

**AN INVESTIGATION OF OPTIMUM AND PROFITABLE
COMBINATION OF CROP-LIVESTOCK ENTERPRISE IN JAMMU
REGION OF UT OF J&K**

by

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(J-19-M-615)

**A Thesis submitted to
Faculty of Agriculture
in partial fulfilment of the requirements
for the degree of**

**MASTERS OF SCIENCE IN AGRICULTURE
AGRICULTURAL ECONOMICS**



Division of Agricultural Economics and Agri-Business Management

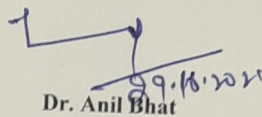
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CERTIFICATE - I

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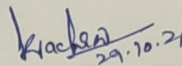
The work has been carried out by **Mr. Vijay Rajan Sahni**, Registration No. **J-19-M-615** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma. It is further certified that help and assistance received during the course of this investigation have been duly acknowledged.



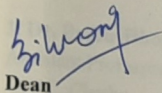
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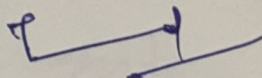
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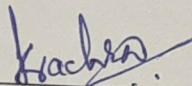
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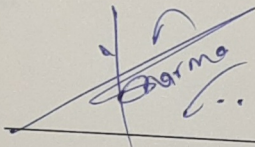


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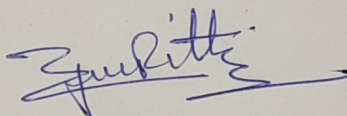


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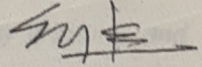
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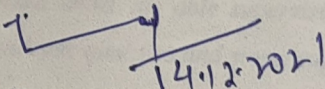
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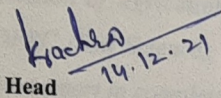
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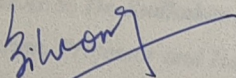
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ACKNOWLEDGEMENTS

First of all, I would like to thank my loving creator GOD for making me and who blessed me with strength and courage throughout my research work to complete it successfully.

I emphatically dedicate my whole work to my family who continues to inspire me and always believed in my ability to be successful in the academic arena. I feel highly privileged, when I award them with the epithet of priceless asset, who revitalized my dream to live and theme to struggle with an eternal touch of dedication.

*I feel extremely happy, obliged and greatly privileged to express my gratitude and indebtedness to my esteemed major advisor **Dr. Anil Bhat, Assistant Professor, Division of Agricultural Economics and ABM, SKUAST-J**, for his keen interest, critical evaluation and appreciation in the execution of my entire work meticulous supervision, constant encouragement throughout the course of this work. I simply consider myself fortunate enough to have worked under his able supervision and guidance. I was greatly benefitted by his excellent academic qualities and moral support offered by him to me from time to time during the period.*

*I express my special gratitude to thank honourable members of my advisory committee **Dr. Jyoti Kachroo**, Director (Planning & Monitoring), Professor and Head, Division of Agricultural Economics and ABM, SKUAST-J. **Dr. Lakshmi Kant Sharma**, Associate professor, Division of Agricultural Extension Education and **Dr. Balbir Dhotra**, Assistant Professor, OFRC (Soil Science), SKUAST-J, Chatha for their constructive suggestions and unconditional support to complete my present endeavor.*

*I equally extend my gratitude and sincere thanks to **Dr. S.P.Singh**, Assistant Professor, Division of AEABM, **Dr. Sudhakar Dwivedi**, Associate Professor, Division of AEABM and **Dr. Manish Sharma**, Professor and Head, Division of Statistics and Computer Science for their help and support during the analysis of data.*

I avail myself of this rare opportunity to express my ecstatic gratitude to esteemed and preponderant honourable teaching staff of the Division of Agricultural Economics and ABM.

*I am extremely grateful to **Dr. J. P. Sharma**, Honorable Vice chancellor, **Dr. S.E.Z. Rizwi**, Director Education and Dean of FoA, SKUAST-J, Chatha for allowing me to undertake*

the study and providing me necessary facilities and financial assistance for timely completion of the study.

It is my privilege and pleasure to express profound sense of love for my loving parents, my father **Shri. Swami Raj** and my mother **Smt. Indu Bala** for making my life most memorable and their morale boosting during every phase of my life, indeed actuated me to make this ideal expectancy true.

I record with immense pleasure my sincere thanks to my senior colleagues & juniors Vipal Bhagat sir, Surjeet Singh, Pankaj Lochan, Sumit Singh, Rupali Kaundal, Kajal Thaper, for sharing their lighter and focused moments during this tenure.

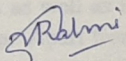
There is nothing more wonderful than the love and guidance elder sister and brother-in-law can give. I am thankful to all my family members who support me during the completion of my research work.

The cooperation and ever willing support of non-teaching staff of the division especially **Mrs. Monika Sharma, Mrs. Jyoti, Mr. Manjeet Singh** is really admirable and appreciable.

On a different note, many people have been a part of my education and I offer my regards to all of those who supported me in any respect during the completion of my study.

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ABSTRACT

Title of the Thesis	: An Investigation of Optimum and Profitable combination of Crop-Livestock Enterprise in Jammu Region of UT of J&K
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Year of award of degree	: 2021
Name of the University	: Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu

A study entitled, An investigation of optimum and profitable combination of crop-livestock enterprise in Jammu region of UT of J&K was carried out during the agricultural year 2020-21. The objectives of the study were to find out the economics of different enterprises at selected farms, to estimate the level of income and employment of existing enterprises, to develop the optimum enterprise combination with existing patterns and to identify the constraints in adoption of enterprises in the study area. The study was conducted in Jammu and Doda district of Jammu division of J&K UT. From each district two blocks were selected randomly and from each block two villages were selected randomly constituting eight villages in total. In the final stage 15 farmers from each village were selected. Both primary and secondary data were collected for the study. For computing cost and returns the concept framed by CACP was used. For financial viability of various enterprises net present value, internal rate of return and benefit cost ratios were calculated. By using linear programming optimum and profitable combination of crops with livestock were suggested. The study revealed that majority of the farmers belonged to middle age having an average land holding size of 0.72 hectare. Paddy was found in both districts but wheat and berseem crop were found only in Jammu district. In addition to this, vegetables and fruit crops were found in Doda district only. The net returns from paddy were ₹41977.37 per hectare with the cost-benefit ratio of 1:2.76. As far as the wheat crop is concerned, Jammu district has shown the cost-benefit ratio of 1:2.01. Maize crop were grown in rainfed area of Nagrota block as well as in the blocks of Doda district. The net returns per hectare were ₹31872.88 for the maize crop. Apart from these cereal crops, the two fodder crops were grown by the farmers during rabi season viz., berseem in Jammu and oats in Doda district. The vegetable crops were found to be much remunerative for the farmers as compared to the cereal and fodder crops. Among the vegetable crops garlic and onion gives highest cost benefit ratio of 1:8.71 and 1:5.79, respectively. The cost and returns from livestock was also found to be found beneficial for the farmers of both the district but among the livestock, crossbred cows were found to be highest returning Among the fruit crops the highest NPV, IRR as well as BCR was found from walnut. The income and employment generated from various crops was calculated from both districts. The highest labour utilized in paddy crop and least in case of wheat crop from R.S. Pura block. The income generated from crops were divided into family labour income and farm business income. The profitable combination of crop livestock was found by using linear programming. The existing and proposed values on the basis of three parameters viz., land allotment, cash outlay and labour was calculated in case of crops whereas in case of livestock instead of land allotment number of animals were concerned. Costly labour and shortage of irrigation has proved to be the dominant constraint in the study. Lack of information was another factor that hindered the agricultural production in the sampled area.

Keyword: Net returns, Cost-Benefit Ratio, Income and employment, Linear programming, constraints.

Signature of the Major Advisor

Signature of the Student

LIST OF ABBREVIATIONS USED

Abbreviation/Symbol	Meaning
/	Per
et al.	Et alii (and others)
Fig.	Figure
i.e.	Id est (that is)
viz.	Vi delictet (namely)
Kg	Kilogram
Q	Quintals
Ha	Hectares
FYM	Farm yard manure
HYV	High yielding varieties
q/ha	Quintals per hectares
Vis-a-vis	In relation to
FAO	Food and Agriculture Organization
IFAD	International Fund for Agricultural Development
MoA & FW	Ministry of Agriculture & Farmers Welfare
DAC & FW	Department of Agriculture, Cooperation & Farmers Welfare
GVA	Gross Value Added
B/C ratio	Benefit- cost ratio
RFMI	Reservoir fishing management index
NPV	Net present value
IRR	Internal rate of return
Agri.	Agriculture
J&K	Jammu and Kashmir
CACP	Commission for Agricultural Costs and Prices
Rs.	Rupee
UT	Union Territory
DAP	Di-ammonium phosphate
S.No.	Serial Number

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CERTIFICATE- IV

Certified that all necessary corrections as suggested by the external examiner and the Advisory committee have been duly incorporated in the thesis entitled “**An Investigation of Optimum and Profitable Combination of Crop-Livestock Enterprise in Jammu Region of UT of J&K**”, submitted by **Mr. Vijay Rajan Sahni**, Registration No. **J-19-M-615**.

Dr. Anil Bhat
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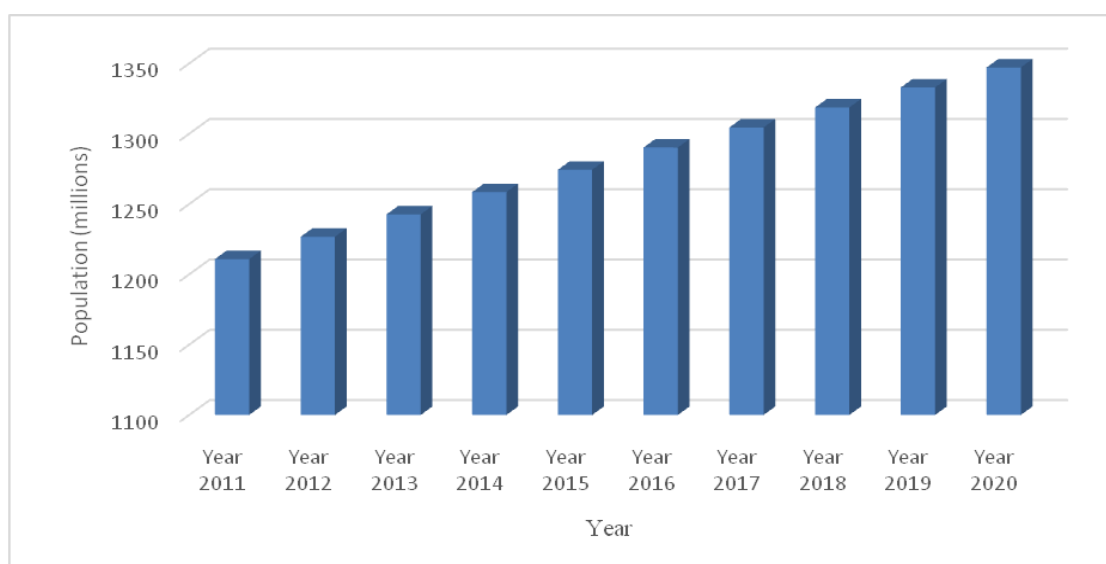
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Introduction

The current global population of 7.9 billion people as of March 2021 is expected to reach 9.7 billion by 2050. At present, nearly 11 per cent of the world population suffer from hunger and many facing malnutrition and chronic food deprivation has reached to nearly 821 Million people in 2020 (FAO, 2018). Hence, world food production will have to increase for better livelihood of the individuals.

India occupies only 2.4 per cent of the world's area yet it has supports and sustains 17.70 per cent of the world's population (censusindia.gov.in). The Indian economy is predominantly agrarian. India is an agricultural country. Agriculture and its allied activities are the main source of livelihood providing employment directly and indirectly to majority of population in this country. Agriculture is considered as the backbone of the Indian rural economy and is a family enterprise and an important element in reduction of rural growth poverty. Agriculture has been a way of life and most important livelihood of the Indian masses. Agricultural policy in India across decades has been focusing on self-sufficiency and self-reliance in food grain production. More than 296 million people in India still belongs to below poverty line, i.e., about one-third of the poor population of the world, also the year 2020 shown the first rise in global extreme poverty in the generation, while hopes for eradicating hunger worsened (IFAD, 2020). Agriculture and its allied sectors not only provides the good quality food to the individual but also provide employment for many people in agriculture sector. Its contribution to GDP is 20.20 per cent in 2020-2021 (National Statistical Office, India). In 2020-2021, the government allocates ₹1.34 lakh crore in 2020-21, a 32 per cent increase over the revised estimate of 2019-20 (NSO, India). As India's population grows and agricultural land becomes scarce, the need for food rises and there is no single farming operation is likely to be able to meet the demands of marginal and small farmers without adopting with other allied enterprises to generate income and employment year-round (Mahapatra, 1994). The reduction in farmland size from 2.28 hectares in 1970-71 to 1.84 hectares in 1980-81 to 1.41 hectares in 1995-96 to 1.23 hectares in 2005-06 and to 1.08 hectares in 2015-16 offers a substantial challenge to farming's long-term viability and profitability (Anonymous, 2020). The given decline in per capita income from 0.5 ha in 1950-51 to 0.15 ha by the end of the century and it still reducing to less than 0.1 hectares by 2020, so it made

important to develop agricultural strategies and various technologies to allow for adequate income generation and employment, especially for farmers who have small and marginal land holding and those farmers are the most important component of the farming community (Jha, 2003). To meet the growing goals of poverty alleviation, food security, competitiveness and sustainability, several researchers have recommended a farming approach to research and development. This means food production in India is also needed to increase. The Indian agriculture is of subsistence nature with medium productivity and the return on investment is not up to the mark and majority of the farmers are small and marginal farmers. So, there is a great need for farmers to maximize their output such as food production throughout the year, increase in income and optimum resource utilization



Source: *Tradingeconomics.com/Ministry of Statistics & Programme*

Fig. 1.1. Growth rate of population in past ten years

According to FAO, a farming system is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. There are various potential enterprises which are important in farming system in the way of making a significant impact on farm by generating adequate income and employment and providing livelihood security. Crop production is a crucial farming activity that every farmer follows.

Jammu and Kashmir, a Union Territory of India has a varied topography. A hilly region with a large diversity in terms of culture, language, socio-economic

conditions, and religions in different areas. The economy of Jammu and Kashmir was predominantly dependent on agriculture and allied activities. The state's agro-climatic diversity, which ranges from sub-tropical in Jammu to temperate in Kashmir and intermediate in Doda makes it perfect for a wide range of crops. Agriculture has always been a top priority at the federal and state levels. At the state level, agriculture currently contributes 16 per cent. For its unique agro-climatic zones, Jammu and Kashmir has a distinct geographical view. In general, there are finite resources but we always want to make most of them by optimum utilization of these resources. In Jammu and Kashmir, there are mostly small and marginal farmers with a land holding of less than 2 hectares. Small farmers are usually focused on how to allocate scarce resources optimally to maximize their output or to attain their objectives such as food security for the family, efficient resource usage and steady flow of income. They not only produce different crops but also choose among the different enterprises rationally. Usually their decisions are influenced by farmer's experiences, neighbourhood etc.

In Jammu and Kashmir, agriculture is a diversified farming system in which crop production and animal husbandry are most prominent sector for efficient and economic utilization of land capital and labour. Crop production as well as livestock farming should be encouraged to provide year-round employment and revenue. Experimental evidences have also shown that yield stability and monetary return is higher in diversified farming. Basic land use decision in farming system is crop planning which considers the choice of crop to be grown, the resource allocation and acreage within a particular farm. These planning decisions mostly take place at the farm level.

In India and in Jammu and Kashmir, food crop is predominantly grown in most suitable seasons and thus particular food crop is basic to the farming system followed by the farmers. Dairy farming adds to the income of farmers, particularly when the land holding is small. This sector is quite livelihood intensive, providing additional income to over 70 per cent of rural and a small number of urban households. Goat and sheep rearing can add to the income of farmers as they have the capability to sustain in different kinds of environments, including dry, hot, wet and cold, high mountains or low-lying plains.

On the other hand nearly 70 per cent of the population in the union territory derives its livelihood directly or indirectly from the agriculture sector (Digest of Statistics, 2017-18). As per the NARP classification Jammu division of the union territory is divided into three broad physical divisions from agricultural point of view. viz. subtropical zone, intermediate zone and temperate zone. Rice-wheat and maize-wheat are the most common cropping systems in Jammu's irrigated and rain-fed districts, respectively. The average yield of the principal crops of the Jammu division in '000 quintals i.e. in rice, wheat and maize is 2839, 6671 and 4365, respectively (Digest of Statistics, Govt. of Jammu and Kashmir, 2017-18; Agricultural Statistics at a glance, 2017). That is why, apart from the increasing productivity of these crops through various technological interventions, it also becomes necessary to evaluate and quantify how much efficiently the resources are utilized, besides providing the optimum plans to the farmers which could not only generate more income but will provide additional employment to the farmers.

Generally, mathematical programming tools have been used covering large range of activities like mixed farming, crop farming, all sorts of combinations of different activities. In a regional or inter-regional condition, linear programming technique has been used for studying optimum resource allocation and resource requirements. Linear programming is one of the most important approach used in farm planning and decision making particularly when there is more than one crop raised, on the same land, at the same time. Optimized agricultural planning is most important activity in enterprise profitability as it increases the income with low additional cost. Linear programming developed by Dantzig (1991) is more popular due to the proportionate characteristics of the allocation problems which is more helpful in defining the technical relationship between input and output. When different crops are competing for limited land and other resources, linear programming tools can overcome such constraints and limitations and therefore an effective tool to aid optimization.

Linear programming is employed in farm planning because of its simplicity and practical relevance to resource allocation for optimal solutions. It determines the optimum plan for the selection and combination of farm enterprises to maximize the income and minimize the costs within the available farm resources.

In the UT of Jammu and Kashmir the overall economic process depends largely on the progress of agriculture sector. Lack of technical knowledge was the major problem faced by farmers in agricultural activities. In dairy farming activities, majority of the respondents faced problems of maintenance of hygiene in the cattle sheds and keeping records. In vegetable growing activities, farmers faced problem in identifying the insect-pests, diseases and their symptoms. The general problems faced by the respondents particularly in agriculture and subsidiary occupation were hard and tedious which demands high physical work and at the same time do not have the fixed working hours. Balancing in society can be achieved only when agriculture and livestock practices are considered equal. Government policies should be framed to provide legal support and build confidence in farmers.

1.1 Objectives of the study:

Keeping in view the facts discussed above, the present study entitled “**An investigation of optimum and profitable combination of crop livestock enterprise in Jammu region of UT of J&K**” was carried out with the following objectives:-

1. To work out the economics of different enterprises at selected farms
2. To estimate the level of income and employment of existing enterprises
3. To develop the optimum enterprise combination with existing patterns
4. To identify the constraints in adoption of enterprises in the study area

1.2 Importance and need for study

So far, studies on agriculture along with livestock in the Jammu division of the Union Territory of Jammu and Kashmir are merely even negligible. In recent years, the farming system approach in analysing various agricultural challenges has grown in popularity. Such research will shed light on the issues associated with various farming methods, allowing academicians and policymakers to design region-specific, appropriate, and tailor-made plans for increasing the livelihood security of different farm sizes in different agro-climatic zones of Jammu division. The land holding is shrinking, so as the productivity, profitability, and sustainability of per unit land is also declining. Farmers are relocating to cities in pursuit of a more secure source of income. This necessitates the development of a research activity that will aid in determining the most effective manner for farmers to utilise the small amount of land they own. Because of the various climatic conditions, there is enormous potential for

the expansion of various firms in the regions. The importance of the horticulture sector to the economy of J&K cannot be overstated. By the end of the fiscal year 2018-19, Jammu and Kashmir has exported over 21 lakh metric tonnes of fresh and dry fruits (Digest of statistics, 2019). The implementation of more horticultural-related firms would not only increase farmer income, but will also contribute to the economy of Jammu and Kashmir by generating valuable foreign exchange.

In our study, our effort is to expand the researches which are already existing on optimum plans with which the farmers of the UT should improve their standard of living and also the conditions of the farmers of the UT will become better by adopting these plans. It will not help the farmers in various ways only but instead of the farmers of the UT it will also help many researchers, academicians in designing the optimum plans in future and helps in understanding the constraints faced by the farmers of various regions.

1.3 Scope of the study:

The situations of the farmers in the sampled region are taken into consideration and various crops grown by them. The farmers of the specific region are involved in various agriculture related enterprises and the main focus of our study relies on this. The study calculated the selected respondent's gross and net returns, as well as the NPV, IRR, and BC ratio. The study will aid in understanding the interdependence of various enterprises as well as the lacunae in it. The findings of our study will not only helps the sampled farmers of the area but other farmers also which have grown the similar crops in the related type of climatic conditions and also helps farmers in decision making in selection of enterprise. The importance of agriculture with allied enterprises in income generation shows by this research study. The study intends to examine the common challenges and problems faced by farmers in agriculture and related enterprises. The constraints faced by the farmers were mostly man made and by adopting the suitable methods the farmers will eliminate the various constraints that create problems in procuring the benefit from agriculture and allied enterprises. The current study will be useful in evolving, developing, and implementing farming methods in various agro-climatic zones in the Jammu region, as well as in areas with similar situations elsewhere. It will also be critical in assisting farmers, academicians and policymakers in developing policies that would lead to the overall development of agriculture in the region and enhance the socio-economic

situations of rural population of the region. As a result, the current study will aid in understanding the significance of various types of enterprises in agricultural growth. It will aid in the formulation of plans that will not only boost the production of important agricultural crops, but will also strengthen the associated sector and ensure the long-term sustainability of the Jammu division.

1.4 Limitations of the study:

The study was based on a sample survey of farmers in two districts of Jammu division. Personal interviews were used to obtain information based on respondent remembrance, previous experience and involvement. Despite the fact that every attempt was made to collect valid information, there may be some lacunae in the information provided by respondents. Due to time and resource restrictions for research academics, a small sample size (120 farmers) was used. A greater sample size would undoubtedly increase reliability. The information was gathered during the pandemic year of 2020-21. So, different variables of production were affected by the pandemic and the lockdown imposed by the government during this year. Because the study was conducted in a specific place, the results may not be applicable to other areas, but they may be useful as a guide for future research.

Review of Literature

The main purpose of review of literature is to present findings of the past and recent research studies, which are related to the present investigation. It provides a basis for theoretical framework, to provide an insight into methods and procedures, to suggest operations of major concepts, and to provide a basis for interpretation of findings. However, attempt was made to review to make this proposed study more concrete on realistic background. With this background and keeping the objectives of study in mind, the available related literature was reviewed and presented under following heads:

- 2.1. Economics of different enterprises at selected farms
- 2.2. Level of income and employment of existing enterprises
- 2.3. Optimum enterprise combination with existing patterns
- 2.4. Constraints in adoption of enterprises in the study area

2.1. Economics of different enterprises at selected farms

Sharma *et al.* (1991) has noticed diverse livestock based farming systems in the hill zones of Himachal Pradesh. In the hilly zones of Himachal Pradesh they also studied the interdependency among distinctive subsystems of farming. They showed that crop cultivation with animal husbandry and forestry were the main closely interrelated components of the farming systems in the hills. It also showed that the fodder worth ₹4555 consumed by livestock sector came from crop residues and farmland forestry (28.6 per cent and 57.6 per cent, respectively) in the lower hills. The crop production depended on the livestock sector for goods and services worth \$758 per farm in the mid hills.

Pawar *et al.* (1996) found that cropping sequences adopted by the farmers in the state of Maharashtra was bajra +wheat, bajra +gram, bajra+ jowar and bajra +wheat +groundnut. Among these farming sequences, bajra +wheat was largely adopted. In respect to the net income, the most profitable cropping sequence found was bajra +wheat +groundnut. They also studied the farming system with milch animals, the economically profitable cropping sequence was bajra-gram followed by bajra +wheat +groundnut and bajra+jowar. They showed that maintenance of milch animals improves the relative productivity of crops indirectly by the application of available farm yard manure.

Ganesh (2000) evaluated various farming strategies such as paddy farming, paddy cum prawn farming, and mixed farming in the Gazani areas of coastal Karnataka. On small and large farm the highest net profit realised was ₹52,52,495 and ₹32,27,082, respectively.

Regeena (2000) studied livestock production of smallholder farmers in the home gardens of south Kerala, observed that farmers having a unit of one or two crossbreed milch animals. And the average milk yield was found out to be 6.40 litres per day, generated an annual income of ₹3.30 lakh per annum when sold at the rate of ₹13/litre. From this activity it was found that there was generation of 141 man-days of gainful employment. A complementary relation was shown by the dairy enterprise with the crop enterprise.

Rajeshwari (2004) evaluated the costs and benefits of coconut-based farming techniques in Karnataka's Tumkur district. The farmers of this region follow the Farming System comprising of coconut, arecanut, ragi and dairy and were getting the highest net farm income of ₹785,600 per farm and the cost of cultivation was ₹1,59,645. The study showed that the net farm income was higher in coconut, arecanut, ragi and dairy farming system, but the employment generation (both human and bullock) were high in coconut, greengram, rabi ragi, dairy farming system, as farmers under this farming system were taking up labour intensive enterprises. The major components of cost of production were operational cost, amortized establishment cost, material cost and rental value of land.

Shukhla (2004) studied rice-wheat sequence in Punjab, Haryana and Uttar Pradesh. In his study he found that this sequence produced net returns of ₹6417, ₹6583 and ₹37206 per hectare in Punjab, Haryana and Uttar Pradesh, respectively. In these states this sequence was more remunerative than other sequences. The study further indicated that in total returns of all the wheat-based systems the highest contribution was of wheat.

Ramrao *et al.* (2005) conducted research in Drug district of Chattisgarh to identify a sustainable mixed farming model that integrated the various components and was economically viable. On a 3.5-acre land, the components included crops, livestock, poultry and duckery. A model consisting of 1 cow, 2 bullocks, 2 buffaloes, 20 poultry, 15 goats, and 20 ducks, in addition to crop cultivation, produced the highest net income

of ₹58456 per year when compared to crop farming (arable farming) alone (₹18300 per year) with a B:C ratio of 2.25:1 and generated 571 days of employment.

Saikumar (2005) evaluated the cost and return structure of three primary farming systems in tank commands in north eastern Karnataka. The study found that, of the three major farming systems observed in the study area, dairy farming was the most popular as a complementary activity. The highest net returns per hectare were ₹53,404.59 and the highest per hectare cultivation cost was ₹84414.21 in the Farming System consisting of redgram+ kharif jowar+ groundnut+, followed by bengalgram+ rabi jowar + dairy.

Singh *et al.* (2005) while researching several types of agricultural systems in the Murrumbidgee Irrigation Area in NSW, they discovered three types of irrigated farming systems: broadacre farming, horticulture, and vegetable farming. Rice was the most common crop planted in broadacre farming methods. Horticulture plantation farms were well-known for their citrus and grape output. Onions, carrots, tomatoes, and melons were the most common vegetables grown in vegetable farming systems.

Bhatia, M.S (2006) revealed that GDP from agriculture, which included associated sub-sectors like as animal husbandry, rises from ₹13390 in 1996-97 to ₹15006 in 2002-03 per hectare, a 12 percent rise in six years. He believed that animal husbandry plays a significant part in the economic prosperity of Indian farmers.

Chandel and Malhotra (2006) investigated livestock systems in India's poorly equipped semi-arid regions. According to the findings of this study, seven primary systems are prevalent in the region. There were significant discrepancies in current averages, and the exploitable potential in milk productivity is high in a buffalo-based livestock system was identified.

Kumar and Singh (2007) in the Panipat district of Haryana, India, conducted research on the economic implications of milk production. The research took into account a variety of factors, including different categories of livestock. Feeds, fodder, and concentrates, veterinary and labour expenses, acquisition of dairy animals, milk yield, and income from the sale of by-products were among the variables. In addition, the variable and fixed costs, as well as returns/income for various breeds, were determined. Following the analysis, it was discovered that raising buffalo was more profitable than raising local cows to enhance farm income.

Ravisankar *et al.* (2007), during the years 2004–2006, in Calicut, South Andaman, evaluated the productivity, profitability, employment generation, energy flow, and nutrient recycling of an integrated agricultural system for slopy upland areas of the Bay Islands. Crops, vegetables, floriculture, fishing, poultry, duckery, and cattle (bullock, cow, and calf) rearing were the key components. Crops yielded the highest net return (81.09 per cent), followed by cattle (14.3 per cent), poultry (4.38 per cent), and fish (4.38 per cent). The integrated farming system generated 346 man days/ha/year of employment. With a B: C ratio of 3.30, the net return obtained from all components was also higher under this sort of system. In these hilly upland regions of the Andaman and Nicobar Islands, instead of farming the crop alone, integration of all of these components could be used to boost productivity, economic returns, and employment generation for family labour.

Shekinah and Sankran (2007) conducted a study in western zone of Tamil Nadu on productivity, profitability and employment generation under unirrigated farming conditions. They found that when compared to the conventional method of cropping alone, the study found that all of the enterprise combinations tried were successful. The most profitable farming system on a holistic basis was found to be the integration of crop (0.80 ha) with manure of livestock produced on the farm, with goat, pigeon, agro forestry (0.10 ha), and farm pond (0.04 ha). Higher productivity and employment was achieved by recycling of resources and leftovers.

Singh and Agrawal (2007) in the Indian state of Manipur, conducted a research on the costs and returns of milk production. A sample of 80 milk producing households was selected using the cumulative square root approach from four villages in two blocks of West Imphal district, with 42 small, 31 medium, and 7 big herd size categories. During the research, it was found that 66.66 per cent of all milch cows were in their lactation period. Milch cows were found to have the greatest average fixed investment in dairying per household (₹54697). A crossbreed cow during its lactation period was fed with 21.00 kg of green fodder, 6.30 kg of concentrates and 10.00 kg of dry fodder on an average basis. In addition to this, the daily gross maintenance cost per milch local cow and cross breed cow was estimated to be around ₹22.90 and ₹73.00, respectively. Except for the large herd size group, net returns were shown negative from milk production in case of local cow which showed that local cows were not beneficial for

the farmers in that area. In the case of crossbred cows, the results were positive and highest in the big herd size group, followed by medium and small herd sizes.

Khairo *et al.* (2008) across pastoral zone of New South Wales, recognised three agricultural systems: Upper Darling, Murray-Darling, and Far West regional farming systems. A mixed agricultural system of cattle and sheep enterprises with minor cropland was defined as the farming system in the Upper Darling region. The integration and management of crops and animal enterprises were used to characterise the Murray-Darling basin farming system. Sheep breeding enterprises for meat and wool were prevalent in the Far West farming system.

Singh *et al.* (2008) showed that the pulse crop was found to be the most important crop in most cropping systems since it required less fertiliser and water than cereal and oilseed crops. The majority of farmers selected pulse-based agriculture due to increased yield, better market facilities, and larger net gain. The gram-based farming system, which included soybean-gram+1 graded buffalo, moong-gram+1 graded buffalo, and moonggram+1 mustard+1 graded buffalo, had cultivation and maintenance costs of ₹340 950/ha, ₹137 460/ha, and ₹37 300/ha, respectively, and yielded net returns of ₹26,750/ha, ₹320,120/ha, and ₹323,530/ha. Similarly, in other case, moong-dwarf pea+1 graded buffalo, soyabean-dwarf pea+1 graded buffalo and moong-dwarf pea+mustard+1 graded buffalo gave net return by ₹19,705/ha, ₹23,935/ha and ₹322,440/ha, respectively. Jowar + arhar long duration+1 graded buffalo farming system provided least net return by ₹18240/ha and needed lowest cost (₹31460/ha).

Singh and Gangwar (2010) conducted research in Uttar Pradesh on "Economics of crop and livestock production". The research was conducted with the help of a survey schedule and 108 respondents were selected for the study who have main occupation was agriculture in south-west region of semi-arid plain of Uttar Pradesh. The study discovered that there were around 24 farming techniques in use in the study area. The net returns from the various agricultural systems in the research region were estimated, with the vegetable component providing the highest net returns (₹137112) in the vegetable-based farming system, followed by sugarcane (₹60634) in the sugarcane-based farming system. Furthermore, all agricultural systems except sugarcane-based farming systems had a high B/C ratio. The findings suggest a proper mix of livestock, such as sheep, goats, poultry, and fisheries, as well as an adequate farming strategy, to

help farmers earn more money. Prioritization of restrictions was also a requirement for farming system diversification, planning, and programmes.

Kumar *et al.* (2011) for the Eastern Region, Patna for lowland situations, calculated seven models of farming systems for sustained productivity, profitability, employment production, and nutrient recycling using distinct combinations of crop, animal, bird, and fish. In terms of productivity, employment generation (752 man days/years), net returns (₹159,485/year), and income sustainability index for net returns, the best combination was Crop+ fish + duck + goat (80 percent).

Torane *et al.* (2011) while conducting the research on the economics of farming systems in North Konkan Region of Maharashtra identified the best enumerating farming systems were Paddy + Irrigated plantations + Betelvines (B:C ratio of 2.02), Paddy + Pulses + Dairying + Poultry (B:C ratio of 1.74), Paddy + Vegetables + Dairying (B:C ratio of 1.62), Paddy + Irrigated plantations + Rainfed plantation + Dairying (B:C ratio of 1.57), Irrigated plantations + Dairying (B:C ratio of 1.56), and Pa (B:C ratio, 1.42). The agricultural economy was shown to have a wide range of income per farm, ranging from 1135 to 218015 across various farming methods.

Ugwumba *et al.* (2011) in the Awka South Agricultural Zone of Anambra State, Nigeria, investigated several types of agricultural systems and their effects on farm cash income. They discovered that 29.76 per cent of the farmers have included catfish farming into their agricultural systems, resulting in crop-fish-livestock farming. Crop-fish integration (9.52 per cent), livestock-fish integration (11.92 per cent), and crop-livestock-agro-processing integration (9.52 per cent) were among the other types of comparative integration proposed by the remaining farmers (1.19 percent).

