IMPACT OF KRISHI VIGYAN KENDRAS ON ADOPTION OF FARM TECHNOLOGIES AND INCOME OF FARMERS-A CASE STUDY OF KVK KANGRA

THESIS

By

BHARTI

(A-2017-30-009)

Submitted to

CHAUDHARY SARWAN KUMAR
HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA
PALAMPUR – 176 062 (H.P.) INDIA

in

Partial fulfilment of the requirements for the degree

of

MASTER OF SCIENCE IN AGRICULTURE

(DEPARTMENT OF AGRICULTURAL ECONOMICS, EXTENSION EDUCATION & RURAL SOCIOLOGY)

(AGRICULTURAL ECONOMICS)

2019

Dr. K.D. Sharma
Principal Scientist & Head
(Agricultural Economics)

Department of Agricultural Economics, Extension
Education & Rural Sociology, COA,
CSK Himachal Pradesh Krishi Vishvavidyalaya,
Palampur - 176 062 (H.P.) India

CERTIFICATE – I

This is to certify that the thesis entitled, **"Impact of Krishi Vigyan Kendras on adoption of Farm Technologies and Income of Farmers-A Case Study of KVK Kangra"** submitted in partial fulfilment of the requirements for the award of the degree of **Master of Science (Agriculture)** in the discipline of **Agricultural Economics** of CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur is a bonafide research work carried out by **Ms. Bharti (Admission No. A-2017-30-009)** daughter of **Sh. Arun Kumar** and **Smt. Nirmla** under my supervision and that no part of this thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been fully acknowledged.

Place : Palampur
Dated: July , 2019

(Dr. K.D. Sharma)
Major Advisor

CERTIFICATE- II

This is to certify that the thesis entitled, **"Impact of Krishi Vigyan Kendras on adoption of Farm Technologies and Income of Farmers-A Case Study of KVK Kangra",** submitted by **Ms. Bharti (Admission No. A-2017-30-009)** daughter of **Sh. Arun Kumar** to the CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur in partial fulfilment of the requirements for the degree of **Master of Science (Agriculture)** in the discipline of **Agricultural Economics** has been approved by the Advisory Committee after an oral examination of the student in collaboration with an External Examiner.

(Dr. K.D. Sharma)
Chairperson
Advisory Committee

( )
External Examiner

(Dr. Harbans Lal)
Member

(Dr. Manoj Bhargava)
Member

(Dr. P.N. Sharma)
Dean's nominee

Head of the Department

Dean, Postgraduate Studies

ACKNOWLEDGEMENTS

This treatise, a humble expression of my life's ambition and a scientific dream come true, would have not materialized the way it is, without the benediction from almighty ***God.*** *I am grateful to* ***God,*** *the merciful, the compassionate, for bestowing me with health, tenacity and courage enough to go through this crucial juncture.*

With the overwhelming sense of legitimate pride and genuine obligation which gives me exuberant pleasure and privilege to express my eternal gratitude to my learned and revered advisor, ***Dr. K. D. Sharma****, Principal Scientist and Head, Department of Agricultural Economics, Extension Education and Rural Sociology for his excellent and praiseworthy guidance, keen interest, adroit admonition, juvenile encouragement during whole course of my study and particularly at times of research and preparation of this manuscript.*

No expression of thanks will be sufficient without recognition of intelligent and professional dexterity of the members of my Advisory Committee viz., ***Dr. Harbans Lal,*** *Principal Scientist (Agricultural Economics),* ***Dr. Manoj Bhargava****, Professor (Department of Physical Sciences and Languages) and* ***Dr. P. N. Sharma****, (Department of Plant Pathology) for their valuable guidance, utilitarian exhortation and constructive suggestions.*

I sincerely thank ***Dr. Ashok Kumar Sarial*** *Hon'ble Vice Chancellor,* ***Dr. R. K. Agnihotri****, Dean, Postgraduate Studies and other university authorities of CSK HPKV for providing necessary facilities and providing merit scholarship during the course of investigation.*

My special thanks to ***Dr. Sanjay*** *(Department of Soil Science),* ***Dr. Vishal Dogra*** *(Department of Vegetable Science), for the help extended by them during data collection from KVK Kangra. My thanks are also due to all the members of* ***ministerial staff*** *of the Department of Agricultural Economics, Extension Education and Rural Sociology for their cordial assistance and timely help extended during the study. I also extend my gratitude to the sample respondents for availing precise information and providing warm welcome during the period of investigation.*

