Andaman. They observed that net returns and benefit cost ratio were highest for the okra sequences followed by the cowpea sequence. Employment potential was higher with a double than single crop of rice and was highest for okra and cowpea.

Behera and Jha (1999) shown that there is a severe problem of seasonal unemployment and under-employment in large parts of our country leading to seasonal migration of labourers/farmers to nearby cities/towns in search of contractual employment.

Mahapatra and Behera (2004) concluded that the risk reduction through crop diversification related to climatic and biotic variables particularly in fragile ecosystems, and commodity fluctuations by expanding locally adapted or introducing new varieties and related production systems will contribute to improved food security and income generation for resource poor farmers and protect the environment.

Chandrappa *et al.* (2005) concluded that paddy-gram-okra is most employment generative cropping sequences among all other cropping sequences in Karnataka.

Behera *et al.* (2008) suggested that the crop sequence is considered as an important tool for acceleration is of agricultural growth in India by promoting food and nutritional security, income and employment generation.

Sharma and Kumar (2009) suggested that among the different crop sequences, the most economical was rice-gobisarson-greengram, a maximum employment generating sequence.

Sah *et al.* (2010) observed that cropping sequences like paddy - chilli and paddy-sunflower were suggested for saline soils whereas, paddy-potato and paddy-greenpea were suggested for non-saline soils. Incorporation of sunflower in the existing paddy based cropping sequences enhanced the land utilization up to a maximum of 26.32 per cent in case of marginal farmers and 36.44 per cent in case of small farmers. They suggested land use may generate an enhanced employment option from 142 to 205 and 176 to 197 man-days ha^{-1} $year^{-1}$ for the marginal and small farmers, respectively, and increase their per capita income irrespective of their class.

Chitale *et al.* (2011) found that the rice-potato-cowpea cropping sequence was found most preferable in terms of providing employment with better economic return. This sequence employed maximum number of man-days (554) in a year and showed highest employment generation efficiency (152.3 per cent) as compared with other sequences.

Singh *et al.* (2012) concluded that the employment generation efficiency much higher in cropping system involving menthol mint and vegetable crops, the highest employment in maize-cauliflower-onion-menthol mint + okra cropping system.

Kachroo *et al.* (2014) founded by three year field study revealed that the existing rice-wheat cropping sequence can be diversified to short duration rice-garlic-cowpea which recorded the highest employment generation efficiency 110.9 per cent over other rice based cropping sequences.

2.5 Constraints adopting cropping sequence

Atibudhi *et al.* (1993) studied that the high yielding varieties adoption of package of practices was another impediment in the way of increased productivity of rice and groundnut and reported that the inputs were available timely but the poor quality seeds, low purchasing power of sample farmers, unsuitability of mustard and groundnut varieties to the particular soil type put another hurdle in the way of realising higher productivity.

Vyas (1996) suggested a high elasticity of supply of various crops in response to prices, and suggested that some of the physical and geographical features (*e.g.,* drainage characteristics, elevation and slopes) as well as climatic

factors (*e.g.,* total rainfall and its distribution, minimum and maximum temperature, humidity, intensity of sunlight, *etc.*) are other factors which have to be taken as "given" while making production decisions. Any effort to modify these natural and physical conditions in order to introduce a different cropping pattern may prove, in most of the circumstances, quite difficult and economically non-viable.

Jones and Thomas (1997) concluded that the relative to SM management, NT management of wheat residues increased average soil water contents at planting of the next crop by 22 mm with WSF, 15 mm with WF, and 29 mm with CW; it was not as effective with sorghum residues. Mean grain yields were not affected by residue management on any cropping system, because the additional water stored with NT management was slight in relation to seasonal evapotranspiration.

Diwvedi *et al.* (1998) observed that the lowest net returns and benefit cost ratio of 1.97 was under maize-wheat sequence due to lower price in the market and lower productivity.

Rattan *et al.* (1999) observed that sulphur deficiency had reported from sandy soils particularly in wet winters, affecting the productivity of oilseeds.

Tanner (2000) studied the effect of tillage and cropping sequence practices on wheat production over eight year on a farmer's field in South-Eastern highlands of Ethiopia. They observed that farmer adopting minimum tillage for wheat production must be encouraged to practice crop rotation with French bean in order to minimize the risk of an

increase in the density of *Bipectinatus*.

Timsina and Connor (2001) suggested the need to look for new production strategies that might avoid existing constraints in some areas of the R±W region. In particular, soil, water and nutrient management strategies, such as reduced tillage and use of raised beds, that avoid the deleterious effects of puddling on soil structure and fertility, improve water and nutrient use efficiencies, and increase crop productivity, may be appropriate.

Chand (2002) observed that due to increasing demand of organically grown commodities in international market, India's efforts to concentrate on basmati rice pay good dividends in export market in future

Adjei-Nsiah *et al.* (2007) observed that the choice of a particular rotational sequence is related to access to resources and the needs of the farmer. Therefore they suggests that, in a heterogeneous farming community like Wenchi, technology development should be targeted to suit the needs and resources available to each particular group of farmers.

Kumar et al. (2011) reported that rice-potato-greengram sequence was found the most efficient for production (18.1 t^{-1} ha^{-1} $year^{-1}$), employment generation (1.18 man $days^{-1}$ ha^{-1}. Berseem may be taken as a break crop successfully for reducing weed problem (weed-control efficiency 88.7 per cent) in continuous rice-wheat system without any monetary loss.

Robertson *et al.* (2010) found that the scope for increased area of break crops beyond 23–38 per cent of the

farm is limited, even with increases in the yield enhancements in subsequent cereal crops, higher break crop prices, and higher fertiliser costs in Western Australian farming systems.

Fletcher *et al.* (2011) observed that the most productive crop sequences are those that maximise the interception and use of solar radiation there was a consistent trend identifying the most productive combinations of sowing date and hybrid duration. The sequence of comparatively late sowing date of maize (1st December) and a long-season hybrid maximised the total yield of the sequence.

3. METHODOLOGY

The object of any scientific investigation is to draw the useful conclusions in the light of the objectives of the study. In order to arrive at the conclusions, it is essential for the investigator to adopt appropriate methods and procedures. Keeping this in view, this chapter has been devoted to explain the methodology adopted to fulfill the objectives under study. It deals with the procedure used for the selection of sample, method of data collection, type of data collected, sources of data and analytical procedures used to get the results as per the objectives under 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 cropping sequences for crop production 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 farm

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, chemical fertilizer, plant protection measures and other inventory expenditure as well as the data on physical quantities of output composing of main and by-products of crop 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, chemical fertilizers, insecticides, fungicides, repairs of implements or machinery *etc.*, and maintenance of livestock by the selected sample families. In addition to this for computing the value of output from crop, 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 records of Government office such as Agriculture, Animal's husbandry, Co-operatives, *etc.* The micro level data were obtained by personal interview from the selected 90 sample families for the year 2013-14.

3.3 Sampling design

The sampling design adopted for the present study was three stages stratified random sampling design with tahsils a primary sampling unit, village as a secondary

sampling unit and farm household as the ultimate unit of sampling.

3.3.1 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 order in district. Three tahsils were selected purposively on the basis of the highest cropped area thus, three tahsils namely Indapur, Shirur and Junnar from Pune district were selected for present study.

3.3.2 Selection of villages

The village, being the secondary unit of sample, randomly two villages were selected from each tahsil by listing them in ascending order, having maximum cropped area villages *viz.*; Lasurne and Varkute (kh). from Indapur tahsil, Pabal and Kanuhar-Mesaii from Shirur tahsil and Rajuri and Alle from Junnar tahsil of Pune district were selected.

3.3.3 Selection of sample farmers

The tertiary and ultimate unit of sample was the farmer. The list of the farmers having the cropped area were prepared from revenue record of villages and were categorized into three size groups on the basis of the operational holdings *viz.,* holding size below 1.00 ha., 1.01 ha. to 2.00 ha. and above 2.01 ha. were designated as small, medium and large size groups, respectively. Then, thirty cultivators were selected

randomly from each size groups. Thus, the total sample consisted of 90 farms.

Table 3.1.Distribution of selected farmers

(No.)

Sr. No.	Name of villages	Size group			
		Small	Medium	Large	Overall
Indapur					
1.	Lasurne	5	5	5	15
2.	Varkute (kh.)	5	5	5	15
Shirur					
1.	Pabal	5	5	5	15
2.	Kanuhar-Mesaii	5	5	5	15
Junner					
1.	Rajuri	5	5	5	15
2.	Alle	5	5	5	15
	Total	30	30	30	90

3.4 Collection of data

3.4.1 Primary data

The data were collected by survey method for the year 2013-14. The detailed information was especially collected from personal interviews of sample farmers. The data were collected with help of specially designed schedule together information on cost of cultivation and employment, income and expenditure of farmers. The details of schedule used for data collection is given in Appendix-I.

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 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 was estimated by a tabular system of analysis with simple averages. The input requirements were calculated separately for each crop on per hectare basis. The inputs requirements for crop enterprise included human labour (hired + family), bullock labour, seeds, manures and fertilizers, plant protection chemicals, irrigation *etc.* The input requirements were estimated for each of the sample categories

3.5.2 Estimation of costs and returns

The data were analysed to find out the unit production cost and returns of each crop separately. A cross sectional (*i.e.* size group wise) comparison of cost and returns of crop as well as cropping sequence as whole was done separately in order to find out the extent of profitability.

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 crop as well as for the cropping sequence as a whole.

3.6 Concepts and their meanings

3.6.1 Cost concepts used

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':

It is also called as paid out cost, this cost approximates the expenditure incurred by the farmer in cash and kind in the cultivation of crop and includes the following items.

1. Hired human labour
2. Seed
3. Manure
4. Fertilizers
5. Plant protection measures
6. Machinery charges
7. Owned and hired bullock labour
8. Land revenue and other cesses
9. Interest on working capital
10. Depreciation on implements and machinery
11. Repairs of machinery and Irrigation charges

Cost 'B'

Cost 'B' = Cost 'A' + Rental value of owned land + Interest on fixed capital

Cost 'C'

Cost 'C' = Cost 'B' + imputed value of family labour.

Thus, the cost 'C' represents the total cost of cultivation.

Cost concepts *i.e.* Cost 'A', Cost 'B' and Cost 'C' has been utilized for working out per hectare cost and returns of crops in different 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 there of for various operations.

b) Imputed value of labour put in by the family members for various operations.

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

The wages of male and female member of the family were calculated on the basis of wage rate in forces from time of the casual labour for different operations.

However, for converting the female labour in man-days following formula has been used.

Mandays = Female labour days x 0.75

2. Bullock labour: In the case of hired bullock labour, the prevailing rate of bullock labour for particular operation in 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 operation like ploughing, harrowing, manuring and organization of inputs.

3. Machine labour: In the case of hired machine labour, the prevailing rate of machine labour (*i.e.* tractor, threshing machine) or 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: Manure produced on the own farm was evaluated at the rate prevailed in village. The cost of purchased manure was accounted according to the price paid by cultivators. One load cartload of manure was considered as four quintals and its prevailing price was Rs. 120 per quintal.

6. Fertilizer: Fertilizers in the form of urea, diamonium phosphate (DAP), Single Super Phosphate (SSP) were used and quantity of nitrogen, phosphorus and potash was

calculated in order to determine the actual expenditure on nitrogen, phosphorus and potash.

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

8. Irrigation charges: Irrigation was mostly by well, bore well, canal. Electricity bill of electric motor which was used to draw irrigation water was charged in proportionate to the area under irrigated crops. 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, canal charges were worked out as the charges paid by the cultivators for irrigation the crop.

9. Land Revenue, cesses and taxes: This item of cost includes land revenue, additional land revenue, and cess by the Zillah Parishad, taxes on account of Employment Guarantee Scheme and educational taxes, which were actually paid by the cultivator.

10. Depreciation on implements and machinery and Repairs: Depreciation means the decrease in the value of asset through wear and tear. The uniform rate of 10 per cent on the present value at the beginning of the year of farm implements and machinery was taken and only the proportionate charges were taken for the crop on hectare basis.

11. Interest on fixed capital: Interest on present values of fixed asset (excluding land, animal and traditional old well)

such as farm building, implements, equipment, machinery, bore wells, irrigation structure was charged at the rate of 10 per cent of present value.

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

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

Concept of Income in crop production

Gross Income: Value of main produce and by-produce at

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.

3.7 Economic analysis

It was planned to estimate the employment and income function with the help of multiple linear regression analysis for knowing the parameters influencing these economic indicators in respect of sample family. The data at the household level irrespective of size groups were used for the purpose

3.7.1 Estimation of employment function

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e^u$$

Where,

Y = Annual total family employment (man-days)

a = Intercept

X_1 = Number of Earners (Number per family.)

X_2 = Number of Milch animal (Number per family.)