Kumar *et al.* (2013) conducted study in the subtropical Kandi belt of Jammu region. The study found that among the different food crops grown in that area the cost of cultivation in maize was found to be highest (₹23975.84/ha) with the highest gross returns of ₹30662.36 per hectare. The cost benefit cost ratio in maize was found to be 1:1.28.

Gupta (2019) the studied per hectare cost and returns structure of cultivation of rice and found that ₹55642.45 for Bishnah, ₹51729.92 for Marh, ₹59543.40 for Mahreen and ₹57446.37 for Nagri. The overall per hectare gross returns of rice cultivation in these four blocks was ₹117829.28. The expenditure incurred on machine

labour was found to be highest i.e., ₹9730.11 per hectare among the all inputs incurred. The cost structure revealed that cost C2 was highest for Mahreen block whereas the net return was found to be highest in Nagri block. The cost- benefit ratio with an overall ratio of 1:2.10 in Jammu district, found to be highest (1:2.22) for Marh block.

Malik (2019) studied the cost of cultivation for wheat where the cost incurred in different processes worked out to be ₹41750.70, ₹44351.05, ₹46273.08, ₹44996.93 for Akhnoor, Marh, Marheen and Barnoti respectively with an overall average of ₹44342.94. The overall gross returns of wheat cultivation in four different blocks were found out to be ₹604741.75. The expenditure incurred on machine labour which was 40 per cent (approx.) of the operational cost was found to be highest. The concept wise cost structure revealed that cost C2 was highest (₹31246.08/ha) for Mahreen block. Akhnoor block had the highest net return (₹26224.30/ha) with the highest cost- benefit ratio (1:1.62)

2.2. Level of income and employment of existing enterprises

Sain *et al.* (1994) conducted a study on "The effect of dairy farming on farm family income and distribution: An empirical study of Punjab farmers." For this study the data used were taken from the data collected in the project "Economics of farming in Punjab" and pertaining to the year 1991-92. In this study Statistical analysis, such as, percentage, simple averages, functioning analysis and Ginni's distribution were used to meet the particular objectives. The study showed that dairying enterprise was the most optimistic occupation, helping in supplementing farm family income to the extent of one third of total income, particularly for small farmers. The factors, contributing to the production of milk were the No. of milch animals, investment on feed and fodder. As compared to the crop farming where alone crops were raised the dairying enterprise along with crop farming has a greater impact on the improvement of distribution of farm family income especially helping the smaller farmers with a greater share. The study revealed that to supplement farm family income of the Punjab farmers dairy farming needs to be encouraged in the rural area of the state.

Choudhary (1995) attempted in his study "Income and employment opportunities under dairying and crop enterprise", to find out the role of crop and dairying enterprises in income generation and sustainable rural employment and labour utilization. The data for the study were taken by personal interview from villages of Raipur district and pertained to the year 1994-95. 30 households were divided into

different categories, i.e., agri. with dairying, dairying with agri., and dairying with other occupation. Further dairy enterprise was divided into two different classes depending upon the No. of milch cattle/dairy enterprise generated better economic returns in farming situations of agriculture along with dairy enterprise. It was largely based on minimum cost of milk production using surplus farm family human labour and by-product. The study further showed that for the viability of the dairy enterprise male labour power was responsible. The result suggested that for increasing income of small and marginal households mixed enterprises offer a greater scope.

Gopalappa (1996) investigated crop diversification and income levels in Andhra Pradesh's Karimnagar area. They tried to analyse the effect of agricultural diversification on the income and the standard of living of farmers making progress at the village of Gopalpur in the Karimnagar district of A.P.'s Elakathurthi mandal. Based on primary data collection purposive sampling method was followed for the study. It has been noted in the survey that there was a good scope through crop diversification to increase the income. For diversifying the farming system an appropriate cropping pattern along with some suitable supplementary enterprises have to be identified. With suitable infrastructural and institutional support all these have to go hand in hand.

Ravisankar *et al.* (2007) conducted a study in Calicut, South Andaman, evaluated the employment generation in an integrated agricultural system for slopy upland areas of the Bay Islands. The key components were crops, vegetables, floriculture, fishing, poultry, duckery, and cattle rearing. The highest net returns were yielded by crops (81.09 per cent), followed by cattle (14.3 per cent), poultry (4.38 per cent) and fish (4.38 per cent). The employment generated was 346 man days/ha/year. To boost productivity, economic returns, and employment generation for family labour in these hilly upland regions of the Andaman and Nicobar Islands, instead of farming the crop alone, integration of all of these components could be used.

Shekinah and Sankran (2007) conducted a study in western zone of Tamil Nadu on employment generation under unirrigated farming conditions. They found that when compared to the conventional method of cropping alone, the study found that all of the enterprise combinations tried were successful. The most profitable farming system on a holistic basis was found to be the integration of crop (0.80 ha) with manure of livestock produced on the farm, with goat, pigeon, agro forestry (0.10 ha), and farm

pond (0.04 ha). Higher productivity and employment was achieved by recycling of resources and leftovers.

Suresh and Singh (2008) recognized the average net income per hectare from paddy was ₹5516, wheat was ₹6614, and sugarcane crops was ₹24142, while the family labour income per hectare generated from these crops was less than ten thousand in case of cereal crops whereas the farmer generated more income from sugarcane crop each year. Human labour employment was 235.60 man-days per year, 146.42 man-days per year, and 118.81 man-days per year, respectively. The net income from buffalo rearing was ₹1064 per farm, while family labour income was ₹4373 per farm, generating 78.41 man-days per year. The family labour income was ₹6038 on small families, ₹7787 on large households, and human labour employment was highest at 80.50 man-days on small households, according to net income analysis. The mean net income from cow milk production was ₹1559 per farm, with family labour income of ₹4758 per farm and human labour employment of 74.76 man-days per year.

Malathesh *et al.* (2009) revealed that in the eastern dry-zone of Karnataka, high employment generation was discovered in the crop + dairy + sericulture farming system (75 man days/year), followed by crop + sericulture (59 man days/year) and very little in the crop only farming system.

Singh *et al.* (2010) observed that in existing farming systems there have a lot of scope to minimize labour employment. Cereal, livestock, vegetable, and sugarcane production were the main sources of farm revenue. The ideal number of dairy animals per farm was found to be around three. Farmers used surplus labour at a rate of roughly 1300 man days per hectare, despite the fact that the optimal labour demand was around 500 man days per hectare.

Kumar *et al.* (2011) conducted a research in the Eastern Region, Patna for lowland situations, calculated employment production in distinct combinations of crop, animal, bird, and fish. In terms of productivity, employment generation (752 man days/year) and income sustainability index for net returns, the best combination was Crop+ fish + duck + goat (80 percent).

2.3. Optimum enterprise combination with existing patterns

Jacob and Nair (1999) used linear programming to develop an ideal Integrated Farming System (IFS) model for farmers with farm holdings of 0.2 ha or less which consisted of 43 partnerships with a cropping intensity of 161 per cent and a B:C ratio of 1:2.5.

Wadear (2003) identified and analysed the optimality of different animal based farming systems. The research was conducted in three dry zones in northern Karnataka. According to him, maize in kharif and onion in rabi turned out to be most profitable crops in Zone-III. It was noticed that sustainability value index was highest in all the zones in all the categories of farm, Farming System-I (paddy, sunflower, greengram, jowar, tur, blackgram, and groundnut in Kharif season; jowar and bengalgram in rabi and sugarcane and dairy animals) compared to Farming System-II (sunflower, tur, greengram, chilli and groundnut in kharif; jowar and jowar and bengalgram in rabi and dairy animals). Further, the author estimated the optimum plans by reallocating the existing resources and by relaxing the capital and labour constraints to obtain optimum plan-I and optimum plan-II, respectively. In Zone-I, there was marginal decline in the net returns from farming in optimum plan-II, compared to existing plan (₹66,121.00). However, there was slight increase in net income in optimum plan-I (₹96,321.00). As a result, per cent change in net returns over existing plan was marginal in optimum plan-I (44.93%) and optimum plan-II (42,34%). As per his estimation, across the selected zones, with the increase in the farm size milk production also increased and ranged from 4.5-5.0 litre/day/animal.

Kiresur *et al.* (2004) studied the optimum plans in northern eastern dry zone in Karnataka for sustainable farming systems by using Linear Programming, divided the sample farmers into various farming system viz., field crops + Dairy animals (FS I) and field crops + Dairy Animals + Draught Animals (FS II). In farming system II during kharif season the area under sunflower was increased by 77.27 per cent in model-I and 89.78 per cent in model-II whereas during Rabi season area under bengal gram hiked from 0.10 ha to 0.96 ha, while area under sorghum decreased by 87.65 per cent. The cropping intensity was also increased 189.78 per cent in optimum plan from 159.12 per cent in existing plan. The area of Kharif sunflower in large farms was increased by 56.51 per cent. It was concluded that FS-I was found to be more sustainable as compared to FS-II.

Veerkar (2004) formulate optimum plans by employing linear programming technique. The optimum plans recommended that, the plant population in sole cropping of coconut plant should be decreased by 18 per cent. In system III, the optimal plan which accommodated 136 coconut palms along with 733 black pepper vines and 600 arecanut palm per hectare could generate about 33 per cent more employment and 24 per cent excess income.

Ramrao *et al.* (2005) conducted research to identify a sustainable mixed farming model in Drug district of Chattisgarh that integrated the various components and was economically viable. On a 3.5-acre land, the components included crops, livestock, poultry and duckery. A model consisting of 1 cow, 2 bullocks, 2 buffaloes, 20 poultry, 15 goats, and 20 ducks, in addition to crop cultivation, produced the highest net income of ₹58456 per year when compared to crop farming (arable farming) alone (₹18300 per year) with a B:C ratio of 2.25:1 and generated 571 days of employment.

Srinivasa *et al.* (2005) conducted research in southern arid zone of Karnataka to determine the best cropping pattern for sericulture dominating farms. The deterministic linear programming method was used to find the best mix of different enterprises for the sample farmers. The model suggested shifting cropping patterns from subsistence crops such as ragi to commercial crops such as bivoltine sericulture and crossbred sericulture in the Kolar area Mysore area, respectively. The model also suggested keeping two buffaloes and one crossbred cow.

Kumar *et al.* (2006) in his study in water scarce region of Uttar Pradesh, various sustainable farming systems such as wheat-mustard-based and potato-based farming systems were observed. Using the linear programming technique, optimal farming systems were discovered. Non-integer values were used for other enterprises, whereas integer values were used for cattle enterprises. According to their estimates, approximately 68.53 percent of the households belonged to the wheat-mustard farming system group. It was concluded that the rise in net returns on small farms was greater than on large farms due to better resource allocation.

Mahendran *et al.* (2006) in the overexploited groundwater region of Perambalur district of Tamil Nadu, optimal cropping patterns are evolved using linear programming techniques. Land, capital, and irrigation were all major constraints. The capital element has been reduced from ₹62248 per hectare to ₹361123 per hectare. When compared to

the current situation, the use of the majority of inputs was reduced in the optimal crop plan, demonstrating that the right use of input might minimise the cost of obtaining the same amount of income.

Sharma et al. (2006), investigated and represented five major mountain farming systems, viz. paddy-based, maize-based, livestock-based, vegetable-based, and fruit-based farming systems. Over time, it has been discovered that many changes have occurred in the socioeconomic milieu and agricultural techniques in the mountains. Cropping patterns, the level of diversification, and commercialization have been shown to vary significantly throughout mountain agricultural systems. Scarcity is a growing indicator of unsustainable systems centred on fruits and vegetables.

Channabasavanna and Biradar (2007) conducted study in different integrated farming systems and recommended that integrated farming system at Siruguppa, Karnataka during 2004-05 and 2005-06 over conventional rice-rice system (6667 kg/ha/year and ₹21,599/ha/year, respectively) recorded more system productivity (15,555 kg/ha/year) and net returns (₹48,603/ha/year) (6667 kg/ha/year and ₹21,599/ha/year, respectively). The productivity per day was 2.3 folds higher (42.6 kg/ha/day) in integrated farming system over conventional type system (18.2 kg/ha/day). IFS also recorded the highest labour use efficiency (25.17 kg/ha/labor). Rice-fish (pit in the centre of the field) – poultry (reared separately) had the highest total productivity of the different models in terms of rice grain equivalent yield (17502 kg/ha/year) and net returns (₹62977/ha/years) and benefit cost ratio (1.91 followed by Rice-fish-poultry (poultry shed on fish pit).

Nedunchezian and Thirunavukkarasu (2007) in the Tamil Nadu district of Thanjavur, a study was done to maximise farm plans in various farming systems. To arrive at the best farm plans for several types of farms (landless, marginal, small, and large), a linear programming (LP) model was devised. Only three of the six crops included in the model looked to be advantageous, according to the results. Crop farming thus provided ₹61,364 (70.30 percent) to the aggregate net returns of ₹87,228 under the ideal plan. Dairying yielded a net profit of ₹25,864, or around 29.70 percent of overall profits.

Amarnath (2009) used linear programming technique to determine the importance of agricultural diversification for long-term sustainability and its impact on

farm income. Minimum land for paddy and fodder crops was one of the specific constraint of the model. Raising paddy I, fodder sorghum I, sorghum II, and maize II, together with a 50% increase in input application, was recommended as the best approach. Raising paddy I, fodder sorghum I, and maize I, as well as dairying, had also been suggested. As a result, farmers might use a variety of crops, as well as increased inputs and dairy activity, to boost farm profitability and sustainability.

Dey & Mukhopadhyay (2010) in the Kakdwip block of South used Parganas district of West Bengal linear programming to optimise vegetable crop distribution. More resources were given to brinjal and pointed gourd in the ideal crop plan. The net return from the ideal crop plan was 49.79 percent higher than the net return from the previous crop.

Kachroo *et al.* (2012) on 1.5 hectares of land, found that an integrated farming system model consisting of crops, a unit of one buffalo + one cow and their young, horticulture intercropped with vegetables under canopy cover, 100 broiler birds + 50 Van raja birds, five bee boxes, fish, vermin-composting unit, mushroom production unit, and farm boundary plantations was more profitable than existing practises.

Majeke *et al.* (2013) used a linear programming model to find the best crop combination for a Zimbabwean rural farmer. Maize, soyabean, and cotton were among the crops considered. The model produced an optimal crop mix that yielded a larger income than the farmer's plan. The disparity in income was 73 percent.

Hassan *et al.* (2015) concluded in their research that increase in productivity for the ever increasing population is the only way to meet the ever-increasing need for food, fibre, and fuel. This is expected to be attained by more effective resource allocation to maximise returns and more systematic use of these resources.

Raghav and Srivastava (2015) investigated farming practises optimization on tribal farms in Uttarakhand. Using the linear programming technique, the possibility of improving agricultural revenue was studied. The potential to increase return on variable cost (ROVC) over existing plans was greatest in farming system (FS)-IV (Livestock), followed by FS-I (Crop + Livestock) and FS-II (Crop), while income increased by only 0.27 percent in FS-III (Crop + Livestock + Orchard). The study's key policy recommendations were that orchard and livestock production improvements should be prioritised. Potato farming should be fostered in the research area.

Ramarao *et al.* (2017) attempted to broaden the criteria for evaluating farming systems beyond profitability. The system with rainfed and irrigated crops, as well as animal raising, produced the highest household income. The input - output ratio was found to be highest in farming systems with both rainfed and irrigated agriculture. The requirement for external inputs may be reduced in farming systems, which played an important role in sustaining agricultural systems in rainfed agriculture. An in-depth examination of farming methods might be beneficial in planning for technology generation and transfer in Indian agriculture.

2.4. Constraints in adoption of enterprises in the study area

Wagh *et al.* (2002) studied the constraints in adoption of dairy technology in Sirpurataluka of Dhule district of Maharashtra. The study revealed that the important economic constraints were non-availability of loan (100 per cent) and lack of capital (81 per cent) among the constraints related to input supply, non-supply of improved breeds and feeds (100 per cent), lack of knowledge of improved fodder and non-availability of veterinary aid centre (67 per cent).

Sharma *et al.* (2008) in their study highlighted the lack of a communication facility, a family's financial difficulty, very low support price fixed by the government, increased input costs, and insufficient and untimely rainfall as the most significant constraints. According to the study, communication tools for farmers should be made available to reduce the effects of these restraints. Extension organisations should perform village-level training on leadership development and technology diffusion, and co-operative societies should be made more successful so that farmers have access to original plant protection chemicals. It went on to say that the lengthy and complicated loaning procedure should be simplified and that the support price should be increased.

Singh *et al.* (2013) in their research revealed that non-availability of high-quality seed was a major impediment for 91 per cent of farmers. Furthermore, the scarcity of cross-breed and exotic breed animals results in low animal productivity. Furthermore, approximately 87 percent of respondents stated that appropriate quality planting material for horticultural crops should be made available.

Kolekar *et al.* (2013) conducted research to analyse the constraints of dairy farmers with the help of Garret's ranking technique in the Satara district of Maharashtra. Contract dairy farmers reported difficulty achieving quality criteria, as well as pressure

to maintain milk quality, low milk production, delayed payment of milk yield, erroneous milk grading and delays in organising inputs. In addition to all those constraints identified, the other important constraints identified by the enterprise were frequent market milk price fluctuations and farmer input diversion.

Sori *et al.* (2014) identified constraints in paddy production, marketing, and processing in the Mahasamund district of Chhattisgarh were ranked and analysed. They discovered in their research that significant insect pest infestations, the problem of excessive weed incidence, and high labour costs were viewed by farmers as key constraints in paddy production. Furthermore, they discovered issues with marketing. Absence of transportation and road facilities, lack of a controlled market, and uncompetitive prices were identified as serious challenges in paddy marketing. When it comes to processing issues and limits, electricity shortages and processing unit inefficiencies were the most significant.

Sharma *et al.* (2017) highlighted the constraints in the adoption of various enterprises as the diversion of highly productive areas from agriculture to infrastructure development, urbanisation, and other associated activities.

Paul *et al.* (2020) used garret ranking approaches to investigate constraints which are susceptible to socio-economic changes in the region and the solutions that were calculated by small scale fishing groups in tropical reservoirs in India, including Peechi and Pothundi. Diverse stakeholder interest, human and wildlife interaction, and inconsistent fish stocking were identified as main vulnerabilities faced by communities in this study. In addition to this, Reservoir fishing management index were used by which it was found that there is immense need in allowing gender equity in fish production centres which were land based for regular and continuous fish production as the appropriate strategy to generate the incomer of fishermans from reservoir of the Pothundi area. The results from RFMI for reservoirs of Pothundi and Peechi were 68.60 and 52.15, respectively.

The review of literature gave a complete analysis on various issues connected to socioeconomic, costs and returns, income and employment, resource optimization, and farmer restrictions in agricultural areas. Some studies focused solely on economics, i.e., crop costs and returns, whereas others concentrated on the cost and return structure of agricultural-allied firms. Furthermore, previous research has indicated the

optimization of inputs in many crops as well as industries. Similarly, the various constraints have been explored in depth to learn more about the various challenges faced by farmers in various agricultural locations.

Materials and Methods

The present investigation entitled “An Investigation of Optimum and Profitable Combination of Crop-Livestock Enterprise in Jammu region of UT of J&K” was conducted during the year 2020-21. This chapter deals with the methodology followed to accomplish the objectives of the study. The description of locale of the study, sampling design, collection of the data and structure and experimental procedure and techniques adopted during the course of investigation are discussed under the following headings:-

3.1. Locale of study

The present study was conducted in Sub-tropical region of Jammu district and Temperate region of Doda district of Jammu division of UT of J&K. The districts were selected purposively on the basis of diversified farming system in which crop production and animal husbandry are most prominent sectors.

Table 3.1. District-wise area of Jammu division (2016-17)

(Area in ha)

District	Net area sown	Irrigated area	Rainfed area/ Unirrigated area
Jammu	106798	66115	40683
Samba	32645	10067	22578
Udhampur	48885	10212	38673
Reasi	20937	1439	19498
Doda	29848	2495	27353
Kishtwar	16044	2815	13229
Ramban	19961	1372	18589
Kathua	58797	21218	37579
Rajouri	53632	4768	48864
Poonch	27336	3501	23835
Total	414883	124002	290881
J&K	757026	336083	420943

Source: Digest of statistics 2016-17 (J&K)

JAMMU & KASHMIR



Fig 3.1 Map of the Sampled districts

3.2 Profile of the Study Area

Union Territory of Jammu and Kashmir, a mountainous part of India and home to many valleys. The Pir Panjal mountain ringed the valley from the west and south, cutting it off from the Great Plains of northern India. The long Himalayan mountain separates the Kashmir valley from the Tibetan plateau. Jhelum, Tawi, Ravi, and Chenab rivers are among the important rivers that run through the Himalayan River. The climatic conditions of Jammu and Kashmir is different from place to place so it is divided into three agro-climatic zones. Jammu and Kashmir is a Union Territory in the Himalayan area, located between 32.17 and 37.06 north latitude and 73.2 and 80.36 east longitude. More than 75% of the population in the UT live in rural areas and rely on agriculture for a living. The area under agriculture is 42 per cent is irrigated and remaining 58 per cent is rainfed i.e., unirrigated.

Agriculture and allied activities constitute the backbone of the Jammu and Kashmir economy. A diverse range of agricultural and horticultural goods are exported from the region, among them are rice, wheat, maize, sorghum, vegetables, saffron etc.

Horticultural crops like apple, pear, citrus, peach, plum, mangoes etc. having much importance in the UT.

According to the Jammu district's agriculture contingency plan, the district's latitude is 320.33 to 330.07 N and its longitude is 740.27 to 770.21 E. Rice, maize, wheat, berseem, millet, and pulses are among the principal crops grown in this division. Mango, ber, citrus, guava, and peach are among important horticulture fruit crops grown.

Doda is a district in the Indian Union territory of Jammu and Kashmir, located in the eastern section of the Chenab Valley. The district is divided into 18 tehsils. Demography of Doda district is complex when compared to neighbouring districts, owing to the broad diversity of its population. The district is located inside the Chenab Valley and has boundaries with the Kashmir Valley. Doda district is located at 33.13°N 75.57°E and has an average elevation of 1,107 metres (3631 feet). Because of the large differences in altitude from place to place, the climate of the area is not homogeneous. The climate in the area is generally temperate to subtropical. The district has a nearly dry climate. During the winter, the region receives snowfall. Rice, maize, wheat, oats, millet, legumes, and vegetables are among the principal crops farmed in the district. The principal horticulture fruit crops are apple, pear, walnut, peach, apricot, citrus, and so on.

3.3 Sampling design:

A multistage sampling technique was used for the selection of blocks, villages and farmers.

- a) **Selection of blocks:** Two districts were selected purposively on the basis of diversified farming system in which crop production and animal husbandry are most prominent sectors.
- b) **Selection of blocks:** Two blocks each were selected from both the districts randomly to constitute four blocks in total.
- c) **Selection of villages:** A list of villages falling in each block were prepared with the help of Department of Agriculture and two villages from each block were selected randomly to constitute a total of 8 villages in total.
- d) **Selection of farmers:** Selection of 15 farmers from each village were done randomly that makes a total sample size of 120 farmers for this research study.

3.4 Collection of data

The data collection is the method to collect important information to keep on record for further use, to make important decisions about different issues and is vital significance for others. Both primary and secondary data was collected to accomplish the objectives of the study. The primary data was collected through survey method by interviewing the farmers with the help of prepared and pre-tested interview schedule. The required secondary data was collected from various published sources/ agencies such as Economic Survey (various issues), Digest of Statistics, Annual Reports and other relevant government publications.

Table 3.2: Selected districts, blocks, villages and number of respondents

S.No.	District	Block	Village	No. of Respondents
1	Jammu	R.S.Pura	Qutub Nizam	15
			Raipur Gojra	15
		Nagrota	Damuni	15
			Dok waziria	15
2	Doda	Bhaderwah	Rainda	15
			Kharothi	15
		Khellani	Saras	15
			Paryot	15
Total	2	4	8	120

3.5 Method of analysis of data:

By seeing the behaviour of the collected data, following economic and statistical tools were used to analyse the data in order to achieve the objectives of study.

3.5.1 Computation of cost & return structure of major crops and enterprises.

The cost and returns analysis was worked out using CACP cost concepts like cost A₁, cost A₂, cost B₁, cost B₂, cost C₁, cost C₂ and cost C₃

Cost A₁ includes:

1. Wages of hired human labour
2. Value of hired bullock labour
3. Value of owned bullock labour

4. Value of owned machinery labour
5. Hired machinery charges
6. Value of seed (both farm produced and purchased)
7. Value of insecticides and pesticides
8. Value of manure (owned and purchased)
9. Value of fertilizer
10. Depreciation on implements and farm buildings
11. Irrigation charges
12. Land revenue, cesses and other taxes
13. Interest on working capital
14. Miscellaneous expenses

Cost A₂ :

Cost A₁ + rent paid for leased-in land

Cost B₁:

Cost A₁ + interest on the value of owned fixed capital assets (excluding land).

Cost B₂:

Cost B₁ + rental value of owned land + rent paid for leased in land

Cost C₁:

Cost B₁ + imputed value of family labour

Cost C₂:

Cost B₂ + imputed value of family labour

Cost C₃:

Cost C₂ + value of management input (10 % of Cost C₂)

The data were also subjected to the application of the following financial tools for the financial analysis:

3.5.2 Net present value

Net present value (NPV) of an investment is the discounted value of all cash inflows and cash outflow of the project during its life time. It can be computed as

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

where,

- | | | |
|----------------|---|----------------------------------|
| B _t | : | gross returns in time t |
| C _t | : | variable cost incurred in time t |
| r | : | rate of interest |
| t | : | time period |

3.5.3 Internal rate of return (IRR)

The internal rate of return is a rate of return at which the Net Present Value of a stream of payments/incomes is equal to zero.

$$\text{IRR} = \sum_{t=0}^n \{(B_t - C_t) / (1+r)^t\} = 0$$

where,

B_t	:	gross returns in time t
C_t	:	variable cost incurred in time t
r	:	rate of interest
t	:	time period

3.5.4 Benefit cost ratio (BCR)

The Benefit Cost Ratio (BCR) of an investment is the ratio of the discounted value of all cash inflows to the discounted value of all cash outflows during the life of the project. It's possible to estimate it as follows:

$$\text{BCR} = \sum_{t=0}^n \{(B_t)/(1+r)^t\} / \sum_{t=0}^n \{(C_t) / (1+r)^t\}$$

where,

B_t	:	gross returns in time t
C_t	:	variable cost incurred in time t
r	:	rate of interest
t	:	time period

3.5.5 The Linear programming model

To meet the needs of the study's third objective, optimal farm production plans were developed using the linear programming technique. The simplex approach, which is used to solve linear programming, was invented by George B. Danzig in 1947 as a result of his research effort while working in the pentagon with the mill during World War II. It has been used to evaluate the optimum utilisation of available resources inside the farm and to examine whether the farmer's utilisation of various accessible resources is optimum under various combinations of enterprises. The term "optimization" is used in linear programming analysis or when determining a saddle point. Optimal farm designs are those that satisfy all resource limitations at the farm level while yielding the

highest value of the objective function. A normative supply function for farmers could be derived using linear programming. It would show how many products should be produced at each price for factors and products if farmers had perfect knowledge and genuinely maximised profitability (Heady and Candler, 1958)

It is a strategy for optimising a linear objective function that is subject to constraints viz., linear equality and linear inequality constraints. The LP method is also known as the linear optimization method. Furthermore, this strategy was used to produce the optimal outcome. In the suggested research, this strategy was used to maximise the profit function of the farming firms. For linear programming analysis, the software Linear Discrete Optimizer (LINDO, 6.10 versions) was utilised. A linear function of a number of variables (activities) had to be maximised subject to a number of restrictions in the form of linear equalities and in-equalities in linear programming analysis.

Mathematical programming is regarded as an excellent tool for producing production plans when a big number of competing activities are related with a large number of resources and are simultaneously burdened with diverse types and magnitudes of constraints. The linear programming technique was used in this study to calculate the greatest attainable returns by allocating various available resources optimally. To maximize the total returns involving the cropping with other allied enterprises during imposition to various constraints on various variables this model is designed. The mathematical representation is as follows:

$$\text{Maximize } Z = \sum_{j=1}^n C_j X_j$$

Subject to the following resource constraints:

$$\sum_{j=1}^n a_{ij} X_j \leq b_i \text{ (Resource restrictions)}$$

$$(i=1, 2, 3, \dots, m)$$

$$\sum X_j \geq 0 \text{ (Non-negativity restriction)}$$

$$(j=1, 2, \dots, n)$$

where,

Z = Returns to Fixed Farm Resources (RFFR) from all the activities (₹/ha)

C_j = Returns over cash variable expenses or RFFR per unit of j^{th} activity

X_j = Level of the j^{th} activity (crops, livestock, fruits, fodder, hiring, borrowing, etc.)

b_i = Total availability of i^{th} resource on the farm

a_{ij} = Total quantity/amount of i^{th} resource per input required per unit of j^{th} activity

n = Number of activities used in the model

The C_j was calculated as below:

C_j (RFFR) = (value of main product)- (total cash variable expenses)

Objective function

The objective function of the model was to maximise the annual Returns on Fixed Farm Resources (RFFR). The cash variable expenses comprised the cost of seeds, fertilisers, hired labour, insecticides and chemicals, and so on. RFFR were estimated for dairying, sheep/goat, and poultry activity by deducting cash variable expenses such as concentrate, minerals, feed, medicines, and hired labour from gross income of dairy, sheep/goat, and poultry activity. To calculate C_j values for mushrooms, cash variable expenses were deducted from the gross value of the items for a certain unit size of these businesses. The maximising of RFFR was constrained by the model's assumptions and resource constraints.

Resource levels and constraints

In this the important components of linear programming model i.e., identification of resource constraints is given below.

Land constraint

As the respondent farmers in our study have no leased in land, so from here we were restricted to the farmer's operational holding as the total acreage in possession.

Labour constraint

The actual working hours by the family members are included in family labour. The duration of the working hours was 8 hours a day and this constraint was enacted for Kharif as well as Rabi seasons.

Capital/input constraint

This constraint was included as a limitation a way that in a specific cropping season the cost C1 is to be satisfied by the net returns produced from the preceding crop of that season.

3.5.6 For constraints Garrett's Ranking Analysis

Garrett's ranking technique was used to achieve the final goal of identifying the constraints in different blocks. The farmers were asked to rank the various constraints in order of importance. The following formula was used to convert these orders of merit into units of score:

$$\text{Per cent position} = 100 \frac{(R_{ij} - 0.50)}{N_j}$$

where,

R_{ij} = Rank given for the i^{th} factor by the j^{th} respondent

N_j = Number of factor ranked by the j^{th} respondent

By referring to the table given in Garrett and Woodworth table (1969), the percent position was transformed into scores. Individual scores of the respondents for each aspect were then summed together and divided by the total number of respondents with scores. The mean scores for all elements will be put in decreasing order, and the most influential factors were selected based on the ranks assigned.

3.6 Quantification of the variables

3.6.1 Cost and return concept of major cereal crops

The various inputs used along with various costs and returns concepts were quantified as follows:

3.6.1.1 Human labour

It consisted of both hired and family labour. The majority of the labour force engaged in major cereal crop production was made up of family labour. However, the cultivator was also required to hire labour. Wages paid to hired labour as well as wages paid to family members labouring in the fields are included in the cost of human labour.

3.6.1.2 Machine use

Tractors were employed on the farm to perform key farm tasks such as preparatory tillage, moving input and product from and to the farm, and so on. The cost of machine used was calculated by calculating the number of tractor hours utilised per hectare on key cereal crops and the market rate at which a tractor could be rented on a customer basis.

3.6.1.3 Manure and fertilizers

This included the cost of chemical fertilisers and manure used in the production of main grain crops, fruit crops, and vegetable crops. The manure utilised in the field was priced according to the market conditions in the research location. Likewise, the physical quantities of various fertilisers used were multiplied by the market price.

3.6.1.4 Seed

The amount of seed utilised per hectare in kilogram/quintals for major cereal crops and vegetable crops at the farm under study was provided. To calculate the cost of cultivation, the value of seed produced on the farm was appraised at the current market price (year 2020), and the value of seed acquired from the market was based on actual payments made for its purchase.

3.6.1.5 Plant protection chemicals

The different plant protection agents used per hectare for key cereal and vegetable crops were evaluated. Real charges were computed by multiplying the amount of various pesticides, insecticides, fungicides and herbicides used by the market rate charges per unit of area item used.

3.6.1.6 Depreciation

The diminishing balance method was used to worked out the depreciation on the storage houses and equipment.

3.6.1.7 Rental value of land

The rental value of land was determined by the amount of money paid by the farmer for leased in land in the area.

3.6.1.8 Variable costs

It accounted for expenditures on human labour, seed, manure, and fertilisers, plant protection chemicals, irrigation, machine labour, working capital interest and miscellaneous costs.

3.6.1.9 Fixed costs

It included expenditure on numerous fixed components, such as the rental value of owned land, rent paid for leased land, depreciation on implements and farm buildings, and interest on fixed capital.

3.6.1.10 Interest on working capital

Interest on working capital was calculated at the prevailing bank rate for KCC loans (7 per cent for the period of six months)

3.6.1.11 Interest on fixed capital

Interest on fixed capital was calculated at the prevailing bank rate of Punjab National Bank for long term loans (9 percent for the period of six months).

3.6.1.12 Gross returns

The gross returns from main cereal crops per hectare were calculated by multiplying the yield of key cereal crops by the price received by farmers.