*All the words in the lexicon will be futile and meaningless, if I fail to divulge my extreme sense of regards to my adorable parents****, Sh. Arun Kumar*** *and* ***Smt. Nirmla*** *for their sacrifice, prayers and blessings without which this work would have been a sweet dream. I am yet to find suitable words to express my heartiest respectful affection for my elder brother* ***Sh. Ashish and entire family*** *for their tender attachment and constant encouragement during the course of investigation.*

I can hardly overlook the co-operation, timely help, moral support extended by the galaxy of my seniors, peers and friends especially ***Shivalika Di, Sethi Di, Mahima Di, Kanika Di, Manju Di, Shilpa di*** *and* ***Avinash Sir****. Genuine appreciation goes to my classmates* ***Nitika****,* ***Shivali, Prathibha, Damini, Shalvi, Arshdeep, Harjeet, Narender*** *for their kind cooperation, support and help rendered. I extend my heartfelt thanks to my friends,* ***Shilpa Di, Aaina, Deeksha, Avnee, Puneet, Deeksha, Sunidhi****, and* ***Jasmeet*** *for their ever-cherishing love, inspiration, care and unending encouragement.*

Acknowledgements are inherently endless & incomplete, and I request indulgence from many friendly & helpful people whom I could not name here. Needless to say, all omissions and errors are mine.

Place: Palampur
Dated: July 22, 2019 ***(Bharti)***

TABLE OF CONTENTS

LIST OF ABBREVIATIONS USED

S. No.	Abbreviation	Meaning
1.	( )	parenthesis
2.	S. No.	Serial Number
3.	@	At the rate of
4.	%	Per cent
5.	/	per
6.	et al.	et alii (and others)
7.	ha	Hectares
8.	Fig.	Figures
9.	i.e.	id est (that is to easy)
10.	hrs	Hours
11.	kg	Kilogram
12.	Q	Quintal
13.	m	Meter
14.	km	Kilometer
15.	*vis-a vis*	Compared to
16.	*viz.*	Videlicet (namely)
17.	etc.	Et cetera (and other things)
18.	FYM	Farm Yard Manure
19.	Rs.	Rupees
20.	N	Nitrogen
21.	P	Phosphorous
22.	K	Potassium
23.	Sq.	Square
24.	KVK	Krishi Vigyan Kendra
25.	N	North
26.	E	East
27.	ml	Millilitre
28.	l	Litre
29.	B:C	Benefit-Cost Ratio
30.	ICT	Information and Communication Technolgy

LIST OF TABLES

LIST OF FIGURES

Department of Agricultural Economics, Extension Education & Rural Sociology
COA, CSK Himachal Pradesh Krishi Vishvavidyalaya
Palampur-176 062 (HP)

Title of the Thesis	:	Impact of Krishi Vigyan Kendras on adoption of Farm Technologies and Income of Farmers-A Case Study of KVK Kangra
Name of the Student	:	Bharti
Admission Number	:	A-2017-30-009
Major discipline	:	Agricultural Economics
Minor discipline	:	Statistics
Date of Thesis submission	:	July 23, 2019
Total pages in Thesis	:	187
Major Advisor	:	Dr. K.D. Sharma