X_3 = Area under Vegetables

X_4 = Area under cash crops

X_5 = GIA (Gross Irrigated Area) in hectare

X_6 = GCA (Gross Cropped Area) in hectare

b_i's = Regression coefficient

e^u = Error term

3.7.2 Estimation of income function

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e^u$$

Where,

Y = Annual total family Income (₹)

a = Intercept

X_1 = Number of Earners (Number per family.)

X_2 = Number of Milch animal (Number per family.)

X_3 = Area under Vegetables

X_4 = Area under cash crops

X_5 = GIA (Gross Irrigated Area) in hectare

X_6 = GCA (Gross Cropped Area) in hectare

b_i's = Regression coefficient

e^u = Error term

4. SOCIO-ECONOMIC FEATURES OF STUDY AREA

Agriculture is the backbone of the Indian economy. The agricultural production is primarily influenced by the natural resources. The control over natural resources is beyond the limits of human beings. The cultivation and growth of crops depend mainly on soil type and the precipitation. Though these natural factors are beyond the control of man, the crops to be grown and farming technique to be adopted has to be adjusted to the climatic and geographic factors.

This chapter mainly deals with general information of the area under study including physical features and the pattern of agriculture by depicting land use, cropping pattern *etc.*, as farmers carry out their farm activities taking into account the environmental and economic conditions existing in the region. The information pertaining to the region under study will be of great utility to understand the rationale behind the results obtained.

4.1 Physical features of Pune district

4.1.1 Location and geographical features

The Pune district lies between 17° 50' and 19° 20' North latitude and 73^0 20' and 75°10' East longitude. The district has a shape of triangle with its base in the Sahyadri mountain of the west and its apex in the extreme south-east corner near the Bhima and Nira river. Pune district is bounded on the north by the talukas; Akole, Sangamner and Parner of Ahmednagar district. At the east, Karmala of Solapur district. At the south, Phaltan and Wai of Satara district and of the west by Roha, Pen, Karjat of Raigad district

and murbad in Thane district. The Total geographical area of Pune district is 15642 sq. km. It consists of 14 tehsils. 25 towns and 11 Nagar Parishads. There are 1556 villages and 1377 Gram Panchayats according to 2011 census.

4.1.2 Area and demography

The district has an area of 15,642 square km which consist of 5 per cent of the total area of the State. According to 2011 census, population of district is 72,25,000 out of which 37,68,000 are males and 34,56,000 are females. The density of population is 462. The sex ratios is 917. Out of total population 30,29,000 *i.e.* 42 per cent population is in rural area as against 61,96,000 *i.e.* 58 per cent of urban area. Literacy of the district is 80.78 per cent. There are 72.32 literate females per 100 males according to 2011 census (Male-88.55 per cent). Rural literacy percentage is 73. Out of which 89 per cent are males and 72 per cent females. In literacy, Pune district ranks seventh in the State.

4.1.3 Climate and rainfall

The maximum average temperature in the district is 34.7°C. December is the coldest month of the year with mean daily minimum temperature at about 10.5°C and from March on wards temperature begin to increase rapidly. May is the hottest month of the year with mean daily maximum temperature at about 42°C. It is hottest in eastern talukas Indapur, Daund and Baramati. Average maximum temperature of Pune district was 37.7°C and minimum temperature was 10.5°C. Maximum rainfall receives from

south-west monsoon. It declines from West to East side. Rainfall receives in Pune district was 956.5 mm.

(Source: Socio-Economic Review and District Statistical Abstract of Pune district: 2014-15)

4.1.4 Soils

The soil of the district is lighter in the west than that in the east. It belongs broadly to the three classes *viz.,* Black, Red and Brown. In some places one class of the soil blends with another in varying proportions and in turn modified by sand, gravel, lime-salts and other ingredients.

4.1.5 Rivers

Bhima river is the main river having many tributaries in Pune district. Its origin is to the west side of Pune distirict near Sahyadri, (Bhimashankar). Bhima flows to the west-east direction and enters in Solapur distirct. To the left side of the Bhima, Welu, Ghod and to right sides Indrayani, Mula and Mutha are tributaries. To the south border to Pune distirct Nira river flows. Kanhan, Kukadi, Pavana, Meena, Gunjavani, Pushapawati, Shaivaganga are other rivers flow in Pune district. All these rivers flow with a magnificent volume of Water but during summer they shrink to a narrow lane.

4.1.6 Hill ranges

Main range of Sahyadri is covering about 177 km in the district. The coast of Sahyadri falls at places to about 609.6 meters above mean sea level. In other places, it rises in rounded bluffs and clear cut ridges to short 1219.2 meter. About 10 km to the south west at the head of the Kukadi

valley and corning and the Nane pass, the massive rock of Jivdhan with its fortifications surmounted by gross covered top rises about 304.8 meter above the Deccan plateau. The next important hill is Dhak about 5 km south of Jivadhan. It is one of the highest and strongest points under the battlements of Sahyadris. The bluff of Ahupe is at 16 km south west of Dhak where the direction of Sahyadris ranges from the west to south. It rises from Deccan plateau in gentle slopes, but falls west into the Konkan a sheer cliff between 914.4 and 1219.2 meters ft. height.

4.2 General information about study area

4.2.1 Transport

The transport facilities are well developed in the district. The total railway length in the district is 311 km. The total road length in the district is 13554 km and the length of National highway in the district is 302 km. The length of state highway passing through the district is 1384 km and the state transport bus service is also well developed in most of the villages in the district.

4.2.2 Infrastructural facilities

The district has covers 14 tahsils. The district has 12 co-operative sugar factories, 18701 co-operative institutes, 1200 primary agricultural credit co-operative societies, 5 cotton spinning mills, 2422 dairy co-operative societies, 40 hospitals, 95 primary health centers, 4440 primary schools and 1099 secondary schools.

4.2.3 Livestock

The total livestock population in the district is 2,90,000 out of which 8,96,000 are cows and bullocks,

2,87,000 are buffaloes, 20,58,000 are sheep and goats. The population of poultry is 39,42,000 in Pune district.

4.2.4 Land utilization pattern

The information in respect of the land utilization pattern in Pune district and selected tahsil for the year 2013-14 is presented in the Table 4.1

Table 4.1 land utilization pattern of study area (2013-14)

(ha)

Sr. No	Particulars	Indapur	Shirur	Junnar	Pune District
1	Geographical area	146791 (100.00)	155727 (100.00)	138452 (100.00)	1562018 (100.00)
2	Area under forest	7800 (5.31)	6019 (3.86)	7864 (5.67)	171809 (10.99)
3	Area not available for cultivation	5862 (3.99)	6590 (4.23)	3033 (2.19)	64470 (4.12)
4	Cultivation waste	2906 (1.97)	9027 (5.79)	6822 (4.92)	104226 (6.67)
5	Total fallow	5966 (4.06)	3762 (2.41)	4571 (3.30)	105623 (6.76)
6	Current fallow	4183 (2.84)	1364 (0.87)	509 (0.36)	62083 (3.97)
7	Other fallow	1783 (1.21)	2398 (1.53)	4062 (2.93)	67303 (4.30)
8	Net sown area	101543 (69.17)	120931 (77.65)	100435 (72.54)	991787 (63.49)
9	Double crop area	11427 (7.78)	10317 (6.62)	19491 (14.07)	181165 (11.59)
10	Gross cropped area	112970 (76.95)	131248 (84.28)	119926 (86.61)	1172952 (75.09)
11	Total cultivable area	134091 (91.34)	130159 (83.58)	107721 (77.80)	1221513 (78.20)

(Figures in the parentheses indicate percentage to the total geographical area.)

Source: District Socio-economic survey of Pune (2014-15)

Table 4.1 shows that the percentage of the total cultivable land to total geographical area was 78.20 percent in Pune district. In selected tehsils Indapur, Shirur and Junnar per cent of total cultivable land to total geographical area was 91.34, 83.58 and 77.80 per cent, respectively. The per cent of fallow land to total geographical area was 6.76 per cent in Pune district where as it was about 2.41 per cent in Shirur tehsil, 4.06 per cent in Indapur and 3.30 per cent in Junnar. The gross cropped area was 75.09 per cent in the Pune district.

4.2.5 Cropping pattern

The cropping pattern of the district and selected tahsilis given for year 2013-14 in Table 4.2. From table it can be seen that sorghum was the main crop which occupied 39.70 per cent of the gross cropped area in the district. In Indapur, Shirur and Junnar tahsil the area under sorghum crop was 56.90, 68.70 and 30.10 per cent of gross cropped area, respectively. The other important crops of the district and tahsil were bajra, wheat, rice, sugarcane, total vegetables, total oilseed and total pulses occupying 10.56, 5.52, 4.92, 5.59, 5.13, 6.05, and 7.91 per cent of gross cropped area of the district, respectively. In Indapur tehsil, sugarcane and groundnut occupied 7.91 and 2.16 per cent of the gross cropped area, respectively. In Shirur tehsil, pearl millet and gram occupied 16.7 and 4.38 per cent of the gross cropped area, respectively.

Table 4.2: Cropping pattern of Pune district and selected tahsils (2013-14)

(ha)

Sr.No	Particular	Indapur Tahsil	Per cent	Shirur Tahsil	Per cent	Junnar Tahsil	Per cent	Pune District	Per cent
1	Rice	2524	2.23	1879	1.43	6042	5.04	57722	4.92
2	Wheat	6540	5.79	7459	5.68	6719	5.6	64715	5.53
3	Sorghum	64325	56.9	90158	68.7	36080	30.1	465627	39.70
4	Pearl millet	2410	2.13	21930	16.7	23511	19.6	123889	10.56
5	Maize	2006	1.78	1048	0.8	1230	1.03	14887	1.27
6	Wari	0	0	130	0.1	312	0.26	1354	0.11
7	Nachni	0	0	185	0.14	1010	0.84	12008	1.02
8	Other Cereals	27	0.02	10	0.01	349	0.29	2462	0.21
9	**Total Cereals**	**77832**	**68.9**	**122799**	**93.6**	**75253**	**62.7**	**742664**	**63.32**
10	Gram	2574	2.28	5749	4.38	10580	8.82	54611	4.66
11	Green gram	621	0.55	385	0.29	614	0.51	7808	0.67
12	Black pea	0	0	57	0.04	410	0.34	2106	0.18
13	Kulthi	219	0.19	341	0.26	470	0.39	2096	0.18
14	Moth been	710	0.63	512	0.39	341	0.28	2897	0.25
15	Rajma	305	0.27	334	0.25	816	0.68	4014	0.34
16	Pea	85	0.08	170	0.13	750	0.63	4094	0.35
17	Red Gram	397	0.35	267	0.2	706	0.59	3809	0.32
18	Other Pulses.	1415	1.25	917	0.7	1871	1.56	11372	0.97
19	**Total Pulses**	**6326**	**5.6**	**8732**	**6.65**	**16558**	**13.8**	**92807**	**7.91**
20	Potato	21	0.02	450	0.34	1674	1.4	7305	0.62
21	Onion	2478	2.19	2075	1.58	2710	2.26	21629	1.84
22	Brinjal	219	0.19	71	0.05	519	0.43	2685	0.22
23	Tomato	440	0.39	392	0.3	2650	2.21	9368	0.79
24	Other Vegetable	1060	0.94	971	0.74	3776	3.15	19222	1.64
25	**Total Vegetable**	**4218**	**3.73**	**3959**	**3.02**	**11401**	**9.51**	**60209**	**5.13**

26	Chilli	230	0.2	530	0.4	410	0.34	4201	0.36
27	Garlic	89	0.08	130	0.1	129	0.11	1011	0.08
28	Other Spices	48	0.04	25	0.02	239	0.2	974	0.08
29	**Total Spices**	**367**	**0.32**	**685**	**0.52**	**778**	**0.65**	**6186**	**0.53**
30	Groundnut	2440	2.16	2826	2.15	8311	6.93	45031	3.84
31	Sunflower	595	0.53	661	0.5	121	0.1	3184	0.27
32	Safflower	1467	1.3	1637	1.25	1772	1.48	16604	1.42
33	Other Oilseed	359	0.32	339	0.26	923	0.77	6154	0.52
34	**Total Oilseed**	**4861**	**4.3**	**5463**	**4.16**	**11127**	**9.28**	**70973**	**6.05**
35	Mango	773	0.68	430	0.33	1090	0.91	7212	0.61
36	Grape	25	0.02	40	0.03	661	0.55	1613	0.14
37	Banana	271	0.24	195	0.15	842	0.7	1986	0.17
38	Citrus fruit	1277	1.13	1237	0.94	1570	1.31	8006	0.68
39	Other Fruit	825	0.73	960	0.73	2265	1.89	11506	0.98
40	**Total Fruit**	**3171**	**2.81**	**2862**	**2.18**	**6428**	**5.36**	**30323**	**2.59**
41	Sugarcane	8935	7.91	3804	2.9	7817	6.52	65628	5.59
42	Total Fodder crop	7549	6.68	11514	8.77	11808	9.85	121531	10.36
43	**GCA**	**112970**	**100**	**131248**	**100**	**119926**	**100**	**1172952**	**100**

Source: District Socio-economic survey of Pune (2014-15)

In Junnar tahsil fodder crop and potato occupied 9.85 and 2.26 per cent of the gross cropped area, respectively.