3.6.1.13 Farm Business income:

It is also known as profit at Cost A. It provides an estimate of returns to the farmer for his investment and profit. It was calculated as:

Farm Business income = Family labour income + interest on fixed capital

3.6.1.14 Family Labour Income:

It is also known as profit at Cost B. It was calculated as:

Family Labour Income = Net profit + Imputed wages of labour of farmer

3.6.1.15 Net income/ returns

It is also known as profit at Cost C. It was calculated as:

Net income = Gross returns - Cost C₂

3.6.1.16 Returns over variable cost

Returns over variable cost per hectare for major cereal crops and vegetable crops were obtained by subtracting per hectare variable cost incurred from the per hectare gross returns of the crops.

3.6.1.17 Returns over fixed cost

Returns over fixed cost per hectare from key cereal crops and vegetable crops were calculated by deducting the fixed cost per hectare from the gross returns of crops per hectare.

3.6.2 Cost Components of milk production

3.6.2.1 Depreciation on fixed assets

It was the loss of an asset's worth as a result of use, wear and tear, accidental damage, and time. It was computed using the diminishing balance technique for animals, cow shed, trough, chaffing cutter, machinery, and equipment while keeping depreciation in mind.

3.6.2.2 Variable cost

Variable costs are those costs incurred on variable components of production that can be changed in the short run. It covers feed costs, labour costs, veterinarian costs and other expenses.

3.6.2.3 Feed and fodder cost

Cost on green fodder, dry fodder and concentrate were calculated by multiplying the quantities of feeds and fodders consumed by animals by the existing prices in the research area.

3.6.2.4 Labour cost

It includes both family and paid labour (hired labour). The hired labour was calculated based on the sort of work assigned and the wages paid. In the case of family labour, the imputed value obtained is determined by the amount of time spent performing dairy activities and the wage rate of permanent labour in the research area.

3.6.2.5 Veterinary cost

It included the cost of service charge of livestock as well as cost of vaccination

and medicines.

3.6.2.6 Miscellaneous cost

Miscellaneous costs included the cost of repair, power, water charges and the purchase of milk cans, buckets, rope, and so on. They were estimated on a per-animal-per-year basis for the various sorts of milch animals held by the sample households.

3.6.2.7 Total cost

It was obtained by adding all the cost components including fixed and variable costs, i.e.,

$$\text{Total Cost} = \text{Total Variable cost} + \text{Total Fixed cost}$$

3.6.2.8 Gross returns

Gross returns were calculated by multiplying the milk yield of a single milch cow by the prevailing prices in the research area, i.e.

$$\text{Gross Returns} = \text{Quantity of milk} \times \text{Market price of milk} + \text{value of dung}$$

3.6.2.9 Net Returns

Net return was calculated by subtracting total cost from gross returns, i.e.,

$$\text{Net Returns} = \text{Gross Returns} - \text{Total Cost}$$

Results

The results pertaining to the present investigation, “**An Investigation of Optimum and Profitable Combination of Crop-Livestock Enterprise in Jammu region of UT of J&K**” have been presented in this chapter through appropriate tables and figures under the following headings: -

- 4.1 Socio-economic status and resource structure of the sampled farmers in Jammu region
- 4.2 Economics of production of Cereals, fodder and vegetable crops
- 4.3 Cost and return of livestock enterprises
- 4.4 Economic analysis and economic viability of fruit crops found in sampled area
- 4.5 Income and employment generated from various enterprises
- 4.6 Optimum enterprise combination with existing pattern
- 4.7 Identification of constraints experienced by the sampled farmers in adoption of various enterprises

4.1 Socio-economic status and resource structure of the sampled farmers in Jammu region

The information related to the economic profile of the farmers was gathered by a survey approach, in which farmers were interviewed using a predetermined and pre-tested schedule, and the results are reported in the following parts.

In Table 4.1, the descriptive statistics of the farmers of sampled area of Jammu and Doda district are shown. The average age of the farmers was 54.45 years, with a maximum age of 82 years and a minimum age of 28 years. The average family size was determined to be 5.58 members, with the largest number of members being 13.00 and the smallest number being 2.00. The average size of the land area was found to be around 0.72 hectares, with a maximum size of around 4.00 hectare and a lowest size of about 0.10 hectare. The educational status of the sampled farmers depicts that, out of 120 farmers 79 were literates and 41 were illiterates.

Table 4.1: Descriptive statistics of sampled farmers of Jammu region

Variable	Unit	Mean	Standard Error	Range
Age	Years	54.45	±1.16	28.00-82.00
Family Size	Numbers	5.58	±0.19	2.00-13.00
Land Area	Hectare	0.72	±0.05	0.10-4.00
Education (number)	Block			
	R.S.Pura	Nagrota	Bhaderwah	Khellani
Literate	23.00	15.00	24.00	17.00
Illiterate	7.00	15.00	6.00	13.00
Total	30.00	30.00	30.00	30.00

Table 4.2 depicts the occupational status of farmers. According to the table, agriculture was the sole occupation of 53.33 percent of the respondents in the R.S. Pura block followed by Nagrota (50.00 per cent), Khellani (36.67 per cent) and Bhaderwah (16.67 per cent) with an overall average of 39.17 per cent. In contrast to the other blocks, 46.67 percent of the farmers were found to be engaged in agriculture with government jobs in Bhaderwah block. The table also revealed that percentage of overall farmers engaged in agriculture and private job was found to be lowest (15.00 per cent).

Table 4.2. Block wise occupational status of sampled farmers of Jammu region

Particular	Block				Overall
	R.S. Pura (n=30)	Nagrota (n=30)	Bhaderwah (n=30)	Khellani (n=30)	(n=120)
Agriculture only	16 (53.33)	15 (50.00)	5 (16.67)	11 (36.67)	47 (39.17)
Agriculture & private job	7 (23.33)	2 (6.67)	2 (6.67)	7 (23.33)	18 (15.00)
Agriculture & govt. job *	7 (23.33)	9 (30.00)	14 (46.67)	4 (13.33)	34 (28.33)
Agriculture & business	0 (0.00)	4 (13.33)	9 (30.00)	8 (26.67)	21 (17.50)
Total	30 (100.00)	30 (100.00)	30 (100.00)	30 (100.00)	120 (100.00)

(Figures in parentheses shows percentage to the total)

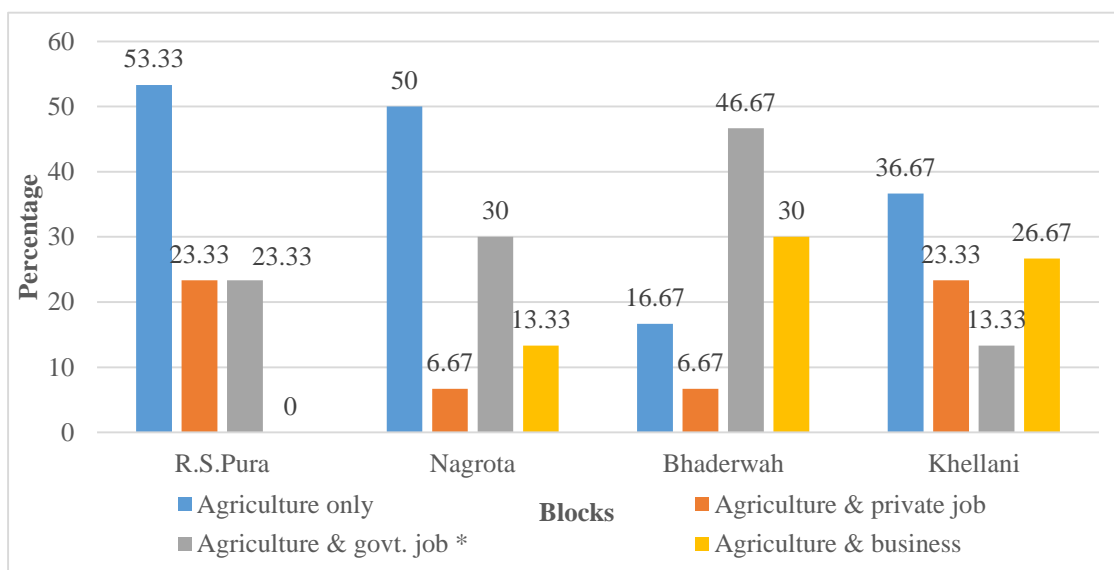


Fig 4.1 Occupational status of sampled farmers

Table 4.3. showed the status of fixed resource structure of the sampled farmers from both the districts. The results showed that in R.S.Pura amount paid on tractors were more followed by cultivator and least in wooden plough, whereas in Doda district the sampled farmers used power tillers in place of tractors to cultivate their land. Different types of sprayers were also found among the sampled farmers. Agricultural tools used for various operation by the sampled farmers includes sickles, spade, mining pick, rake, saw, axe, rope, trowel, hoe, plastic pipes etc.

Table 4.3. Fixed resource structure of sampled farmers (₹)

Machinery	Jammu		Doda		Overall Average
	R.S.Pura	Nagrota	Bhaderwah	Khellani	
Tractor	463407.62	436915.31	171747.74	168451.38	310130.51
Cultivator	20595.89	19418.46	17174.77	16845.14	18508.57
Engine	9783.05	9223.77	3864.32	3790.16	6665.32
MB/Wooden plough	4119.18	4854.61	6440.54	6316.93	5432.82
Knapsack sprayer	10812.84	10194.69	4723.06	4632.41	7590.75
Other agricultural tools*	6178.77	4854.61	10734.23	10528.21	8073.96
Total	514897.35	485461.45	214684.68	210564.23	356401.93

(Figures in parentheses show percentage to the total)

*Sickle, spade, rope, plastic pipes, hoe, trowel, axe, rake, saw, mining pick

As shown in table 4.4, the most irrigated area was discovered in the instance of R.S. Pura, where 100 per cent of the area was irrigated, however in Nagrota, Bhaderwah, and Khellani, both irrigated and unirrigated areas were discovered. The current investigation covered an area of 87.41 hectares.

Table 4.4. Irrigational status of sampled farmers under study

Particular	Block				Overall (n=120)
	R.S. Pura (n=30)	Nagrota (n=30)	Bhaderwah (n=30)	Khellani (n=30)	
Total Area (ha)	13.90 (100.00)	24.56 (100.00)	22.65 (100.00)	26.30 (100.00)	87.41 (100.00)
Irrigated area (ha)	13.92 (100.00)	5.55 (22.60)	8.10 (35.76)	6.50 (24.72)	34.05 (38.95)
Unirrigated area (ha)	0 (0.00)	19.01 (74.40)	14.55 (64.24)	19.80 (75.28)	53.36 (61.05)

(Figures in parentheses show percentage to the total)

4.2 Economics of production of cereal. Fodder and vegetable crops

The study took into consideration both irrigated and unirrigated regions of the designated blocks of Jammu division. Table 4.3 shows the irrigation status of the sampled farms under study (in hectares). The cost of cultivation and the returns on various variables of production aid in the decision-making process when selecting an enterprise. As a result, various components of cost and returns from various crops were calculated and provided in the tables below.

4.2.1 Economics of paddy crop in Jammu region

Rice, as a cereal grain, is the most extensively consumed staple food. It simply means that paddy was cultivated everywhere there was a chance to produce it, as it is one of the most essential staple foods in the Jammu region. Table 4.5 shows the descriptive statistics for the paddy crop in four blocks. The table depicts the changes in input utilisation for the paddy crop.

Table 4.5. Descriptive statistics of quantitative variables of paddy in Jammu region

Block	Particular	Unit	Mean	Standard error	Range
R.S.Pura	Area	ha	0.46	±0.07	0.10-1.60
	Seed	kg.	9.27	±1.33	2.00-32.00
	Production	q	13.90	±2.00	3.00-48.00
	Manure	q	278.00	±39.96	60.00-960.00
	Fertilizers	kg.	58.39	±8.95	12.30-228.80
	Human labour*	days	13.90	±2.00	3.00-48.00
	Machine labour*	hours	4.63	±0.67	1.00-16.00
Nagrota	Area	ha	0.37	±0.07	0.10-1.00
	Seed	kg.	7.40	±1.36	2.00-20.00
	Production	q	10.36	±1.90	2.80-28.00
	Manure	q	222.00	±40.76	60.00-600.00
	Fertilizers	kg.	55.50	±10.19	15.00-150.00
	Human labour*	days	9.99	±1.59	4.16-25.10
	Machine labour*	hours	3.24	±0.59	0.88-8.75
Bhaderwah	Area	ha	0.34	±0.04	0.15-1.00
	Seed	kg.	11.48	±1.37	5.10-34.00
	Production	q	10.13	±1.21	4.50-30.00
	Manure	q	202.50	±24.11	90.00-600.00
	Fertilizers	kg.	48.60	±5.79	21.60-144.00
	Human labour*	days	9.62	±1.03	4.30-24.70
	Machine labour*	hours	2.17	±0.26	0.96-6.43
Khellani	Area	ha	0.43	±0.09	0.15-1.50
	Seed	kg.	13.00	±2.76	4.50-45.00
	Production	q	12.13	±2.58	4.20-42.00
	Manure	q	260.00	±55.29	90.00-900.00
	Fertilizers	kg.	43.33	±9.22	15.00-150.00
	Human labour*	days	12.05	±2.56	4.17-41.70
	Machine labour*	hours	2.48	±0.53	0.86-8.57

*Includes imputed values

4.2.1.1 Cost and Returns

4.2.1.1.1 Cost structure for paddy cultivation in Jammu region

Table 4.6 shows the item-wise cost of paddy cultivation for the sampled farmers. The total cost of cultivation per hectare was ₹47995.31 in R.S. Pura block and

₹41740.93 in Nagrota block of Jammu district, but it was ₹39265.39 in Bhaderwah block and ₹38907.85 in Khellani block of Doda district, with an overall average of ₹41977.37. Human labour, seed, and manure costs were significant components of operational costs. Similarly, the most important component of fixed cost was the rental value of owned land. The data also revealed that, of all the inputs used, human labour was determined to be the most expensive, at ₹12000/ha from R.S. Pura, ₹10800/ha from Nagrota block, ₹11400/ha from Bhaderwah, and ₹11150/ha from Khellani block.

Table 4.6. Item-wise cost structure of paddy crop in Jammu region

(₹/ha)

S. No.	Items	Jammu		Doda		Overall
		R.S.Pura	Nagrota	Bhaderwah	Khellani	
A)	Variable Cost					
1.	Seed	760.00	700.00	850.00	780.00	772.50
2.	Manure	5000.00	4400.00	7000.00	6000.00	5600.00
3.	Fertilizers	2112.43	2300.00	1924.00	1320.00	1914.11
4.	Human Labour	12000.00	10800.00	11400.00	11150.00	11337.50
	Family Labour	3000.00	2500.00	6840.00	6690.00	4757.50
	Hired Labour	9000.00	7500.00	4560.00	4460.00	6380.00
5.	Machine Labour	8000.00	6369.37	4500.00	4000.00	5717.34
6.	Irrigation	1000.00	700.00	0.00	0.00	425.00
7.	Plant protection chemicals	1000.00	800.00	500.00	400.00	675.00
8.	Interest on working capital	2091.07	1824.86	1832.18	1655.50	1850.90
	Total variable cost	31963.50	27894.23	28006.18	25305.50	28292.35
B)	Fixed Cost					
1.	Depreciation on farm buildings and equipment	2708.08	2503.40	2329.55	2929.22	2617.56
2.	Estimated rental value of owned land	12000.00	10200.00	8000.00	9550.00	9937.50
3.	Interest on fixed capital	1323.73	1143.31	929.66	1123.13	1129.96
4.	Total fixed cost	16031.81	13846.71	11259.21	13602.35	13685.02
	Total Cost (A+B)	47995.31	41740.93	39265.39	38907.85	41977.37

4.2.1.1.2 Concept wise cost of cultivation of paddy crop in Jammu region

Table 4.7 presents various cost ideas calculated on a per hectare basis in order to provide a detailed insight of the cost of paddy farming in four blocks. The table revealed that the per hectare costs A1 from R.S. Pura, Nagrota, Bhaderwah, and Khellani blocks were ₹31671.58, ₹27697.63, ₹23495.73, and ₹21544.72, with an overall average of ₹26102.41. The key components of cost A1 were seeds, manure and hired human labour. Cost A2 per hectare was the same as Cost A1. Cost B1 was found ₹32995.31, ₹28840.93, ₹24425.39, and ₹22667.85 in R.S. Pura, Nagrota, Bhaderwah, and Khellani blocks, respectively, with an overall average of ₹27232.37, whereas cost B2 was ₹44995.31, ₹39040.93, ₹32425.39 and ₹32217.85 in R.S.Pura, Nagrota, Bhaderwah, and Khellani blocks, with C1 cost ₹35995.31, ₹31540.93, ₹31265.39 and ₹29357.85 per hectare in R.S.Pura, Nagrota, Bhaderwah, and Khellani, with an overall average of ₹32039.87. C2 cost per hectare was determined to be ₹47995.31, ₹41740.93, ₹39265.39, and ₹38907.85 in R.S. Pura, Nagrota, Bhaderwah, and Khellani, respectively, with an overall average of ₹41977.37. After calculating the management cost, which was 10% of the cost C2, similarly cost C3 were ₹52794.84, ₹45915.02, ₹43191.93, and ₹42798.64 in R.S. Pura, Nagrota, Bhaderwah, and Khellani, respectively, and the overall average found out to be ₹46175.11.

Table 4.7. Concept –wise cost of cultivation of paddy crop in Jammu region

(₹/ha)

S.No.	Particular	Block				Overall
		R.S.Pura	Nagrota	Bhaderwah	Khellani	
1	Cost A1					
a)	Hired Labour	9000.00	8100.00	4560.00	4460.00	6530.00
b)	Machine Labour	8000.00	6369.37	4500.00	4000.00	5717.34
c)	Irrigation	1000.00	700.00	0.00	0.00	425.00
d)	Manure	5000.00	4400.00	7000.00	6000.00	5600.00
e)	Seed	760.00	700.00	850.00	780.00	772.50
f)	Fertilizers(NPK)	2112.43	2300.00	1924.00	1320.00	1914.11
g)	Plant protection chemicals	1000.00	800.00	500.00	400.00	675.00
h)	Interest on working capital	2091.07	1824.86	1832.18	1655.50	1850.90
i)	Depreciation charges	2708.08	2503.40	2329.55	2929.22	2617.56
	Total Cost-A1	31671.58	27697.63	23495.73	21544.72	26102.41
2	Cost-A2					
a)	Cost-A1	31671.58	27697.63	23495.73	21544.72	26102.41
b)	Rent Pain for leased-in land	0.00	0.00	0.00	0.00	0.00
	Total Cost-A2	31671.58	27697.63	23495.73	21544.72	26102.41
3	Cost-B1					
a)	Cost A1	31671.58	27697.63	23495.73	21544.72	26102.41
b)	Interest on fixed capital(excluding land)	1323.73	1143.31	929.66	1123.13	1129.96
	Total Cost-B1	32995.31	28840.93	24425.39	22667.85	27232.37
4	Cost-B2					
a)	Cost B1	32995.31	28840.93	24425.39	22667.85	27232.37
b)	Land Revenue	0.00	0.00	0.00	0.00	0.00
c)	Estimated Rental Value	12000.00	10200.00	8000.00	9550.00	9937.50
	Total Cost-B2	44995.31	39040.93	32425.39	32217.85	37169.87
5	Cost C1					
a)	Cost B1	32995.31	28840.93	24425.39	22667.85	27232.37
b)	Imputed value of Family labour	3000.00	2700.00	6840.00	6690.00	4807.50

	Total Cost-C1	35995.31	31540.93	31265.39	29357.85	32039.87
6	Cost C2					
a)	Cost B2	44995.31	39040.93	32425.39	32217.85	37169.87
b)	Imputed value of Family labour	3000.00	2700.00	6840.00	6690.00	4807.50
	Total Cost C2	47995.31	41740.93	39265.39	38907.85	41977.37
7	Cost C3					
a)	Cost of Management (10% of Cost-C2)	4799.53	4174.09	3926.54	3890.79	4197.74
	Total Cost-C3	52794.84	45915.02	43191.93	42798.64	46175.11

4.2.1.1.3 Cost and return structure of paddy crop in Jammu region

Table 4.8 shows the cost and return analysis of paddy in Jammu region on a per hectare basis, which found that the total cost of cultivation was greater in the R.S. Pura block (₹47995.31) and lowest in the Khellani block (₹38907.85), with an overall average of ₹41977.37 per hectare. Farmers in the R.S. Pura block earned the highest gross returns (₹141000.00/ha), while those in the Khellani block earned the lowest (₹102200.00 per hectare). Net returns per hectare were similarly greater in the R.S. Pura block (₹93004.69/ha) and lower in the Khellani block (₹63292.15/ha). Overall, per hectare gross returns were ₹116030.00 and net returns ₹47052.63/ha. The cost benefit ratio for the R.S. Pura block was greater (1:2.94) than for the Khellani block (1:2.63), resulting in an overall benefit cost ratio of 1:2.76. Table 4.9 revealed the paddy cultivation production pattern in which the highest quantity of main product was found to be 30.00 q/ha from R.S. Pura and Bhaderwah block each and the least from Nagrota block i.e., 27.60 q/ha with an overall average of 28.90 q/ha while the overall average of quantity of by-product was found to be 34.96 q/ha from all four blocks.

Table 4.8. Cost and returns of paddy crop in Jammu region

(₹/ha)						
S. No	Particulars	R.S. Pura	Nagrota	Bhaderwah	Khellani	Overall
Cost						
a)	Total Variable Cost	31963.5	27894.23	28006.18	25305.5	28292.35
b)	Total Fixed Cost	16031.81	13846.71	11259.21	13602.35	13685.02
c)	Total Cost	47995.31	41740.93	39265.39	38907.85	41977.37
Returns						
a)	Yield (q/ha)	30.00	27.60	30.00	28.00	28.90
b)	Gross Returns	141000.00	115920.00	105000.00	102200.00	116030.00
c)	Net Returns	93004.69	74179.07	65734.61	63292.15	74052.63
	Benefit Cost Ratio	1:2.94	1:2.78	1:2.67	1:2.63	1:2.76

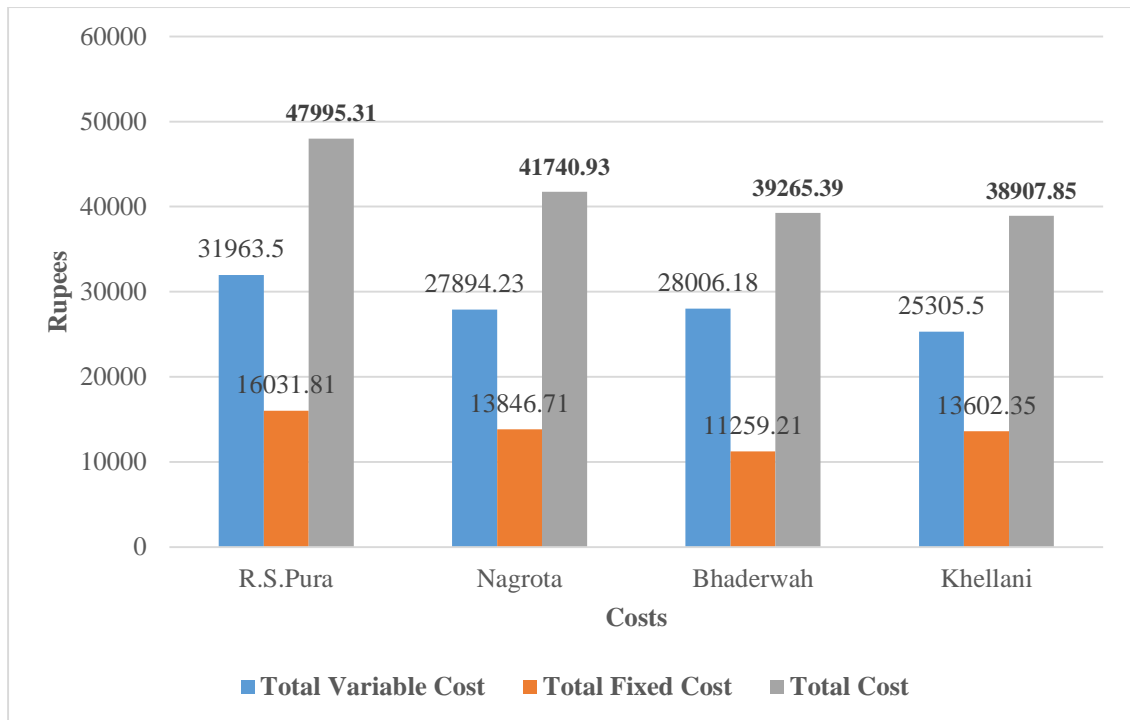


Fig.4.2 Costs of paddy crop in Jammu region

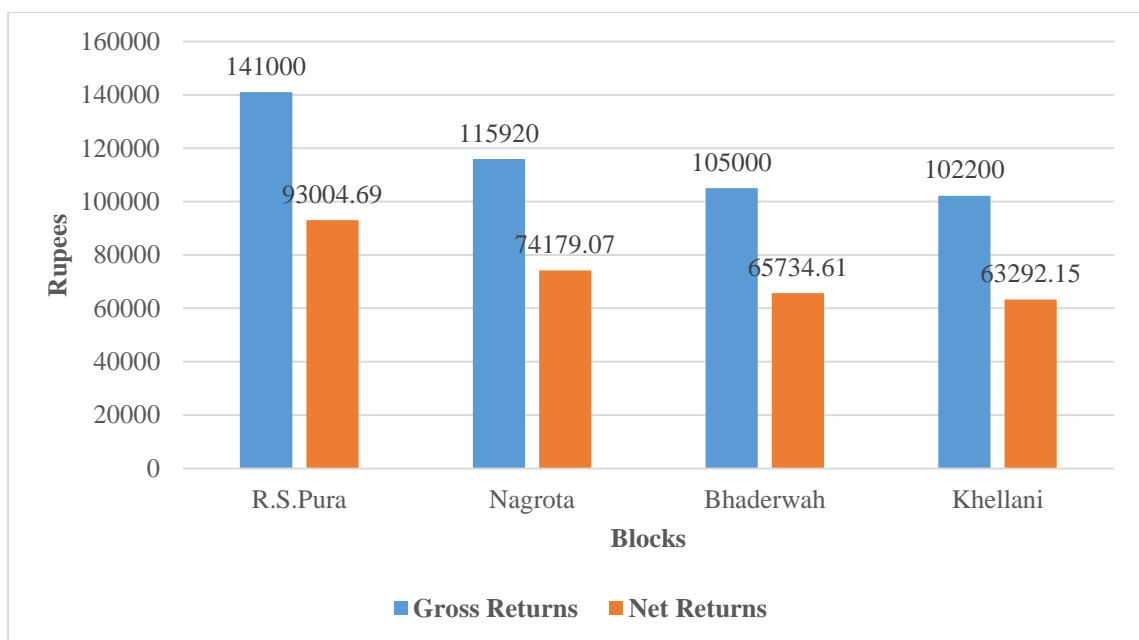


Fig.4.3 Returns from paddy crop in Jammu region

Table 4.9. Production pattern of paddy crop cultivation in Jammu region

S. No.	Particular	Block				Overall
		R.S. Pura	Nagrota	Bhaderwah	Khellani	
	Main product					
a)	Quantity (quintals)	30.00	27.60	30.00	28.00	28.90
b)	Average price per quintal (₹)	4000.00	3600.00	3000.00	3100.00	3425.00
	Total amount (A)	120000.00	99360.00	90000.00	86800.00	99040.00
	By-product					
a)	Quantity (quintals)	35.00	33.12	37.50	34.22	34.96
b)	Average price per quintal (₹)	600.00	500.00	400.00	450.00	487.50
	Total amount (B)	21000.00	16560.00	15000.00	15400.00	16990.00
	Total (A+B)	141000.00	115920.00	105000.00	102200.00	116030.00

4.2.2 Economics of wheat crop in Jammu district

Wheat was more common in the R.S. Pura and Nagrota blocks in Jammu region, according to our research. At this point, it is vital to discuss the descriptive statistics of the wheat production in these two blocks. Table 4.10 displays descriptive data for quantitative variables of wheat crop in Jammu district. The table depicts changes between two separate blocks under investigation.

Table 4.10. Descriptive statistics of quantitative variables of wheat crop in Jammu district

Block	Particular	Unit	Mean	Standard Error	Range
R.S.Pura	Area	ha	0.36	±0.05	0.10-1.20
	Seed	kg.	40.60	±5.21	11.20-134.40
	Production	q	11.60	±1.49	3.20-38.40
	Manure	q	130.50	±16.76	36.00-442.00
	Fertilizers	kg.	65.25	±8.38	18.00-216.00
	Human labour*	days	1.81	±0.23	0.50-6.00
	Machine labour*	hours	4.08	±0.52	1.13-13.50
Nagrota	Area	ha	0.70	±0.11	0.10-3.00
	Seed	kg.	77.44	±12.48	11.00-330.00
	Production	q	19.71	±3.18	2.80-84.00
	Manure	q	422.39	±68.09	60.00-1800.00
	Fertilizers	kg.	112.64	±18.16	16.00-480.00
	Human labour*	days	9.24	±1.49	1.31-39.38
	Machine labour*	hours	3.61	±0.58	0.51-15.38

*Includes imputed values

4.2.2.1 Cost and Returns

4.2.2.1.1 Cost structure for wheat cultivation in Jammu district

Table 4.11 shows the cost of wheat cultivation by item-wise for the sampled farmers of Jammu district. It was discovered that the total cost of cultivation per hectare was ₹37628.69 in R.S. Pura block and ₹33845.01 in Nagrota block of Jammu district, with an overall average of ₹35736.85. Human labour, seed, manure, and fertilisers were significant components of operational costs. The overall value of fixed cost was found out to be ₹14939.26 per hectare. The results also revealed that, of all the inputs used, the spending on human labour from Nagrota block was found to be the highest, i.e.,

₹5250.00 per hectare, whereas the expenditure on machine labour was found to be high in R.S. Pura block.

Table 4.11: Item-wise cost structure of wheat crop in Jammu district

S. No.	Items	Jammu		Overall
		R.S.Pura	Nagrota	
A)	Variable Cost			
1.	Seed	2464.00	2200.00	2332.00
2.	Manure	3000.00	4400.00	3700.00
3.	Chemical Fertilisers	2620.00	2140.00	2380.00
4.	Human Labour	2000.00	5250.00	3625.00
	Family Labour	400.00	1575.00	987.50
	Hired Labour	1600.00	3675.00	2637.50
5.	Machine Labour	9000.00	4100.00	6550.00
6.	Irrigation	600.00	200.00	400.00
7.	Plant protection chemicals	500.00	400.00	450.00
8.	Interest on working capital	1412.88	1308.30	1360.59
	Total variable cost	21596.88	19998.30	20797.59
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2708.08	2503.40	2605.74
2.	Estimated rental value of owned land	12000.00	10200.00	11100.00
3.	Interest on fixed capital	1323.73	1143.31	1233.52
	Total fixed cost	16031.81	13846.71	14939.26
	Total Cost (A+B)	37628.69	33845.01	35736.85

4.2.1.1.2 Concept wise cost of cultivation of wheat crop in Jammu district

Table 4.12 presents a detailed picture of the cost of wheat cultivation in Jammu district based on several cost concepts calculated on a per hectare basis. The table revealed that the per hectare cost A1 from R.S. Pura and Nagrota blocks were ₹23904.96 and ₹20926.70, respectively, with an overall average of ₹22415.83. The key components of cost A1 were seeds, manure, fertiliser, irrigation, plant protection chemicals, machine labour, and paid human labour. Cost A2 and Cost A1 on a per hectare basis were the same. Cost B1 was ₹25228.69 in R.S. Pura and ₹22070.01 in Nagrota on per hectare basis with an overall average of ₹23649.35, cost B2 was found out to be ₹37228.69 in R.S. Pura and ₹32270.01 in Nagrota, and an overall average of ₹34749.35 was found. Per hectare cost C1 was ₹25628.69 in R.S. Pura and ₹23645.01 in Nagrota, with an overall average of ₹24636.85. C2 costs ₹37628.69 in R.S. Pura and ₹33845.01 per hectare in Nagrota, with an overall average of ₹35736.85. When the management cost was calculated, cost C3 was found to be ₹41391.56 per hectare in

R.S. Pura and ₹37229.51 per hectare in Nagrota, respectively, with an overall average of ₹39310.53 per hectare.