ABSTRACT

The growth of Indian economy depends upon performance of agriculture and allied sectors. With the use of technology based knowledge on farm, farmer is able to realize better production and income. To bridge the gap between potential yields and actual yields obtained by farmers in our country, extension agencies like KVK are working to serve the farming society. Keeping this background in view, the present study pertained to impact of Krishi Vigyan Kendras on adoption of farm technologies and income of farmers. The investigation was undertaken in Kangra block of Kangra district where KVK is located. The main aim was of the study to examine the extent of adoption of improved management practices by farmers and impact of KVK on adoption, farm productivity and income. Stratified two-stage random sampling design was employed to select 60 sample farmers (30 beneficiary farmers and 30 non-beneficiary farmers) from the study area. Data were collected by survey method from sample farmers and office of KVK Kangra. It has been found that KVK Kangra played a significant role in dissemination of technical know-how about farming. The achievement of planned target was found to be more than 100 per cent which was clearly indicated by FLDs, OFTs, trainings and the number of participants in extension activities executed by KVK. The findings of study revealed that paddy, wheat and vegetables were the main crops grown by beneficiary farmers. Paddy, maize and wheat were the major crops grown on non-beneficiary farms. Area under vegetable crops was higher and, thus, beneficiary farms were more diversified than non-beneficiary farms. This was also validated through Herfindahl, Simpson and Entropy indices. The beneficiary farmers used more critical inputs and better management practices. Therefore, the technological gap was lower on KVK adopted farms as compared to non-beneficiary farms. The composite management index based on adoption of improved practices indicated higher adoption on beneficiary as compared to non-beneficiary farms for cereals, vegetables as well as livestock production. It was found that on the whole, the extent of adoption of improved practices was 45-50 per cent higher on beneficiary farms as majority of the farmers were in the category of very high to high adopters. Regression analysis also revealed the significant impact of KVK Kangra on increasing the productivity of crops and milch animals. There was a significant difference in the gross and net returns particularly with respect to summer and winter vegetable crops. Similarly, the returns from milch animals were also higher on beneficiary farms. The composition of farm income showed significant difference in the income from vegetable crops. On overall basis, the farm income was Rs. 1,88,572/farm on beneficiary farms and Rs. 82,862/farm on non-beneficiary farms. The factor analysis revealed that irrigated area, area under vegetable crops and KVK significantly contributed in enhancing farm income. The beneficiary farmers obtained Rs. 66,254 higher income than the non-beneficiary farmers. It was found that there is a need to expand the outreach of KVK to those areas which have not been served so far. The emphasis should be laid on resource poor farmers having less irrigated area and poor economic status. There is also need to include entrepreneurship and record keeping so that farmers can effectively adopt improved technology and prepare business plans to enhance their incomes.

(Bharti)
Student
Date: July 23, 2019

(Dr. K.D. Sharma)
Major Advisor
Date: July 23, 2019

Head of the Department

1. INTRODUCTION

General Background

India is a land of villages and agriculture is the mainstay of economy and livelihoods of rural population. It is well known fact that the growth of Indian economy depends mainly upon the growth and performance of agriculture and allied sectors. More than 55 per cent of working population depends upon agriculture for their livelihood (Ashalatha and Rajeshwari 2018). Although, the contribution of agriculture and allied sectors to Gross Domestic Product (GDP) in 2018-19 was 15.4 per cent (Anonymous 2019). Agriculture sector in India is the largest employer of the total workforce. However, over the years, the growth in agricultural sector has slowed down. To boost the slow pace of agricultural growth and development, the importance of extension advisory services cannot be underestimated. Providing trainings regarding the technological skills effectively is one of the key challenges of rural development. Farmers are the nerve centre of rural economy and thus, the development of rural areas should receive top priority.

Due to small land holdings, scope for increasing farm production through horizontal expansion is limited. Therefore, the only option left is to enhance productivity through technology-led knowledge-based farming. Since independence, one of the major concerns in the process of technology transfer has been to explore the effective way of dissemination of new technologies fully integrating the view point of farmers. The moot questions have been to address the issues of where, how and what technologies are appropriate for adoption and compatible with their resource matrix. Different extension approaches have been adopted to disseminate the ideas and new technologies. Agricultural scientists evolved pithier of new technologies from time to time. But, there has been a substantial lag in the evolution of new varieties and technologies and their actual adoption by the farmers. As a result of this lag, many of the technologies become obsolete till the time they are adopted. There is a huge gap between the potential gain and the actual gain realized by the farmers.

Therefore, to promote agricultural technology-led knowledge based agricultural development, the Government of India has taken various initiatives from time to time. Many extension programmes have been implemented to promote knowledge based scientific agriculture. The Grow More Food Enquiry Committee recommended a broader programme for increasing food production in the country and the Community Development Programme (CDP) was started in 1952 that was followed with the Intensive Agriculture District Programme (IADP) of 1960s and Intensive Agricultural Area Programme (IAAP) in 1964.

Then, High Yielding Variety Programme (HYVP) was launched in 1966, which perhaps was the most successful endeavour that helped the country in attaining self-sufficiency in food. The irrigation-seed-fertilizer led technologies ushered in the Green Revolution in the country. The introduction of high yielding varieties combined with irrigation, balanced fertilizer use, plant protection, improved implements, etc., increased the productivity of crops mainly, rice and wheat that resulted in substantial increase in foodgrain production.