4.2.6 Irrigation facilities

Irrigation is the most important and critical input in the cultivation of crops. Its plays a crucial role in pushing up the crop yields. In Pune district as well as in the selected tehsils the dominance of well irrigation is there. In Pune, gross irrigated area was 2,61,636 hectares which is 27 per cent of total area under crops for the year 2013-14. In Indapur, Shirur and Junnar tahsils, the gross irrigated area was 18,569 hectares, 19,500 hectares and 31478 hectares which is 35 per cent, 17 per cent and 22.74 per cent of the total area under crops in respective tahsils.

The principal source of irrigation was the wells. The number of wells was 161010, 13312 and 18500 in the Indapur, Shirur and Junnar tahsil respectively, for the year 2013-14.

5. RESULTS AND DISCUSSION

This chapter deals with presentation and interpretation of results of the study. The major emphasis of the study is on resource structure, costs and returns, resource use productivity of major cropping sequences. The employment, income and expenditure pattern of selected farmer which are adopted major cropping sequences are also studied. The primary data pertains to 90 sample households from Maharashtra for the year 2013-14 and secondary data (2014-15) were subjected to statistical analysis and the results are presented. In general, this chapter deals and presents the objective wise findings of the study under the following major heads:

5.1 General information about sample households
5.2 To identify the major cropping sequences
5.3 To study resource use structure of major cropping sequences
5.4 To study employment, income and expenditure pattern of sample farmers, adopting major cropping sequence
5.5 To study the constraints in adoption major cropping sequences

5.1 General information about sample households

As explained earlier 90 households were selected from six villages which are categorized into three groups *viz.,* small, medium and large on the basis of predetermined sized masses of land holdings. These groups were formed with view to study their characteristics in details.

In this section, an attempt has been made to examine some important aspects of structure of sample farms and their organization in the selected area. The aspects examined are related to family size and its composition, land use pattern, cropping pattern, income and employment generation and capital investment for the year 2013-14.

It is the general experience that many of the farmers were not very much conscious about cropping sequence and do not work out the precise profitability though they try to go for enterprise giving more returns.

5.1.1 Size of family and its composition

The information on the size of family and its composition according to different size of classes of sample household is given in Table 5.1.

Table 5.1 Average size of family and its composition of sample households

(No.)

Sr. No.	Particular	Size of households			Overall
		Small	Medium	Large	
1	Male	1.72 (31.73)	1.84 (31.29)	1.97 (30.26)	1.84 (30.98)
2	Female	1.64 (30.26)	1.78 (30.27)	1.98 (30.41)	1.80 (30.30)
3	Children	2.06 (38.01)	2.26 (38.44)	2.57 (39.32)	2.30 (38.72)
	Total	**5.42 (100.00)**	**5.88 (100.00)**	**6.52 (100.00)**	**5.94 (100.00)**
4	Earner	3.36 (61.99)	3.62 (61.57)	3.95 (60.58)	3.64 (61.28)
5	Dependents	2.06 (38.01)	2.26 (38.43)	2.57 (39.42)	2.30 (38.72)

(Figures in parentheses indicate percentage to total)

Information presented in Table 5.1 reveals that the average size of family was 5.42, 5.88, and 6.52 members in case of small, medium and large size households, respectively. The average family composition of males, females and children was 30.98, 30.30, and 38.72 percent, respectively.

At overall level, the average numbers of earners was 3.64 *i.e.* 61.28 per cent of the total family members. The average number of earner was 3.36 in small, 3.62 in medium and 3.95 in large size group holdings. The average number of dependents at overall level was 2.30 *i.e.* 38.72 per cent. The average number of dependents was 2.06 in small, 2.26 in medium and 2.57 in large size group household.

5.1.2 Educational status

The information of the educational status according to size of classes of samples households is given in Table 5.2.

Table 5.2 Educational status of the sample households

(No.)

Sr. No.	Particular	Size of households			
		Small	Medium	Large	Overall
1	Illiterate	0.78 (14.39)	1.03 (17.52)	0.94 (14.42)	0.92 (15.49)
2	Up to primary	1.04 (19.19)	0.78 (13.25)	1.64 (25.15)	1.15 (19.36)
3	Up to secondary	2.47 (45.57)	2.47 (42.01)	2.19 (33.59)	2.38 (40.07)
4	College	1.13 (20.85)	1.60 (27.21)	1.75 (26.84)	1.49 (25.08)
	Total	5.42 (100.00)	5.88 (100.00)	6.52 (100.00)	5.92 (100.00)

(Figures in parentheses indicate percentage to total)

From the Table 5.2, it revealed that 14.39, 17.52 and 14.42 percent cultivators were illiterate in small, medium and large size group, respectively. At overall level, 15.49 percent cultivators were illiterate, 19.36 percent cultivators were up to primary educated school level, 40.07 percent cultivators were educated up to secondary school level and 25.08 percent cultivators had taken education up to graduate level.

5.1.3 Capital assets

The value of capital assets on different items such as building, implements and livestock are presented in Table 5.3.

Land is the major factor of production which dominates the total assets held by the cultivator. The percentage of land to the total assets accounted for 66.75, 63.33 and 63.71 percent in small, medium and large size groups, respectively.

Table 5.3 Capital assets of the Sample farmers

(₹)

Sr. No.	Particular	Size of households			
		Small	Medium	Large	Overall
1	Land	303500.00 (66.75)	329365.00 (63.33)	355872.00 (63.71)	329579 (64.48)
2	Building	95525.00 (21.01)	126588.00 (24.34)	132500.00 (23.72)	118204 (23.13)
3	Implements	25575.00 (5.63)	28564.00 (5.49)	29500.00 (5.28)	27879.67 (5.45)
4	Bullock	12530.00 (2.76)	15286.00 (2.94)	17230.00 (3.08)	15015.33 (2.94)
5	Milch Animal	17520.00 (3.85)	20312.00 (3.90)	23500.00 (4.21)	20444 (4.00)
	Total	454650 (100.00)	520115 (100.00)	558602 (100.00)	511122 (100.00)

(Figures in parentheses indicate percentage to total)

A milch animal is contributed on an average about 4.00 percent of total asset. There was little variation in case of

investment on bullock in different size groups of holding. Investment on implements contributed on an average 5.45 per cent in the total assets at overall level.

5.1.4 Land use pattern of sample farmers

The information relating to the land utilization of the selected holdings is given in Table 5.4.

Table 5.4: Land use pattern of sample farmers

(ha)

Sr. No.	Particular	Small	Medium	Large	Overall
1.	Total holdings	0.76 (100)	1.63 (100)	5.18 (100)	2.52 (100)
2.	Permanent fallow	0.08 (10.52)	0.12 (7.36)	0.32 (6.17)	0.17 (6.74)
3.	Operational holding	0.68 (89.47)	1.51 (93.63)	4.86 (93.82)	2.35 (93.25)
4.	Current fallow	0.04 (5.26)	0.05 (3.06)	0.2 (3.86)	0.09 (3.57)
5.	Net cultivated area	0.63 (82.89)	1.46 (89.57)	4.66 (89.96)	2.24 (89.28)
	a. Irrigated	0.24 (31.57)	0.86 (52.76)	2.79 (53.86)	1.29 (51.19)
	b. Unirrigated	0.39 (51.31)	0.60 (36.80)	1.87 (36.10)	0.95 (37.69)
6.	Gross cropped area (GCA)	0.97	2.10	5.86	2.98
7.	Cropping Intensity	153.97	143.84	125.75	133.03

(Figures in parentheses indicate percentage to total holding)

The total holdings in respect of small, medium and large size of farms were worked out to 0.76, 1.63 and 5.18 hectares, respectively, and at the overall level it was 2.52 hectares. The overall proportion of irrigated area and unirrigated area was worked out to 51.19 and 37.69 per cent to the total holding. Thus, the proportion of net cultivated area was worked out 89.28 per cent of total holding at the overall level.

The proportion of net cultivated area was maximum in case of large size group of holding (89.96 per cent) while it was low in case of small size group of holding (82.89 per cent). The irrigated area showed the decreasing trend from large to small size groups. The unirrigated area shows increasing trend from small to large size groups. At the overall level, the irrigated area was worked out to 1.29 hectares and unirrigated area was 0.95 hectares.

5.1.5 Cropping pattern of sample farmers

Cropping pattern is another vital factor influencing the level of expenses on farm and the returns from farm business. It is also an indicator of economic condition of selected farm families.

The information of average cropping pattern of sample cultivators in Pune district Maharashtra is given in Table 5.5. At the overall level, total vegetable crops occupied major share in gross cropped area (*i.e.* 28.64 per cent). Total pulses, oilseeds, total fruit crop, sugarcane and total cereal crops occupied 4.36, 3.24, 28.52, 12.35 and 18.01 per cent share in cropping pattern, respectively. The proportion of area under total vegetable crops

was 28.64 per cent. The cropping intensity of small size group was more than medium and large group because area under perennial crops in large size group was more than small and medium groups. At the overall level, the cropping intensity was 133.03 per cent.

Table 5.5. Cropping pattern of Sample farmers.

(ha)

Sr. No.	Particulars	Small	Per cent	Medium	Per cent	Large	Per cent	Overall	Per cent
1	Per millet	0.12	12.37	0.16	7.62	0.31	5.29	0.20	6.60
2	Sorghum	0.11	11.34	0.14	6.67	0.21	3.58	0.15	5.15
4	Wheat	0.06	6.19	0.10	4.76	0.17	2.90	0.11	3.69
5	Maize	0.04	4.12	0.08	3.81	0.11	1.88	0.08	2.57
6	**Total cereals**	**0.33**	**34.02**	**0.48**	**22.86**	**0.8**	**13.65**	**0.54**	**18.01**
7	Gram	0.03	3.09	0.01	0.48	0.07	1.19	0.04	1.23
8	Green gram	0.02	2.06	0.08	3.81	0.04	0.68	0.05	1.57
9	Black gram	0.01	1.03	0.01	0.48	0.05	0.85	0.02	0.78
10	Other pulses	0.02	2.06	0.03	1.43	0.02	0.34	0.02	0.78
10	**Total pulses**	**0.08**	**8.25**	**0.13**	**6.19**	**0.18**	**3.07**	**0.13**	**4.36**
12	Groundnut	0.05	5.15	0.09	4.29	0.15	2.56	0.10	3.24
13	Other oil seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	**Total Oil seed**	**0.05**	**5.15**	**0.09**	**4.29**	**0.15**	**2.56**	**0.10**	**3.24**
15	Tomato	0.05	5.15	0.09	4.29	0.14	2.39	0.09	3.13
16	Chilli	0.06	6.19	0.07	3.33	0.09	1.54	0.07	2.46
17	Onion	0.06	6.19	0.09	4.29	0.23	3.92	0.13	4.25
18	Cauliflower	0.04	4.12	0.06	2.86	0.10	1.71	0.07	2.24
19	Coriander	0.04	4.12	0.1	4.76	0.16	2.73	0.10	3.36
20	Fenugreek	0.03	3.09	0.07	3.33	0.18	3.07	0.09	3.13
21	cluster bean	0.00	0.00	0.01	0.48	0.09	1.54	0.03	1.12
22	Cabbage	0.02	2.06	0.02	0.95	0.12	2.05	0.05	1.79
23	Spinach	0.00	0.00	0.02	0.95	0.08	1.37	0.03	1.12
24	Potato	0.05	5.15	0.07	3.33	0.16	2.73	0.09	3.13

25	Other vegetables	0.05	5.15	0.06	2.86	0.15	2.56	0.09	2.91
26	**Total vegetables**	**0.4**	**41.24**	**0.66**	**31.43**	**1.50**	**25.60**	**0.85**	**28.64**
27	Crusted appeal	0.02	2.06	0.09	4.29	0.70	11.95	0.27	9.06
28	Pomegranate	0.03	3.09	0.18	8.57	0.75	12.80	0.32	10.74
29	Other Fruit crop	0.02	2.06	0.10	4.76	0.65	11.09	0.26	8.61
30	**Total Fruit Crop**	**0.07**	**7.22**	**0.37**	**17.62**	**2.10**	**35.84**	**0.84**	**28.52**
31	Sugarcane	0.02	2.06	0.22	10.48	0.90	15.36	0.38	12.75
32	Fodder	0.02	2.06	0.15	7.14	0.23	3.92	0.13	4.47
33	**GCA**	**0.97**	**100.00**	**2.10**	**100.00**	**5.86**	**100.00**	**2.98**	**100.00**

5.2 Identify the different cropping sequences

It is observed from the table 5.6, that Pearl millet-Coriander-Rabi Onion, Green gram-Rabi Sorghum, Pearl millet-Wheat-Summer Groundnut, Green gram-Rabi Onion, Black gram-Gram, Groundnut-Rabi Potato-Fodder Jowar, Pearl millet-Rabi Sorghum, Maize-Wheat-Summer Pearl millet, Maize-Rabi Sorghum-Chilli, Onion-Wheat-Watermelon, Tomato-Coriander-Fenugreek-Cluster bean, Tomato-Fodder Jowar, Tomato-Wheat-Cabbage, Capsicum-Marigold-Tomato, Cauliflower-Rabi Potato-Fenugreek, Onion-Coriander-Fenugreek-Summer Groundnut adopted by the selected farmers.