Table 4.12. Concept –wise cost of cultivation of wheat crop in Jammu district
(₹/ha)

S.no	Particular	Block		Overall
		R.S.Pura	Nagrota	
1	Cost A1			
a)	Hired Labour	1600.00	3675.00	2637.50
b)	Machine Labour	9000.00	4100.00	6550.00
c)	Irrigation	600.00	200.00	400.00
d)	Manure	3000.00	4400.00	3700.00
e)	Seed	2464.00	2200.00	2332.00
f)	Fertilizers(NPK)	2620.00	2140.00	2380.00
g)	Plant protection chemicals	500.00	400.00	450.00
h)	Interest on working capital	1412.88	1308.30	1360.59
i)	Depreciation charges	2708.08	2503.40	2605.74
	Total Cost-A1	23904.96	20926.70	22415.83
2	Cost-A2			
a)	Cost-A1	23904.96	20926.70	22415.83
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	23904.96	20926.70	22415.83
3	Cost-B1			
a)	Cost A1	23904.96	20926.70	22415.83
b)	Interest on fixed capital(excluding land)	1323.73	1143.31	1233.52
	Total Cost-B1	25228.69	22070.01	23649.35
4	Cost-B2			
a)	Cost B1	25228.69	22070.01	23649.35
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	12000.00	10200.00	11100.00
	Total Cost-B2	37228.69	32270.01	34749.35
5	Cost C1			
a)	Cost B1	25228.69	22070.01	23649.35
b)	Imputed value of Family labour	400.00	1575.00	987.50
	Total Cost-C1	25628.69	23645.01	24636.85
6	Cost C2			
a)	Cost B2	37228.69	32270.01	34749.35
b)	Imputed value of Family labour	400.00	1575.00	987.50
	Total Cost C2	37628.69	33845.01	35736.85
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	3762.87	3384.50	3573.68
	Total Cost-C3	41391.56	37229.51	39310.53

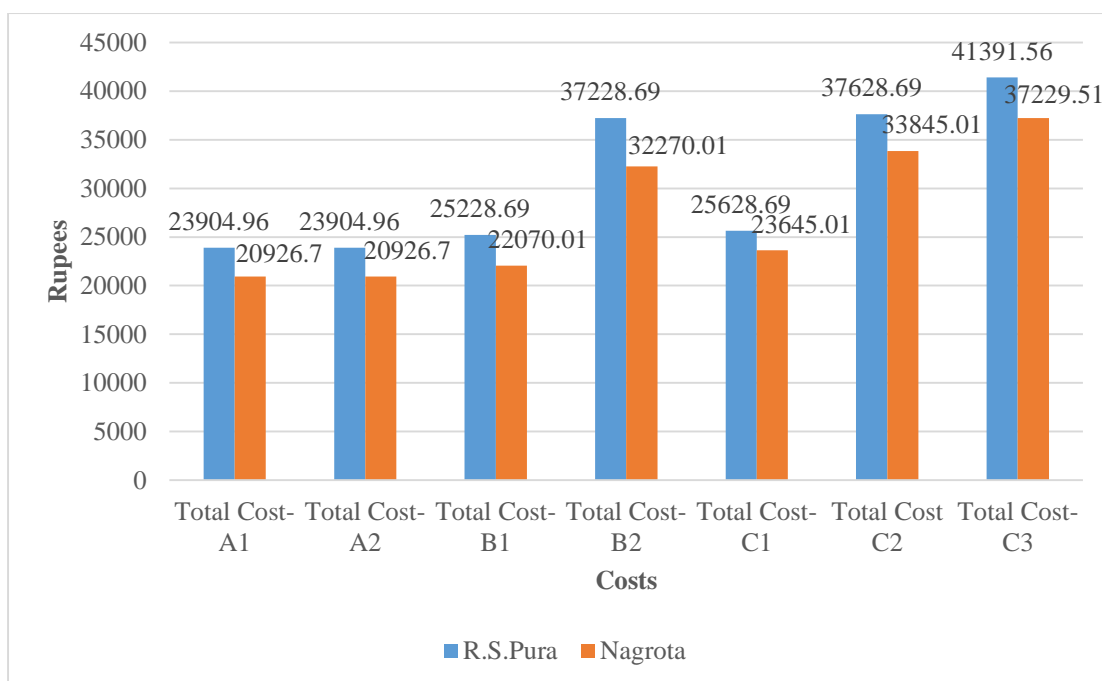


Fig.4.4 Concept wise cost of wheat crop in Jammu district

4.2.1.1.3 Cost and return structure of wheat crop in Jammu district

Table 4.13 provides a clear picture of the cost and returns of wheat crop in the Jammu district under consideration. The overall cost of agriculture was determined to be the highest in R.S. Pura block, at ₹37628.69 per hectare, followed by Nagrota block (₹33845.01 per hectare). As a result, the aggregate average was determined to be ₹35736.85 per hectare. It is most important to find out that the R.S. Pura block employed less human labour than the Nagrota block. In terms of returns, the net returns for the R.S. Pura block were found to be ₹38371.31 per hectare, whereas the net returns for the Nagrota block were found to be ₹33354.99. The total average was determined to be ₹35863.15 per hectare. As a result, the cost-benefit ratio was found to be highest in the instance of R.S. Pura block (1:2.02), followed by Nagrota block (1:1.99). The whole cost-benefit ratio was calculated to be 1:2.01. Table 4.14 shows that the quantity of main product was 32.00 q/ha and 28.00 q/ha, but the quantity of by-product was 26.67 q/ha and 30.55 q/ha from R.S. Pura and Nagrota blocks, respectively.

Table 4.13. Cost and returns of wheat crop in sampled farms of Jammu district
(₹/ha)

S.No	Particulars	R.S.Pura	Nagrota	Overall
Cost				
a)	Total Variable Cost	21596.88	19998.30	20797.59
b)	Total Fixed Cost	16031.81	13846.71	14939.26
c)	Total Cost	37628.69	33845.01	35736.85
Returns				
a)	Yield (q/ha)	32.00	28.00	30.00
b)	Gross Returns	76000.00	67200.00	71600.00
c)	Net Returns	38371.31	33354.99	35863.15
	Benefit-Cost Ratio	1:2.02	1:1.99	1:2.01

Table 4.14. Production pattern of wheat crop cultivation in Jammu district
(₹/ha)

S. No.	Particular	Block		
		R.S.Pura	Nagrota	Overall
	Main product			
a)	Quantity (quintals)	32.00	28.00	30.00
b)	Average price per quintal (₹)	1875.00	1800.00	1837.50
	Total amount (A)	60000.00	50400	55200.00
	By-product			
a)	Quantity (quintals)	26.67	30.55	28.61
b)	Average price per quintal (₹)	600.00	550.00	575.00
	Total amount (B)	16000.00	16800.00	16400.00
	Total (A+B)	76000.00	67200.00	71600.00

4.2.3 Economics of maize crop in Jammu region

Maize was another crop that was found primarily in the water stressed regions of the studied area, and it was found in three blocks, excluding R.S. Pura block. Table 4.15 shows the descriptive statistics for maize's quantitative variables. The table depicts the wide range of input-usage for the maize crop.

Table 4.15. Descriptive statistics of quantitative variables of maize crop in Jammu region

Block	Particular	Unit	Mean	Standard Error	Range
Nagrota	Area	ha	0.70	±0.11	0.10-3.00
	Seed	kg.	16.90	±2.72	2.40-72.00
	Production	q	19.71	±3.18	2.80-84.00
	Manure	q	211.19	±34.05	30.00-900.00
	Fertilizers	kg.	77.44	±12.48	11.00-330.00
	Human Labour*	mandays	9.20	±1.56	1.35-40.50
	Machine Labour*	hours	2.64	±0.43	0.38-11.25
Bhaderwah	Area	ha	0.37	±0.04	0.10-0.90
	Seed	kg.	9.71	±0.99	2.60-23.40
	Production	q	11.20	±1.15	3.00-27.00
	Manure	q	44.80	±4.58	12.00-108.00
	Fertilizers	kg.	43.31	±4.43	11.60-104.40
	Human Labour*	mandays	4.02	±0.41	1.08-9.70
	Machine Labour*	hours	1.49	±0.15	0.40-3.60
Khellani	Area	ha	0.60	±0.07	0.15-1.25
	Seed	kg	15.60	±1.73	3.90-32.50
	Production	kg.	16.80	±1.87	4.20-35.00
	Manure	q	72.00	±7.99	18.00-150.00
	Fertilizers	q	70.80	±7.86	17.70-147.50
	Human Labour*	mandays	6.80	±0.75	1.70-14.17
	Machine Labour*	hours	2.74	±0.30	0.69-5.71

*Includes imputed values

4.2.3.1 Cost and Returns

4.2.3.1.1 Cost structure for maize cultivation

The cost incurred on different inputs of cultivation in maize by the sampled farmers is presented in Table 4.16. It revealed that per hectare total cost of cultivation was ₹27315.83 in Nagrota block of the Jammu district whereas it was ₹23350.21 in Bhaderwah block and ₹26365.31 in Khellani block of the Doda district, with an overall average of ₹25677.12. Human labour, seed, manure, fertilizers, plant protection chemicals were the important component of this cost. Rental value of owned land and

the depreciation on implement was the components of fixed cost. Human labour found out to be most costly variable for the farmers growing maize crop highest with an overall average of ₹5059.32 per hectare.

Table 4.16. Item-wise cost structure of maize crop in Jammu region

S.No.	Items	Doda			Overall
		Jammu Nagrota	Bhaderwah	Khellani	
(₹/ha)					
A)	Variable Cost				
1.	Seed	600.00	598.00	572.00	590.00
2.	Manure	2200.00	1400.00	1600.00	1733.33
3.	Fertilizers	1560.00	1492.00	1356.00	1469.33
4.	Human Labour	5227.96	4850.00	5100.00	5059.32
	Family Labour	1306.99	3880.00	4080.00	3089.00
	Hired Labour	3920.97	970.00	1020.00	1970.32
5.	Machine Labour	3000.00	2800.00	3200.00	3000.00
6.	Plant protection chemicals	0.00	160.00	100.00	86.67
7.	Interest on working capital	881.16	791.00	834.96	835.71
	Total variable cost	13469.12	12091.00	12762.96	12774.36
B)	Fixed Cost				
1.	Depreciation on farm buildings and equipment	2503.40	2329.55	2929.22	2587.39
2.	Estimated rental value on owned land	10200.00	8000.00	9550.00	9250.00
3.	Interest on fixed capital	1143.31	929.66	1123.13	1065.37
	Total fixed cost	13846.71	11259.21	13602.35	12902.76
	Total Cost (A+B)	27315.83	23350.21	26365.31	25677.12

4.2.3.1.2 Concept wise cost of cultivation of maize crop in Jammu region

Table 4.17 presents a detailed picture of the cost of maize farming in three blocks based on various cost concepts worked out on a per hectare basis. The data revealed that the per hectare costs A1 from Nagrota, Bhaderwah, and Khellani blocks were ₹14665.53, ₹10540.55, and ₹11612.18, with an overall average of ₹12272.75. The main components of cost A1 were seeds, manure, plant protection agents, fertilisers, and paid human labour. Rent was paid on leased in land from these blocks was zero, hence Cost A2 on a per hectare basis was the same as Cost A1. Cost B1 was ₹15808.84 (Nagrota), ₹11470.21 (Bhaderwah), and ₹12735.31 (Khellani) with an overall average of ₹13338.12, whereas cost B2 was ₹26008.84 (Nagrota), ₹19470.21 (Bhaderwah) and

₹22285.31 (Khellani), with an overall average of ₹22588.12. Per hectare cost C1 was ₹17115.83 (Nagrota), ₹15350.21 (Bhaderwah) and ₹16815.31 (Khellani), with an overall average of ₹16427.12. C2 cost per hectare was determined to be ₹27315.83 (Nagrota), ₹23350.21 (Bhaderwah) and ₹26365.31 (Khellani) with an overall average of ₹25677.12. At last the management cost was calculated i.e., C3 cost per hectare was determined to be ₹30047.41 (Nagrota), ₹25685.23 (Bhaderwah) and ₹29001.84 (Khellani) with an overall average of ₹28244.83.

Table 4.17. Concept –wise cost of cultivation of maize crop in Jammu region
(₹/ha)

S.No.	Particular	Block			
		Nagrota	Bhaderwah	Khellani	Overall
1	Cost A1				
a)	Hired Labour	3920.97	970.00	1020.00	1970.32
b)	Machine Labour	3000.00	2800.00	3200.00	3000.00
c)	Manure	2200.00	1400.00	1600.00	1733.33
d)	Seed	600.00	598.00	572.00	590.00
e)	Fertilizers(NPK)	1560.00	1492.00	1356.00	1469.33
f)	Plant protection chemicals	0.00	160.00	100.00	86.67
g)	Interest on working capital	881.16	791.00	834.96	835.71
h)	Depreciation charges	2503.40	2329.55	2929.22	2587.39
	Total Cost-A1	14665.53	10540.55	11612.18	12272.75
2	Cost-A2				
a)	Cost-A1	14665.53	10540.55	11612.18	12272.75
b)	Rent Pain for leased-in land	0.00	0.00	0.00	0.00
	Total Cost-A2	14665.53	10540.55	11612.18	12272.75
3	Cost-B1				
a)	Cost A1	14665.53	10540.55	11612.18	12272.75
b)	Interest on fixed capital(excluding land)	1143.31	929.66	1123.13	1065.37
	Total Cost-B1	15808.84	11470.21	12735.31	13338.12
4	Cost-B2				
a)	Cost B1	15808.84	11470.21	12735.31	13338.12
b)	Land Revenue	0.00	0.00	0.00	0.00
c)	Estimated Rental Value	10200.00	8000.00	9550.00	9250.00
	Total Cost-B2	26008.84	19470.21	22285.31	22588.12
5	Cost C1				
a)	Cost B1	15808.84	11470.21	12735.31	13338.12
b)	Imputed value of Family labour	1306.99	3880.00	4080.00	3089.00
	Total Cost-C1	17115.83	15350.21	16815.31	16427.12
6	Cost C2				
a)	Cost B2	26008.84	19470.21	22285.31	22588.12

b)	Imputed value of Family labour	1306.99	3880.00	4080.00	3089.00
	Total Cost C2	27315.83	23350.21	26365.31	25677.12
7	Cost C3				
a)	Cost of Management (10% of Cost-C2)	2731.58	2335.02	2636.53	2567.71
	Total Cost-C3	30047.41	25685.23	29001.84	28244.83

4.2.3.1.3 Cost and return structure of maize crop in Jammu region

Table 4.18 shows the cost and return of maize crop in Jammu region. The total cost was discovered to be highest in the Nagrota block (₹27315.83 per hectare) and lowest in the Bhaderwah block (₹23350.21 per hectare). Furthermore, in the instance of the Khellani block, a value of ₹26365.31 per hectare was found. The entire average was found to be ₹25677.12 per hectare. The highest net returns were obtained in the Bhaderwah block (₹35899.79 per hectare) and the lowest in the Khellani block (₹28234.69 per hectare). As a consequence, Bhaderwah had the highest cost-benefit ratio (1:2.54), followed by Nagrota (1:2.15) and Khellani (1:2.07). The overall cost-benefit ratio was calculated to be 1:2.25. According to Table 4.19, the quantity of the main product per hectare from different blocks was determined and the results were found out to be 30.00 quintals, 28.00 quintals, and 28.00 quintals in the case of Bhaderwah, Nagrota and Khellani, respectively, with the overall average being 28.67 quintals of the main product.

Table 4.18. Cost and returns of maize crop in Jammu region

(₹/ha)					
S. No	Particulars	Nagrota	Bhaderwah	Khellani	Overall
Cost					
a)	Total Variable Cost	13469.12	12091.00	12762.96	12774.36
b)	Total Fixed Cost	13846.71	11259.21	13602.35	12902.76
c)	Total Cost	27315.83	23350.21	26365.31	25677.12
Returns					
a)	Gross Returns	58800.00	59250.00	54600.00	57550.00
b)	Net Returns	31484.17	35899.79	28234.69	31872.88
	Benefit-Cost Ratio	1:2.15	1:2.54	1:2.07	1:2.25

Table 4.19. Production pattern of maize crop cultivation in Jammu region
(₹/ha)

S. No.	Particular	Block			
		Nagrota	Bhaderwah	Khellani	Overall
	Main product				
a)	Quantity (quintals)	28.00	30.00	28.00	28.67
b)	Average price per quintal (₹)	1500.00	1475.00	1450.00	1475.00
	Total amount (A)	42000.00	44250.00	40600.00	42283.33
	By-product				
a)	Quantity (quintals)	33.60	37.50	35.00	35.37
b)	Average price per quintal (₹)	500.00	400.00	400.00	4966.67
	Total amount (B)	16800.00	15000.00	14000.00	15733.33
	Total (A+B)	58800.00	59250.00	54600.00	57550.00

4.2.4 Economics of berseem crop in Jammu district

Berseem, in addition to being a highly nutritious and tasty fodder for livestock in the winter season in repeated cuttings, is a frost sensitive crop, hence it was not produced in the Doda district. In addition, the sampled farmers of Nagrota block did not grow this crop. Berseem was only found in the R.S. Pura block. Table 4.20 displays descriptive statistics for quantitative variables of berseem.

Table 4.20: Descriptive statistics of quantitative variables of berseem crop in Jammu district

Block	Particular	Unit	Mean	Standard Error	Range
R.S.Pura	Area	hectare	0.31	±0.10	0.05-1.20
	Seed	kg.	6.25	±1.94	1.00-24.00
	Production	q	12.50	±3.87	2.00-48.00
	Manure	q	46.88	±14.51	7.50-180.00
	Fertilizers	kg.	31.25	±9.68	5-120.00
	Human Labour*	mandays	2.50	±0.17	1.50-3.50
	Machine Labour*	hours	0.63	±0.14	0.25-2.00

*Includes imputed values

4.2.4.1 Cost and Returns

4.2.4.1.1 Cost structure for berseem cultivation in Jammu district

Table 4.21 shows the item-wise cost incurred on berseem crop grown in sampled area by sampled farmers. The cost of cultivation in the R.S. Pura block of the Jammu district was ₹28818.31 per hectare. The largest component of this cost was in human labour, seed, manure, and fertilisers. Fixed costs included the rental value of owned land and depreciation on implements. The cost of human labour was determined to be ₹3200.00 per hectare.

Table 4.21. Item-wise cost structure of berseem crop in Jammu district

(₹/ha)		
S.No.	Items	Block
		R.S.Pura
A)	Variable Cost	
1.	Seed	2800.00
2.	Manure	1250.00
3.	Fertilizers	2500.00
4.	Human Labour	3200.00
	Family Labour	640.00
	Hired Labour	2560.00
5.	Machine Labour	1600.00
6.	Irrigation	600.00
7.	Interest on working capital	836.50
	Total variable cost	12786.50
B)	Fixed Cost	
1.	Depreciation on farm buildings and equipment	2708.08
2.	Estimated rental value on owned land	12000.00
4.	Interest on fixed capital	1323.73
	Total fixed cost	16031.81
	Total Cost (A+B)	28818.31

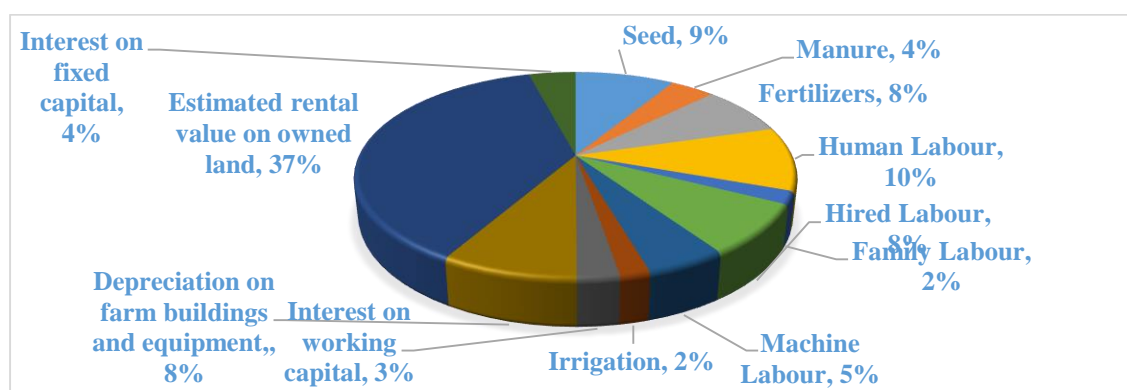


Fig 4.5 Item-wise cost structure of berseem crop in Jammu district

4.2.4.1.2 Concept wise cost of cultivation of berseem crop in Jammu district

Table 4.22 presents a detailed analysis of the cost of berseem cultivation in R.S. Pura block of the Jammu district, based on several cost concepts worked out on a per hectare basis. The chart shows that the cost of A1 per hectare was ₹14854.58. The key components of cost A1 were seeds, manure, fertilisers and hired labour. Rent was paid on the leased in land from these blocks was zero, hence Cost A2 on a per hectare basis was the same as Cost A1. Similarly, the cost per hectare for B1 was ₹16178.31, whereas the cost for B2 was ₹28178.31. The cost per hectare for C1 was ₹16818.31. The cost of C2 per hectare was discovered to be ₹28818.31. After calculating the 10% of the cost C2 i.e., management cost, cost C3 was found to be ₹31700.14.

Table 4.22. Concept –wise cost of cultivation of berseem crop in Jammu district

(₹/ha)

S.no	Particular	Block
		R.S.Pura
1	Cost A1	
a)	Hired Labour	2560.00
b)	Machine Labour	1600.00
c)	Irrigation	600.00
d)	Manure	1250.00
e)	Seed	2800.00
f)	Fertilizers(NPK)	2500.00
g)	Interest on working capital	836.50
h)	Depreciation charges	2708.08
	Total Cost-A1	14854.58
2	Cost-A2	
a)	Cost-A1	14854.58
b)	Rent Pain for leased-in land	0.00
	Total Cost-A2	14854.58
3	Cost-B1	
a)	Cost A1	14854.58
b)	Interest on fixed capital(excluding land)	1323.73
	Total Cost-B1	16178.31
4	Cost-B2	

a)	Cost B1	16178.31
b)	Land Revenue	0.00
c)	Estimated Rental Value	12000.00
	Total Cost-B2	28178.31
5	Cost C1	
a)	Cost B1	16178.31
b)	Imputed value of Family labour	640.00
	Total Cost-C1	16818.31
6	Cost C2	
a)	Cost B2	28178.31
b)	Imputed value of Family labour	640.00
	Total Cost C2	28818.31
7	Cost C3	
a)	Cost of Management (10% of Cost-C2)	2881.83
	Total Cost-C3	31700.14

4.2.4.1.3 Cost and return structure of berseem crop in Jammu district

The economics of the berseem crop in the R.S. Pura region of Jammu district are shown in Table 4.23. According to the table, the cost of cultivation was ₹28818.31 per hectare. The net returns per hectare were found to be ₹31181.69, and the average price per cut was ₹15000. As a result, the cost-benefit ratio was calculated to be 1:2.08.

Table 4.23. Cost and returns of berseem crop in Jammu district

		(₹/ha)
S.No	Particulars	R.S.Pura
Cost		
a)	Total Variable Cost	12786.50
b)	Total Fixed Cost	16031.81
c)	Total Cost	28818.31
Returns		
a)	Yield(cuts/ha)	3-4
b)	Average price per cut	15000
c)	Gross Returns	60000.00
d)	Net Returns	31181.69
	Benefit-Cost Ratio	1:2.08

4.2.5 Economics of oats crop

Oats crop is an important fodder crop in Bhaderwah and Khellani block of Doda district. It was found only in two blocks of the Doda district i.e., Bhaderwah and Khellani. The detailed descriptive statistics of this crop with respect to two districts has been presented in Table 4.24.

Table 4.24. Descriptive statistics of quantitative variables of oats crop in Doda district

Block	Particular	Unit	Mean	Standard Error	Range
Bhaderwah	Area	ha	0.37	±0.04	0.10-0.90
	Seed	kg.	27.93	±2.86	7.48-67.32
	Production	q	85.87	±8.78	23.00-207.00
	Manure	q	44.80	±4.58	12.00-108.00
	Fertilizers	kg.	18.13	±1.97	4.00-45.00
	Human Labour*	days	2.96	±0.30	0.78-7.04
	Machine Labour*	hours	1.07	±0.11	0.29-2.57
Khellani	Area	ha	0.60	±0.07	0.15-1.25
	Seed	kg.	42.00	±4.66	10.50-87.50
	Production	q	141.60	±15.72	35.40-295.00
	Manure	q	72.00	±7.99	18.00-150.00
	Fertilizers	kg.	32.40	±3.60	8.10-67.50
	Human Labour*	days	4.48	±0.50	1.12-9.33
	Machine Labour*	hours	2.06	±0.23	0.51-4.29

*Includes imputed values

4.2.5.1 Cost and Returns

4.2.5.1.1 Cost structure for oats cultivation

The item wise cost of cultivation of oats of sampled farmers is presented in Table 4.25. It revealed that per hectare total cost of cultivation was ₹20175.86 in Bhaderwah block and ₹23106.09 in Khellani block, with an overall average of ₹21640.98. Expenditure on human labour, seed, manure and fertilizers were the main component of item wise operational cost. Rental value of owned land and the depreciation on the farm implements was included in fixed cost. The expenditure incurred on human labour was found to be ₹3564.29 per hectare from Bhaderwah block and ₹3360.00 per hectare from Khellani block.

Table 4.25. Item-wise cost structure of oats crop in Doda district

S.No.	Items	Doda		(₹/ha)
		Bhaderwah	Khellani	Overall
A)	Variable Cost			
1.	Seed	897.60	910.00	903.80
2.	Manure	1400.00	1600.00	1500.00
3.	Fertilizers	471.43	612.00	541.72
4.	Human Labour	3564.29	3360.00	3462.15
	Family Labour	2851.43	2688.00	2769.72
	Hired Labour	712.86	672.00	692.43
5.	Machine Labour	2000.00	2400.00	2200.00
6.	Interest on working capital	583.33	621.74	602.54
	Total variable cost	8916.65	9503.74	9210.20
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2329.55	2929.22	2629.39
2.	Estimated rental value on owned land	8000.00	9550.00	8775.00
3.	Interest on fixed capital	929.66	1123.13	1026.40
	Total fixed cost	11259.21	13602.35	12430.78
	Total Cost (A+B)	20175.86	23106.09	21640.98

4.2.5.1.2 Concept wise cost of cultivation of oats crop

Various cost concepts presented in Table 4.26 were worked out on per hectare basis. The table revealed that per hectare cost A1 were ₹8394.77 and ₹9744.96 from Bhaderwah and Khellani blocks, respectively with an overall average of ₹9069.87. Seeds, manure, fertilizer, machine labour and hired human labour were the main components of cost A1. Cost A2 and Cost A1 on per hectare basis were same because rent paid on leased in land were zero on the farms. Cost B1 was ₹9324.43 (Bhaderwah) and ₹10868.09 (Khellani) with an overall average of ₹10096.26 per hectare. Cost B2 were ₹17324.43 (Bhaderwah) and ₹20418.09 (Khellani) with an overall average of ₹18871.26. Cost C1 was ₹12175.86 and ₹13556.09 in Bhaderwah and Khellani block, respectively with an overall average of ₹12865.98. Cost C2 was found to given an overall average of ₹21640.98 per hectare. After working out 10 per cent of cost C2 i.e., management cost, cost C3 was found to be ₹22193.45 in Bhaderwah and ₹25416.70 in Khellani with an overall average of ₹23805.07.

Table 4.26. Concept –wise cost of cultivation of oats crop in Doda district

S.no	Particular	Block		Overall
		Bhaderwah	Khellani	
				(₹/ha)
1	Cost A1			
a)	Hired Labour	712.86	672.00	692.43
b)	Machine Labour	2000.00	2400.00	2200.00
c)	Manure	1400.00	1600.00	1500.00
d)	Seed	897.60	910.00	903.80
e)	Fertilizers(NPK)	471.43	612.00	541.72
f)	Interest on working capital	583.33	621.74	602.54
g)	Depreciation charges	2329.55	2929.22	2629.39
	Total Cost-A1	8394.77	9744.96	9069.87
2	Cost-A2			
a)	Cost-A1	8394.77	9744.96	9069.87
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	8394.77	9744.96	9069.87
3	Cost-B1			
a)	Cost A1	8394.77	9744.96	9069.87
b)	Interest on fixed capital(excluding land)	929.66	1123.13	1026.40
	Total Cost-B1	9324.43	10868.09	10096.26
4	Cost-B2			
a)	Cost B1	9324.43	10868.09	10096.26
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	8000.00	9550.00	8775.00
	Total Cost-B2	17324.43	20418.09	18871.26
5	Cost C1			
a)	Cost B1	9324.43	10868.09	10096.26
b)	Imputed value of Family labour	2851.43	2688.00	2769.72
	Total Cost-C1	12175.86	13556.09	12865.98
6	Cost C2			
a)	Cost B2	17324.43	20418.09	18871.26
b)	Imputed value of Family labour	2851.43	2688.00	2769.72
	Total Cost C2	20175.86	23106.09	21640.98
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	2017.59	2310.61	2164.10
	Total Cost-C3	22193.45	25416.70	23805.07

4.2.5.1.3 Cost and return structure of oats crop

Table 4.27 shows the cost and returns of oats crop in the two blocks. The total cost was high in case of Khellani block i.e., ₹23106.09 per hectare in comparison to that of the Bhaderwah block i.e., ₹20175.86 per hectare. If we looked the per hectare

net returns, it was higher in case of Bhaderwah block i.e., ₹25824.14, hence the cost-benefit ratio was also higher in Bhaderwah block (1:2.28) as compared to Khellani block (1:2.04) with an overall average found out to be 1:2.16. The per hectare yield was higher in case of Khellani block (236.00 quintals) in comparison to that of Bhaderwah block (236.00 quintals).

Table 4.27. Cost and returns of oats crop in Doda district

(₹/ha)				
S.No	Particulars	Bhaderwah	Khellani	Overall
Cost				
a)	Total Variable Cost	8916.65	9503.74	9210.19
b)	Total Fixed Cost	11259.21	13602.35	12430.78
c)	Total Cost	20175.86	23106.09	21640.97
Returns				
a)	Yield (quintals)	230.00	236.00	233.00
b)	Average price per hectare	200.00	200.00	200.00
c)	Gross Returns	46000.00	47200.00	46600.00
d)	Net Returns	25824.14	24093.91	24959.03
	Benefit-Cost Ratio	1:2.28	1:2.04	1:2.16

Sampled farmers in R.S. Pura and Nagrota block were not cultivating oats crop

4.2.6 Economics of potato crop in Doda district

Potato crop was found in two blocks of the Doda district i.e., Bhaderwah and Khellani block. The descriptive statistics was given in Table 4.28 of potato crop in Jammu district.

Table 4.28. Descriptive statistics of quantitative variables of potato crop in Doda district

Block	Particular	Unit	Mean	Standard Error	Range
Bhaderwah	Area	acres	0.01	±0.001	0.006-0.019
	Seed	kg.	5.95	±0.40	3.70-11.10
	Production	Q	0.92	±0.06	0.58-1.73
	Manure	Q	3.21	±0.21	2.00-6.00
	Human Labour*	days	0.05	±0.00	0.02-0.05
Khellani	Area	acres	0.0095	±0.0006	0.0063-0.0125
	Seed	kg.	5.31	±0.34	3.50-7.00
	Production	Q	0.91	±0.06	0.60-1.20
	Manure	Q	3.04	±0.20	2.00-4.00
	Human Labour*	days	0.11	±0.01	0.07-0.14

**Includes imputed values*

4.2.6.1 Cost and Returns

4.2.6.1.1 Cost structure for potato cultivation in Doda district

The cost incurred on various items used in cultivation of potato crop by the sampled farmers is presented in Table 4.28. Per acre total cost of cultivation was ₹57534.57 in Bhaderwah block and ₹54621.87 in Khellani block, with an overall average of ₹56078.22. Expenditure on human labour, seed and manure were the main component of item wise operational cost. The expenditure incurred on seed was found to be highest among the components of the variable cost i.e., ₹20720.00 per acre from Bhaderwah block and ₹16800.00 per acre from Khellani block, with an overall average of ₹18760.00 per acre.

Table 4.29: Item-wise cost structure of potato crop in Doda district

S.No.	Items	Doda		
		Bhaderwah	Khellani	Overall
				(₹/acre)
A)	Variable Cost			
1.	Seed	20720.00	16800.00	18760.00
2.	Manure	17600.00	16000.00	16800.00
3.	Human Labour	4928.00	4576.00	4752.00
	Family Labour	4928.00	4576.00	4752.00
	Hired Labour	0.00	0.00	0.00
4.	Irrigation	0.00	960.00	480.00
5.	Interest on working capital	3027.36	2683.52	2855.44
	Total variable cost	46275.36	41019.52	43647.44
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2329.55	2929.22	2629.39
2.	Estimated rental value on owned land	8000.00	9550.00	8775.00
3.	Interest on fixed capital	929.66	1123.13	1026.40
	Total fixed cost	11259.21	13602.35	12430.78
	Total Cost (A+B)	57534.57	54621.87	56078.22

4.2.6.1.2 Concept wise cost of cultivation of potato crop in Doda district

Table 4.29 shows the details of the cost of potato cultivation in two blocks, as well as other cost concepts calculated on a per-acre basis. The chart shows that the per acre cost A1 from Bhaderwah and Khellani blocks was ₹43676.91 and ₹39372.74, respectively, with an overall average of ₹41524.83. The primary components of cost A1 were seeds and manure. On per acre basis Cost A2 and Cost A1 were the same. After calculating the cost B1 it was discovered that ₹44606.57 and ₹40495.87 in Bhaderwah and Khellani blocks, respectively, was resulted from cost B1 with an overall

average of ₹42551.22, Cost B2 was ₹52606.57 in Bhaderwah and ₹50045.87 in Khellani block, with an overall average of ₹51326.22. Cost C1 in Bhaderwah was ₹49534.57 and Khellani blocks was ₹45071.87, with an overall average of ₹47303.22. Cost C2 per acre was found ₹57534.57 in Bhaderwah and ₹54621.87 in Khellani, with an overall average of ₹56078.22. After calculating 10% of the cost C2, per acre cost C3 was found to be ₹63288.03 in Bhaderwah and ₹60084.06 in Khellani, respectively with an overall average of ₹61686.04.

Table 4.30. Concept –wise cost of cultivation of potato crop in Doda district
(₹/acre)

S.no	Particular	Block		Overall
		Bhaderwah	Khellani	
1	Cost A1			
a)	Irrigation	0.00	960.00	480.00
b)	Manure	17600.00	16000.00	16800.00
c)	Seed	20720.00	16800.00	18760.00
d)	Interest on working capital	3027.36	2683.52	2855.44
e)	Depreciation charges	2329.55	2929.22	2629.39
	Total Cost-A1	43676.91	39372.74	41524.83
2	Cost-A2			
a)	Cost-A1	43676.91	39372.74	41524.83
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	43676.91	39372.74	39372.74
3	Cost-B1			
a)	Cost A1	43676.91	39372.74	41524.83
b)	Interest on fixed capital(excluding land)	929.66	1123.13	1026.40
	Total Cost-B1	44606.57	40495.87	42551.22
4	Cost-B2			
a)	Cost B1	44606.57	40495.87	42551.22
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	8000.00	9550.00	8775.00
	Total Cost-B2	52606.57	50045.87	51326.22
5	Cost C1			
a)	Cost B1	44606.57	40495.87	42551.22
b)	Imputed value of Family labour	4928.00	4576.00	4752.00
	Total Cost-C1	49534.57	45071.87	47303.22
6	Cost C2			
a)	Cost B2	52606.57	50045.87	51326.22
b)	Imputed value of Family labour	4928.00	4576.00	4752.00
	Total Cost C2	57534.57	54621.87	56078.22
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	5753.46	5462.19	5607.82
	Total Cost-C3	63288.03	60084.06	61686.04

4.2.6.1.3 Cost and return structure of potato crop in Doda district

Table 4.30 provides information on the economics of the potato harvest in the Bhaderwah and Khellani blocks. Total cost of cultivation which includes variable and fixed costs was calculated to be ₹57534.57 per acre and net returns were calculated to be ₹62065.43 per acre in the Bhaderwah block, with a cost-benefit ratio of 1:2.08. In Khellani block, the total cost of cultivation was ₹54621.87 per acre, with a net return of ₹70178.13 per acre and a cost-benefit ratio of 1:2.28. In Bhaderwah and Khellani, the yield per acre was 92.00 quintals and 96.00 quintals, respectively.