The ‘lab to land’ programme was launched in 1979 which intended to improve the economic conditions of marginal, marginal farmers and landless agricultural labourers by the transfer of improved technology developed by agricultural universities and research institutions. Thereafter, Institutional Village Linkage Programme (IVLP) launched in 2000, was also an innovative programme developed by ICAR to help scientists to have direct interaction with the farming community so that appropriate technologies are developed and recommended for the farmers. In IVLP model, research, extension and farmers were encouraged to establish intimate links for carrying together development dissemination, assessment and refinement of farm technologies.

The concept of Krishi Vigyan Kendras (KVKs) was developed way back in 1974. For proper dissemination of agricultural technology to farmers, ICAR came up with an idea of establishing the farm science centres popularly known as Krishi Vigyan Kendras (KVKs). A committee was constituted in 1973 under the chairmanship of Dr. Mohan Singh Mehta to work out a detailed plan for implementing KVK scheme in the country. The first KVK was established in 1974 in Pondicherry under Tamil Nadu Agricultural University (TNAU). Since then, KVKs have been established in various states and the number continues to grow. As on October 2018, the number of KVKs in India were 706 (Anonymous 2019). Krishi Vigyan Kendras serve as a development centre for rapid agricultural growth providing vocational trainings to the farmers, farm women, rural youth and other field functionaries. Krishi Vigyan Kendras are mandated to perform various activities like organizing training programmes, organizing short-term and long-term training programmes and vocational courses on crops, dairying, organic farming, protected cultivation, ancillary enterprises, etc., for farmers, rural youth and women to arrange for front-line demonstrations and on-farm trials for refinement of technologies to suit to the needs of the farmers, capacity-building and to work as the knowledge and resource centres of agricultural technologies and providing farm advisory services using Information and Communication Technology (ICT) and other media means on varied subjects of interest to the farmers.

The KVKs are expected to play a decisive role in agricultural and rural development as these are grass root level organizations meant for dissemination and demonstrations of proven farm technologies. Training is an important component in the stated mandate of KVK. The training component is devised to impart new skills, improving job-efficiency in farming and to build organizational capacities of participants. The Krishi Vigyan Kendras (KVKs) have been established by ICAR under various state agricultural universities in all the states. In the furtherance of doubling the farmers' income by 2022, KVKs are expected to play a pivotal role in realization of this ambitious endeavour as these form the first-line extension system for farmers and field level extension functionaries. These KVKs have been mandated to identify technologies in terms of location-specific sustainable land use systems, organising training to update the extension personnel/ farmers with emerging advances in agricultural research on regular basis, organising training courses in agriculture and allied vocations, organizing demonstrations, etc. CSKHPKV Palampur has established eight KVKs in different districts of the state. These KVKs are serving the farming community and creating awareness through conducting demonstrations, training camps and field days/visits. However, there is dearth of systematic study to assess the impact and quantify the nature of impact in agriculture and allied sectors. The ICAR and donor agencies are also interested to know the quantitative impact of the services rendered by KVKs on technology adoption, farm production, income and overall livelihood of farmers. Therefore, this case study has been conducted to study the following specific objectives of KVK:

- To organize on and off campus training programmes for farmers, rural women, youth, and officers of the Department of Agriculture to make them aware about the latest technologies in agriculture.
- To organize short and long term vocational training courses on vegetable, floriculture, beekeeping, dairying, mushroom, organic farming and protected cultivation etc. for rural youth for self-employment.
- To arrange front-line demonstrations and on-farm trials at farmer's fields on improved technologies and refinement of existing technology so as to suit the need of the farmer.

Activities of KVK:

- On-farm testing to assess the location specificity of agricultural technologies under various farming systems.
- Frontline demonstrations to establish production potential of technologies on the farmers' fields.
- Capacity development of farmers and extension personnel to update their knowledge and skills on modern agricultural technologies.
- To work as knowledge and resource centre of agricultural technologies for supporting initiatives of public, private and voluntary sector in improving the agricultural economy of the district.
- Provide farm advisories using ICT and other media means on varied subjects of interest to farmers. (Anonymous 2019).

Keeping above background in view, the present study has been planned to analyze the impact of KVKs on adoption of farm technologies and income of farmers in Kangra district of Himachal Pradesh. This study will be a timely endeavour and relevant to improve the extension advisory network in the state.

Objectives: The broad objectives of this study are outlined below:

1. To assess the role of KVK Kangra in terms of transfer of technologies and their adoption status at farm level.
2. To examine the impact of improved practices on resource use, productivity and farm income and measures to enhance outreach of KVK.