In case of small farmers, Pearl millet-coriander-Rabi Onion cropping sequence is the dominant cropping sequence which is adopted by 8 farmers followed by Pearl millet-Rabi Sorghum by 6 farmers and cauliflower-Rabi Potato-Fenugreek by 6 farmers and Maize-Rabi Sorghum-Chilli by 5 farmers.

In case of medium farmers, Pearl millet-Rabi Sorghum cropping sequence is the dominant cropping sequence which is adopted by 7 farmers followed by Pearl millet-coriander-Rabi Onion by 6 farmers and Green gram-Rabi Sorghum by 6 farmers and Groundnut-Rabi Potato-Fodder Jowar by 5 farmers.

In case of large farmers, Cauliflower-Rabi Potato-Fenugreek cropping sequence are dominant cropping sequence which is adopted by 8 farmers, followed by Pearl millet-Coriander-Rabi Onion and Pearl millet-Rabi Sorghum by 7 farmers and Black gram-Gram and Tomato-Coriander-Fenugreek-Cluster bean by 6 farmers.

Table 5.6. Existing cropping sequences observed on farm of sample farmers

Sr.no	Cropping Sequences	Group			Total N=90	Per cent
		Small	Medium	Large		
1	**Pearl millet-Coriander-Rabi Onion**	**8**	**6**	**7**	**21**	**23.33**
2	Green gram-Rabi Sorghum	4	6	3	13	14.44
3	Pearl millet-Wheat-Summer Groundnut	1	2	5	8	8.88
4	Green gram-Rabi Onion	-	2	5	7	7.77
5	Black gram-Gram	4	1	6	11	12.22
6	Groundnut-Rabi Potato-Fodder Jowar	3	5	5	13	14.44
7	**Pearl millet-Rabi Sorghum**	**6**	**7**	**7**	**20**	**22.22**
8	Maize-Wheat- Summer Pearl millet	-	4	5	9	10.00
9	Maize-Rabi Sorghum-Chilli	5	4	3	12	13.33
10	Onion-Wheat-Watermelon	3	2	3	8	8.88
11	Tomato-Coriander-Fenugreek-Cluster bean	1	1	6	8	8.88
12	Tomato-Fodder Jowar	2	2	2	6	6.66
13	Tomato-Wheat-Cabbage	2	5	2	9	10.00
14	Capsicum-Marigold-Tomato	2	2	3	7	7.77
15	**Cauliflower-Rabi Potato - Fenugreek**	**4**	**6**	**8**	**18**	**20.00**
16	Onion-Coriander-Fenugreek-Summer Groundnut	3	1	4	8	8.88

At the overall level, Pearl millet-Coriander-Rabi Onion cropping sequence is the dominant cropping sequence which is adopted by 21 farmers followed by Pearl millet-Rabi Sorghum adopted by 20 farmers and Cauliflower-Rabi Potato-Fenugreek cropping sequence is adopted by 18 farmers.

For further calculation and analysis we select three major cropping sequences *viz.;* Pearl millet-coriander-Rabi Onion, Pearl millet-Rabi Sorghum and Cauliflower-Rabi Potato-Fenugreek as CS I, CS II and CS III, respectively. These cropping sequences were selected on the bases of percentage to the total number of sample cultivar *i.e.* 90 in number. This selected cropping sequences I (Pearl millet-Coriander-Rabi Onion) is adopted by 21 *i.e.* 23.33 per cent farmers, cropping sequences II (Pearl millet-Rabi Sorghum) is adopted by 20 *i.e.* 22.22 per cent farmers and cropping sequences III (Cauliflower-Rabi Potato-Fenugreek) is adopted by 18 *i.e.* 20.00 per cent farmers.

5.3 Resource use structure of major cropping sequences

The information on per hectare utilization of different inputs for major cropping sequences in Pune district of Maharashtra is presented in Table 5.7.

5.3.1 Human labour

It can be observed from the table that, in cropping sequence I, the use of total human labour was 358.87 man days per hectare which was highest, comprising 119.37 male man days and 239.49 female man days. In cropping sequence II, the use of total human labour was 145.65 man days per hectare,

comprising 51.85 male man days and 93.80 female man days. In cropping sequence III, the use of total human labour was 315.95 man days per hectare, comprising 121.18 male man days and 194.76 female man-days. The per hectare labour utilization indicated that the utilization of human labour was maximum in cropping sequence I which was followed by cropping sequence III.

5.3.2 Bullock power

In case of cropping sequence I , the per hectare use of bullock power was 19.44 pair days which is highest as compare to remaining two cropping sequences. The per hectare bullock power utilization was 12.49 and 15.77 pair days in cropping sequence II and III, respectively.

5.3.3 Machine power

In case of cropping sequence III, per hectare utilization of machine power was observed to be 25.02 hr. The per hectare utilization of machine power 16.13 and 13.99 was observed in case of cropping sequence I and II, respectively, cropping sequence III observed per hectare utilization of machine power was more than cropping sequence I and II. The machine power *i.e.* use of tractors was mostly for the operation of carrying and spreading of FYM, ploughing and harrowing.

5.3.4 Planting material

In case of cropping sequence III, on an average, utilization of planting material was 1029.80 kg per hectare which was much higher than the other two cropping sequences which was 82.82 and 13.96 kg per hectare in cropping sequence I and

cropping sequence II, respectively.

Table 5.7 Per hectare resource use levels of major cropping sequence

Sr. No.	Particular	Unit	Cropping Sequence		
			I	II	III
			Per millet-Coriander-*Rabi* Onion.	Per millet-*Rabi* Sorghum.	Cauliflower-*Rabi* Potato-Fenugreek.
1	Total Human labour		358.87	145.65	315.95
	a. Male	(Man Days)	119.37	51.85	121.18
	b. Female	(Man Days)	239.49	93.80	194.76
2	Bullock power	(Pair days)	19.44	12.49	15.77
3	Machine power.	hr	16.13	13.99	25.02
4	Planting material	(kg)	82.82	13.96	1029.80
5	Manures	(qtl)	58.27	20.83	90.19
6	Fertilizers				
	N	kg	196.76	96.57	276.61
	P	kg	68.54	22.07	115.95
	K	kg	51.56	16.34	130.70
7	Irrigation Charges	₹	6072.34	1327.64	8242.21
8	Plant protection charges	₹	1679.83	911.25	8306.39

High seed rate in case of cropping sequence III, because of this cropping sequence contribute potato crop as *Rabi* crop which have high seed rate as compeer to all other crop contributing in remaining two cropping sequences.

5.3.5 Manures and fertilizers

In case of cropping sequence I, the use of manure was 58.27 qtl per ha, in case of cropping sequence II, the use of manure was 20.83 qtl per ha and in case of cropping sequence III, the use of manure was 90.19 qtl per ha. The use of

manure was found more in case of cropping sequence III than cropping sequences I and II. In case of cropping sequence III, the per hectare use of chemical fertilizers *i.e.* Nitrogenous, Phosphorus and Potash was 276.61, 115.95 and 130.70 kg per ha, respectively. In case of cropping sequence II, the per hectare use of chemical fertilizers *i.e.* Nitrogenous, Phosphorus and Potash was 96.57, 22.07 and 16.34 kg per ha, respectively. In case of cropping sequence I, the per hectare use of chemical fertilizers *i.e.* Nitrogenous, Phosphorus and Potash was 196.76, 68.54 and 51.56 kg per ha, respectively. The farmers adopted cropping sequence III had used more fertilizers than cropping sequence I and II.

5.3.6 Irrigation and plant protection charges

Per hectare irrigation charges were observed more in cropping sequence III (₹ 8242.21 per ha) than that of cropping sequence I (₹ 6072.34 per ha) and cropping sequence II (₹ 1327.64 per ha)

Per hectare plant protection charges were observed more in cropping sequence III (₹ 8306.39 per ha) than that of cropping sequence I (₹ 1679.83 ha) and cropping sequence II (₹ 911.25 per ha).

5.4 Costs and Returns of major cropping sequences

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

quantum and proportions of out of pocket expenses and imputed cost in the total costs stricter either increase or decrease depending upon changes in the use of different resources and substitution of one form of resource for another. The process of 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. This section examines in the costs and returns structure of the farm for the crop, livestock and horticulture enterprises. The cropping sequence wise cost and returns of major cropping sequence in Pune region are presented in Table 5.8.

At overall level, the gross income of cropping sequence-I, II and III were ₹ 2,92,129.08, ₹ 66,622.58 and ₹ 4,10,648.84, respectively. While the net returns at cost 'A' were higher in cropping sequence-III (₹ 261223.53) followed by cropping sequence-I (₹ 191361.85) and cropping sequence-II (₹ 24457.19).

In cropping sequence-III, the average per hectare cost 'C' was ₹ 236774.42, while it was ₹ 179574.88 in cropping sequence I and ₹ 63398.97 in cropping sequence-II. It clearly indicated that the cost of cultivation of crop was higher in cropping sequence-III than in cropping sequence I and II because of the cost of input were higher in cropping sequence-III than in cropping sequence I and II. However, it is expected that the increased input use must result into the higher returns in gross

returns in cropping sequence-III than in cropping sequence I and II, which has been reflected in gross income of ₹ 410648.84 in cropping sequence-III as compared to cropping sequence I and II (₹ 292129.08 and ₹ 66622.58).

Table 5.8. Per hectare costs and return of major cropping sequences

(₹)

Sr. No.	Particular	Cropping Sequence		
		I	II	III
1.	Total cost			
	i) Cost 'A'	100767.23	42165.39	147291.60
	ii) Cost 'B'	154857.35	54157.69	225314.40
	iii) Cost 'C'	179574.88	63398.97	239403.60
2.	Profit at			
	i) Cost 'A'	191361.85	24457.19	263836.30
	ii) Cost 'B'	137271.73	12464.89	185813.50
	iii) Cost 'C'	112554.20	3223.61	171724.30
3.	Production (qtl)	320.81	37.47	433.43
4.	Gross income	292129.08	66622.58	411127.90
5.	B:C ratio			
	i) Cost 'A'	2.90	1.58	2.79
	ii) Cost 'B'	1.89	1.23	1.82
	iii) Cost 'C'	1.63	1.05	1.72

It is assumed that farm families' members have no alternatives of employments rather their own farm or they do not feel like to work on others farms, hence they would be rather ideal, if they do not work on their own farm. Therefore, cost 'A' have been estimated to ₹ 100767.23, ₹ 42165.39 and ₹ 149425.31 in cropping sequence-I, II and III, respectively. The net returns at cost 'C' are positive, but substantially lower than

at cost 'A' in all cropping sequences. The net returns at cost 'C' were ₹ 112554.20, ₹ 3223.61 and ₹ 173874.42, respectively. The output-input ratio revealed that the cropping sequence-III was more profitable, which shows output-input ratio as 1.73 followed by 1.63 in cropping sequence-I and 1.05 in cropping sequence-II.

5.5 Employment, income and expenditure pattern

5.5.1 Employment pattern

The main activity of the farmer is to cultivate land and grow crops in such a way as to efficient use of labour to secure the maximum income. However, owing to limitation of land holding and irrigation, all 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. The details of source wise average annual employment pattern of the per farm of earner (male and female workers) in different cropping sequences is presented in Table 5.9, 5.9(a) and 5.9(b).

5.5.1.1 Average annual employment of farm families

On account of its highly-mechanized production, commercially important crops have generally high labour demand. However, some important production practices, especially weeding and irrigation which may require substantial amount of labour.

The total employment was 390.93, 351.72 and 325.10 man days in cropping sequence-I, II and III, respectively. The average annual employment available on their own farm including crop production and livestock activity was to the tune

of 66.41 per cent in cropping sequence I followed by cropping sequence III (62.49 per cent) and 60.09 per cent in cropping sequence II.