Table 4.31. Cost and returns of potato crop in Doda district

(₹/acre)				
S.No	Particulars	Bhaderwah	Khellani	Overall
Cost				
a)	Total Variable Cost	46275.36	41019.52	43647.44
b)	Total Fixed Cost	11259.21	13602.35	12430.78
c)	Total Cost	57534.57	54621.87	56078.22
Returns				
a)	Yield(q/acre)	92.00	96.00	94.00
b)	Average price per quintal (₹)	1300.00	1300.00	1300.00
c)	Gross Returns	119600.00	124800.00	122200.00
d)	Net Returns	62065.43	70178.13	66121.78
	Benefit-Cost Ratio	1:2.08	1:2.28	1:2.18

Sampled farmers in R.S.Pura and Nagrota block were not cultivating potato crop

4.2.7 Economics of knol-khol crop in Doda district

Table 4.31 represents the descriptive statistics of knol-khol, which was found being cultivated only in Bhaderwah and Khellani block of Doda district.

Table 4.32. Descriptive statistics of quantitative variables of knol-khol in Doda district

Block	Particular	Unit	Mean	Standard Error	Range
Bhaderwah	Area	acres	0.0151	±0.0007	0.0125-0.0250
	Seed	kg.	0.0072	±0.0003	0.0060-0.0120
	Production	q	1.21	±0.05	1.00-2.00
	Manure	q	4.83	±0.21	4.00-8.00
	Human labour*	days	0.30	±0.01	0.25-0.50
Khellani	Area	acres	0.012	±0.001	0.006-0.019
	Seed	kg.	0.0066	±0.0004	0.0035-0.0105
	Production	q	1.1308	±0.0692	0.60-1.80
	Manure	q	3.77	±0.23	2.00-6.00
	Human labour*	days	0.23	±0.01	0.02-0.37

**Includes imputed values*

4.2.7.1 Cost and Returns

4.2.7.1.1 Cost structure for knol khol cultivation

Table 4.32 shows the itemised cost of knol khol farming by sampled farmers from the two blocks. It was found that the total cost of cultivation per acre from Bhaderwah block was ₹37826.03 and ₹42571.10 in Khellani block, with an overall average of ₹40198.57. The largest component of item-wise operational cost was expenditure on human labour, seed, irrigation, and manure. Fixed costs included depreciation on implements and the rental value of owned land. The findings also revealed that, of all the inputs used, the expenditure on manure was determined to be the greatest, at ₹16000/acre from the Bhaderwah block and ₹17600.00/acre from the Khellani block with an overall average of ₹16800.00/acre.

Table 4.33: Item-wise cost structure of knol khol crop in Doda district

S.No.	Items	Doda		(₹/acre)
		Bhaderwah	Khellani	Overall
A)	Variable Cost			
1.	Seed	28.80	33.60	31.2
2.	Manure	16000.00	17600.00	16800.00
4.	Human Labour	8000.00	8800.00	8400.00
	Family Labour	8000.00	8800.00	8400.00
	Hired Labour	0.00	0.00	0.00
6.	Irrigation	800.00	640.00	720.00
8.	Interest on working capital	1738.02	1895.15	1816.59
	Total variable cost	26566.82	28968.75	27767.79
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2329.55	2929.22	2629.39
2.	Estimated rental value on owned land	8000.00	9550.00	8775.00
3.	Interest on fixed capital	929.66	1123.13	1026.40
	Total fixed cost	11259.21	13602.35	12430.78
	Total Cost (A+B)	37826.03	42571.10	40198.57

4.2.7.1.2 Concept wise cost of cultivation of knol khol crop in Doda district

The detail of the cost of cultivation of knol khol in two blocks, various cost concepts were worked out on per acre basis are interpreted in Table 4.33. The table revealed that per acre cost A1 were ₹20896.37 and ₹23097.97 from Bhaderwah and Khellani blocks, respectively with an overall average of ₹21997.17. Seeds, manure were the main components of cost A1. Cost A2 and Cost A1 on per acre basis were same. Per acre cost B1 was ₹21826.03 and ₹24221.10 in Bhaderwah and Khellani

block, respectively whereas cost B2 were ₹29826.03 and ₹33771.10 in Bhaderwah and Khellani block, respectively. The per acre cost C1 was ₹29826.03 and ₹33021.10 in Bhaderwah and Khellani block, respectively. The per acre cost C2 was found to be ₹37826.03 and ₹42571.10 in Bhaderwah and Khellani, respectively with an overall average of ₹40198.57. After working out per acre management cost C3, was found to be ₹41608.63 and ₹46828.21 in Bhaderwah and Khellani, respectively with an overall average of ₹44218.42.

Table 4.34. Concept –wise cost of cultivation of knol khol crop in Doda district
(₹/acre)

S.no	Particular	Block		Overall
		Bhaderwah	Khellani	
1	Cost A1			
a)	Irrigation	800.00	640.00	720.00
b)	Manure	16000.00	17600.00	16800.00
c)	Seed	28.80	33.60	31.20
d)	Interest on working capital	1738.02	1895.15	1816.59
e)	Depreciation charges	2329.55	2929.22	2629.39
	Total Cost-A1	20896.37	23097.97	21997.17
2	Cost-A2			
a)	Cost-A1	20896.37	23097.97	21997.17
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	20896.37	23097.97	21997.17
3	Cost-B1			
a)	Cost A1	20896.37	23097.97	21997.17
b)	Interest on fixed capital(excluding land)	929.66	1123.13	1026.40
	Total Cost-B1	21826.03	24221.10	23023.57
4	Cost-B2			
a)	Cost B1	21826.03	24221.10	23023.57
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	8000.00	9550.00	8775.00
	Total Cost-B2	29826.03	33771.10	31798.57
5	Cost C1			
a)	Cost B1	21826.03	24221.10	23023.57
b)	Imputed value of Family labour	8000.00	8800.00	8400.00
	Total Cost-C1	29826.03	33021.10	31423.57
6	Cost C2			
a)	Cost B2	29826.03	33771.10	31798.57
b)	Imputed value of Family labour	8000.00	8800.00	8400.00
	Total Cost C2	37826.03	42571.10	40198.57
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	3782.60	4257.11	4019.86
	Total Cost-C3	41608.63	46828.21	44218.42

4.2.7.1.3 Cost and return structure of knol-khol crop in Doda district

Table 4.34 shows the cost and returns of knol-khol in Bhaderwah and Khellani block. The cost-benefit ratio for this crop was high which meant it was quite beneficial for the farmers. Though the total overall cost was high (₹40198.57 per acre), the gross profits were similarly high (₹88000.00 per acre), with a benefit-to-cost ratio of 1:2.19.

Table 4.35. Cost and returns of knol-khol

(₹/acre)				
S.No	Particular	Bhaderwah	Khellani	Overall
Cost				
a)	Total Variable Cost	26566.82	28968.75	27767.79
b)	Total Fixed Cost	11259.21	13602.35	12430.78
c)	Total Cost	37826.03	42571.10	40198.57
Returns				
a)	Yield(q/acre)	80.00	96.00	88.00
b)	Average price per quintal	1000.00	1000.00	1000.00
c)	Gross Returns	80000.00	96000.00	88000.00
d)	Net Returns	42173.97	53428.90	47801.44
	Benefit-Cost Ratio	1:2.11	1:2.26	1:2.19

Sampled farmers in R.S.Pura and Nagrota were not cultivating knol-khol

4.2.8 Economics of onion crop in Doda district

Onion crop was found cultivating only in Bhaderwah and Khellani block and not grown by the farmers of R.S. Pura and Nagrota block. Descriptive statistics of onion crop has been represented in Table 4.35.

Table 4.36: Descriptive statistics of quantitative variables of onion crop in Doda district

Block	Particular	Unit	Mean	Standard Error	Range
Bhaderwah	Area	acres	0.008	±0.001	0.006-0.013
	Seed	kg.	0.033	±0.002	0.025-0.050
	Production	q	0.79	±0.05	0.60-1.20
	Manure	q	0.59	±0.04	0.45-0.90
	Fertilizers	kg.	0.40	±0.03	0.30-0.60
	Human labour*	days	0.15	±0.01	0.12-0.23
Khellani	Area	acres	0.0071	±0.0006	0.0063-0.0125
	Seed	kg.	0.03	±0.001	0.02-0.05
	Production	q	0.70	±0.06	0.62-1.24
	Manure	q	0.57	±0.05	0.50-1.00
	Fertilizers	kg.	0.62	±0.05	0.55-1.10
	Human labour*	days	0.16	±0.01	0.14-0.28

**Includes imputed values*

4.2.8.1 Cost and Returns

4.2.8.1.1 Cost structure for onion cultivation in Doda district

Table 4.36 shows the input wise cost of onion growing for sampled farmers in the two blocks. Total cost of cultivation per acre in Bhaderwah block was ₹31649.13 and ₹36055.23 in Khellani block, with an overall average of ₹33852.18. The largest component of input-wise operational cost was expenditure on human labour, seed, irrigation, and manure. Total overall fixed costs were found out to be ₹33852.18. Among all the inputs employed in cost of cultivation, the expenditure on human labour was determined to be the highest at the rate of ₹8320.00 per acre from the Bhaderwah block and ₹8800.00 per acre from the Khellani block, making an overall average of ₹8560.00 per acre.

Table 4.37. Item-wise cost structure of onion crop in Doda district

S.No.	Items	Doda		Overall
		Bhaderwah	Khellani	
				(₹/acre)
A)	Variable Cost			
1.	Seed	6000.00	5400.00	5700.00
2.	Manure	3600.00	4000.00	3800.00
3.	Fertilizers	336.00	1504.00	920.00
4.	Human Labour	8320.00	8800.00	8560.00
	Family Labour	5824.00	6160.00	5992.00
	Hired Labour	2496.00	2640.00	13800.00
5.	Irrigation	800.00	1280.00	1040.00
6.	Interest on working capital	1333.92	1468.88	1401.40
	Total variable cost	20389.92	22452.88	21421.40
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2329.55	2929.22	2629.39
2.	Estimated rental value on owned land	8000.00	9550.00	8775.00
3.	Interest on fixed capital	929.66	1123.13	1026.40
	Total fixed cost	11259.21	13602.35	12430.78
	Total Cost (A+B)	31649.13	36055.23	33852.18

4.2.8.1.2 Concept wise cost of cultivation of onion crop in Doda district

The detail of the cost of cultivation of onion in two blocks, various cost concepts were worked out on per acre basis are presented in Table 4.37. The table revealed that per acre cost A1 were ₹16895.47 and ₹19222.10 from Bhaderwah and Khellani blocks. The main components of cost A1 were hired labour, seed, irrigation, fertilizers and manure. Cost A2 and Cost A1 on per acre basis were found out to be

same. Overall per acre cost B1 was ₹19085.18 which includes ₹17825.13 and ₹20345.23 from Bhaderwah and Khellani block, respectively. In Bhaderwah and Khellani blocks, cost B2 was ₹25825.13 and ₹29895.23, respectively, with an overall average of ₹27860.18. In the Bhaderwah and Khellani blocks, the per acre cost C1 was ₹23649.13 and ₹26505.23, respectively, with an overall average of ₹25077.18. In Bhaderwah and Khellani, the per acre cost C2 was found to be ₹31649.13 and ₹36055.23, respectively, with an overall average of ₹33852.18. After measuring 10% of cost C2, per acre cost C3 in Bhaderwah and Khellani was determined to be ₹34814.04 and ₹39660.75, respectively, with an overall average of ₹37237.40.

Table 4.38. Concept –wise cost of cultivation of onion crop in Doda district

S.no	Particular	Block		Overall
		Bhaderwah	Khellani	
				(₹/acre)
1	Cost A1			
a)	Hired Labour	2496.00	2640.00	2568.00
b)	Irrigation	800.00	1280.00	1040.00
c)	Manure	3600.00	4000.00	3800.00
d)	Seed	6000.00	5400.00	5700.00
e)	Fertilizers(NPK)	336.00	1504.00	920.00
f)	Interest on working capital	1333.92	1468.88	1401.40
g)	Depreciation charges	2329.55	2929.22	2629.39
	Total Cost-A1	16895.47	19222.10	18058.79
2	Cost-A2			
a)	Cost-A1	16895.47	19222.10	18058.79
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	16895.47	19222.10	18058.79
3	Cost-B1			
a)	Cost A1	16895.47	19222.10	18058.79
b)	Interest on fixed capital(excluding land)	929.66	1123.13	1026.40
	Total Cost-B1	17825.13	20345.23	19085.18
4	Cost-B2			
a)	Cost B1	17825.13	20345.23	19085.18
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	8000.00	9550.00	8775.00
	Total Cost-B2	25825.13	29895.23	27860.18
5	Cost C1			
a)	Cost B1	17825.13	20345.23	19085.18
b)	Imputed value of Family labour	5824.00	6160.00	5992.00
	Total Cost-C1	23649.13	26505.23	25077.18
6	Cost C2			
a)	Cost B2	25825.13	29895.23	27860.18
b)	Imputed value of Family labour	5824.00	6160.00	5992.00
	Total Cost C2	31649.13	36055.23	33852.18
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	3164.91	3605.52	3385.22
	Total Cost-C3	34814.04	39660.75	37237.40

4.2.8.1.3 Cost and return structure of onion crop in Doda district

Table 4.38 showed that in the onion crop ₹20389.92 per acre was the overall variable cost whereas the gross returns worked out to be ₹192000.00 per acre in Bhaderwah block. Consequently, the cost-benefit ratio in Bhaderwah came out to be 1:6.07 which is beneficial for the farmers. Yield per acre was found out to be 96.00 quintals from Bhaderwah. In Khellani block the variable cost was ₹22452.88 per acre and gross returns worked out to be ₹198400.00 per acre. Consequently, the cost-benefit ratio in Khellani came out to be quite high i.e., 1:5.50. Per acre yield was found out to be 99.20 quintals from Khellani.

Table 4.39. Cost and returns of onion crop in Doda district

(₹/acre)				
S.No	Particulars	Bhaderwah	Khellani	Overall
Cost				
a)	Total Variable Cost	20389.92	22452.88	21421.4
b)	Total Fixed Cost	11259.21	13602.35	12430.78
c)	Total Cost	31649.13	36055.23	33852.18
Returns				
a)	Yield(q/acre)	96.00	99.20	97.60
b)	Average price per quintal	2000.00	2000.00	2000.00
c)	Gross Returns	192000.00	198400.00	195200.00
d)	Net Returns	160350.87	162344.77	161347.82
	Benefit-Cost Ratio	1:6.07	1:5.50	1:5.79

Sampled farmers in R.S. Pura and Nagrota were not cultivating onion crop

4.2.9 Economics of garlic crop in Doda district

Garlic crop was found cultivating in Bhaderwah and Khellani block excluding R.S. Pura and Nagrota block. Descriptive statistics of garlic crop has been presented in table 4.39.

Table 4.40. Descriptive statistics of quantitative variables of garlic crop in Doda district

Block	Particular	Unit	Mean	Standard Error	Range
Bhaderwah	Area	acres	0.0084	±0.0008	0.0063-0.0188
	Seed	kg.	1.82	±0.18	1.35-4.05
	Production	q	0.34	±0.03	0.25-0.75
	Manure	q	0.61	±0.06	0.45-1.35
	Fertilizers	kg.	0.41	±0.04	0.30-0.90
	Human labour*	days	0.15	±0.01	0.11-0.34
Khellani	Area	acres	0.007	±0.001	0.006-0.013
	Seed	kg.	1.52	±0.12	1.40-2.80
	Production	q	0.29	±0.02	0.27-0.54
	Manure	q	0.54	±0.04	0.50-1.00
	Fertilizers	kg.	0.60	±0.05	0.55-1.10
	Human labour*	days	0.15	±0.01	0.14-0.28

**Includes imputed values*

4.2.9.1 Cost and Returns

4.2.9.1.1 Cost structure for garlic cultivation in Doda district

The cost incurred on various items of cultivation in garlic crop by sampled farmers of the Doda district is enlisted in Table 4.40. It revealed that per acre total cost of cultivation was ₹46338.09 in Bhaderwah block and ₹49220.51 in Khellani block, with an overall average of ₹47779.30. ₹12430.78 was the overall fixed cost from the two blocks including depreciation on farm implement and rental value of owned. Among all the inputs utilized, the expenditure incurred by the respondent farmers on seed was found to be highest i.e., ₹19440.00 per acre from Bhaderwah block and ₹17920.00 per acre from Khellani block, with an overall average of ₹18680.00/acre.

Table 4.41. Item-wise cost structure of garlic crop in Doda district

(₹/acre)

S.No.	Items	Doda		Overall
		Bhaderwah	Khellani	
A)	Variable Cost			
1.	Seed	19440.00	17920.00	18680.00
2.	Manure	3600.00	4000.00	3800.00
3.	Fertilizers	624.00	1288.00	956.00
4.	Human Labour	8160.00	8800.00	8480.00
	Family Labour	5712.00	6160.00	5936.00
	Hired Labour	2448.00	2640.00	2544.00
5.	Irrigation	960.00	1280.00	1120.00
6.	Interest on working capital	2294.88	2330.16	2312.52
	Total variable cost	35078.88	35618.16	35348.52
B)	Fixed Cost			
1.	Depreciation on farm buildings and equipment	2329.55	2929.22	2629.39
2.	Estimated rental value on owned land	8000.00	9550.00	8775.00
3.	Interest on fixed capital	929.66	1123.13	1026.40
	Total fixed cost	11259.21	13602.35	12430.78
	Total Cost (A+B)	46338.09	49220.51	47779.30

4.2.9.1.2 Concept wise cost of cultivation of garlic crop in Doda district

Table 4.41 shows the cost of garlic cultivation in two blocks, with various cost concepts calculated on a per-acre basis. The table shows that the per acre cost A1 from Bhaderwah and Khellani blocks was ₹31696.43 and ₹32387.38, respectively, with an overall average of 32041.91. The key component of cost A1 was seed and other important components were hired labour, irrigation, fertilisers, and manure. Cost A2 and Cost A1 were the same per acre since the rent paid on the leased in land was zero. Cost B1 was worked out to be ₹32626.09 and ₹33510.51 in Bhaderwah and Khellani blocks, respectively, with an overall average of ₹33068.30. In the Bhaderwah and Khellani blocks, the cost B2 was ₹40626.09 and ₹43060.51, respectively. In the Bhaderwah and Khellani blocks, the per acre cost C1 was ₹38338.09 and ₹39670.51, respectively, with an overall average of ₹39004.30. In Bhaderwah and Khellani, the per acre cost C2 was found to be ₹46338.09 and ₹49220.51, respectively, with an overall average of ₹47779.30. After accounting for all expenditures, including the management cost, which is 10% of the cost C2, the per acre cost C3 in Bhaderwah and Khellani was determined to be ₹50971.90 and ₹54142.56, respectively, with an overall average of ₹52557.23.

Table 4.42. Concept –wise cost of cultivation of garlic crop in Doda district**(₹/acre)**

S.no	Particular	Block		Overall
		Bhaderwah	Khellani	
1	Cost A1			
a)	Hired Labour	2448.00	2640.00	2544.00
b)	Irrigation	960.00	1280.00	1120.00
c)	Manure	3600.00	4000.00	3800.00
d)	Seed	19440.00	17920.00	18680.00
e)	Fertilizers(NPK)	624.00	1288.00	956.00
f)	Interest on working capital	2294.88	2330.16	2312.52
g)	Depreciation charges	2329.55	2929.22	2629.39
	Total Cost-A1	31696.43	32387.38	32041.91
2	Cost-A2			
a)	Cost-A1	31696.43	32387.38	32041.91
b)	Rent Pain for leased-in land	0.00	0.00	0.00
	Total Cost-A2	31696.43	32387.38	32041.91
3	Cost-B1			
a)	Cost A1	31696.43	32387.38	32041.91
b)	Interest on fixed capital(excluding land)	929.66	1123.13	1026.40
	Total Cost-B1	32626.09	33510.51	33068.30
4	Cost-B2			
a)	Cost B1	32626.09	33510.51	33068.30
b)	Land Revenue	0.00	0.00	0.00
c)	Estimated Rental Value	8000.00	9550.00	8775.00
	Total Cost-B2	40626.09	43060.51	41843.30
5	Cost C1			
a)	Cost B1	32626.09	33510.51	33068.30
b)	Imputed value of Family labour	5712.00	6160.00	5936.00
	Total Cost-C1	38338.09	39670.51	39004.30
6	Cost C2			
a)	Cost B2	40626.09	43060.51	41843.30
b)	Imputed value of Family labour	5712.00	6160.00	5936.00
	Total Cost C2	46338.09	49220.51	47779.30
7	Cost C3			
a)	Cost of Management (10% of Cost-C2)	4633.81	4922.05	4777.93
	Total Cost-C3	50971.90	54142.56	52557.23

4.2.9.1.3 Cost and return structure of garlic crop

According to Table 4.42, the cost in the garlic crop found out to be ₹46338.09 per acre whereas net returns was worked out to be ₹353661.91 per acre in Bhaderwah block. The cost-benefit ratio in Bhaderwah came out 1:8.63 that was high for the garlic growing farmers of the region. Yield was found out to be 40.00 quintals from Bhaderwah. In the Khellani block, the cost of cultivation was ₹49220.51 per acre, with net returns of ₹382779.49 per acre. As a result, in Khellani, the cost-benefit ratio was high, i.e., 1:8.78 with a yield of 43.20 quintals per acre.

Table 4.43. Cost and returns of garlic crop in Doda district

(₹/acre)				
S.No	Particulars	Bhaderwah	Khellani	Overall
Cost				
a)	Total Variable Cost	35078.88	35618.16	35348.52
b)	Total Fixed Cost	11259.21	13602.35	12430.78
c)	Total Cost	46338.09	49220.51	47779.30
Returns				
a)	Yield(q/acre)	40.00	43.20	41.60
b)	Average price per quintal	10000.00	10000.00	10000.00
c)	Gross Returns	400000.00	432000.00	416000.00
d)	Net Returns	353661.91	382779.49	368220.70
	Benefit-Cost Ratio	1:8.63	1:8.78	1:8.71

Sampled farmers in R.S. Pura and Nagrota were not cultivating garlic crop

4.3 Cost and return of livestock enterprises

Farmers in the chosen regions were found to be involved in agricultural-related enterprises in addition to their core vocation of farming. Because crop production in these areas is limited, this was largely done to augment their income to meet the farmer's consumption and marketing demands.

4.3.1 Economics of livestock enterprise in Jammu region

Table 4.43 depicts the economics of animal enterprises. Desi cows, cross-breed cows, and buffalo were among the livestock types evaluated. 14 desi cows, 25 cross breed cows, and 45 buffaloes were analysed in the instance of R.S. Pura. The

information was analysed on a per-animal-unit-per-year basis. It was discovered that raising desi livestock was less expensive than raising cross-bred animals. The total cost of desi cows, cross-breed cows and buffalo was found to be ₹52322.77, ₹53535.61 and ₹45556.11, respectively. Net returns were also higher in the case of cross-bred livestock as compared to their desi counterparts. Milk was the most important component among the total returns from milch animals. On a per cow per year basis, the desi cow, cross-breed cow, and buffalo were found to be worth ₹57326.79, ₹82215.00 and ₹54911.11, respectively.

In Nagrota block 16 desi cows, 47 crossbred cows, and 75 buffaloes reared by the respondent farmers. In case of desi cows, cross-breed cows and buffalo, the total cost was found to be ₹51391.05, ₹47237.27, and ₹43037.24. In terms of net returns, they were calculated to be ₹19775.01, ₹43852.68 and ₹67454.40, respectively.

Desi cows (20 in Bhaderwah and 19 in Khellani) and crossbred cows (20 in Bhaderwah and 21 in Khellani) were found. Total cost incurred was found to be ₹51142.12 and ₹48985.65 for desi cows and crossbred cows, respectively, in Bhaderwah block, whereas total cost incurred was found to be ₹48653.68 and ₹50598.72 on desi cows and crossbred cows, respectively, in Khellani block. Cross-breed cows had the highest net returns (₹46381.50 and ₹40157.01) compared to desi cows (₹20733.25 and ₹21115.80) in the Bhaderwah and Khellani blocks, respectively

Table 4.44. Cost and returns of livestock enterprises

(₹ per animal per year)

S. No.	Particular	R.S.Pura			Nagrota			Bhaderwah		Khellani	
		No. of livestock	Desi cows	Crossbred cows	Buffalo	Desi cows	Crossbred cows	Buffalo	Desi cows	Crossbred cows	Desi cows
	Cost										
a)	Dry Fodder	11088.79	8069.20	9321.56	13739.31	12245.11	10395.62	10310.54	11046.38	11185.38	11730.57
b)	Green Fodder	12310.93	12254.12	9655.07	6636.19	7503.77	7555.47	11851.18	8639.54	8411.77	8910.73
c)	Concentrates	9774.79	12931.48	9749.73	10837.83	9772.77	7274.14	6799.06	7631.09	8779.65	8146.55
d)	Human Labour	14432.64	15272.96	12478.36	15588.69	13400.57	13737.61	17807.52	17049.17	14965.11	16942.47
	Family Labour	11546.11	12218.37	9982.68	12470.95	10720.46	10990.09	14246.02	13639.34	11972.09	13553.97
	Hired Labour	2886.53	3054.59	2495.67	3117.74	2680.11	2747.52	3561.50	3409.83	2993.02	3388.49
e)	Medicine and Veterinary care	921.21	1145.52	963.22	883.25	1020.51	1032.22	784.59	934.81	1050.86	1101.07
f)	Miscellaneous	371.43	360.00	407.87	343.75	204.26	226.67	243.48	480.00	294.74	457.14
g)	Interest on working capital	3422.99	3502.33	2980.31	3362.03	3090.29	2815.52	3345.75	3204.67	3966.17	3310.20
	Total Cost	52322.77	53535.61	45556.11	51391.05	47237.27	43037.24	51142.12	48985.65	48653.68	50598.72
	Returns										
	Milk/day/buffalo	4.39	6.30	3.92	4.13	5.69	4.91	4.19	5.94	4.06	5.61
a)	Milk price(₹/year)	57326.79	82215.00	54911.11	53872.03	74204.52	68730.67	54724.89	77517.00	53024.21	73198.07
b)	Manure(₹/year)	12234.25	12272.12	32013.64	12444.03	11385.43	32214.98	12150.48	12302.15	11745.26	11911.67
c)	Sale of Livestock(₹)	5000.00	6548.00	10000.00	4850.00	5500.00	9546.00	5000.00	5548.00	5000.00	5646.00
	Gross Returns	74561.04	101035.12	96924.76	71166.06	91089.95	110491.65	71875.37	95367.15	69769.47	90755.74
	Net Returns	22238.27	47499.51	51368.65	19775.01	43852.68	67454.40	20733.25	46381.50	21115.80	40157.01
	B-C Ratio	1.43	1.89	2.13	1.38	1.93	2.57	1.41	1.95	1.43	1.79

4.4 Economic analysis and economic viability of fruit crops found in sampled area

4.4.1 Economic analysis of apple crop in Doda district

4.4.1.1 Economic Analysis

The information with respect to yearly costs involved in the establishment of apple are as follows:

4.4.1.2 Cost of establishment

Farmers spent money on land preparation, planting material, digging, filling pits and planting, training, plant protection, farm yard manure, fertilisers, and other expenses during the first year of the plantation. Table 4.44 shows the establishment cost per hectare for the first year. The total costs incurred per hectare for the establishment of apple trees during the first year with an overall average of ₹33340.72 were found to be ₹32406.69 and ₹34274.75 in Bhaderwah and Khellani, respectively. The variable costs per hectare in Bhaderwah and Khellani were found to be ₹21147.48 and ₹20672.40, respectively, with an overall average of ₹20909.94. Cost incurred in per hectare land preparation was highest in both the blocks i.e., ₹6100.00 and ₹5400.00 in Bhaderwah and Khellani, respectively.

Table 4.45. Operation wise first year establishment cost of apple in Doda district (₹/ha)

S.No	Item	Cost (in ₹)		
		Bhaderwah	Khellani	Overall
1	Land Preparation	6100.00	5400.00	5750.00
2	Digging, Filling and Planting	4270.00	3600.00	3935.00
3	Planting Material	3660.00	3000.00	3330.00
4	Manure	3416.00	4200.00	3808.00
5	Fertilizers	610.00	960.00	785.00
6	Plant protecting chemicals	854.00	1080.00	967.00
7	Intercultural operations (hoeing, weeding etc)	366.00	480.00	423.00
8	Training	488.00	600.00	544.00
9	Interest on working capital	1383.48	1352.40	1367.94
	Total Variable Cost	21147.48	20672.40	20909.94
1	Depreciation	2329.55	2929.22	2629.39
2	Estimated rental value on owned land	8000.00	9550.00	8775.00
3	Interest on fixed capital	929.66	1123.13	1026.40
	Total Fixed Cost	11259.21	13602.35	12430.78
	Total Establishment cost (A+B)	32406.69	34274.75	33340.72

4.4.1.3 Operational costs

The per hectare operational costs are made up of yearly charges for the upkeep of apple trees that bear fruit. Table 4.45 shows the operational costs for apple trees by item and concept wise. The total costs per hectare in Bhaderwah and Khellani were found to be ₹31101.29 and ₹35173.55, respectively, with an overall average of ₹33137.42 per hectare. The chart also revealed that among the working costs, the maximum expenditures of ₹7320.00 in Bhaderwah were incurred on manure, whilst the highest expenditures on labour, ₹7200.00 per hectare, were incurred in Khellani.

Table 4.46. Item wise and concept wise operational cost of apple in Doda district

S.No.	Items	Cost (in ₹)		
		Bhaderwah	Khellani	Overall
1	Labour	6100.00	7200.00	6650.00
2	Intercultural operations (hoeing, weeding etc)	1098.00	1800.00	1449.00
3	Training/Pruning	976.00	1200.00	1088.00
4	Manure	7320.00	6600.00	6960.00
5	Fertilizers	1830.00	1920.00	1875.00
6	Plant protecting chemicals	1220.00	1440.00	1330.00
7	Interest on working capital	1298.08	1411.20	1354.64
	Total Variable Cost	19842.08	21571.20	20706.64
1	Depreciation	2329.55	2929.22	2629.39
2	Estimated rental value on owned land	8000.00	9550.00	8775.00
3	Interest on fixed capital	929.66	1123.13	1026.40
	Total Fixed Cost	11259.21	13602.35	12430.78
	Total Operational Cost	31101.29	35173.55	33137.42

4.4.1.4 Year wise cost and return analysis of apple

Table 4.46 shows the cost and returns from apple orchards calculated per hectare per year for various age groups. The returns begin in the sixth year of the orchard's establishment, with an average production of 48.80 quintals per hectare in Bhaderwah and 54.00 quintals per hectare in Khellani block from years 6 to 10, increasing to 97.60 quintals and 117.60 quintals per hectare from the fifteenth year and onwards in Bhaderwah and Khellani blocks, respectively. Net returns were determined to be ₹167786.43 and ₹183043.52 per hectare in the sixth to tenth years, respectively, increasing to ₹359298.71 and ₹435226.45 per hectare in the fifteenth year and onwards of the orchard's establishment in Bhaderwah and Khellani blocks. During the sixth to tenth years, the benefit-cost ratio was determined to be 1:7.12 and 1:6.55, respectively, which increases to 1:12.55 and 1:13.37 during the fifteenth year, demonstrating the viability of orchard.

Table 4.47. Year wise cost and return analysis of apple in Doda district

(₹/ha)

S. No	Particulars	Block	Years							
			1	2	3	4	5	Average 6th to 10th Year	Average 11th to 14th Year	15th Year and onwards
1.	Total Cost(₹)	Bhaderwah	32406.69	18007.73	19921.19	21843.37	23766.17	27413.57	29140.41	31101.29
		Khellani	34274.75	26402.02	27543.50	29685.20	31243.43	32956.48	33584.52	35173.55
2.	Production(q)	Bhaderwah	0.00	0.00	7.32	12.20	36.60	48.80	73.20	97.60
		Khellani	0.00	0.00	8.40	18.00	39.60	54.00	78.00	117.60
3.	Gross Returns(₹)	Bhaderwah	0.00	0.00	0.00	0.00	0.00	195200.00	292800.00	390400.00
		Khellani	0.00	0.00	0.00	0.00	0.00	216000.00	312000.00	470400.00
4.	Net Returns(₹)	Bhaderwah	-32406.69	-18007.73	-19921.19	-21843.37	-23766.17	167786.43	263659.59	359298.71
		Khellani	-34274.75	-26402.02	-27543.50	-29685.20	-31243.43	183043.52	278415.48	435226.45
5.	B:C Ratio	Bhaderwah	0.00	0.00	0.00	0.00	0.00	1:7.12	1:10.05	1:12.55
		Khellani	0.00	0.00	0.00	0.00	0.00	6.55	9.29	13.37

4.4.1.5 Economic viability of apple crop

Net present value, internal rate of return and cost-benefit ratio were used to determine economic feasibility in case of multi-year enterprises such as horticulture. Table 4.47 for Bhaderwah and Table 4.48 for Khellani block show the economic viability of apple. Because NPV values at 7.00 percent and 9.00 per cent discount rate were found to be positive, it is economically possible to operate on these enterprises as they gives the farmers better returns. In apple the IRR value for was found out to be 50 per cent and 47 per cent in Bhaderwah and Khellani, respectively.

Table 4.48. Economic viability of apple in Bhaderwah

					Net Present value (₹) @	
Year	Cost (₹)	Net return (₹)	Discount Factor@7%	Discount Factor@9%	7% discount factor	9% discount factor
1	32406.69	-32406.7	0.93	0.92	-30286.63	-29730.91
2	18007.73	-18007.7	0.87	0.84	-15728.65	-15156.75
3	19921.19	-19921.2	0.82	0.77	-16261.63	-15382.81
4	21843.37	-21843.4	0.76	0.71	-16664.20	-15474.39
5	23766.17	-23766.2	0.71	0.65	-16944.95	-15446.38
6	25895	130105	0.67	0.60	86694.46	77577.36
7	26956	145044	0.62	0.55	90326.11	79344.04
8	27583.29	160416.7	0.58	0.50	93363.99	80507.74
9	27949.49	184050.5	0.54	0.46	100111.28	84741.97
10	28684.09	219315.9	0.51	0.42	111489.09	92641.41
11	27550	224450	0.48	0.39	106634.58	86981.75
12	28954	248246	0.44	0.36	110224.19	88260.07
13	29791.95	276208.1	0.41	0.33	114616.52	90093.17
14	30265.7	305734.3	0.39	0.30	118569.03	91489.91
15	31101.29	359298.7	0.36	0.27	130226.39	98641.16
Total Net Present Value					966369.58	779087.33
Internal Rate of Return					50%	

Table 4.49. Economic viability of apple in Khellani

					Net Present value (₹) @	
Year	Cost (₹)	Net return (₹)	Discount Factor@7%	Discount Factor@9%	7% discount factor	9% discount factor
1	34274.75	-34274.75	0.93	0.92	-32032.48	-31444.72
2	26402.02	-26402.02	0.87	0.84	-23060.55	-22222.05
3	27543.5	-27543.50	0.82	0.77	-22483.70	-21268.64
4	29685.2	-29685.20	0.76	0.71	-22646.70	-21029.74
5	31243.43	-31243.43	0.71	0.65	-22276.13	-20306.09
6	32256	139744.00	0.67	0.60	93117.33	83324.78
7	32641.39	155358.61	0.62	0.55	96749.53	84986.48
8	32698	179302.00	0.58	0.50	104355.40	89985.63
9	33196	202804.00	0.54	0.46	110311.94	93376.60
10	33991	238009.00	0.51	0.42	120991.71	100537.57
11	32185	247815.00	0.48	0.39	117735.12	96036.45
12	32981.1	259018.90	0.44	0.36	115007.49	92090.21
13	34421	273579.00	0.41	0.33	113525.56	89235.63
14	34751	333249.00	0.39	0.30	129239.71	99723.59
15	35173.55	435226.45	0.36	0.27	157746.09	119486.22
Total Net Present Value					1036280.32	832511.91
Internal Rate of Return					47%	

4.4.2 Economic analysis of pear crop in Doda district

4.4.2.1 Economic Analysis

The information with respect to yearly costs involved in the establishment of pear are as:

4.4.2.2 Cost of establishment

During the first year of the plantation, farmers spent money on land preparation, planting material, digging, filling pits and planting, training/pruning, plant protection, manure, fertilisers, intercultural activities, and so on. The operational costs per hectare for the first year establishment are shown in Table 4.49. The total expenses expended per hectare for the establishment of pear orchards during the first year were found to be ₹27206.49 in Bhaderwah and ₹30657.08 in Khellani blocks, respectively, with an overall average of ₹28931.79. The variable costs per hectare were determined to be ₹15947.28 and ₹17054.73, with land preparation costing the most in both the blocks.

Table 4.50. Operation wise first year establishment cost of pear in Doda district (₹/ha)

S. No	Item	Cost (in ₹)		
		Bhaderwah	Khellani	Overall
1	Land Preparation	4600.00	4455.00	4527.50
2	Digging, Filling and Planting	3220.00	2970.00	3095.00
3	Planting Material	2760.00	2475.00	2617.50
4	Manure	2576.00	3465.00	3020.50
5	Fertilizers	460.00	792.00	626.00
6	Plant protecting chemicals	644.00	891.00	767.50
7	Intercultural operations (hoeing, weeding etc)	276.00	396.00	336.00
8	Training	368.00	495.00	431.50
9	Interest on working capital	1043.28	1115.73	1079.51
	Total Variable Cost	15947.28	17054.73	16501.01
1	Depreciation	2329.55	2929.22	2629.39
2	Estimated rental value on owned land	8000.00	9550.00	8775.00
3	Interest on fixed capital	929.66	1123.13	1026.40
	Total Fixed Cost	11259.21	13602.35	12430.78
	Total Establishment cost (A+B)	27206.49	30657.08	28931.79

4.4.2.3 Operational costs

The per hectare maintenance costs consists of yearly expenses on the maintenance of bearing pear trees. The item wise and concept wise maintenance costs for pear orchards are presented in Table 4.50. In Bhaderwah and Khellani, the per hectare variable and fixed costs were found to be ₹14962.88 and ₹17796.24, respectively, with an overall average of ₹16379.56 per hectare. The total cost per hectare was determined to be between ₹26222.09 and ₹31398.5, with an average of ₹28810.34. The table further revealed that among the working costs, the highest expenditures of ₹5520.00 per hectare was incurred on manure in Bhaderwah whereas ₹5940.00 per hectare on labour in Khellani.

Table 4.51. Item wise and concept wise operational cost of pear in Doda district (₹/ha)

S. No.	Items	Cost (in ₹)		
		Bhaderwah	Khellani	Overall
1	Labour	4600.00	5940.00	5270.00
2	Intercultural operations (hoeing, weeding etc.)	828.00	1485.00	1156.50
3	Training/Pruning	736.00	990.00	863.00
4	Manure	5520.00	5445.00	5482.50
5	Fertilizers	1380.00	1584.00	1482.00
6	Plant protecting chemicals	920.00	1188.00	1054.00
7	Interest on working capital	978.88	1164.24	1071.56
	Total Variable Cost	14962.88	17796.24	16379.56
1	Depreciation	2329.55	2929.22	2629.39
2	Estimated rental value on owned land	8000.00	9550.00	8775.00
3	Interest on fixed capital	929.66	1123.13	1026.40
	Total Fixed Cost	11259.21	13602.35	12430.78
	Total Operational Cost	26222.09	31398.59	28810.34

4.4.2.4 Year wise cost and return analysis

Table 4.51 shows the cost and profits from pear orchards calculated per hectare per year for various age groups. The returns begin in the fourth year of the orchard's formation, with average production of 9.20 quintals and 11.88 quintals per hectare from the Bhaderwah and Khellani blocks, respectively, increasing to 82.80 quintals and 113.85 quintals per hectare from the 15th year and onwards. Net returns were determined to be ₹10324.97 and ₹15626.51 per hectare in the fourth year, respectively, increasing to ₹263577.91 and ₹367076.41 per hectare in the 15th year of the orchard's creation and onwards in the Bhaderwah and Khellani blocks. The benefit cost ratio of

1:1.47 and 1:1.60 was found during 4th which increases to 1:11.05 and 1:12.69 during 15th year of the establishment of the orchard which proves the viability of the orchard, respectively.

Table 4.52. Year wise cost and return analysis of pear in Doda district

(₹/ha)

S. No	Particulars	Block	Years							
			1	2	3	4	5	Average 6th to 10th Year	Average 11th to 14th Year	15th Year and onwards
1.	Total Cost(₹)	Bhaderwah	27206.49	17520.09	18008.01	21875.03	23530.30	24985.45	25433.33	26222.09
		Khellani	30657.08	23050.23	24563.05	25953.49	26845.21	28212.19	29975.50	31398.59
2.	Production(q)	Bhaderwah	0.00	0.00	0.00	9.20	27.60	36.80	64.40	82.80
		Khellani	0.00	0.00	0.00	11.88	32.67	41.58	71.28	113.85
3.	Gross Returns(₹)	Bhaderwah	0.00	0.00	0.00	32200.00	96600.00	128800.00	225400.00	289800.00
		Khellani	0.00	0.00	0.00	41580.00	114345.00	145530.00	249480.00	398475.00
4.	Net Returns(₹)	Bhaderwah	-27206.49	-17520.09	-18008.01	10324.97	73069.70	103814.55	199966.67	263577.91
		Khellani	-30657.08	-23050.23	-24563.05	15626.51	87499.79	117317.81	219504.50	367076.41
5.	B:C Ratio	Bhaderwah	0.00	0.00	0.00	1.47	4.11	5.16	8.86	11.05
		Khellani	0.00	0.00	0.00	1.60	4.26	5.16	8.32	12.69

4.4.2.5 Economic viability of pear crop

Table 4.52 and Table 4.53 depicts the financial viability of pear in Bhaderwah and Khellani block, respectively. From these tables we found NPV of apple in Bhaderwah was ₹738835.13 and ₹600015.73 at discount factor of 7 per cent and 9 percent, respectively whereas the NPV in Khellani block was found to be ₹848820.19 and ₹687959.68 at discount factor of 7 percent and 9 percent, respectively. The IRR were calculated as 56 percent in Bhaderwah and 55 percent in Khellani block.

Table 4.53. Economic viability of pear in Bhaderwah

					Net Present value (₹) @	
Year	Cost (₹)	Net return (₹)	Discount Factor@7%	Discount Factor@9%	7% discount factor	9% discount factor
1	27206.49	-27206.49	0.93	0.92	-25426.63	-24960.08
2	17520.09	-17520.09	0.87	0.84	-15302.73	-14746.31
3	18008.01	-18008.01	0.82	0.77	-14699.90	-13905.49
4	21875.03	10324.97	0.76	0.71	7876.87	7314.47
5	23530.30	73069.70	0.71	0.65	52097.69	47490.29
6	23975.00	77525.00	0.67	0.60	51658.18	46225.62
7	24864.00	90636.00	0.62	0.55	56443.55	49581.00
8	25315.27	98934.73	0.58	0.50	57580.91	49652.00
9	25352.00	118148.00	0.54	0.46	64264.68	54398.62
10	25421.00	133829.00	0.51	0.42	68031.88	56530.82
11	24987.30	167512.70	0.48	0.39	79584.08	64916.67
12	25345.00	179405.00	0.44	0.36	79657.97	63784.71
13	25460.00	216390.00	0.41	0.33	89794.16	70581.80
14	25941.00	236559.00	0.39	0.30	91741.66	70789.44
15	26222.09	263577.91	0.36	0.27	95532.76	72362.16
Total Net Present Value					738835.13	600015.73
Internal Rate of Return					56%	

Table 4.54. Economic viability of pear in Khellani

					Net Present value (₹) @	
Year	Cost (₹)	Net return (₹)	Discount Factor@7%	Discount Factor@9%	7% discount rate	9% discount rate
1	30657.08	-30657.08	0.93	0.92	-28651.48	-28125.76
2	23050.23	-23050.23	0.87	0.84	-20132.96	-19400.92
3	24563.05	-24563.05	0.82	0.77	-20050.77	-18967.18
4	25953.49	15626.51	0.76	0.71	11921.39	11070.21
5	26845.21	87499.79	0.71	0.65	62386.14	56868.86
6	27265.00	91735.00	0.67	0.60	61126.90	54698.58
7	27656.95	101843.05	0.62	0.55	63422.73	55711.64
8	27951.00	114149.00	0.58	0.50	66435.76	57287.53
9	28765.00	126285.00	0.54	0.46	68690.67	58145.12
10	29423.00	152577.00	0.51	0.42	77562.41	64450.17
11	29161.00	177759.00	0.48	0.39	84452.02	68887.45
12	29295.00	191205.00	0.44	0.36	84897.31	67980.02
13	30625.00	231875.00	0.41	0.33	96219.88	75632.67
14	30821.00	277179.00	0.39	0.30	107494.80	82944.84
15	31398.59	367076.41	0.36	0.27	133045.38	100776.44
Total Net Present Value					848820.19	687959.68
Internal Rate of Return					55%	

4.4.3 Economic analysis of walnut in two blocks

4.4.3.1 Economic Analysis

The information with respect to yearly costs involved in the establishment of walnut trees:

4.4.3.2 Cost of establishment

During the first year of the plantation, farmers had incurred expenditure various operations important for the establishment of the orchard. The first year establishment

costs for various operations for the first year in Bhaderwah block is presented in Table 4.54. The per hectare total costs incurred during first year for the establishment of walnut orchards were found to be ₹29402.13. Variable costs per hectare were found to be ₹18142.92 with highest cost incurred on planting material i.e., ₹5400 and the least cost incurred on fertilizers i.e., ₹270.00.

Table 4.55. Operation wise first year establishment cost of walnut in Doda district

		(₹/ha)
S. No	Item	Cost (in ₹)
		Bhaderwah
1	Land Preparation	4860.00
2	Digging, Filling and Planting	3780.00
3	Planting Material	5400.00
4	Manure	1512.00
5	Fertilizers	270.00
6	Plant protecting chemicals	378.00
7	Intercultural operations (hoeing, weeding etc)	324.00
8	Training	432.00
9	Interest on working capital	1186.92
	Total Variable Cost	18142.92
1	Depreciation	2329.55
2	Estimated rental value on owned land	8000.00
3	Interest on fixed capital	929.66
	Total Fixed Cost	11259.21
	Total Establishment cost (A+B)	29402.13

4.4.3.3 Operational costs

The per hectare operational and maintenance costs consists of yearly expenses on the maintenance of bearing orchard. The item wise and concept wise operational costs for walnut orchards in Bhaderwah block are presented in Table 4.55. The per hectare variable costs and fixed were found to be ₹17507.34 and ₹11259.21, respectively with a total of ₹28766.55 per hectare. The table further revealed that among

the working costs, the highest expenditures of ₹6480.00 per hectare were incurred on labour and lowest of ₹972.00 on intercultural operations.

Table 4.56. Item wise and concept wise operational cost of walnut in Doda district

		(₹/ha)
S. No.	Items	Cost (in ₹)
		Bhaderwah
1	Labour	6480.00
2	Intercultural operations (hoeing, weeding etc)	972.00
3	Training/Pruning	1350.00
4	Manure	4860.00
5	Fertilizers	1620.00
6	Plant protecting chemicals	1080.00
7	Interest on working capital	1145.34
	Total Variable Cost	17507.34
1	Depreciation	2329.55
2	Estimated rental value on owned land	8000.00
3	Interest on fixed capital	929.66
	Total Fixed Cost	11259.21
	Total Operational Cost	28766.55

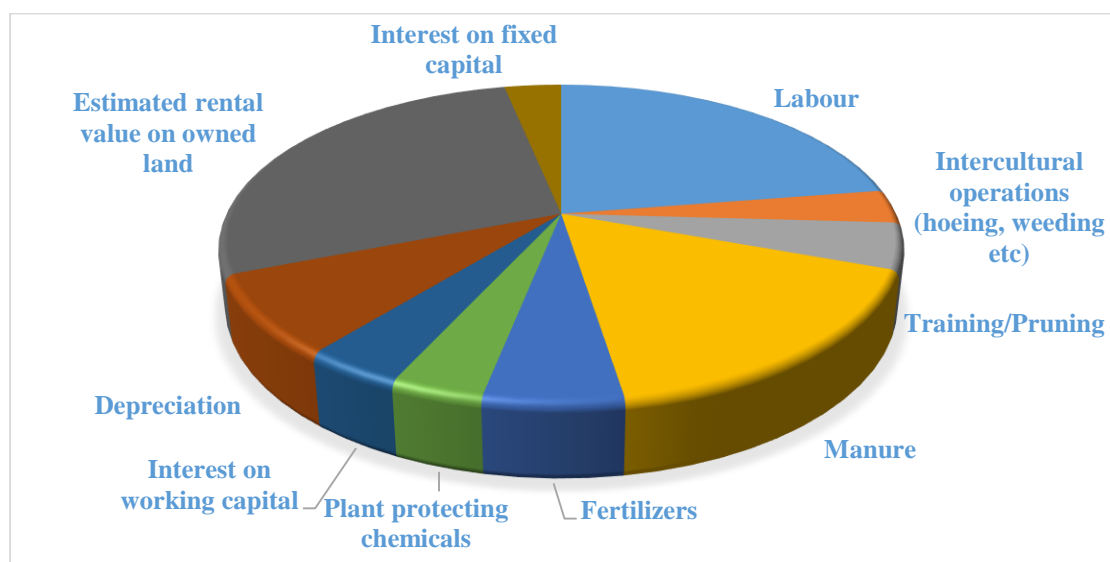


Fig 4.6 Item wise and concept wise operational cost of walnut in Doda district

4.4.3.4 Year wise cost and return analysis

The per hectare per year cost and returns from walnut trees worked out for different age groups are presented in Table 4.56. The returns start from 7th year of the establishment of the orchard with average production of 27.00 quintals per hectare during the year 6th to 10th which increases to 43.20 quintals per hectare from 15th year and onwards. As far as the net returns are concerned, it was found to be ₹220084.80 per hectare during initial phase of returns which increases to ₹360033.45 per hectare during 15th year of the establishment of the orchard and onwards. The benefit cost ratio of 1:10.60 was found during 10th year which increases to 1:13.52 during 15th year of the establishment of the orchard which proves the viability of the orchard.

Table 4.57. Year wise cost and return analysis of walnut in Doda district

(₹/ha)

S. No	Particulars	Block	Years							
			1	2	3	4	5	Average 6th to 10th Year	Average 11th to 14th Year	15th Year and onwards
1.	Total Cost (₹)	Bhaderwah	29402.13	16712.08	17325.25	19035.23	21243.21	22915.20	25952.44	28766.55
2.	Production (q)	Bhaderwah	0.00	0.00	0.00	0.00	0.00	27.00	35.10	43.20
3.	Gross Returns (₹)	Bhaderwah	0.00	0.00	0.00	0.00	0.00	243000.00	315900.00	388800.00
4.	Net Returns (₹)	Bhaderwah	-29402.13	-16712.08	-17325.25	-19035.23	-21243.21	220084.80	289947.56	360033.45
5.	B:C Ratio	Bhaderwah	0.00	0.00	0.00	0.00	0.00	1:10.60	1:12.17	1:13.52

4.4.3.5 Economic viability of walnut crop

Table 4.57 depicts the financial viability of walnut in Bhaderwah block. From the tables we found NPV of walnut was ₹1174339.89 and ₹956219.93 at discount factor of 7 per cent and 9 percent, respectively. The IRR for walnut was calculated highest among all fruit crops i.e., 58 per cent.

Table 4.58. Economic viability of walnut in Bhaderwah

Year	Cost (₹)	Net return (₹)	Discount Factor@7%	Discount Factor@9%	Net Present value (₹) @	
					7% discount rate	9% discount rate
1	29402.13	-29402.13	0.93	0.92	-27478.63	-26974.43
2	16712.08	-16712.08	0.87	0.84	-14596.98	-14066.22
3	17325.25	-17325.25	0.82	0.77	-14142.56	-13378.27
4	19035.23	-19035.23	0.76	0.71	-14521.89	-13485.04
5	21243.21	-21243.21	0.71	0.65	-15146.12	-13806.63
6	21956.00	149044.00	0.67	0.60	99314.31	88870.07
7	22356.50	202643.50	0.62	0.55	126196.19	110852.93
8	22661.00	238339.00	0.58	0.50	138715.47	119614.31
9	23651.50	246348.50	0.54	0.46	133997.26	113425.69
10	23951.00	264049.00	0.51	0.42	134229.12	111537.15
11	24551.25	264348.75	0.48	0.39	125590.19	102443.82
12	25856.26	290043.74	0.44	0.36	128782.89	103120.62
13	26533.13	299266.87	0.41	0.33	124185.11	97614.46
14	26869.12	306130.88	0.39	0.30	118722.83	91608.58
15	28766.55	360033.45	0.36	0.27	130492.69	98842.88
Total Net Present Value					1174339.89	956219.93
Internal Rate of Return					58%	

Economic viability of fruit crops in Doda district

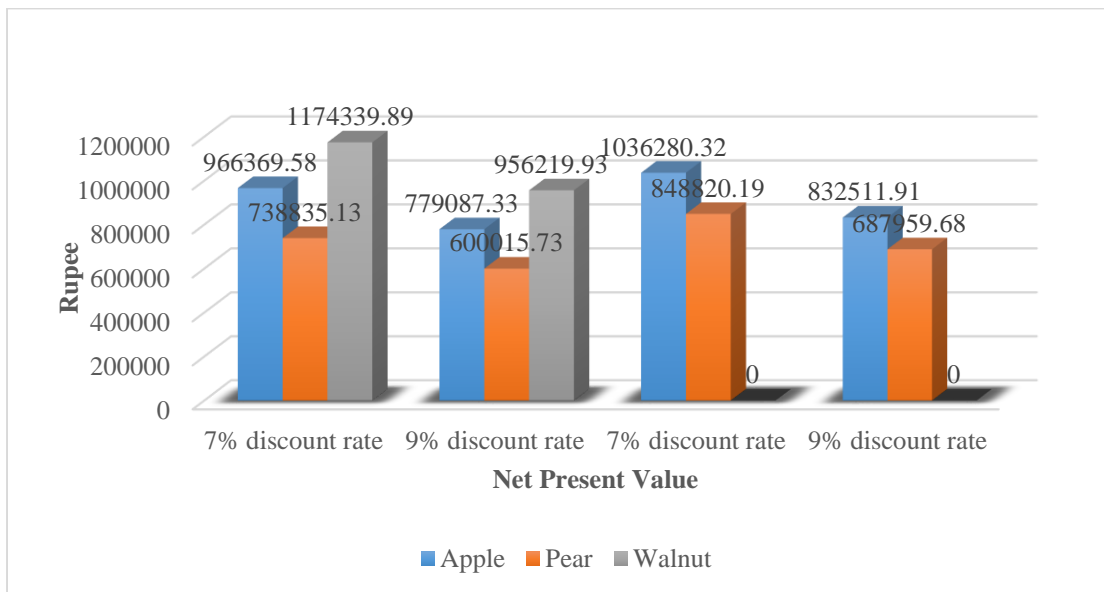


Fig 4.7 Net Present Value (NPV) of fruit crops in Doda district

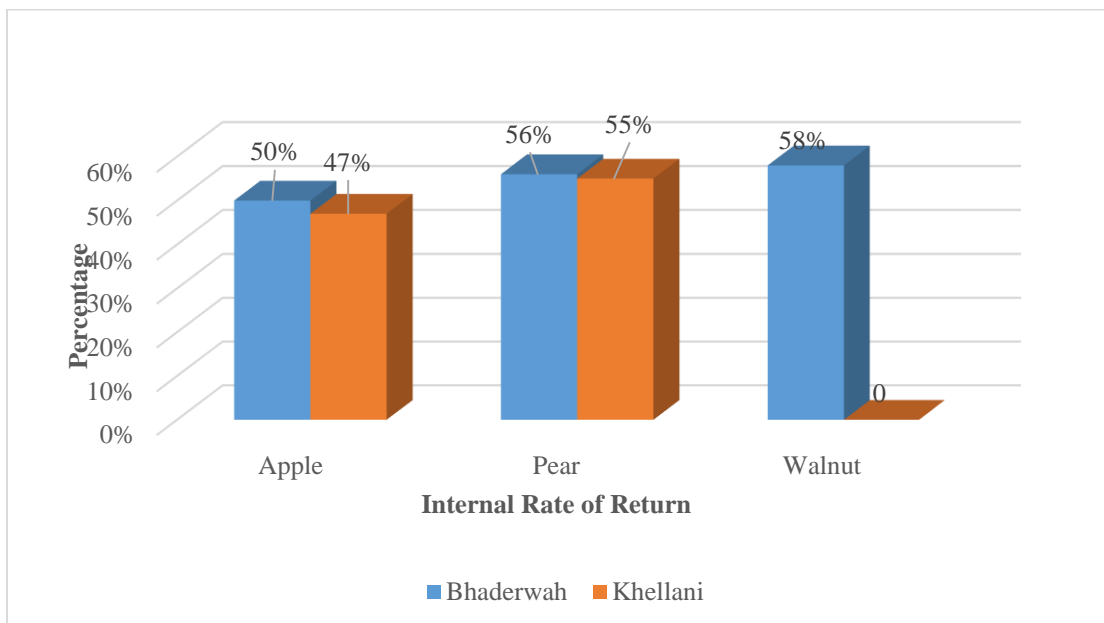


Fig 4.8 Internal Rate of Return (IRR) of fruit crops in Doda district

4.5 Income and employment generated from various crops

4.5.1 Labour-use pattern

Distinct farming practices have different potential for creating employment for different enterprises. To estimate annual labour employment, the period of labour performed in various activities was converted into human labour days. One human labour day was regarded to be eight hours of effort. Table 4.59 shows the number of mandays created by various crops. On a per hectare basis, rice crop used the most labour (30.00, 27.00, 28.50, 27.80 in R.S. Pura, Nagrota, Bhaderwah, and Khellani, respectively). Among the vegetables, Knol khol employed the most man days per acre. Among the fodder crops on per hectare basis, maximum labour was utilized in oats crop followed by berseem crop. Whereas, in livestock highest overall average man days i.e., 39.25 were employed in desi cow from four blocks.

Table 4.59. Labour generation under different crops in Jammu region

S. No.	Particular	R.S.Pura		Nagrota		Bhaderwah		Khellani	
		Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour
I	Cereals	(Mandays/ha)							
i)	Rice	7.50	22.50	6.75	20.25	17.10	11.40	16.68	11.12
ii)	Wheat	1.00	4.00	3.94	9.19	-	-	-	-
iii)	Maize	-	-	3.27	9.80	9.70	2.43	10.20	2.55
2	Fodder crops	(Mandays/ha)							
i)	Berseem	1.60	6.40	-	-	-	-	-	-
ii)	Oats	-	-	-	-	7.13	1.78	6.72	1.68
3	Vegetables	(Mandays/acre)							
vi)	Potato	-	-	-	-	12.32	0.00	11.44	0.00
vii)	Knol Khol	-	-	-	-	20.00	0.00	22.00	0.00
viii)	Onion	-	-	-	-	14.56	6.24	15.40	6.60
ix)	Garlic	-	-	-	-	14.28	6.12	15.40	6.60
4	Livestock	(Mandays/animal/annum)							
i)	Desi cow	28.87	7.21	31.18	7.79	35.62	8.90	29.93	7.48
ii)	Crossbred cow	30.55	7.64	26.80	6.70	34.10	8.52	33.88	8.47
iii)	Buffalo	24.96	6.24	27.48	6.87	-	-	-	-

4.5.1.1 Labour use pattern under different farm enterprises

Labour was utilised in cereals, vegetables, and fodder crops for land preparation and sowing, manures and fertilisers, transplanting in paddy, intercultural activities (weeding, hoeing, etc.), irrigation, chemical spray, harvesting/picking, and winnowing, including other things. Table 4.60 shows the per hectare labour used for cereal and fodder crops, as well as the per acre labour used for vegetable crops, in the research region. In the R.S. Pura block, the most labour was employed in paddy (30 mandays/ha), followed by berseem (8 mandays/ha) and wheat (5 mandays/ha), but in the Nagrota block, the most labour was employed in rice (27 mandays/ha), wheat (13.13 mandays/ha), and maize (13.07 mandays/ha) in the Jammu district. Furthermore, in Bhaderwah and Khellani, rice required approximately 28.50 and 27.80 man days/ha, maize required 12.13 and 12.75 mandays/ha, and oats required 8.91 and 8.40 mandays/ha, respectively, on a per hectare basis, whereas vegetable crops required intensive cultural operations beginning with sowing. The labour engaged in potato was 12.32 mandays/acre and 11.44 mandays/acre from Bhaderwah and Khellani blocks, respectively, whereas in knol khol it was 20 mandays and 22 mandays per acre, respectively, in onion it was 20.80 mandays and 22 mandays, and in garlic it was 20.40 mandays and 22 mandays from Bhaderwah and Khellani blocks, respectively.

Table 4.60. Operation wise labour use pattern of different crop in Jammu region

S. No.	Particulars	R.S.Pura		Nagrota		Bhaderwah		Khellani	
		Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour
I	Paddy	(Mandays/ha)							
1.	Land preparation	1.00	2.00	0.75	2.00	3.00	1.00	2.50	1.00
2.	Nursery raising	0.50	1.00	0.50	0.50	1.00	0.00	1.00	0.00
3.	Transplanting	2.00	4.50	1.00	5.00	4.10	3.40	4.00	3.12
4.	Fertilizer application	0.50	1.00	0.50	0.50	2.00	1.00	2.00	1.00
5.	Irrigation	1.00	1.00	0.50	1.25	0.00	0.00	0.00	0.00
6.	Plant protection operations	0.50	2.00	0.50	1.00	1.00	1.00	1.00	1.00
7.	Harvesting	1.00	7.00	2.00	6.00	4.00	3.00	4.00	3.00
8.	Threshing, Winnowing	1.00	4.00	1.00	4.00	2.00	2.00	2.18	2.00
	Total	7.50	22.50	6.75	20.25	17.10	11.40	16.68	11.12
II	Wheat	(Mandays/ha)							
1.	Land preparation	0.00	0.50	0.50	0.50	-	-	-	-
2.	Seed sowing	0.50	0.50	0.50	1.00	-	-	-	-
3.	Fertilizer application	0.00	1.00	0.25	0.25	-	-	-	-
4.	Irrigation	0.50	0.00	0.00	0.50	-	-	-	-
5.	Plant protection operations	0.00	1.00	0.50	0.50	-	-	-	-
6.	Harvesting	0.00	0.50	1.19	4.44	-	-	-	-
7.	Threshing, Winnowing	0.00	0.50	1.00	2.00	-	-	-	-
	Total	1.00	4.00	3.94	9.19	-	-	-	-
III	Maize	(Mandays/ha)							
1.	Land preparation	-	-	1.00	1.00	0.70	1.00	0.70	1.00
2.	Seed sowing	-	-	0.77	1.00	2.00	0.25	2.00	0.25
3.	Fertilizer application	-	-	0.50	1.00	0.50	0	0.50	0.11

4.	Plant protection operations	-	-	0.00	0.00	2.50	0.00	2.00	0.19
5.	Harvesting	-	-	1.00	6.80	4.00	1.18	5.00	1.00
	Total	-	-	3.27	9.80	9.70	2.43	10.20	2.55
IV	Berseem	(Mandays/ha)							
1.	Land preparation	0.50	1.00	-	-	-	-	-	-
2.	Seed sowing	0.50	0.50	-	-	-	-	-	-
3.	Fertilizer application	0.00	0.50	-	-	-	-	-	-
4.	Irrigation	0.60	0.40	-	-	-	-	-	-
5.	Plant protection operations	0.00	0.00	-	-	-	-	-	-
6.	Harvesting	0.00	4.00	-	-	-	-	-	-
	Total	1.60	6.40	-	-	-	-	-	-
V	Oats	(Mandays/ha)							
1.	Land preparation	-	-	-	-	1.00	0.50	1.00	0.68
2.	Seed sowing	-	-	-	-	1.13	0.00	1.00	0.00
3.	Fertilizer application	-	-	-	-	1.00	0.00	0.72	0.00
4.	Harvesting	-	-	-	-	4.00	1.28	4.00	1.00
	Total	-	-	-	-	7.13	1.78	6.72	1.68
VI	Potato	(Manday/acre)							
1.	Land preparation	-	-	-	-	3.00	0.00	2.50	0.00
2.	Seed sowing	-	-	-	-	3.00	0.00	2.00	0.00
3.	Fertilizer application	-	-	-	-	1.32	0.00	1.50	0.00
4.	Irrigation	-	-	-	-	0.00	0.00	1.00	0.00
5.	Harvesting	-	-	-	-	5.00	0.00	4.44	0.00
	Total	-	-	-	-	12.32	0.00	11.44	0.00
VII	Knol-khol	(Mandays/acre)							

1.	Land preparation	-	-	-	-	3.00	0.00	3.00	0.00
2.	Nursery raising	-	-	-	-	2.00	0.00	2.00	0.00
3.	Seedling sowing	-	-	-	-	4.00	0.00	4.00	0.00
4.	Fertilizer application	-	-	-	-	0.00	0.00	0.00	0.00
5.	Irrigation	-	-	-	-	3.00	0.00	4.00	0.00
6.	Plant protection operations	-	-	-	-	0.00	0.00	0.00	0.00
7.	Harvesting	-	-	-	-	8.00	0.00	9.00	0.00
	Total	-	-	-	-	20.00	0.00	22.00	0.00
VIII	Onion								(Mandays/acre)
1.	Land preparation	-	-	-	-	3.00	0.24	3.00	1.00
2.	Nursery raising	-	-	-	-	1.00	0.00	1.90	0.00
3.	Seeding sowing	-	-	-	-	2.50	3.00	2.50	3.00
4.	Fertilizer application	-	-	-	-	1.00	0.00	1.00	0.00
5.	Irrigation	-	-	-	-	1.00	0.00	1.00	0.00
6.	Plant protection operations	-	-	-	-	0.00	0.00	0.00	0.00
7.	Harvesting	-	-	-	-	6.06	3.00	6.00	2.60
	Total	-	-	-	-	14.56	6.24	15.40	6.60
IX	Garlic								(Mandays/acre)
1.	Land preparation	-	-	-	-	3.00	1.00	3.00	1.00
2.	Seed sowing	-	-	-	-	3.00	1.12	3.40	1.00
3.	Fertilizer application	-	-	-	-	2.00	0.00	2.00	0.00
4.	Irrigation	-	-	-	-	1.00	0.00	1.00	0.00
5.	Plant protection operations	-	-	-	-	0.00	0.00	0.00	0.00
6.	Harvesting	-	-	-	-	5.28	4.00	6.00	4.60
	Total	-	-	-	-	14.28	6.12	15.40	6.60

In the case of livestock rearing, dairying allows farmers to profitably use a higher supply of labour. To estimate yearly labour employment, the period of labour engaged in various dairying-related activities was converted into human labour days. Table 4.61 shows the distribution of labour in various activities in livestock husbandry among the different blocks. The comparison across all blocks revealed that the total annual labour employed for dairying was higher for desi cows, with an overall average of 39.25 man days/local cow whereas 39.17 man days/cross-bred cow and 34.34 man days/buffalo, respectively, representing the highest proportion of total annual labour engaged in cleaning of dung and its disposal.