Table 5.9. Average per farm annual Employment of farm Families

(Man days)

Sr. No.	Particulars	Cropping Sequence		
		I	II	III
I	**Own farm employment**			
1	Crop Production	110.22 (28.19)	57.35 (16.31)	65.82 (20.25)
2	Livestock activity	149.38 (38.21)	154.00 (43.78)	137.34 (42.25)
	Total own farm employment	259.60 (66.41)	211.35 (60.09)	203.16 (62.49)
II	**Off-farm Employment**			
4	Wage earning	45.14 (11.55)	45.00 (12.79)	44.86 (13.80)
5	Services/Business	86.19 (22.05)	95.37 (27.12)	77.08 (23.71)
	Total off farm employment	131.33 (33.59)	140.37 (39.91)	121.94 (37.51)
III	**Total employment**	**390.93 (100.00)**	**351.72 (100.00)**	**325.10 (100.00)**

(Figures in parentheses indicate percentage to the total employment)

Total off-farm employment was 39.91 per cent in cropping sequence II followed by cropping sequence III (37.51 per cent) and cropping sequence I (33.59 per cent). The comparative picture showed that, the employments generated were more in cropping sequence I, includes crop such as Pearl millet, Coriander and *Rabi* Onion required more labours.

5.5.1.2 Average annual employment of male labour

In most part of study area, off-farm employment is viewed as a transitory situation, and only considered necessary as source for low earning farm community. In the study area,

grain trading, vegetable trading and daily labour were found to be some of the off-farm activity in which sample households were participating. Hence, those households who have got an engagement in off-farm employment are understood to raise their annual income. As illustrated in table 5.9(a), from the total off-farm employment was 193.79, 201.25 and 176.67 man days in cropping sequences I, II and III, respectively.

Table 5.9(a). Per farm average annual employment of male labour.

(Man days)

Sr. No.	Particular	Cropping Sequence		
		I	II	III
I	**Own farm employment**			
1	Crop Production	73.32 (14.76)	40.83 (9.15)	50.49 (11.42)
2	Livestock activity	229.52 (46.22)	204.00 (45.73)	214.78 (48.60)
	Total own farm employment	302.84 (60.98)	244.83 (53.88)	265.27 (60.02)
II	**Off-farm Employment**			
4	Wage earning	31.17 (6.28)	19.25 (4.32)	33.61 (7.61)
5	Services/Business	162.62 (32.74)	182.00 (40.80)	143.06 (32.37)
	Total off farm employment	193.79 (39.02)	201.25 (45.12)	176.67 (39.98)
III	**Total employment**	**496.63 (100.00)**	**446.08 (100.00)**	**441.94 (100.00)**

(Figures in parentheses indicate percentage to the total employment)

As shown in table 5.9(a), the average annual employment of male labour was the highest for cropping sequence I (*i.e.* 496.63 man days.) followed by cropping sequence II (*i.e.* 446.08 man days.) and cropping sequence III (*i.e.* 441.94

man days). The own farm employment contributed 60.98, 54.88 and 60.02 per cent in cropping sequences I, II and III, respectively.

5.5.1.3 Average annual employment of female labour

The total employment of female labour was 284.69, 257.37 and 208.26 man days in cropping sequences I, II and III, respectively.

Table 5.9(b). Per farm average annual employment of female labour.

(Man days)

Sr. No.	Particular	Cropping Sequence		
		I	II	III
I	**Own farm employment**			
1	Crop Production	147.12 (51.68)	73.87 (28.70)	81.15 (38.97)
2	Livestock activity	69.24 (24.32)	104.00 (40.41)	59.89 (28.76)
	Total own farm employment	216.36 (76.00)	177.87 (69.11)	141.04 (67.72)
II	**Off-farm Employment**			
4	Wage earning	58.57 (20.57)	70.75 (27.49)	56.11 (26.94)
5	Services/Business	9.76 (3.43)	8.75 (3.40)	11.11 (5.33)
	Total off farm employment	68.33 (24.00)	79.50 (30.89)	67.22 (32.28)
III	**Total employment**	**284.69 (100.00)**	**257.37 (100.00)**	**208.26 (100.00)**

(Figures in parentheses indicate percentage to the total employment)

The highest own farm employment was observed for cropping sequence I (76.00 per cent) followed by cropping sequence II (69.11 per cent) and cropping sequence III (67.72 per

cent), respectively. The crop production (147.12 man days) contributed largely in cropping sequence I. the female employment of cropping sequence I was higher because of large crop production.

5.5.2 Employment function

The extent of employment available to farmers is a key component for sustainability of the agriculture and sufficient income to the farm families. The total employment depend on nature of crops grown and the opportunities in associated activities.

Table 5.10. Regression analysis of employment function

Sr. No.	Particular	Cropping Sequence		
		I	II	III
1.	Sample size	21	20	18
2.	Constant (a)	301.54	243.81	417.41
3.	No. of Earners (X_1)	15.1391 (30.62)	117.346*** (32.4994)	148.919*** (45.4847)
4.	No. of Milch animal (X_2)	69.6251*** (17.0992)	97.3483*** (27.7087)	92.6335** (31.4137)
5.	Area under Vegetable (X_3)	6.5712 (95.7655)	160.8511 (108.162)	1.1497 (148.349)
6.	Area under Cash Crop (X_4)	93.7999** (32.0639)	108.090*** (30.1520)	261.526*** (113.754)
7.	Gross Irrigated Area (X_5)	86.2571*** (22.4795)	98.8993** (41.1393)	317.3894 (188.944)
8.	Gross Cropped Area (X_6)	28.6734 (43.9283)	2.3199 (16.4010)	210.0580 (141.053)
9.	R^2	0.78	0.70	0.69

(Figures in the parentheses are the standard errors of the respective regression coefficient)
(** and *** indicate significance at 5 and 1 per cent level).

However, the extent of contribution of each of these factors can be determined from their functional coefficients obtained by using the existing situation. Therefore, the

employment function of the three cropping sequence was worked out results are given in Tables 5.10.

The variables included in the model were number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in employment function have jointly explained 78.00 per cent, 70.00 per cent and 69.00 per cent variation for cropping sequence I, II and III, respectively.

The highest contribution came from number of milch animal for cropping sequence I and II and number of earners for cropping sequence II and III. The variables *viz.*, number of earners (X_1) was highly significant at one per cent level in cropping sequence II and III but non-significant in cropping sequence I. Number of milch animal was highly significant at one per cent level in cropping sequence I and II, while it was significant at five per cent level in cropping sequence III. Area under cash crop was highly significant at one per cent level in cropping sequence II and III, while it was significant at five per cent level in cropping sequence I. Therefore, it is indicated that these significant variables are most important variables to increase employment on the farm.

5.5.3 Average annual income of sample families

Farm income refers to the total annual earnings of the family from sale of agricultural produce after meeting family requirements. In this study, the household farm income was estimated based on the sales of crop produce and livestock products. The average annual income from different cropping sequences is presented in Table 5.11.

Table 5.11 indicates that the average annual income of the farm from crop production was ₹ 179450.72, ₹ 52465.28 and ₹ 171103.68 from cropping sequence I, II and III, respectively. Crop production account highest for cropping sequence III (46.64 per cent) followed by cropping sequence I (46.28 per cent) and cropping sequence II (21.83 per cent) of average annual farm income.

Table 5.11. Per farm average annual income of farm families

(₹)

Sr. No.	Particular	Cropping Sequences		
		I	II	III
1	Crop production	179450.72 (46.28)	52465.28 (21.83)	171103.68 (46.64)
2	Livestock	99061.90 (25.55)	110100.00 (45.80)	104333.33 (28.44)
3	Wages	15476.19 (3.99)	11425.00 (4.75)	9455.56 (2.58)
4	Service/Business	57409.52 (14.80)	38340.00 (15.95)	40566.67 (11.06)
5	Loan	36380.95 (9.38)	28050.00 (11.67)	41388.99 (11.28)
7	**Total Income**	**387779.28 (100.00)**	**240380.28 (100.00)**	**366848.23 (100.00)**

(Figure in parentheses is the percentage to the total income)

The average gross income of cropping sequence I, II and III was ₹ 387779.28, ₹ 240380.28 and ₹ 366848.23, respectively. In cropping sequence I share of income received from crop production was 46.28 per cent followed by livestock activity (25.55 per cent), service or business (14.80 per cent), loan (9.38 per cent) and wage earning (3.99 per cent).

In cropping sequence II the share of income received from livestock activity was 45.80 per cent followed by crop

production (21.83 per cent), service or business (15.95 per cent), loan (11.67 per cent) and wage earning (4.75 per cent).

In cropping sequence III the share of income received from crop production 46.64 per cent followed by livestock activity (28.44 per cent), loan (11.28 per cent), service or business (11.06 per cent) and wage earning (2.58 per cent).

The difference between the cropping sequence indicate that, the total income in cropping sequence I was more than the cropping sequence II's income. The total income from cropping sequence II was less as compared to cropping sequence I and III, while in cropping sequence II income derived from livestock activity was more as compared to income derived from livestock activity from remaining two cropping sequences. In the cropping sequence II 20.70 per cent income derived from service or business and wages but in cropping sequence I and III, correspondingly, just 18.79 and 13.65 per cent income was derived from service or business and wages. This has indicate that cropping sequence II depends more on livestock activity, wages and service or business sector as compared to cropping sequence I and III.

5.5.4 Income function

The income function of the three cropping sequence was worked out and results are given in Table 5.12.

The variables included in the model were number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in income function have jointly explained 76.00

per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively.

Table 5.12. Regression analysis of income function.

Sr. No.	Particular	Cropping Sequence		
		I	II	III
1.	Sample size	21	20	18
2.	Constant (a)	195301.056	79081.96	131628.57
3.	No. of Earners (X_1)	43698.83* (21231.30)	22816.79* (11230.01)	43141.57* (21852.93)
4.	No. of Milch animal (X_2)	28141.40** (11270.35)	5857.15 (4335.68)	92.6335** (12244.45)
5.	Area under Vegetable (X_3)	67309.81*** (21345.44)	50845.28** (18201.52)	33759.4 (131282.1)
6.	Area under Cash Crop (X_4)	199211.20 (294222.12)	124625.97** (49393.69)	3708.44* (1800.04)
7.	Gross Irrigated Area (X_5)	42101.56*** (22.4795)	56684.27** (20843.31)	253746.6 (151424.3)
8.	Gross Cropped Area (X_6)	8075.70 (66150.92)	30892.49 (17306.44)	45716.75*** (14923.38)
9.	R^2	0.76	0.75	0.73

(Figures in the parentheses are the standard errors of the respective regression coefficient)
(*, ** and *** indicate significance at 10, 5 and 1 per cent level).

The variables *viz.,* number of earners (X_1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in cropping sequence I and III, but it was non-significant in cropping sequence II.

Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III. Therefore, it is indicated that these significant variables are most important variables to increase income on the farm.

5.5.5 Expenditure pattern of the sample families

The details of the expenditure incurred by the sample families on different items of expenditure such as crop production, expenditure on livestock, family consumption, business expenditure, land development and other, are given in Table 5.13.

Table 5.13. Per farm average annual expenditure

(₹)

Sr. No.	Particular	Cropping Sequence		
		I	II	III
1	Crop production	110310.28 (36.92)	49926.69 (20.64)	98656.00 (31.25)
2	Livestock activity	54450.00 (18.23)	63387.50 (27.21)	71225.00 (22.56)
3	Family expenditure			
	a)Food consumption	38944.40 (13.04)	36100.00 (14.93)	40298.70 (12.77)
	b)Education	32789.90 (10.98)	30305.00 (12.53)	33522.10 (10.62)
	c) Health	10292.70 (3.45)	12355.00 (5.11)	15313.40 (4.85)
	d) Other	8163.10 (2.73)	8609.50 (3.56)	10885.50 (3.85)
5	Business Expenditure	27080.90 (9.06)	21175.00 (8.76)	25526.80 (8.09)
6	Land Development	7463.50 (2.50)	9327.50 (3.86)	8060.50 (2.55)
7	Other	9266.40 (3.10)	10664.50 (4.41)	12207.60 (3.87)
8	**Total Expenditure**	**298761.18 (100.00)**	**241850.69 (100.00)**	**315695.60 (100.00)**

(Figure in parentheses are the percentage to the total)

The per farm total expenditure of the sample farms were ₹ 298761.18, ₹ 241850.69 and ₹ 315695.60 in cropping sequence-I, II and III, respectively. Out of that more than 40.00 per cent was the farm expenditure in all the three cropping sequences. The farm expenditure includes expenditure on crop

production and livestock activity. The expenditure on crop production was major expenditure in cropping sequence-I and III, while expenditure on livestock activity was major in cropping sequence-II

In cropping sequence-I and III the expenditure on crop production was the major and it alone accounted 36.92 per cent and 31.25 per cent expenditure to the total annual expenditure, respectively.

In cropping sequence-II, the expenditure on crop production was 20.64 per cent while expenditure on livestock activity more in cropping sequence II than expenditure on livestock activity in cropping sequence I and III. The shares of family expenditure of sample farms were 30.17 per cent, 36.13 per cent and 31.69 per cent in cropping sequence I, II and III, respectively. While expenditure on land development was lower in all cropping sequences.