Table 4.61. Operation-wise labour use pattern in livestock

S. No.	Particulars	R.S.Pura		Nagrota		Bhaderwah		Khellani	
		Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour	Family Labour	Hired labour
I	Dairying (man days/animal/annum)								
1	Local cow								
i)	For cutting, collection and storage of fodder	5.00	0.00	6.00	0.00	5.00	2.00	2.00	1.00
ii)	Fodder fetching for daily use	1.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00
iii)	Preparation of feed	2.00	0.00	2.00	0.00	1.00	0.00	1.00	0.00
iv)	Feeding and watering	5.00	0.00	5.00	0.00	6.00	0.00	4.00	0.00
v)	Milking	6.00	0.00	6.00	0.00	6.00	0.00	6.00	0.00
vi)	Cleaning of dung and its disposal	2.00	7.00	3.00	6.79	3.00	5.90	2.00	5.48
vii)	Taking animals for grazing	0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00
viii)	Veterinary services	0.87	0.00	1.00	0.00	0.62	0.00	0.93	0.00
ix)	Marketing of milk	1.00	0.21	1.00	1.00	2.00	0.00	2.00	0.00
x)	Bathing, grooming and bedding	5.00	0.00	5.18	0.00	5.00	0.00	5.00	0.00
xi)	Any other (buying feed, etc.)	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
	Sub- total (man days)	28.87	7.21	31.18	7.79	35.62	8.90	29.93	7.48
2	Crossbred cow								
i)	For cutting, collection and storage of fodder	5.00	0.00	5.00	0.00	4.50	2.00	3.00	2.00
ii)	Fodder fetching for daily use	2.00	0.00	1.00	0.00	1.00	1.00	1.88	1.00

iii)	Preparation of feed	2.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
iv)	Feeding and watering	5.00	0.00	5.00	0.00	5.50	0.00	4.00	0.00
v)	Milking	6.00	0.00	5.00	0.00	5.50	0.00	6.00	0.00
vi)	Cleaning of dung and its disposal	2.55	7.00	2.00	6.70	3.00	5.52	3.00	5.47
vii)	Taking animals for grazing	0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00
viii)	Veterinary services	1.00	0.00	1.00	0.00	0.60	0.00	1.00	0.00
ix)	Marketing of milk	1.00	0.64	1.00	0.00	2.00	0.00	2.00	0.00
x)	Bathing, grooming and bedding	5.00	0.00	4.80	0.00	5.00	0.00	6.00	0.00
xi)	Any other (buying feed, etc.)	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
	Sub- total (man days)	30.55	7.64	26.80	6.70	34.10	8.52	33.88	8.47
3	Buffalo								
i)	For cutting, collection and storage of fodder	4.00	0.00	4.00	0.00	-	-	-	-
ii)	Fodder fetching for daily use	1.00	0.00	1.00	0.00	-	-	-	-
iii)	Preparation of feed	1.00	0.00	1.00	0.00	-	-	-	-
iv)	Feeding and watering	4.00	0.00	5.00	0.00	-	-	-	-
v)	Milking	6.00	0.00	5.00	0.00	-	-	-	-
vi)	Cleaning of dung and its disposal	2.96	6.24	2.00	6.87	-	-	-	-
vii)	Taking animals for grazing	0.00	0.00	2.00	0.00	-	-	-	-
viii)	Veterinary services	1.00	0.00	1.00	0.00	-	-	-	-
ix)	Marketing of milk	1.00	0.00	1.00	0.00	-	-	-	-
x)	Bathing, grooming and bedding	4.00	0.00	4.48	0.00	-	-	-	-
xi)	Any other (buying feed, etc.)	0.00	0.00	1.00	0.00	-	-	-	-
	Sub- total (man days)	24.96	6.24	27.48	6.87	-	-	-	-

4.5.2 Income generation from different crops in Jammu region

Table 4.62 shows the income level generated by various cereal and fodder crops grown by the farmers in sampled area, whereas table 4.63 and Table 4.64 depicts the income level generated from vegetable crops, fruit crops and livestock, respectively. The tables revealed that the income generation was more in vegetable and fruit crops as compared to cereal and fodder crops. So, vegetable and fruit crops are more beneficial than cereal crops.

Table 4.62. Income generated from cereal and fodder crops

S. No.	Particular	Block			
		R.S.Pura	Nagrota	Bhaderwah	Khellani
	RICE				
1	Family labour income	96004.69	76879.07	72574.61	69982.15
2	Farm business income	97328.42	78022.38	73504.27	71105.28
	WHEAT				
1	Family labour income	38771.31	34929.99	-	-
2	Farm business income	40095.04	36073.30	-	-
	BERSEEM				
1	Family labour income	31821.69	-	-	-
2	Farm business income	33145.42	-	-	-
	MAIZE				
1	Family labour income	-	32791.16	33779.79	26714.69
2	Farm business income	-	33934.47	34709.45	27837.82
	OATS				
1	Family labour income	-		28675.57	26781.91
2	Farm business income	-		29605.23	27905.04

Table 4.63. Income generated from vegetables crops**(₹/acre)**

S. No.	Particulars	Block	
		Bhaderwah	Khellani
	POTATO		
1	Family labour income	66993.43	74754.13
2	Farm business income	67923.09	75877.26
	KNOL KHOL		
1	Family labour income	50173.97	62228.9
2	Farm business income	51103.63	63352.03
	ONION		
1	Family labour income	166174.87	168504.77
2	Farm business income	167104.53	169627.90
	GARLIC		
1	Family labour income	359373.91	388939.49
2	Farm business income	360303.57	390062.62

Table 4.64. Income generated from fruit crops**(₹/ha)**

S. No.	Particulars	Block	
		Bhaderwah	Khellani
	APPLE		
1	Family labour income	359298.71	435226.45
2	Farm business income	11259.21	448828.80
	PEAR		
1	Family labour income	263577.91	367076.41
2	Farm business income	274837.12	380678.76
	WALNUT		
1	Family labour income	360033.45	-
2	Farm business income	371292.66	-

4.6 Optimum enterprise combination with existing pattern

The optimal resource allocation has been expressed by considering the land allocation, cash outlay and labour requirements as the parameters for crops whereas number of animals, cash outlay and labour requirements as the parameters for livestock.

4.6.1 Linear programming optimisation in crops

The linear programming output summary for crops cultivated in different blocks is shown in Table 4.65. In R.S. Pura blocks, there was a need to reduce the land allotment for paddy from 13.90 hectare to 4.58 hectare and for wheat from 10.15 hectare to 6.27 hectare whereas enhanced in berseem from 3.75 hectare to 16.96 hectare. Cash outlay showed to be reduced from existing levels in paddy to ₹29039.32 whereas needed to increase in berseem to ₹48363.4. Wheat crop shows optimum allocation of cash expenditure. Labour requirement in R.S. Pura should be reduced for paddy to 18.54 mandays per hectare whereas need to increase in wheat and berseem to 8.49 mandays per hectare and 15.97 per hectare, respectively. In Nagrota block, there was a need to reduce land allotment for wheat and maize crops to 8.03 hectare and 8.03 hectare, respectively but needed increase in area for paddy crop from their existing levels i.e., 27.50 hectares. The cash outlay in paddy (₹31357.44) and wheat (₹33739.85) i.e., lowered but should be increased in maize (₹37804.52). The labour required for various operations in cultivation needed to be reduced in paddy (25.38 mandays per hectare) whereas there was not much difference in existing and optimum plans in wheat and maize, respectively. Bhaderwah blocks revealed that there should be reduction of land allotment in maize (9.02 hectare) and oats (9.02 hectare) whereas increase for paddy (12.47 hectare). Per hectare cost of cultivation should be enhanced in all the three crops viz., rice (₹44573.94), maize (₹30476.34) and oats (₹30672.04) in proposed plan whereas the labour requirement should be increased in maize and oats to 13.78 mandays per hectare and 9.20 mandays per hectare, respectively but in paddy crop it should be reduced to 26.57 mandays per hectare. In Khellani block, land allotment and cash expenditure needed to be enhanced in paddy crop i.e., 24.68 hectare and ₹45375.26, respectively from their current level but the labour required reduced from existing plan to 25.54 mandays per hectare. In case of maize the land allotted should be reduced to 8.91 hectare whereas cash outlay and labour required for cultivation are utilized in optimum levels in existing plan. In oats, land requirement should be lowered from 18.00 hectare to 8.91 hectare whereas cash outlay for various activities should be enhanced

to ₹26766.25, but the labour required showed not much difference in proposed and existing levels.

Table 4.65 also shows a summary of the linear programming output for the vegetable crops grown in the Doda district. It was found that the land allocated to potato (0.28 acre), knol-khol (0.44 acre), onion (0.23 acre) and garlic (0.17 acre) should be reduced in their optimum plan in Bhaderwah, i.e., 0.18 acre, 0.21 acre, 0.19 acre and 0.14 acre, respectively, whereas the cash outlay should be reduced only in potato to ₹50574.20 and in other three vegetable crops it needed enhancement. The labour requirement in mandays per acre should be tuned to 15.32, 20.33, 21.20 and 17.58 in potato, knol-khol, onion and garlic, respectively. On the one hand, in Khellani block, the present land allotment shown in potato and knol-khol should be lowered to 0.19 acre and 0.30 acre, respectively, whereas it needed enhancement in onion and garlic crop to 0.39 acre and 0.29 acre, respectively. The cash outlay should be increased to ₹50368.31 in garlic and reduced in all other three vegetable crops in optimal plan i.e., potato (₹53271.06), knol-khol (₹34826.98) and onion (₹34628388). The variations in labour requirements between the present and suggested patterns were not as pronounced in the case of knol khol. In the case of potato an increase to 16.50 mandays per acre should be proposed in the optimum plan. Labour requirements in onion were found in the existing (22.00 mandays per acre) and proposed (17.82 mandays per acre) levels, which is a decrease from the existing level, whereas the labour requirement should be 14.49 mandays per acre in proposed plan in garlic, which is a decrease from the current level.

Table 4.65. Linear programming output summary for different crops

S.No	Crop	Parameter	Unit	Paddy	Wheat	Berseem
1.	R.S.Pura					
	Land allocation	Proposed	Ha	4.58	6.27	16.96
		Existing	Ha	13.90	10.15	3.75
	Cash outlay	Proposed	₹/ha	29039.32	37039.59	48363.4
		Existing	₹/ha	47995.31	37628.69	28818.31
	Labour requirement	Proposed	mandays/ha	18.54	8.49	15.97
		Existing	mandays/ha	30.00	5.00	8.00
2.	Nagrota			Rice	Wheat	Maize
	Land allocation	Proposed	Ha	27.50	8.03	8.03
		Existing	Ha	5.55	19.01	19.01
	Cash outlay	Proposed	₹/ha	31357.44	33739.85	37804.52
		Existing	₹/ha	41740.93	33845.00	27315.83
	Labour requirement	Proposed	mandays/ha	25.38	13.36	14.45
		Existing	mandays/ha	27.00	13.13	13.07
3.	Bhaderwah			Rice	Maize	Oats
	Land allocation	Proposed	Ha	12.47	9.02	9.02
		Existing	Ha	8.10	11.20	11.20
	Cash outlay	Proposed	₹/ha	44573.94	30476.34	30672.04
		Existing	₹/ha	36055.39	23350.21	20175.86
	Labour requirement	Proposed	mandays/ha	26.57	13.78	9.20
		Existing	mandays/ha	28.50	12.13	8.91

4.	Khellani			Rice	Maize	Oats	
	Land allocation	Proposed	ha	24.68	8.91	8.91	
		Existing	ha	6.50	18.00	18.00	
	Cash outlay	Proposed	₹/ha	45375.26	26991.11	26766.25	
		Existing	₹/ha	35430.35	26365.31	23106.09	
	Labour requirement	Proposed	mandays/ha	25.54	13.48	10.01	
		Existing	mandays/ha	27.88	12.75	8.40	
Vegetables							
1.	Bhaderwah			Potato	Knol-khol	Onion	Garlic
	Land allocation	Proposed	acre	0.18	0.21	0.19	0.14
		Existing	acre	0.28	0.44	0.23	0.17
	Cash outlay	Proposed	₹/acre	50574.20	39195.83	39449.81	53501.42
		Existing	₹/acre	57534.57	37826.03	31649.13	46338.09
	Labour requirement	Proposed	mandays/acre	15.32	20.33	21.20	17.58
		Existing	mandays/acre	12.32	17.78	18.49	18.13
2.	Khellani			Potato	Knol-khol	Onion	Garlic
	Land allocation	Proposed	acre	0.19	0.30	0.39	0.29
		Existing	acre	0.26	0.31	0.11	0.08
	Cash outlay	Proposed	₹/acre	53271.06	34826.98	34628.88	50368.31
		Existing	₹/acre	54621.87	42571.10	36055.23	49220.51
	Labour requirement	Proposed	mandays/acre	16.50	18.48	17.82	14.49
		Existing	mandays/acre	11.44	19.56	22.00	22.00

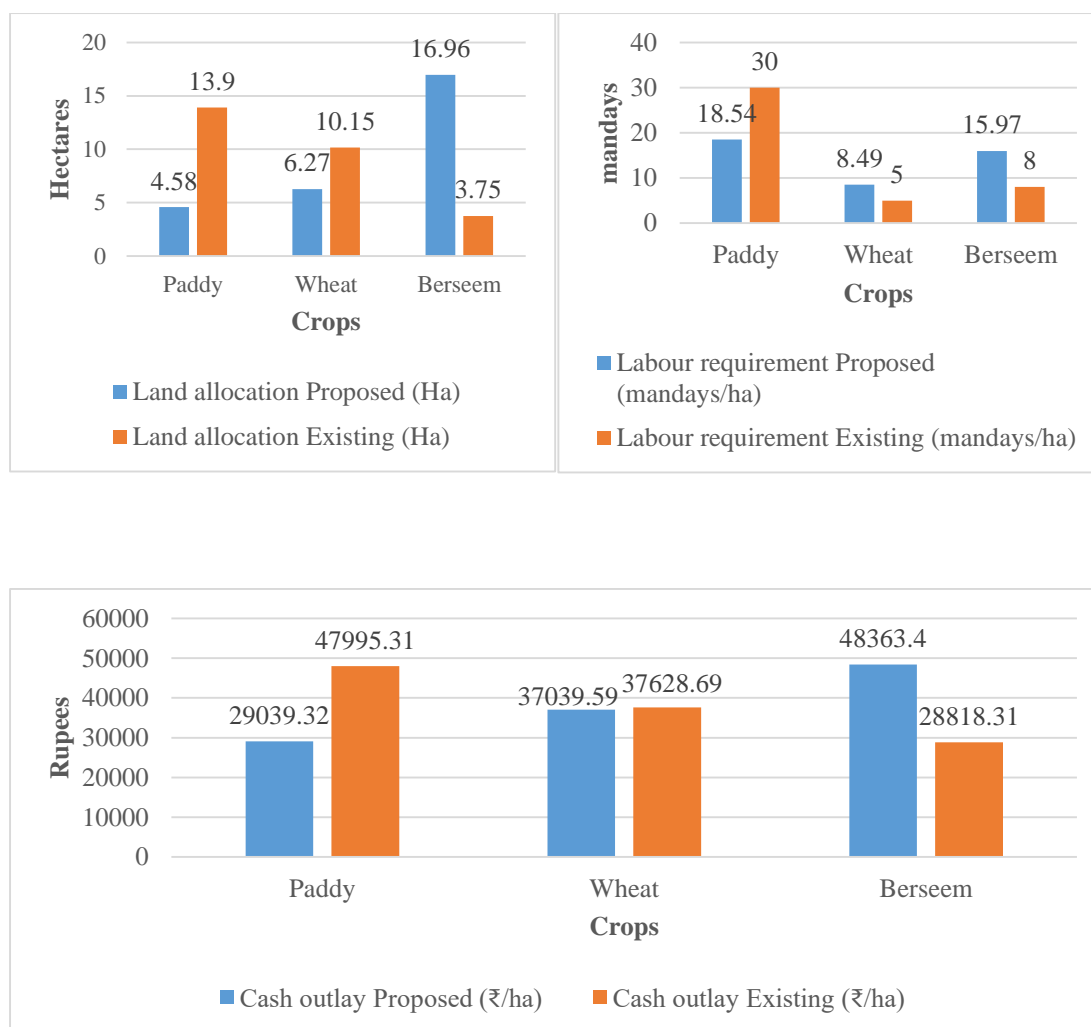


Fig. 4.9 Linear programming output summary for crops grown in R.S. Pura block

4.6.2 Linear programming optimisation in livestock

The linear programming output summary for livestock is shown in Table 4.66. Three categories of livestock were considered in the livestock enterprise: desi cows, crossbred cows, and buffalo. In Jammu district all the three categories of livestock were found whereas in Doda district two categories of livestock were found. In R.S. Pura block, there should be need of increase in number of livestock from their existing level to 22.36 (desi cows), 28.45 (crossbred cows and 61.00 (buffalo) whereas the cash expenditure should be decreased to ₹49436.00, ₹46765.91 and ₹37607.41 in desi cow, crossbred cow and buffalo, respectively in suggested plan. The labour requirement should be decreased in case of crossbred cows (35.38 mandays/animal/annum) and buffalo (25.56 mandays/animal/annum) whereas there was not very difference between proposed and existing plan in labour for desi cows. In Nagrota block, the number for desi cows and crossbred cows suggested to increase (19.56 and 50.44, respectively)

whereas should be reduced in case of buffalo to 68.00. The cash outlay should be reduced from ₹51391.05 and ₹43037.24 in desi cows and buffalo, respectively whereas should be increased to ₹53001.40 in crossbred cows. As the labour is concerned there was hike in crossbred cows i.e., 40.32 mandays/animal/annum whereas it must be reduced in desi cows and buffalo i.e., 34.91 mandays/animal/day and 23.21 mandays/animal/day, respectively. In Bhaderwah block, two categories of livestock were found. In desi cows, number of animals, cash outlay and labour requirement should be decreased from 23.00, ₹51142.12 and 39.57 mandays/animal/year to 18.61, ₹50577.26 and 34.38 mandays/animal/year, respectively. In case of crossbred cows, the number of animals and cash expenditure should be increased to 25.56 and ₹51109.69, respectively but there was reduction in labour requirement from 37.89 mandays/animal/year to 35.65 mandays/animal/year, respectively. In Khellani block, number of animals should be decreased to 16.14 whereas cash outlay and labour require should be enhanced to ₹53164.09 and 40.90 mandays/animal/year, respectively in case of desi cows. In case of crossbred cows, number of animals should be decreased to 23.86 whereas cash outlay and labour requirement should be reduced to ₹49480.34 and 35.88 mandays/animal/year, respectively.

Table 4.66. Linear programming optimization in livestock

S. No	Livestock	Parameter	Unit	Desi cows	Crossbred cows	Buffalo
1.	R.S.Pura					
	Number	Proposed	No.	17.36	33.45	61.00
		Existing	No.	14.00	25.00	45.00
	Cash outlay	Proposed	₹/animal/year	49436.00	46765.91	37607.41
		Existing	₹/animal/year	52322.77	53535.61	45556.11
	Labour	Proposed	mandays/animal/year	37.70	35.38	25.56
		Existing	mandays/animal/year	36.08	38.18	31.20
2.	Nagrota					
	Number	Proposed	No.	19.56	50.44	68.00
		Existing	No.	16.00	47.00	75.00
	Cash outlay	Proposed	₹/animal/year	50332.28	53001.40	39808.50
		Existing	₹/animal/year	51391.05	47237.27	43037.24
	Labour	Proposed	mandays/animal/year	34.91	40.32	23.21
		Existing	mandays/animal/year	38.97	33.50	34.34
3.	Bhaderwah			Desi cows	Crossbred cows	
	Number	Proposed	No.	18.61	25.56	
		Existing	No.	23.00	20.00	
	Cash outlay	Proposed	₹/animal/year	50577.26	51109.69	
		Existing	₹/animal/year	51142.12	48985.65	
	Labour	Proposed	mandays/animal/year	34.38	35.65	
		Existing	mandays/animal/year	39.57	37.89	
4.	Khellani			Desi cows	Crossbred cows	
	Number	Proposed	No.	16.14	23.86	
		Existing	No.	19.00	21.00	
	Cash outlay	Proposed	₹/animal/year	53164.09	49480.34	
		Existing	₹/animal/year	48653.68	50598.72	
	Labour	Proposed	mandays/animal/year	40.90	35.88	
		Existing	mandays/animal/year	33.26	37.65	

4.7 Identification of constraints experienced by the sampled farmers in adoption of enterprises

A number of constraints were found to influence the returns in the study area. In this section an attempt has been made to identify the various problems faced by the farmers in different blocks under study, on the basis of opinion survey. The survey was analysed by using Garrett's ranking technique to identify the problems faced by the farmers under different blocks. The constraints encountered by the respondents and the findings regarding these constraints have been presented in the Table 4.67.

It can be seen from the table that in case of problems related to R.S.Pura block, lack of information about managing multiple enterprises was the most severe problem in crops and shortage of fodder in livestock with an average Garrett score 71.31 and 58.80, respectively. In Nagrota block, lack of irrigation/shortage of irrigation was the severe constraint related to cropping whereas lack of veterinary facilities was most severe problem related to livestock having a Garrett scores 75.60 and 60.75, respectively. It can be observed from the table that in case of Bhaderwah block the main constraint found out to be unavailability of time labour with a Garrett score of 68.38 in crops and in livestock the lack of veterinary facilities was the prominent one with average Garrett score of 57.28. Further, in case of Khellani block, costly labour (80.25) followed by lack of technical know-how (64.00) was the major problems in crops whereas unavailability of improved breeds of livestock (57.80) in livestock.

Table 4.67. Constraints in adoption of enterprises

S.No.	Particulars	R.S.Pura		Nagrota		Bhaderwah		Khellani	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank
1	Crops								
i)	Lack of technical know how	61.68	3	62.58	3	60.08	3	64.00	2
ii)	Lack of knowledge about proper utilization of resources	68.60	2	61.90	4	50.21	7	44.10	7
iii)	Lack of information about managing multiple enterprises	71.31	1	69.82	2	52.93	6	53.03	6
iv)	Non-availability of good quality seeds	47.70	7	40.83	6	57.78	5	53.30	5
v)	Costly labour	58.28	5	40.28	7	62.10	2	80.25	1
vi)	Unavailability of timely labour	60.60	4	57.78	5	68.38	1	58.45	3
vii)	Lack of irrigation/shortage of irrigation	57.75	6	75.60	1	58.10	4	57.40	4
2	Livestock								
i)	Lack of veterinary facilities	55.71	2	60.75	1	57.28	1	57.70	2
ii)	Improved breeds of livestock not available	51.70	3	53.75	3	55.75	2	57.80	1
iii)	Shortage of fodder	58.80	1	54.80	2	55.18	3	56.80	3

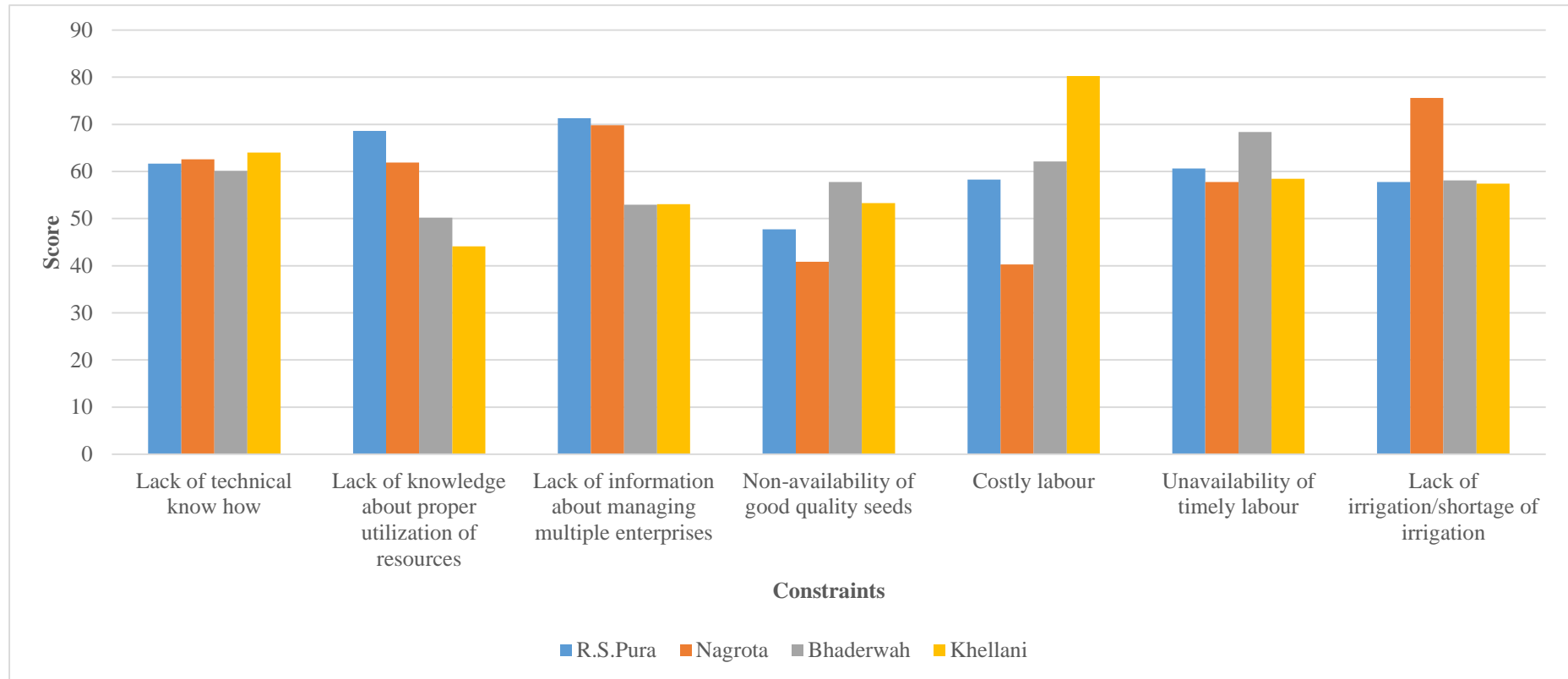


Fig.10 Constraints experienced by farmers in adoption of different enterprises



Plate 1: Picture with the sampled farmers during survey

Discussion

The in-depth analysis of results obtained during the present investigation entitled “**An investigation of optimum and profitable combination of crop-livestock enterprise in Jammu region of UT of J&K**” in preceding chapters have been discussed under the following categories

- 5.1 Socio-economic status and resource structure of the sampled farmers in Jammu region
- 5.2 Economics of production of Cereals, fodder and vegetable crops
- 5.3 Cost and return of livestock enterprises
- 5.4 Economic analysis and economic viability of fruit crops found in sampled area
- 5.5 Income and employment generated from various enterprises
- 5.6 Optimum enterprise combination with existing pattern
- 5.7 Identification of constraints experienced by the sampled farmers in adoption of various enterprises

5.1 Socio-economic status and resource structure of the sampled farmers in Jammu region

Mean age, family size and land holding was worked out to be 54.45 years, 5.58 numbers, and 0.72 hectare, respectively. 65.83 per cent were literates and 34.17 were illiterate in the study area. From the results, it is seen that most of the population engaged in agricultural activities were middle aged. The findings are in close proximity with the findings of Nejadrezaei et al., (2018), who found in his study that most of the sampled farmers engaged in agriculture and allied activities belonged to the middle aged group. Whereas, land holding was less than the average land holding of the Union Territory. Maximum i.e., 39.17 per cent respondents were engaged in the agriculture only followed by 28.33 per cent in agriculture with government jobs and the least (15.00 per cent) in agriculture & private job. Engaged as a casual labourer, working in shops and industrial units were considered in private jobs. As shown above, the percentage of overall farmers engaged in agriculture only was 39.17 per cent because most of the sampled farmers were dependent on agriculture in the study area. The findings of Peer et al., (2014), who found that the primary occupation of the farmers was agriculture are in close proximity with our findings. and it was due to the fact that they were not able

to enhance their income from the agriculture only. The different types of implements used in farm operations were enlisted and maximum i.e., 40 per cent amount was spent on purchase of tractor in Jammu district and 45 per cent for power tiller in Doda district. The power tillers were mostly used in Doda district due to the hilly terrain and friendly operation by power tiller.

The irrigational status of sampled farms under study showed that out of four blocks under study, R.S.Pura block had complete irrigated land i.e., 13.90 hectare and the minimum irrigated land was found in case of Nagrota block (5.55 hectare). The irrigated area and unirrigated area was revealed to be of 38.95 percent and 61.05, respectively.

5.2 Economics of production of Cereals, fodder and vegetable crops

Both irrigated and unirrigated area were taken into study. The Jammu division was taken as the sampled area. To make a decision about selection of an enterprise different factors of production was determined.

5.2.1 Economics of paddy crop in Jammu region

Descriptive statistics of quantitative variables of paddy crop has already been discussed in Table 4.5. Despite the fact that the investigation was conducted in several locales, rice was located to be grown in practically all of them. Because rice is one of the most important staple cereal crops in Jammu division, its cultivation has traditionally been encouraged. In addition to this, when compared to wheat and maize crops, the cost-benefit ratio of paddy was shown to be more profitable and remunerative with an overall average value of 2.76. The R.S.Pura block had the greatest net returns, accounting for 31.40 percent of the total from all blocks. It is due to the fact that the variety grown in this region was Basmati-370 and also due to availability of market facilities, followed by Nagrota block (25.04 per cent), Bhaderwah (22.19 per cent) and the least was found in case of Khellani (21.37 per cent) to the total net returns from both the districts, respectively.

5.2.2 Economics of wheat crop in Jammu district

Wheat was grown only in R.S.Pura and Nagrota block of the Jammu district. In comparison to Nagrota block, the total cost of R.S.Pura block was found to be higher. During the study, it was discovered that the farmers in R.S.Pura block were growing wheat variety HD-2967 and purchasing seeds from private businesses at the rate of ₹22

per kg, which increased their cost of cultivation. In addition, the cost incurred on machine labour (₹9000 per hectare) was high in R.S.Pura block because most of the farmers of this block hired combine for harvesting and threshing operations, whereas farmers of Nagrota block done their harvesting manually. Furthermore, the gross returns were higher in the R.S.Pura block than in the Nagrota block of the Jammu district because the R.S.Pura block was fully irrigated, allowing timely irrigation for the crop. In the instance of R.S.Pura, market facilities were also significant, and the farmer received relatively higher returns than in the Nagrota block. Cost-benefit ratio was also found to be high in case of R.S.Pura (1:2.02) viz-a-viz to that of Nagrota block (1:1.99).

The study carried out by Meshram *et al* (2018) in Wardha district was found out to be in close proximity of our study.

5.2.3 Economics of maize crop in Jammu region

The maize crop was found grown among farmers of three blocks viz., Nagrota, Bhaderwah and Khellani of the study area excluding the fourth block R.S.Pura where the water table is high that may affects the cultivation of maize during rainy season in that area. The economics of the maize crop (Table 4.16) revealed that per hectare highest cost ₹27315.83 was found in Nagrota block of Jammu district whereas lowest (₹23350.21) was found in Bhaderwah block of Doda district. The entire average total cost per hectare was ₹25677.12. Because of the greater availability of inputs, the Nagrota block had the highest total cost (₹27315.83 per hectare), followed by Khellani (₹26365.31) and Bhaderwah (₹23350.21 per hectare). Although the gross returns were highest in the Nagrota block (₹58800 per hectare), the cost-benefit ratio was highest (2.28) in Bhaderwah. The Khellani block has the lowest gross returns (₹49000 per acre). It is worth noting here that by-products were quite important in all three blocks since they were used as cattle fodder. As a result, there was large amount of by-product in contrast to the main product was found. The study conducted in eastern Uttar Pradesh on maize production viability by Rana *et. al.* (2018) found in close proximity with our study.

5.2.4 Economics of berseem crop in Jammu district

Berseem was an important fodder crop found in only one block (R.S.Pura) of the Jammu district because being a frost sensitive crop it has not to be grown in

Bhaderwah and Khellani block. According to the economics of berseem crop, the cost of cultivation was 48.03 per cent of the gross returns. This crop is mainly grown for livestock consumption because of its nutritious value. Higher cost-benefit ratio from this crop would be attained. The harvesting is done in multiple cuts and from one crop about four to five cuts were done during the season.

5.2.5 Economics of oats crop in Doda district

Oats crop was another fodder crop found in the study. Being a frost resistant crop it was found only in the Bhaderwah and Khellani blocks of the Doda district. Because wheat was not very widespread in that location, this crop was discovered to be more common during the winter season in comparison to wheat. The cost of cultivation in this crop were found out to be 6.77 per cent more in Khellani as compared to Bhaderwah block due to more expenditure on various inputs incurred by the sampled farmers of that area.

5.2.6 Economics of potato crop in Doda district

Crop's descriptive statistics represented the vast range of factors of production. Due to the large amount of seed and manure used, the cost of cultivation was significantly high. The yield of the crop in Khellani block was found out to be 2.13 per cent more than Bhaderwah because the sampled farmers of Khellani blocks grown potato crop for marketing purpose. High overall cost-benefit ratio was found i.e., 1:2.18, indicating that this crop was found to be highly profitable for farmers in the hilly regions of Doda district, as the average production of this crop from both blocks was relatively high (94.00 quintals) due to the fact that this crop produces more returns. Despite the fact that this crop was proven to be extremely helpful to farmers in Bhaderwah, the ratio and returns were lower than in irrigated areas such as Khellani due to the lack of timely irrigation.