5.6 Constraints in adoption major cropping sequences

The constraints in adoption major cropping sequences in study area *i.e.* Pune district are presented in Table 5.14.

From the Table 5.14 it is seen that in cropping sequences I, II and III shortage of water in summer was the major problem as reported by 61.88, 65.00 and 61.16 per cent of the farmers, respectively. About 52.36, 60.00 and 50.04 per cent of farmers complained for electricity failure or irregular supply of electricity in cropping sequences I, II and III, respectively. About 47.60, 55.00 and 55.60 per cent of the

farmers expressed the difficulty of high fertilizer cost in cropping sequences I, II and III, respectively.

These problems are expressed as percentages of opinion of the total number of respondents. About 44.48, 52.36 and 55.00 per cent of farmers expressed the shortage of labour for cropping sequence III, II and I, respectively. Lack of technical assistance also constraints in adoption of major cropping sequences.

The transportation was a major bottleneck in efficient marketing of produce. About 47.60, 55.00 and 44.48 per cent farmers complained that transportation charges were high in cropping sequences I, II and III, respectively. The high price fluctuation emerged as an important problem as 52.36, 25.00 and 44.48 per cent farmers complained about it. About 42.84, 40.00 and 22.24 per cent farmers faced the problem of high marketing cost. The farmers were not getting adequate information about market and intelligence and also it was available for limited number of markets. These combined with inadequate and misleading information was hampering the market of produce directly to various unexplored markets of Maharashtra. About 38.08, 35.00 and 50.04 per cent farmers faced the problem of market intelligence in cropping sequence I, II and III, respectively.

Table 5.14. Constraints in adoption of major cropping sequences.

Sr. No.	Constraints	Cropping Sequences		
		I N=21	II N=20	III N=18
	Constraints in Crop production			
1.	High wage rate	3 (14.28)	4 (20.00)	5 (27.80)
2.	Shortage of Labour	11 (52.36)	11 (55.00)	8 (44.48)
3.	Non availability of seed or planting material at time	7 (33.32)	10 (50.00)	9 (50.04)
4.	High cost of fertilizer	10 (47.60)	11 (55.00)	10 (55.60)
5.	Shortage of water in summer	13 (61.88)	13 (65.00)	11 (61.16)
6.	Electricity failure or irregular supply of electricity	11 (52.36)	12 (60.00)	10 (55.60)
7.	Lack of technical assistance	5 (23.81)	4 (20.00)	4 (22.24)
	Constraints in Marketing			
8.	High transportation charges	10 (47.60)	11 (55.00)	8 (44.48)
9.	High price fluctuations	11 (52.36)	5 (25.00)	8 (44.48)
10.	High marketing cost	9 (42.84)	8 (40.00)	4 (22.24)
11.	Lack of market intelligence	8 (38.08)	7 (35.00)	9 (50.04)
	Financial Constraints			
12.	Scarcity of own funds	8 (38.08)	7 (35.00)	4 (22.24)
13.	Lengthy process of loan sanction in bank	6 (28.56)	7 (35.00)	5 (27.80)
14.	No easy access for credit	7 (33.32)	7 (35.00)	3 (16.68)

(Figures in the parentheses indicate percentage to the total number of farmer)

About 38.08, 35.00 and 22.24 per cent farmers expressed the difficulty of scarcity of own funds in cropping sequence I, II and III, respectively. It was major financial constraints in adoption of major cropping sequences followed by lengthy process of loan sanction in bank (ranges from 27.80 to 35.00 per cent) and no easy access for credit (ranges from 16.68 to 35.00 per cent) in adoption of major cropping sequences.

6. SUMMARY AND CONCLUSION

The problem of providing food for an ever growing human population in the developing world is a challenge to human beings. India is not exception to this. The increase in the population in India during the last fourthy year shows that the per capita food production has been increased insignificantly. Thus, there is a need for intensifying the efforts through appropriate for increasing the production.

The net area under irrigation and gross area irrigated have been increased considerably since independence. With the increase in the area under irrigation and availability of short duration varieties of different crops, it has become possible to increase the productivity per unit time and area by taking more than one crop on the same piece of land and within the period of an agricultural year.

This practice of taking more than one crops on the same piece of land in a year is called cropping sequence. Cropping sequence is followed in irrigated area by availability of irrigation in unirrigated condition by using moisture retentive practices. Such cropping sequences enable the farmers not only to increase food production but also to increase the farm income and employment.

The author, therefore, undertook a study on the “Economics of major cropping sequences in Pune district of

Maharashtra" has been taken up with the following specific objectives:

a) To identify the different cropping sequences
b) To study the resource use structure of major cropping sequences
c) To study the employment, income and expenditure pattern of sample farmers adopting major cropping sequences
d) To study the constraints in adopting major cropping sequences

Junnar, Indapur and Shirur tahsil from Pune district were selected purposively for this study because these tahsils have area under irrigation in decending order. Two villages viz., Alle and Rajuri from Junnar tahsil, two villages viz., Varkute (Kh.) and lasurne from Indapur tahsil and two villages viz., Pabal and kanhur Mesaii from Shirur tahsil were selected randomly. Fifteen cultivators from each village were selected randomly.

For the purpose of analysis cultivators selected from these villages were grouped into three categories on the basis of their operational holdings *viz.,* small farmers (up to 1.00 hectares), medium farmers (1.01 to 2.00 hectares) and large farmers (2.01 and above hectares). Thus total sample of ninty were selected randomly for the present study comprising 30 small, 30 medium and 30 large farmers.

6.1 Summary

1.The family size increased with increase in farm size sample households. At the overall level, average size of family was 5.94 persons. The average size of family was 5.42 in small, 5.88 in medium and 6.52 in large size group of households.

2.At the overall level, average number of earner was 3.64 (61.28 per cent of) the total family members. The average number of dependents at overall level was 2.30 (38.72 per cent).

3.At the overall level, average literacy was 84.51 per cent. The average literacy was 85.61 in small, 82.48 in medium and 85.58 in large size group of households.

4.The average per farm value of investment in various farm assets owned by the sample growers was ₹ 4,54,650.00, ₹ 5,20,115.00 and ₹ 5,58,602.00 in small, medium and large size categories, respectively. The contribution of land was more in fixed farm investment in all the size groups. The total investment in asset was more in large size group of households.

5.At the overall level, the average size of holding was 2.52 hectares. It was 0.76 ha in small, 1.63 ha in medium and 5.18 ha in large size groups. The gross cropped area was 0.97 ha, 2.10 ha and 5.86 ha in the case of small, medium and large size categories, respectively. The cropping intensity of small, medium and large size groups was 153.97, 143.84 and 125.75 per cent, respectively, and at overall level, it was 133.03 per cent. The percentage of irrigated area to total area was 51.19 per cent at

overall level and 31.57, 52.76 and 53.86 per cent in the case of small, medium and large size group of holdings, respectively.

6.The cropping pattern on the farms of sample cultivator was dominated by total vegetable crops occupied 28.64 per cent area followed by total fruit crop 28.52 per cent. Whereas, total cereals occupied 18.01 per cent area followed by total pulses 4.36 per cent at overall level. Among the vegetables onion occupied more area and green gram was the major pulse crop at overall level.

7.Existing sixteen cropping sequences three were select as major cropping sequences *viz.*, Pearl millet-Coriander-*Rabi* Onion cropping sequence (CS-I) is the dominant cropping sequence which is adopted by 21 farmers (23.33 per cent) followed by Pearl millet-*Rabi* Sorghum (CS-II) by 20 farmers (22.22 per cent), Cauliflower-*Rabi* Potato-Fenugreek (CS-III) by 18 farmers (20.00 per cent). These cropping sequences were selected on the bases of per cent to the total number of sample cultivar.

8.The average per hectare utilization of resources *viz.,* machine power, planting material, manures and fertilizers *etc.* were more used in cropping sequence III compared to remaining two cropping sequences. Lowest utilization of resources in cropping sequence II and than remaining two cropping sequences(Pearl millet-Coriander-*Rabi* Onion and Cauliflower-*Rabi* Potato-Fenugreek).

9.The average per hectare cost of cultivation was highest in cropping sequence III (₹ 236774.42), followed by cropping

sequence I (₹ 179574.88) and lowest in cropping sequence II (₹ 63398.97).

10.The average per hectare yield and gross income was lowest in cropping sequence II (37.47 qtl and ₹ 66622.58) as compared to cropping sequence I and III (320.81 and 433.47 qtl and ₹ 292129.08 and ₹ 410648.84, respectively). This has resulted into higher B:C ratio (1.73) in cropping sequence III as compared to cropping sequence I (1.63) and cropping sequence II (1.05).

11.Total employment generated was 390.93, 351.72 and 325.10 man days in cropping sequence I, II and III, respectively. Of the total employment generated in cropping sequence III, 20.25 per cent employment was generated through crop production activity and 42.25 per cent through livestock activity, but in cropping sequence II, 16.31 per cent employment generated through crop production activity and 43.78 per cent through livestock activity. While employment generated through crop production 28.19 per cent followed by livestock activity 38.21 per cent, in cropping sequence I.

12.The results of employment function of three cropping sequences indicate that the variables included in the model were a number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in employment function have jointly explained 78.00 per cent, 70.00 per cent and 69.00 per cent variation for cropping sequence I, II and III, respectively. The highest contribution came from number of milch animal (X_2) for

cropping sequence I and II and earners (X_1) for cropping sequence II and III.

13.Highest annual income produced by cropping sequences I (₹ 3,87,779.28) which have major contribution by crop production and livestock activity (46.28 and 25.55 per cent share, respectively). Income produced by cropping sequences II and III are ₹ 2,40,380.28 and ₹ 3,66,848.23, respectively.

14.The results of income function of three cropping sequences indicate that the variables included in the model were area under number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in employment function have jointly explained 76.00 per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively. The variables *viz.,* number of earners (X_1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in cropping sequence I and III, but it was non-significant in cropping sequence II. Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III.

15.Highest annual expenditure spend on cropping sequences III (₹ 3,15,695.60) per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 per cent share, respectively). Expenditure spend on cropping sequences I

and II are ₹ 2,98,761.18 and ₹ 2,41,850.69 per farm, respectively.

II. Conclusions

1.In Pune district among the sixteen cropping sequences observed, Pearl millet-Coriander-*Rabi* Onion, Pearl millet-*Rabi* Sorghum and Cauliflower-*Rabi* Potato-Fenugreek were observed to be the major cropping sequences.

2.In cropping sequences III (Cauliflower-*Rabi* Potato-Fenugreek), the recourse use level were higher than remaining two cropping sequence (Pearl millet-Coriander-*Rabi* Onion and Pearl millet-*Rabi* Sorghum) except total human and bullock labour, on the other hand in cropping sequence II the resource use level were lower than the cropping sequence I and II.

3.The average per hectare cost of cultivation was highest in cropping sequence III (₹ 236774.42) than cropping sequence I (₹ 179574.88) and cropping sequence II (₹ 63398.97). Average per hectare gross income in cropping sequence I, II and III was ₹ 292129.08, ₹ 66622.58 and ₹ 410648.84, respectively. Cropping sequence III was beneficial on the basis of benefit cost ratio, followed by cropping sequence I. Benefit cost ratio of cropping sequence I, II and III was 1.63, 1.05 and 1.73, respectively.

4.According to employment pattern, it was observed that annual employment per farm generated by cropping sequence I was 390.93 man-days, followed by cropping sequence II (351.72 man-days) and cropping sequence III (325.10 mandays). Annual

employment generated by cropping sequence I (Pearl millet-Coriander-*Rabi* Onion) was higher than remaining two cropping sequences (Pearl millet-*Rabi* Sorghum and Cauliflower-*Rabi* Potato-Fenugreek).

5.The analysis of employment pattern which indicate that there existed a scope to increase the total annual employment with increase in number of milch animal and area under cash crop in all cropping sequences. The number of milch animal, number of earner, area under cash crop and gross irrigated area have significant influence on the annual employment.

6.As regard the income, the major source of income in cropping sequence I and III was crop production (46.28 and 46.64 per cent) while in cropping sequence II the major source of income was livestock activity (45.80 per cent). Income level was benign highest in cropping sequence I (Pearl millet-Coriander-*Rabi* Onion) than remaining two cropping sequences (Cauliflower-*Rabi* Potato-Fenugreek and Pearl millet-*Rabi* Sorghum).

7.From the result of regression analysis it can be concluded that, number of earner, number of milch animal, area under vegetable and gross irrigated area have significant influence over the annual income in case of cropping sequence I. In case of cropping sequence II, number of earner, area under cash crop, area under vegetable and gross irrigated area have significant influence over the annual income, while in cropping sequence III, number of earner, number of milch animal, area under cash

crop and gross irrigated area have significant influence over the annual income.

8. The proportion of crop production expenditure in total expenditure was higher in case of cropping sequences I and III. In case of cropping sequence II livestock activity contributed major share in expenditure compare with remaining two cropping sequence expenditure on livestock activity. Total annual expenditure in cropping sequence III was highest than cropping sequence I and cropping sequence II.