5.2.7 Economics of knol-khol in Doda district

The descriptive statistics of knol-khol in two knol-khol growing blocks of Doda district (Table 4.31). Though, not much vegetable cultivation was found in the Jammu district as the farmers of Jammu district was engaged in cereal crop cultivation. Per acre cost of cultivation in knol-khol came out to be in Bhaderwah (₹37826.00) and in Khellani (₹42571.10) in which 42.30 per cent and 41.34 percent expenditure was incurred on manure because being a green leafy vegetable manure is important for its

higher production. The yield in Khellani block was found out to be 9.1 percent more in comparison to Bhaderwah block as the sampled farmers of Khellani grown their crop for marketing purpose and better pickle formation, they utilize much time on crop during its cropping season. Consequently, net returns were revealed to be high in Khellani due to better marketing of this crop. Highest cost-benefit ratio was also found in Khellani block i.e., 1:2.26.

5.2.8 Economics of onion crop in Doda district

Onion crop was found cultivating only in Bhaderwah and Khellani blocks of the Doda district. With respect to different variables the descriptive statistics (Table 4.35) revealed significant variations. Descriptive statistics revealed that the mean area of the sampled farmers in onion crop was found out to be 0.008 acres and 0.0071 acres in Bhaderwah and Khellani block, respectively. Further, onion crop fetches better prices to the farmers in the sampled district. Overall yield was found out to be 97.60 quintals per acre which is relatively high. Overall net returns and gross returns from these blocks were found out to be ₹161347.82 per acre and ₹195200.00 per acre, respectively.

5.2.9 Economics of garlic in Doda district

Garlic a very remunerative crop found in Doda district. The descriptive statistics of garlic represented in Table 4.39. The cost of cultivation found to be ₹46338.09 in Bhaderwah and ₹49220.51 in Khellani where 41.95 per cent and 36.40 per cent expenditure incurred on seed in Bhaderwah and Khellani, respectively because the seed sown were cloves of the garlic itself the cost of garlic was much high. The difference in net returns from both blocks was not large because of the value of garlic crop. The overall cost-benefit ratio from both the blocks was much high i.e., 1:8.71 as the garlic fetches more prices in the market.

5.3 Cost and return of livestock enterprises

Farmers in the selected locations were found to be engaged in agricultural-related enterprises during the study in order to maximize their revenue and produce employment, while crop cultivation income was not determined to be highly remunerative enough to support the farmer's livelihood, as a result, multiple enterprises were located in the Jammu region's sampling areas under investigation.

5.3.1 Economics of livestock enterprise in Jammu region

In the Jammu and Doda districts, livestock of four types were found: desi cows, cross-breed cows, and buffalo. Apart from desi cows, prominent types of cows and buffalo include *Jersey*, *Holstein*, *Murrah*, *Haryanvi* etc. Cross-bred animals were found in the Jammu district as a result of the district's proximity to cities, where animal buying and selling was relatively straightforward. The data was examined on a per-animal-unit-per-year basis. In comparison to cross-bred cows, raising desi livestock was less expensive. Net returns were also shown to be higher in the case of cross-bred livestock when compared to their desi counterparts, owing to the higher quality of the cross-bred animals. In terms of returns, milk was the most important component of the total returns of livestock enterprise. More specifically, ₹22238.27, ₹47499.51, and ₹51368.65 in R.S.Pura block and ₹19775.01, ₹43852.68, and ₹67454.40 in case of desi cow, cross-breed cow, and buffalo, respectively, were found on a per cow per year basis.

During the survey, 23 desi cows and 20 crossbred cows were found in Bhaderwah, whereas 19 desi cows and 21 crossbred cows were discovered in Khellani block. In terms of gross returns, Bhaderwah had ₹71755.37 and ₹95367.15 in desi cows and cross-breed cows, respectively, while Khellani had ₹69769.47 and ₹90755.74 in desi cows and cross-breed cows, respectively. Following that, the returns were determined to be best in the case of cross-breed cows (₹46381.50 per cow per year in Bhaderwah) and lowest in the case of desi cow (₹20733.25 per cow per year in Bhaderwah). When comparing cross-bred animals to desi animals, the returns were shown to be higher in the case of cross-bred animals. Because milk constituted such an important component of farmer profits, it helped farmers of Jammu and Doda district to generate higher returns.

5.4 Economic analysis and Economic viability of fruit crops found in sampled area

5.4.1 Economic analysis of apple crop in Doda district

Apple cultivation were found in blocks of Doda district. The first year establishment cost was ₹32406.69 (Bhaderwah) and ₹34274.75 (Khellani), which was found to be more in Bhaderwah and less in Khellani in comparison to their relative operational cost given in Table 4.45 because in Khellani the farmers look after their fruit trees and check the quality of the fruits on a regular basis. Furthermore, due to

marketing of their produce, net returns in the Khellani block were determined to be 9.56 percent higher than in the Bhaderwah block.

5.4.2 Economic analysis of pear crop in Doda district

Pear found in temperate region of Doda district. First year establishment cost of pear cultivation revealed that the per hectare total cost incurred for various operations were ₹27206.49 and ₹30657.08 in Bhaderwah and Khellani, respectively. The operational and maintenance cost were found to be ₹26222.09 and ₹31398.59 in Bhaderwah and Khellani, respectively. The pear is beneficial for farmers with a benefit-cost ratio of 11.05 in Bhaderwah and 12.69 in Khellani as the production were high in this fruit crop which fetches better prices in the market.

5.4.3 Economic analysis of walnut cultivation in Doda district

Walnut was found in *Rainda* and *Kharothi* villages of Bhaderwah block of Doda district as the farmers grown these trees because being big sized trees the production was high. It was discovered to be incredibly profitable for farmers because walnuts have a high market price due to their nutritional content. Though the walnut was not of the same excellent grade as that found in Kashmir, it did bring in larger profits for the farmers in those areas. Further, 1st year establishment cost was more in comparison to operational and maintenance cost as this crop does not require much maintenance after bearing. With respect to returns, walnut was proved to be highly remunerative when the production was good and the returns goes in lakhs.

5.4.4 Economic viability of fruit crops found in sampled area

Economic viability in terms of net present value and internal rate of return was also analysed for perennial crops such as fruit (Table 4.58). Net present value for all the selected fruit crops was calculated at 7 per cent and 9 per cent discount rate. Among all the three selected fruits, walnut was found to have highest NPV in both mentioned discount rates with the value of ₹1174339.89 and ₹956219.93, respectively., Other two fruits viz, apple and pear were also found to have positive NPV which clearly indicates that all the fruit crops were found to be economically viable under time value of the money. Bhaderwah block of Doda district was found to have highest IRR in case of apple (50 per cent) and pear (56 per cent). Internal rate of return in case of walnut grown in only Bhaderwah block of Doda District was found to be highest (58 per cent) among all the fruits crops. Return per rupee invested was more than rupees ten in all the fruit

crops and highest cost benefit ratio of 1:13.52 was found in walnut which shows that these enterprises were giving high returns to the farmers. The number of fruit trees were found less in number as compared to recommended level i.e., in apple 122 in Bhaderwah and 120 in Khellani, in pear 92 from Bhaderwah and 99 from Khellani was found. Whereas number of walnut trees were found to be 54 which was found only in Bhaderwah block of the district. By focussing on spacing and high density planting the farmers of the district fetch even more returns from these horticultural crops.

5.5 Income and employment generated from various crops enterprises

5.5.1 Labour use pattern

The different operations required for cultivating crops and managing different enterprises creates employment. Table 4.59 gives us the idea of distribution of family and hired labour among various crops grown and the livestock found in the sampled area. We found that the requirement of hired labour was high in rice crop among the four blocks because in rice the transplanting and harvesting activity was time consuming and it also required other activities too. In wheat crop the human labour distribution was less in R.S.Pura block because in that particular region most of the harvesting operations was done by the combine which minimizes the usage of human labour in that area. In vegetable crops found in the sampled area, most of the operations were done by the family members themselves so the requirement for hired labour was less in these crops. Similarly, in livestock, family labour was high and requirement of hired labour was less among the various categories of livestock found in the sampled area. In Table 4.60 the distribution of labour among various operations in crops were enlisted, whereas Table 4.61 presented the distribution of labour among different operation occurred in livestock rearing where during survey we found that the highest labour requirement was used in cleaning of dung and its disposal as this includes the washing the floor, removal of livestock waste etc.

5.5.2 Income generation from different crops

In Table 4.62, the family labour income and farm business income was calculated. In cereal crops, maximum income generated from rice crop from R.S.Pura region as the farmers of that region grown Basmati-370 which fetched better prices to farmers due to its aroma and also due to the nearby market facilities. Among the vegetable crop the onion and garlic fetches maximum returns to the farmers as these

vegetables have great importance in everyday life and also have better prices in the market. As we all know the importance of fruits crop in our daily life. The farmers of the sampled area grown fruit trees for better returns as these does not require much cost of cultivation after establishment and the returns from fruit crops is maximum which not only increased the family labour income but also increases the farm business income. The highest returns among the fruit crops found in the study area was found in walnut as this crop fetches better returns in the market due to its nutritious value.

5.6 Optimum enterprise combination with existing pattern

Proposed results from linear programming optimisation has been presented in Table 4.65 on the basis of three parameters viz., land allocation, cash outlay and labour requirements in case of crops and number of animals, cash outlay and labour requirements in case of livestock. The software used for linear programming optimization utilized simplex algorithm. Sofi *et al* (2015) for decision making in agriculture used this technique.

5.6.1 Linear programming optimisation in crops

The technique was used in the study to determine the best land allocation for three cereal crops and two fodder crops using agricultural data and taking into account various production parameters. It was observed that, adjustment in land allocation and cash outlay in paddy and wheat should be decreased in R.S.Pura whereas it should be enhanced in berseem. Labour requirement shown a decreasing pattern in paddy by there should be more labour utilized in wheat and berseem. From that the optimum combination was found out to be paddy (kharif) + wheat (rabi). In Nagrota block the land allocation was lessens in wheat and maize crop to a large extent and other values were found optimum in wheat and maize so the profitable combination of crops from Nagrota block was found out to be maize (kharif) + wheat (rabi). In Bharderwah and Khellani blocks, the three crops viz., two cereal crops and one fodder crop were grown commonly on different land during their cropping season i.e., rice on irrigated land during kharif, maize on unirrigated land (rainfed) during kharif and oats on unirrigated land during rabi. The returns from these crops were not much but the respondents from Doda district were habitual for this cropping pattern. So, the combination of crops from Doda district were suggested as rice and maize in kharif and oats in rabi. For additional income generation the farmers of Doda district grows different vegetables which fetch them a better returns from small land holdings. Also some farmers tune to fruit crops

for income generation as the cereal crops were not much profitable to them. Mellaku et al. (2018) investigated agricultural allocation in Ethiopia using linear programming. One of the key contributors in decreased agricultural yield and environmental deterioration, according to the report, is the lack of attention paid to crop land distribution. Furthermore, the study claimed that meeting household food crop production needs was another cause in crop production being reduced. As a result, the study advocated the use of a linear programming model to boost not only crop output but also sustainable resource utilisation.

Similarly, the linear programming for vegetables crops in Doda district were shown in Table 4.65. The vegetable crops found were potato, knol-khol, onion and garlic that fetches better returns to the farmers of Doda district in existing plan. But the results from linear programming helps the farmers to enhance their returns by optimum combination of these crops with cereal crops.

5.6.2 Linear programming optimisation in livestock

In case of livestock the linear programming output summary were given. Three types of livestock (desi cow, crossbred cow and buffalo) from Jammu district and two types (desi cow and crossbred cows) from Doda district were found. The linear programming results showed that by increasing the number of crossbred cows, they found out to be more profitable as compared to desi cows and buffaloes in Jammu district. In Bhaderwah block of Doda district desi cows were found out to be profitable in optimal plan whereas from Khellani block crossbred were found profitable in optimal plan as compared to existing one.

5.8 Identification of constraints experienced by the sampled farmers in adoption of enterprises.

Table 4.67 shows the variety of constraints faced by farmers in the selected regions. Costly labour (with an average score of 80.25) appeared to be the most significant impediment to crop production among the four blocks. With an average score of 75.60, water scarcity was found to be the second most important limitation. It is important to note that the problem and constraint differ not only between blocks in different districts of the research area, but also between villages within the same block, e.g., absence of irrigation facilities was shown to be the main limitation in the *Dhok waziria* village, while lack of technical know-how was discovered to be the main restraint in the *Damuni* village of the Nagrota block. Furthermore, several villages, such

as *Rainda* in the Bhaderwah block of Doda district, faced labour shortages throughout the cropping season, which hampered harvesting and transplanting activities. As seen in the table, the absence of veterinary facilities was the biggest limitation in the livestock, with an average value of 60.75.

Summary and Conclusions

India, an agricultural country mainly depends on agriculture and its allied activities for livelihood which provides employment directly or indirectly to most of its population. Agriculture is regarded as the backbone of the Indian rural economy, and it is a family business that plays a vital role in reducing rural poverty. Agriculture has long been a way of life and the primary source of income for the Indian population. Agricultural policy in India has always emphasised self-sufficiency and self-reliance in food grain production. Agriculture not only provides individuals with high-quality food, but it also employs a large number of people. As the population of India is increasing day by day and there is reduction in land under agriculture, the demand of the individuals is also increasing and no single farming enterprise is likely to be able to meet the demands of the marginal and small farmers without adopting cropping with other enterprises to generate income and employment year around.

Union territory of Jammu and Kashmir is rich in natural beauty, with mountains, rivers, plateaus, and so on. It is an agricultural state, with more than 75 percent of the population earning a living from agriculture, either directly or indirectly. With this in mind, a research study entitled “An investigation to optimum and profitable combination of crop livestock enterprise in Jammu region of UT of J&K” was considered. The following is the summary, conclusions and policy recommendations from the study:

6.1 Summary

Data was acquired from both primary and secondary sources. With the help of well-prepared schedules, primary data was obtained by directly vesting the farmers, schedules aided in the collection of information. Secondary data was gathered from government publications such as economic surveys, statistical digests and other research papers. Two districts were chosen in the first step and two blocks from each district were chosen at random in the second step, for making a total of four blocks. Two villages from each block were chosen at random in the third stage. As a result, a total of eight villages were chosen, with fifteen respondents/farmers chosen from each village, thereby, making the sum of 120 farmers were formed in total.

To determine the profitability of various crops and enterprises, the economics of crop enterprises and agricultural-allied enterprises were calculated. The economic viability of fruit crops was determined. The income and employment created by various enterprises during various operations were computed. The linear programming technique helps in the examination of the optimisation in terms of three distinct parameters. Finally, Garrett's ranking technique were applied to examine the constraints in agriculture and allied enterprises.

6.1.1 Socio-economic status and resource structure of the sampled farmers in Jammu region

The average age of the sampled farmers was 54.45, with the youngest being 28 years old and the oldest being 82 years old. The average family size was 5.58, with a minimum of 2 and a maximum of 13 members in a family. The average land area was 0.72 hectares, while the level of education was reported in terms of literates (79) and illiterates (41). The farmers of the Doda district utilize power tillers instead of tractors due to undulating topography whereas tractors are needed in Jammu district for various purposes during cropping seasons.

6.1.2 Economics of production of cereals, fodder and vegetable crops

The economics of paddy crop revealed that the cost-benefit ratio was higher in the Jammu district when compared to the Doda district. The overall production of the paddy crop was 28.90 quintals per hectare, with the highest yield reported in the R.S. Pura and Baderwah blocks and the lowest in the Nagrota block. Similarly, the R.S. Pura block had the highest cost-benefit ratio, followed by Nagrota, Baderwah, and finally the Khellani block. The overall yield per hectare found in wheat crop was 30.00 quintals with overall cost-benefit ratio of 1:2.01. In maize crop, 35.37 quintals per hectare were the overall by-product yield as compared to its main product (28.67 quintals per hectare). In case of fodder crops, net returns found out to be high (₹31181.69) as compared to oats crops (₹24959.03). It was not uncommon to find the paddy crop under different climatic conditions in both the districts under study. Farmers in the Jammu district, in compared to farmers in the Doda areas, gained more.

The potato crop in the Doda district was found to be highly profitable, with an overall yield of 94.00 quintals per acre and net returns of ₹66121.78 per acre. The farmers who grown Pahari potatoes were always found to be financially in profit as the

Pahari potatoes are tasty, so their demand was high in the market. Knol-khol a green leafy vegetable consumed for its taste and pickle purpose in the Doda district yielded 88.00 quintals per acre with the overall cost-benefit ratio of 1:2.19. Onion crop, mostly consumed crop by the people showed an average yield of 97.60 quintals per acre that in turns gives net returns of ₹161347.82 per acre and the gross returns ₹195200.00 per acre. Garlic has its own importance in terms of its nutritious value, grown in Doda district produced a net returns of ₹368220.70 with a very high overall cost-benefit ratio of 1:8.71. So, in comparison to cereal and fodder crops grown by sampled farmers, vegetable crops were found to be more remunerative and fetches a better returns to the farmers.

6.3 Cost and return of livestock enterprises

The revenue and returns from crops alone were lower than the income and returns from cropping along with livestock enterprise. According to the findings of the study, farmers were engaged in agricultural-related enterprises in order to increase their income. Cross-bred cows and buffaloes were more profitable to farmers than desi cows, according to the economics of livestock. This was due to the fact that cross-bred livestock produced more milk. Furthermore, the net returns from cows were higher in the R.S. Pura block as compared to other blocks.

6.4 Economic analysis and Economic viability of fruit crops found in sampled area

The NPV was calculated in all of the fruit crops under study. As a result, all the fruit crops revealed economic viability. Furthermore, the value of the IRR was calculated to be much better for the sampled farmers. In terms of BCR, it was found that apple, pear, and walnut had higher value. In case of walnut the highest BCR was found, indicating the importance of walnut trees in such places as its value in the market was much high as compared to other fruit trees.

6.5 Income and employment generated from various crops

Most of the operations in agriculture and its allied activities generate income and employment to the farmers. Level of income and employment were calculated for operations occurred in crops and livestock in the two districts under study.

6.1.7 Optimum enterprise combination with existing pattern

The output of the linear programming model revealed that in the case of paddy, land adjustments are required in both Jammu and Doda districts, financial outlay adjustments are required in all districts and labour adjustments are required in both Jammu and Doda districts. In the case of wheat crop, land adjustments are required in Jammu district, financial outlay adjustments are required in the district, and labour adjustments are required in both blocks of the Jammu district. Large changes in land distribution are required in all blocks except R.S. Pura, which did not cultivate maize. In this crop, cash outlay modifications are required in all three maize growing blocks, but labour requirements did not differ much. In the case of area (district) specific crops, the area for oats crops should be reduced, but the area for vegetables crops should be reduced to the recommended level in Bhandarwah block. In case of oats, knol-khol, onion, and garlic, cash outlay should be increased, whereas it should be lowered in the case of potato crop in the Bhandarwah block, labour has to be increased for the potato, knol-khol and onion crops. In the case of the Khellani block, land allocation for onion and garlic should be enhanced. The cash outlay for the oats and garlic crop needs to be increased. As far as the labour requirement was concerned, only in the case of potatoes labour requirements need to be enhanced.

In case of livestock, number of desi cows and crossbred cows should be increased in R.S. Pura and Nagrota block whereas buffalo should be encouraged in R.S. Pura block. Cash outlay needs to be decreased in all categories but in crossbred cows it should be enhanced. In case of Bhandarwah desi cows found out to be more enumerating but from Khellani block crossbred cows were more profitable in optimum plan whereas labour requirements needs to increase in case of desi cows.

6.7 Identification of constraints experienced by the sampled farmers in adoption of various enterprises

The most significant limitation discovered in crop production and horticulture sector was the high cost of labour, with an estimated Garrett score of 80.25. In the sampled area, lack of irrigation/shortage of irrigation was the second most important cause. As far as the constraints were concerned, this is not an exhaustive list. Many issues determined to be unique to a certain block, like the lack of information about managing multiple enterprises in Nagrota block of Jammu district and unavailability of

timely labour in Bhaderwah block of Doda district. Lack of veterinary facilities (60.75) was the main problem in livestock enterprise.

6.2 Conclusions

According to the findings, the average age of farmers in the research area was 54.45 years old, and the average family size was 5.58. The average land area was 0.72 hectare and the percentage of literate farmers was 65.83 percent. The majority of farmers were involved in agricultural activity. Unirrigated land made up 61.05 percent of the acreage sampled by the farmers. According to the economics of the crops in question, rice, wheat, and maize crop in Jammu district and rice, maize and oats crop in Doda district, have shown to be viable agricultural operations for farmers in terms of cost-benefit ratio. Among the several vegetable crops, onion and garlic in case of Doda district worked out to be more profitable crop as compared to potato and knol-khol. Moreover, vegetable crops showed higher cost-benefit ratio in comparison to the cereal and fodder crops in the study area.

Economics of livestock revealed the profitability of cross-breed cows and buffaloes. Farmers did not gain significantly from Desi breeds. Fruit crops, which remained more profitable in the Doda district, provided a better boost to farmer's income in communities located on undulating land in this case. In the Doda district, apple growing was more profitable. Walnut has shown to be an important addition in enhancing the income of farmers in remote areas and villages. At the same time, these connected enterprises functioned as a major source of employment and high returns for the farmer.

The results of linear programming were revealed that land allocation, as well as cash outlay and labour requirements, needed to be adjusted. Again, the best linear programming solution was found for the livestock in both districts by taking the number of animals, cash outlay and labour requirement as parameters. Finally, the Garrett ranking technique revealed that the primary constraints in crop production were costly labour, a lack of irrigation facilities, and a lack of information about managing various enterprises, whereas the major constraints in livestock were a lack of veterinary facilities and shortage of fodder.

6.3 Policy recommendations

The following suggestions are made to make farming more profitable and sustainable as an agricultural practise:

- Rice, wheat and maize crops in Jammu district, as well as rice and maize crops in Doda district, should be promoted in terms of profitability.
- In unirrigated areas of Doda district, oats, a fodder crop, should be grown since it has the potential to provide substantial returns to farmers. Furthermore, vegetable crops have a high potential in the sampled areas of Doda district.
- Special attention should be given to cross-bred animals, whose profitability has been found to be high. Furthermore, efficient methods must be established to introduce the population of such breeds in different areas of the Jammu.
- As fruit plants viz., apple, pear and walnut generates income to farmers, therefore the horticulture sector needs prioritization on large scale in Doda district.
- High water availability should be prioritized in areas where water scarcity has occurred. Farmers should be equipped with modern technology such as drip irrigation systems, boring, and so on a regular basis.
- In Jammu region, a lack of information proved to be the most significant constraint. Therefore, regular training and awareness programs need to be organized about various agricultural enterprise opportunities.

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**Sher-e-Kashmir University of Agricultural Sciences and
Technology of Jammu**
Survey Schedule for Data Collection of M.Sc. Research Problem

**An Investigation of Optimum and Profitable Combination of Crop Livestock
Enterprise In Jammu Region of UT of J&K**

Sr. No: _____ Village: _____ Block: _____ Date: _____

**I. SOCIO-DEMOGRAPHIC PROFILE OF THE RESPONDENT AND
BASE LINE DATA**

1. Name of the farmer :
2. Father's name :
3. Age (years) :
4. Marital Status : Married/ Un-married/ Widow/ Widower
5. Sex : Male/Female
6. Telephone/ Mobile no. :
7. Occupation :
 - i) Main :
 - ii) Subsidiary :
8. What is the highest grade in School/College you have completed?
9. No of family members :
10. Family composition:

Age	Male	Female	Higher Education	Income/Year	Source of income
0-15					
15-30					
30-45					
45-60					
Above 60					

11. Working people in family?
12. How far is your village from nearest market (km)?
13. How far is your house from nearest Agriculture Extension Office (km)?
14. Operational land holdings (in kanals):

	Irrigated	Unirrigated
Total		
1. Owned		
2. Leased in		
3. Leased out		

Total operational land holding: (1+2)-3

If leased out, sum of money received from the tenant per unit area:

Or Crop produce paid per unit area:

If leased in, sum of money paid to the owner per unit area:

Or Crop produce received per unit area:

I. COST OF CULTIVATION

15. Land Preparation

Please give the information about land preparation.

Crop	No. of Ploughing	Cost/Ploughing /Kanal	Labour involved in ploughing/planking	Total expenditure on preparation of one kanal of land (including hired and family labour).

16. List the crops cultivated last year:

S.No.	Crop	Variety	Source	Area (in Kanal)	Production (q)

Please give the reasons for selecting a particular variety.

Variety	High yield	Good quality	Tolerant to insects	Tolerant to diseases	Market price	Seed availability	Others specify

III. NURSERY RAISING

1. Please give the information regarding nursery raising of crops cultivated by you.

Crop	Month of Sowing	Area Sown	Variety Sown	Quantity of seed/kanal	Cost of Seed/kanal	Source of seed

(I) Did you treat the seed with seed treating chemical before sowing?
Yes/No

(II) If yes, please give the following information

Name of seed Treating chemical	Quantity of seed treated	Quantity of seed treating chemical used	Total cost of seed treatment

(III) Where from did you get the information about seed treatment?

(IV) If no, was the seed already treated?

Yes/No

(V) If no, what were the constraints for not applying the seed treating chemical?

- a) Lack of technical Knowledge
- b) Unawareness about chemical treatment
- c) Timely availability of chemicals
- d) Any other (please specify)

(VI) Are there any benefits of seed treatment?

Yes/No/Don't Know

IV. FERTILIZER USAGE

1. Please give the information regarding manures and fertilizers used in the crop.

Crop	Urea kg/kanal	DAP kg/kanal	MOP kg/kanal	FYM/kanal	Any other

2. Did you apply urea in split doses?

Yes/No

2 (i) If yes, please give the following information.

No. of split doses

Quantity of urea applied (kg)/Stage

A. Basal Dose

B. Top dressing

i) One

ii) Two

iii) Three

2 (ii) If no, what were the constraints?

- a)
- b)
- c)

2 (iii) Where from did you get the information about the application of urea in split doses?

- i) University scientists
- ii) Krishi Vigyan Kendra
- iii) Mass Media
- iv) Others (Please Specify)

2 (iv) Time taken to apply fertilizers in one kanal.

V. WEED MANAGEMENT

1. Please give the information about the methods of weed control in the field.

- i) Manual
- ii) Mechanical
- iii) Chemical
- iv) All
- v) None

2. Average number of hoeing/intercultural operations done for control of weeds.

Crop	Number of hoeing/intercultural operations done

2.(i). Time taken to hoeing in one kanal. _____

3. Expenditure incurred for hoeing one kanal of land in

Crop	Expenditure/kanal	Labour(hired & family labour)

4. If you use herbicides, then give the following information?

Name of herbicide	Quantity of herbicide/kanal	Total cost of herbicide/kanal

5(i). Cost of herbicide application (Rs/kanal) _____

5(ii) Labour required for herbicide application /kanal. _____

5 (iii) Constraints you face in weed management.

- a) _____
- b) _____
- c) _____

6. Do you clean the water channels and bunds in the field? Yes/No

6 (i) If Yes, which of the following methods did you adopt?

- a) Chemical methods
- b) Mechanical methods
- c) Any other

6(ii) Cost of manual weed control in the whole area where crops were cultivated.

6(iii) If no, what were the constraints? a)

b)

c)

VI. IRRIGATION

1. Source of irrigation for crops:

- i) Tube well/ bore well
- ii) Canal
- iii) Tube/bore well and canal

2. Average number of irrigations applied to crops grown by you.

Name of the crop	Average number of irrigations

3. Expenditure of irrigation **with Tube/Bore well/kanal** for irrigating crop.

Source of irrigation	Expenditure of irrigation/kanal
Tube/bore well (electric/diseal)	
Canal	
Canal+ Tube/bore well	

3(i) Labour required for the total number of irrigations.

3(ii) In case of diseal tube well, quantity of diseal used /kanal. _____

VII. PEST & DISEASE MANAGEMENT

1. Name the insect pests prevalent in your crop field.

(i) _____

(ii) _____

(iii) _____

(iv) _____

(v) Which were the serious insect pest in your area?

a) _____

b) _____

2. What measures you adopted to control these insect pests in your crops?

S.no	Measures available				
1	Chemical				

2	Biological				
3	Cultural				
4	Mechanical				
5	All				
6	None				

3. Did you apply chemical pesticides in your crop last year? **Yes/No**

4. If Yes, please give detail the detail of different insecticides applied in flower crops.

Name of insecticide	Dose of insecticide/kanal	Against which pest	Cost/kanal	Cost of spraying/kanal

4(i) Source of information about use of pesticide.

Agril. Deptt/Pesticide dealer/Neighbour/Ag.University/KVK/any other

17. Please give the cost of cultivation of crop/kanal _____ (in ₹)

18. Gross income from crops _____ (in ₹)

19. Cost of Picking, Bagging and Transportation of one quintal _____ (in ₹)

20. Crops grown for self-consumption or sale, If sold, income out of it:

S.No.	Crop	Self-consumption	Quantity sold	Income (₹)

21. What was the yield of horticultural crops during last year?

S.No.	Crop	Area in kanal	Production	Quantity sold	Income (₹)

19. Total annual income from agriculture (₹):

- a) Cereal crops :
- b) Fruit crops :
- c) Vegetable crops :
- d) Livestock :
- e) Mushroom :
- f) Others :

Since, how many years you cultivating these crops?

VIII. Farm Inventories:

S. No.	Equipment	No.	Year of Purchasing	Value at time of purchase (₹)	Depreciation (%)	Present value (₹)
1.	Threshing machine					
2.	Tractor					
3.	Tube well					
4.	Pump set					
5.	Chaff Cutter					
6.	Plough					
7.	Sprayer/Duster					
8.	Seed drill					
9.	Flour mill					
10.	Oil crusher machine					
11.	Bullock cart					
8.	Others					

IX. Livestock

S.No.	Kind of animal	No.	Breed	Age (in yrs)	Owned/ Purchased	Month and year of purchase	Purchase value (₹)	Present value (₹)
1.	Bullock							
2.	Cow (local)							
3.	Cow (hybrid)							
4.	Buffalo							
5.	Sheep							
6.	Goat							
7.	Poultry							
8.	Others							

1. Maintenance of farm animals/others

	Items		Quantity		Price/unit	Total cost	
			Owned	Purchased			
	Source						
Dairy animals	Churi/concentrate						
	Dry fodder						
	Green fodder						
	Mineral mixture						
	Labour	Own ed	Male				
			Female				
		Hired	Local				
			Migratory				
	Vety and misc						
	Concentrate						
	Mineral mixture						
	Labour	Own ed	Male				
			Female				
		Hired	Local				
Migratory							
Vety & misc.							
Others							
Sheep and Goat	Dry fodder						
	Green fodder						
	Mineral mixture						
	Labour	Own ed	Male				
			Female				
		Hired	Local				
Migratory							
Others							
Poultry	Starter feed						
	Finisher feed						
	Labour	Own ed	Male				
			Female				
		Hired	Local				
			Migratory				
Vety & misc.							
Others							
	Cow dung						
	Calcium Carbonate						
	Ammonium sulphate						
	SSP						

Fisheries	MOP					
	Rice bran					
	Mustard cake					
	Water supply					
	Labour	Own ed	Male			
			Female			
		Hired	Local			
			Migratory			
	Finger lings					
	Harvesting					
Others						
Other						

Kind of animal	Disease	Medicine	Cost of Medicine

2. Water Supply

Kind of Animal	Water Supply (Lts.)	Water supply charges	Labour Required	Labour Charges	Total Cost

3. Disposal of livestock produce

1.	Production						
	Milk (Kg)						
	Ghee (Kg)						
	Chicken (Kg)						
	Egg (No.)						
	Pork (Kg)						
	Fish (Kg)						
	Mutton (Kg)						
	Upale (Kg)						
	Manures (tones)						
2.	Sale of animals						
	Milch buffalo before pregnancy						
	Dry buffalo						
	Pregnant and milch buffalo						
	Pregnant buffalo						
	Milch cow						
	Pregnant and milch cow						
	Dry pregnant cow						
	Male calves						
	Female calves						
3.	Sale of sheep/Goat						
4.	Bee keeping						
	Honey (Kg)						
	Honey bee boxes (No.)						
5.	Others						

Note: 1. Wage rate/day:

Male (₹/day):

Female (₹/day):

2. Bullock labour/day:

3. Machine Rate per unit area:

VI. Total production and their sale rate

Crop	Total Production (qtls)	Sale Rate per qtl

Please give the cost of cultivation of crop/kanal _____ (in ₹)

Gross income from crop _____ (in ₹)

Cost of Transportation of one quintal _____ (in ₹)

XII. Problems faced in adoption of an enterprise:

S.No.	Problems	Facing problem or not
1.	Production problems	
a.	Lack of technical know how	
b.	Lack of knowledge about proper utilization of resources	
c.	Lack of information about managing multiple enterprises	
d.	Non-availability of good quality seeds	
e.	Costly labour	
f.	Unavailability of timely labour	
g.	Lack of irrigation/shortage of irrigation	
h.	Livestock	
i.	Lack of veterinary facilities	
j.	Improved breeds of livestock not available	
k.	Shortage of fodder	

VITA

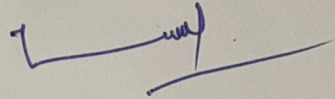
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CERTIFICATE- IV

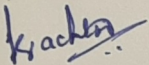
Certified that all necessary corrections as suggested by the external examiner and the Advisory committee have been duly incorporated in the thesis entitled "**An Investigation of Optimum and Profitable Combination of Crop-Livestock Enterprise in Jammu Region of UT of J&K**", submitted by **Mr. Vijay Rajan Sahni**, Registration No. **J-19-M-615**.



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