9. The scarcity of water in summer, irregular supply of electricity with low voltage, high wage rate and non- availability of input (*i.e.* planting material, manures, chemical fertilizer and pesticides *etc.*) are the major problem faced by farmer in adoption of major cropping sequences. During marketing, the problem faced by the farmer high transportation cost, high price fluctuation, high marketing cost and lack of market intelligence.

III. Policy implications

1. The average per farm gross income from cropping sequence I (Pear millet-Coriander-*Rabi* Onion) is more than that of other cropping sequences (Pear millet-*Rabi* Sorghum and Cauliflower-*Rabi* Potato-Fenugreek). Hence, extension officer from state agriculture department, may suggest this cropping sequence to adapt by the farmers in Pune district to get maximum income through crop production.

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8 (A) APPENDIX

MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI.
Post Graduate Institute

Department of Agricultural Economics

QUESTIONNAIRE

Name of the student : Gaikwad Tejas Bapu
Year of data collection : 2013-14
Title : Economics of Major Cropping Sequence In Pune District of Maharashtra.

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1. General information of the cultivator

Name of cultivator

Age: Village: Tahsil:

District: Pune Education:

Occupation: - i) Main: ii) Subsidiary:

2) Family composition

Sr. No.	No	Education I, P, M, H, C	Engaged in		Income (₹)	
			Agriculture	Others	Agriculture	other
1. Male						
2. Female						
3.Children						
Total						

(I- Illiterate, P- Primary, M- Middle, H- High school, C- College)

3) Information about land (small / medium / large)

Sr. No	Survey no.	Total land holding (ha)	Permanent fallow (ha)	Cultivable land (ha)		Current price (₹)	Land revenue (₹)	Rent paid (₹)	Rent Received (₹)
				Irri.	Unir.				

4) Assets

A) Buildings

Sr. No.	Particulars	No	Year of const ruction	Rema-ining life (year)	Repair charges (₹)	Present value (₹)	% Use for Agril. purpose
1	Residential House						
2	Farm House						
3	Farm shed						
4	Godown						
5	Engine / Motor house						
6	Other						

B) Irrigation facilities

Sr. No.	Name	No.	Irrigated area (ha.)	Year of constr.	Purchase (₹)	Present life (Yr.)	Rema-ining life (Yr.)	Present value (₹)
1 2 3 4 5	Wells Tube well Drip Sprinkler Pipeline							

C) Livestock

Sr. No.	Particulars	No.	Year of purchased	Value (₹)	Remaining life (yr)	Present value (₹)	Medical expenses (₹)
1	Bullocks						
2	Cows						
	Local						
	Hybrid						
	Buffalos						
3	Calf						
4	Goats						
5	Sheep						
6	Poultry						

D) Machinery and Implements

Sr. No.	Particulars	No	Purchase Year	Purchase Price (₹)	Remaining life (Yrs)	Present value (₹)	Repairs (₹)
A	Farm Implement						
1	Bullock cart Iron/ Wooden						
2	Iron plough						
3	Wooden plough						
4	Harrow						
5	Ridger						
6	Hoe						
7	Seed drill						
8	Other						
B	Machinary						
1	Tractor						
	Tractor drawn implements						
2	Power tiller						
3	Sprayer						
4	Duster						
5	Thresher						
6	Electric Motor (hp)						
7	Other						
C	Agril. used implements						
1	Ghameli						

2	Spade						
3	Koyta						
4	Cutting knife / sickles						
5	Khurpi / Weeding hooks						
6	Bucket						
7	Other						
D	Other implements						

4) Cropping pattern

Season		Crop	Irrigated (ha)	Rain fed (ha)	Total (ha)	Yield (Qtl.)	Value (₹)
1 Field crops							
Kharif	1						
	2						
	3						
	4						
	5						
Rabi	1						
	2						
	3						
	4						
Summer	1						
	2						
	3						
	4						
2 Annual/Horticultural crops							
	1						
	2						
	3						
	4						
	5						

5. Cost of cultivation ( )

Variety - Area - Previous crop

Irrigation type - well / canal / lift / other

Sr. No.	Items	Expenditure		Required labours and wages											
		No.	Value	Family labour (man-days)				Hired labour (man-days)				Wages (₹)			
				M	F	B	Mach.	M	F	B	Mach.	M	F	B	Mach
1	Ploughing														
2	Clod crushing														
3	Harrowing														
4	Collection of stubbles														
5	Manure														
6	Seed														
7	treatment														
8	Sowing														
9	Fertilizers														
10	Hoeing														
11	Weeding														
12	Irrigation														
13	Plant														
14	Protection														
15	Harvesting & threshing														
16	Other														
	Total														

M-male, F-female, B-Bullock pair, Mach-machine hours

Yield : Main (Qtls) : . . . . . Value (₹) . . . . . By-produce (Qtls). . .

6. Annual employment of family worker

(man-days)

Sr.no	Item	Male	Female
1	Crop production		
2	Livestock		
3	Wage Earning		
4	Service/Business		
5	Other		

7. **Annual Expenditure (₹)**

a. Crop production

b. Livestock

c. Family expenditure

i) Food consumption

ii) Education

iii) Health

iv) Other

d. Business expenditure

e. Land improvement

f. Other

8. Annual Income (₹)

a. Crop production

b. Livestock

c. Wages

d. Service/Business

e. Loan taken – (Source)

f. Other

9. Constraints in adoption of cropping sequence

Sr. No.	**Constraints**	Yes	No
	Constraints in crop production		
1.	Shortage of labouer		
2.	High Wage rate		
3.	Non availability of seed or planting material at planting time		
4.	High cost of fertilizers		
5.	Shortage of water in summer		
6.	Electricity failure or Irregular supply of electricity		
7.	Lack of technical assistance		
	Constraints in marketing		
8.	High transportation charges		
9.	High price fluctuation of market price		
10.	High marketing cost		
11.	Lack of market intelligence		
	Financial Constraints		
12.	Scarcity of own funds		
13.	Lengthy process of lone sanction in bank		
14.	No easy access for credit		

7. VITA

Mr. Gaikwad Tejas Bapu

A candidate for the Degree
of
MASTER OF SCIENCE (AGRICULTURE)
in
Agricultural Economics
2016

Title of Thesis	**:**	**"**Economics of Major Cropping Sequences in Pune District of Maharashtra."
Major field	**:**	Agricultural Economics

Biographical informance

Personal	**:**	Born at Wadkigoan, Tah. Haveli, Dist. Pune on 4th May, 1992, Son of Sau. Sunita and Shri. Bapu Dharmaji Gaikwad.
Educational	**:**	Passed S.S.C. examination from Nav Maharashtra Vidhyalay, Pimpari, Pune-17 during 2007 obtain first class withdistinction
	:	Passed H.S.C. from Nav Maharashtra Jr. College, Pimpari, Pune-17 in 2009 with first class.
	:	Received B.Sc. (Agri.) Degree from College of Agriculture, Phaltan, Satara in 2013 with Second class from MPKV, Rahuri Completed M.Sc. Course work in Agril. Economics P.G.I., M.P.K.V., Rahuri.
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8 B(I) APPENDIX

Item wise per hectare cost of cultivation Crop- **Perl millet**

Area-**18 ha**Year- **2013-14** No. of Cultivators-**21,20** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	11.56	2486.18	8.43
	b. Female	31.27	3346.18	11.35
2	Bullock power (Pair days)	4.82	2660.70	9.03
3	Machine power (hr)	6.72	4347.40	14.75
4	Seed (kg)	3.78	453.96	1.54
5	Manures (q)	9.50	1691.00	5.74
6	Fertilizers (kg)			
	N	40.21	763.97	2.59
	P	9.01	445.95	1.51
	K	8.17	171.55	0.58
7	Irrigation Charges		531.27	1.80
8	Plant protection charges		155.66	0.53
9	Incidental charges		210.36	0.71
10	Reapirs		234.64	0.80
11	Working capital		17498.83	59.36
12	Int.on Working Capital		1049.93	3.56
13	Depre.on farm impliments		480.36	1.63
14	Land revenue and taxes		21.73	0.07
15	Cost 'A'		19050.85	64.63
16	Rental value of land		4746.28	16.10
17	Int .on fixed capital		247.84	0.84
18	Cost 'B'		24044.97	81.57
19	Family labour			
	a.Male	14.29	3071.76	10.42
	b. Female	22.07	2361.78	8.01
20	Cost 'C'		29478.52	100
21	Output (q)			
	a.Main produce	17.45	24859.77	
	b.By-produce	32.81	3748.28	
22	Per quintal cost		1474.97	

8 B(II) APPENDIX

Item wise per hectare cost of cultivation Crop- ***Rabi* Sorghum**

Area- **13.5 ha** Year- **2013-14** No. of Cultivators-**20** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	15.55	3109.09	9.17
	b. Female	25.45	2545.45	7.50
2	Bullock power (Pair days)	7.67	2767.89	8.16
3	Machine power (hr)	7.28	5202.60	15.34
4	Seed (kg)	10.18	1170.91	3.45
5	Manures (q)	11.33	2244.24	6.62
6	Fertilizers (kg)			
	N	56.36	1070.91	3.16
	P	13.06	632.54	1.86
	K	8.17	212.40	0.63
7	Irrigation Charges		796.36	2.35
8	Plant protection charges		755.59	2.23
9	Incidental charges		250.36	0.74
10	Reapirs		284.36	0.84
11	Working capital		21042.70	62.04
12	Int.on Working Capital		1262.56	3.72
13	Depre.on farm impliments		788.55	2.32
14	Land revenue and taxes		20.73	0.06
15	Cost 'A'		23114.54	68.14
16	Rental value of land		6315.03	18.62
17	Int .on fixed capital		683.16	2.01
18	Cost 'B'		30112.72	88.77
19	Family labour			
	a.Male	10.45	2202.73	6.49
	b. Female	15.00	1605.00	4.73
20	Cost 'C'		33920.45	100
21	Output (q)			
	a.Main produce	20.02	27525.00	
	b.By-produce	30.05	10489.53	
22	Per quintal cost		1170.49	

8 B(III) APPENDIX

Item wise per hectare cost of cultivation Crop- **Coriander**

Area- **9 ha** Year- **2013-14** No. of Cultivators-**21** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	4.54	975.18	2.68
	b. Female	35.48	3795.95	10.45
2	Bullock power (Pair days)	4.46	2566.96	7.07
3	Machine power (hrs)	0.72	515.14	1.42
4	Seed (kg)	67.67	4626.24	12.73
5	Manures (q)	24.49	2814.86	7.75
6	Fertilizers (kg)			
	N	18.93	360.36	0.99
	P	15.14	742.70	2.04
	K	0.00	0.00	0.00
7	Irrigation Charges		1350.60	3.72
8	Plant protection charges		150.00	0.41
9	Incidental charges		320.06	0.88
10	Reapirs		331.00	
11	Working capital		18549.59	51.06
12	Int.on Working Capital		1112.98	3.06
13	Depre.on farm impliments		1348.81	3.71
14	Land revenue and taxes		27.67	0.08
15	Cost 'A'		21039.04	57.91
16	Rental value of land		10915.96	30.05
17	Int .on fixed capital		1423.83	3.92
18	Cost 'B'		33378.84	91.88
19	Family labour		0.00	
	a.Male	2.70	568.51	1.56
	b. Female	22.38	2382.26	6.56
20	Cost 'C'		36329.61	100
21	Output (q)			
	a.Main produce	51.85	65661.77	
	b.By-produce	0.00	0.00	
22	Per quintal cost		700.74	

8 B(IV) APPENDIX

Item wise per hectare cost of cultivation Crop- ***Rabi* Onion**

Area- **11.7 ha** Year- **2013-14** No. of Cultivators-**21** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	21.90	4709.52	4.14
	b. Female	98.69	10559.88	9.28
2	Bullock power (Pair days)	10.15	6165.67	5.42
3	Machine power (hr)	8.70	6522.32	5.73
4	Seed (kg)	11.37	11084.82	9.74
5	Manures (q)	24.27	4733.39	4.16
6	Fertilizers (kg)			
	N	137.62	2619.18	2.30
	P	44.39	2175.25	1.91
	K	43.39	867.86	0.76
7	Irrigation Charges		4190.48	3.68
8	Plant protection charges		1374.17	1.21
9	Incidental charges		372.62	0.33
10	Reapirs		348.93	0.31
11	Working capital		55724.08	48.98
12	Int.on Working Capital		3343.45	2.94
13	Depre.on farm impliments		1566.43	1.38
14	Land revenue and taxes		43.38	0.04
15	Cost 'A'		60677.33	53.33
16	Rental value of land		32933.17	28.95
17	Int .on fixed capital		3823.04	3.36
18	Cost 'B'		97433.54	85.64
19	Family labour			
	a.Male	64.38	13191.67	11.60
	b. Female	29.60	3141.55	2.76
20	Cost 'C'		113766.76	100
21	Output (q)			
	a.Main produce	250.26	197859.26	
	b.By-produce	0.00	0.00	
22	Per quintal cost		454.24	

8 B(V) APPENDIX

Item wise per hectare cost of cultivation Crop- **Cauliflower**

Area- **6.1ha** Year- **2013-14** No. of Cultivators-**18** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	36.39	7824.59	8.36
	b. Female	26.07	2789.02	2.98
2	Bullock power (Pair days)	4.29	2464.96	2.63
3	Machine power (hrs)	11.88	8551.48	9.14
4	Seed (kg)	0.29	8213.65	8.78
5	Manures (q)	26.39	5146.72	5.50
6	Fertilizers (kg)			
	N	114.75	2180.33	2.33
	P	47.38	2321.48	2.48
	K	30.23	634.82	0.68
7	Irrigation Charges		4726.56	5.05
8	Plant protection charges		4468.52	4.78
9	Incidental charges		350.49	0.37
10	Reapirs		230.49	0.25
11	Working capital		49903.10	53.34
12	Int.on Working Capital		2994.19	3.20
13	Depre.on farm impliments		4602.46	4.92
14	Land revenue and taxes		43.83	0.05
15	Cost 'A'		57543.57	61.51
16	Rental value of land		28562.40	30.53
17	Int .on fixed capital		2856.24	3.05
18	Cost 'B'		88962.21	95.09
19	Family labour			
	a.Male	11.31	2431.97	2.60
	b. Female	20.16	2157.54	2.31
20	Cost 'C'		93551.72	100.00
21	Output (q)			
	a.Main produce	124.93	171637.38	
	b.By-produce	0.00	0.00	
22	Per quintal cost		742.83	

8 B(VI) APPENDIX

Item wise per hectare cost of cultivation Crop- **Fenugreek**

Area- **8.1ha** Year- **2013-14** No. of Cultivators-**18** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune.**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	8.36	1797.54	3.75
	b. Female	29.51	3157.38	6.59
2	Bullock power (Pair days)	4.76	2738.32	5.72
3	Machine power (hrs)	2.65	1906.23	3.98
4	Seed (kg)	90.33	6509.51	13.59
5	Manures (q)	25.48	5033.81	10.51
6	Fertilizers (kg)			
	N	27.27	518.14	1.08
	P	15.46	757.49	1.58
	K	0.00	0.00	0.00
7	Irrigation Charges		1604.43	3.35
8	Plant protection charges		285.08	0.60
9	Incidental charges		249.34	0.52
10	Reapirs		224.26	0.47
11	Working capital		24781.53	51.73
12	Int.on Working Capital		1486.89	3.10
13	Depre.on farm impliments		1277.54	2.67
14	Land revenue and taxes		37.49	0.08
15	Cost 'A'		27583.46	57.58
16	Rental value of land		14815.31	30.93
17	Int .on fixed capital		1481.53	3.09
18	Cost 'B'		43880.30	91.60
19	Family labour			
	a.Male	7.05	1515.57	3.16
	b. Female	23.44	2508.36	5.24
20	Cost 'C'		47904.23	100.00
21	Output (q)			
	a.Main produce	64.34	89116.80	
	b.By-produce	0.00	0.00	
22	Per quintal cost		745.09	

8 B(VII) APPENDIX

Item wise per hectare cost of cultivation Crop- ***Rabi* Potato**

Area- **8.1ha** Year- **2013-14** No. of Cultivators-**18** Village-All

Tah.-**Shirur, Indapur and Junnar.** Dist.-**Pune**

Sr. No.	Cost items	Qty	Value	Per cent
1	Hired Human labour (Mandays)			
	a.Male	42.46	8916.39	9.35
	b. Female	76.23	8156.56	8.56
2	Bullock power (Pair days)	6.72	5297.98	5.56
3	Machine power (hr)	10.49	7554.10	7.93
4	Seed (kg)	939.18	5635.08	5.91
5	Manures (q)	38.31	7470.74	7.84
6	Fertilizers (kg)			
	N	134.59	2557.21	2.68
	P	53.11	2602.62	2.73
	K	100.47	2078.87	2.18
7	Irrigation Charges		1911.23	2.01
8	Plant protection charges		3552.79	3.73
9	Incidental charges		317.87	0.33
10	Reapirs		217.70	0.23
11	Working capital		56269.14	59.03
12	Int.on Working Capital		3376.15	3.54
13	Depre.on farm impliments		4602.46	4.83
14	Land revenue and taxes		50.54	0.05
15	Cost 'A'		64298.28	67.46
16	Rental value of land		24931.90	26.16
17	Int .on fixed capital		747.96	0.78
18	Cost 'B'		89978.14	94.40
19	Family labour			
	a.Male	15.61	3270.49	3.43
	b. Female	19.35	2069.84	2.17
20	Cost 'C'		95318.47	100.00
21	Output (q)			
	a.Main produce	243.93	149894.66	
	b.By-produce	0.00	0.00	
22	Per quintal cost		391.24	

8 C(I) APPENDIX

Cropping pattern of sample farmers adopting cropping sequence I

(ha)

Sr. No	Particulars	Small	Per cent	Medium	Per cent	Large	Per cent	Overall	Per cent
1	Per millet	0.34	18.68	0.45	15.36	0.69	14.61	0.49	15.56
2	Sorghum	0.19	10.44	0.37	12.63	0.20	4.24	0.25	7.94
3	Wheat	0.00	0.00	0.00	0.00	0.26	5.51	0.09	2.86
	Total Cereals	**0.53**	**29.12**	**0.82**	**27.99**	**1.15**	**24.36**	**0.83**	**26.36**
4	Gram	0.11	6.04	0.03	1.02	0.24	5.08	0.13	4.13
5	Green gram	0.11	6.04	0.20	6.83	0.23	4.87	0.18	5.71
6	Black gram	0.09	4.95	0.03	1.02	0.20	4.24	0.10	3.17
	Total Pulses	**0.31**	**17.03**	**0.26**	**8.87**	**0.67**	**14.19**	**0.42**	**13.33**
7	Groundnut	0.09	4.95	0.17	5.80	0.31	6.57	0.19	6.03
8	Other Oil Seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Oil Seed	**0.09**	**4.95**	**0.17**	**5.80**	**0.31**	**6.57**	**0.19**	**6.03**
9	Onion	0.34	18.68	0.45	15.36	0.57	12.08	0.45	14.28
10	Coriander	0.34	18.68	0.45	15.36	0.43	9.11	0.41	13.02
11	Potato	0.09	4.95	0.17	5.80	0.06	1.27	0.10	3.18
	Total Vegetable	**0.77**	**42.31**	**1.07**	**36.52**	**1.06**	**22.40**	**0.96**	**30.48**
12	Crusted appeal	0.09	4.95	0.35	11.95	0.83	17.58	0.42	13.33
13	Other Fruit crop	0.03	1.65	0.03	1.02	0.36	7.63	0.14	4.44
	Total Fruit crop	**0.12**	**6.60**	**0.38**	**12.97**	**1.19**	**25.21**	**0.56**	**17.77**
14	Fodder	0.00	0.00	0.23	7.86	0.34	7.20	0.19	6.04
	GCA	**1.82**	**100.00**	**2.93**	**100.00**	**4.72**	**100.00**	**3.15**	**100.00**

8 C(II) APPENDIX

Cropping pattern of sample farmers adopting cropping sequence II (ha)

Sr. No.	Particulars	Small	Per cent	Medium	Per cent	Large	Per cent	Overall	Per cent
1	Per millet	0.28	25.00	0.29	11.19	0.49	10.72	0.35	12.68
2	Sorghum	0.42	37.50	0.41	15.83	0.52	11.38	0.45	16.30
3	Wheat	0.03	2.68	0.11	4.25	0.23	5.03	0.13	4.71
4	Maize	0.13	11.61	0.19	7.34	0.23	5.03	0.18	6.52
	Total cereals	**0.86**	**76.79**	**1.00**	**38.61**	**1.47**	**32.16**	**1.11**	**40.21**
5	Gram	0.00	0.00	0.00	0.00	0.06	1.31	0.02	0.73
	Total pulses	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**	**1.31**	**0.02**	**0.73**
6	Groundnut	0.00	0.00	0.06	2.32	0.12	2.63	0.06	2.17
7	Other oil seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Oil seed	**0.00**	**0.00**	**0.06**	**2.32**	**0.12**	**2.63**	**0.06**	**2.17**
8	Tomato	0.00	0.00	0.06	2.32	0.09	1.97	0.05	1.81
9	Chilli	0.13	11.61	0.13	5.01	0.06	1.31	0.10	3.62
10	Onion	0.03	2.68	0.06	2.32	0.11	2.41	0.07	2.54
11	Coriander	0.00	0.00	0.06	2.32	0.03	0.65	0.03	1.09
12	Fenugreek	0.00	0.00	0.06	2.32	0.03	0.65	0.03	1.09
13	cluster bean	0.00	0.00	0.09	3.47	0.09	1.97	0.06	2.17
14	Potato	0.00	0.00	0.06	2.32	0.12	2.63	0.06	2.17
15	Other vegetables	0.00	0.00	0.09	3.47	0.20	4.38	0.10	3.62
	Total vegetables	**0.16**	**14.29**	**0.61**	**23.55**	**0.73**	**15.97**	**0.50**	**18.11**
16	Crusted appeal	0.00	0.00	0.06	2.32	0.29	6.35	0.12	4.35
17	Pomegranate	0.07	6.25	0.43	16.60	0.63	13.79	0.38	13.77
18	Other Fruit crop	0.00	0.00	0.00	0.00	0.14	3.06	0.04	1.45
	Total Fruit Crop	**0.07**	**6.25**	**0.49**	**18.92**	**1.06**	**23.20**	**0.54**	**19.57**
19	Sugarcane	0.00	0.00	0.20	7.72	0.83	18.16	0.34	12.32
20	Fodder	0.03	2.68	0.23	8.88	0.30	6.57	0.19	6.89
	GCA	**1.12**	**100.00**	**2.59**	**100.00**	**4.57**	**100.00**	**2.76**	**100.00**

8 C(III) APPENDIX

Cropping pattern of sample farmers adopting cropping sequence III (ha)

Sr. No.	Particulars	Small	Per cent	Medium	Per cent	Large	Per cent	Overall	Per cent
1	Per millet	0.00	0.00	0.07	2.92	0.03	0.72	0.03	1.09
2	Sorghum	0.05	2.91	0.00	0.00	0.03	0.72	0.02	0.73
3	Wheat	0.05	2.91	0.03	1.25	0.00	0.00	0.03	1.09
	Total cereals	**0.1**	**5.82**	**0.10**	**4.17**	**0.06**	**1.44**	**0.08**	**2.91**
4	Groundnut	0.00	0.00	0.03	1.25	0.06	1.44	0.03	1.09
5	Other oil seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Oil seed	**0.00**	**0.00**	**0.03**	**1.25**	**0.06**	**1.44**	**0.03**	**1.09**
6	Tomato	0.15	8.72	0.03	1.25	0.26	6.22	0.14	5.46
7	Chilli	0.00	0.00	0.07	2.92	0.03	0.72	0.03	1.09
8	Onion	0.00	0.00	0.10	4.17	0.09	2.15	0.06	2.18
9	Cauliflower	0.33	19.19	0.28	11.67	0.39	9.33	0.33	12.00
10	Coriander	0.00	0.00	0.03	1.25	0.06	1.44	0.03	1.09
11	Fenugreek	0.33	19.19	0.28	11.67	0.45	10.77	0.35	12.73
12	Cabbage	0.05	2.90	0.03	1.25	0.00	0.00	0.03	1.09
13	Spinach	0.05	2.90	0.03	1.25	0.00	0.00	0.03	1.09
14	Potato	0.33	19.19	0.28	11.67	0.39	9.33	0.33	12.00
15	Other vegetables	0.00	0.00	0.00	0.00	0.15	3.59	0.05	1.82
	Total vegetables	**1.24**	**72.09**	**1.13**	**47.08**	**1.82**	**43.54**	**1.39**	**50.36**
16	Pomegranate	0.05	2.91	0.33	13.75	0.63	15.07	0.34	12.36
17	Other Fruit crop	0.00	0.00	0.13	5.42	0.33	7.89	0.15	5.46
	Total Fruit Crop	**0.05**	**2.91**	**0.46**	**19.17**	**0.96**	**22.97**	**0.49**	**17.81**
18	Sugarcane	0.10	5.81	0.58	24.17	1.10	26.32	0.59	21.45
19	Fodder	0.23	13.37	0.10	4.17	0.18	4.31	0.17	6.18
	GCA	**1.72**	**100.00**	**2.40**	**100.00**	**4.18**	**100.00**	**2.75**	**100.00**