2. REVIEW OF LITERATURE

The scientific research is based upon the knowledge and experience accumulated in the past. Learning from the past knowledge is the hallmark of the scientific investigation. It helps to ascertain the level of theoretical and empirical works that are currently being done or have been done in India and abroad on the related field. Therefore, it is of utmost importance to review pertinent literature related to the study for an insight and thorough understanding of the research problem for better precision, conceptual clarity and to design the plan of the study there on. Review of literature related to the study, therefore, becomes an imperative segment of the study for knowing the major aspects of the problem and to identify the critical gaps in the past studies so as to address these gaps in the present investigation. In this backdrop, the brief resume of the relevant research work done by various scholars across the country and abroad relating to the impact of institutions on adoption of farm technologies and income of farmers has been documented chronologically under the following sub-heads:

2.1 Role of KVKs in terms of transfer of technology

2.2 Extent of adoption of farm technology

2.3 Impact of technology on production and farm income

2.4 Problems and constraints in transfer of technology

2.1 Role of KVKs in terms of transfer of technology

Bar et al. (2005) assessed the impact of transfer of technology in four Krishi Vigyan Kendra villages in Cooch Behar district of West Bengal during 1999-2002. It was found that component-wise technology adoption was statistically significant for both wheat and mustard. Also, the farmers in the adopted villages were in the way of improvement both technically and technologically. Lack of technological knowledge resulted from poor awareness of the farmers that led to the poor adoption of few components of wheat and mustard production in the study area.

Miller and Cox (2006) studied the transfer of information from researchers to producers in a research process in Utah, USA. They examined the methods used to transfer sustainable agricultural research technology to producers. Investigators preferred to transfer research information via workshops and periodicals. Producers preferred workshops primarily for the dialogue with the other producers. On-farm demonstrations were particularly important for technology that required a drastic transition from the methods used in farm operation.

Singh et al. (2006) conducted a study in Rampur district of Uttar Pradesh, for the period 2003 to 2004 to determine the perceived characteristics and adoption levels of Krishi Vigyan Kendra trainees on different plant protection measures. They revealed that the emphasis should be given on human resource development programmes on seed treatment activities, which had direct impact on improvement of yields of various crops.

Binkadakatti (2008) conducted a study in KVK, Gulbarga district of Karnataka on use of bio-fertilizers and bio-pesticides in four taluks namely, Gulbarga, Chittapur, Aland and Sedam were purposively selected with 160 farmers (80 trained and 80 untrained farmers). The study revealed that majority of trained respondents had correct overall knowledge about improved practices of bio-fertilizers and bio-pesticides as compared to untrained respondents. The knowledge about bio-fertilizer practices (53.75% and 17.5%) and bio-pesticides (46.25% and 18.70%) in case of trained and untrained respondents, respectively.

Indu et al. (2009) evaluated farm trials conducted by Krishi Vigyan Kendra, Khagaria in two villages, namely Marar and Sabalpur of Bihar. Four trials were undertaken as source of formation for new agriculture technology, namely prevailing farmer’s practice (T1), radio (T2), television (T3) and newspaper (T4). Findings of the study revealed that ‘radio’ was the most reliable source of information for farmers than any other sources.

Kumar et al. (2009) examined Kisan Club Linkage-initiated by Krishi Vigyan Kendra, Burdwan, West Bengal for development of agriculture. The results of the study showed that the farmers' clubs constituted by KVK were engaged in distributing Kisan Credit Cards (KCCs), arrangement of quality seed/ planting material, improved implements, input supply and marketing of farm produce at remunerative price. The members of these farmers' club were working on cooperative basis and making farming a promising enterprise in the study area.

Pennobaliswamy et al. (2010) studied Krishi Vigyan Kendra (KVK) as an innovative institution established mainly to impart vocational skill training to the farmers and field level extension workers in Bangalore. They pointed out that an innovative approach for evaluation of KVKs, however, was highly essential to look for more scientific and comprehensive approach for performance assessment and suggestions for improvement. For this, they suggested to develop a scale to assess the performance of KVKs by using Logical Frame Approach (LFA) relevancy weightage test was to find out the appropriateness of items.

Ajrawat and Kumar (2012) studied the socio-economic status and level of knowledge of trainees after KVK training programme in Kathua district, Jammu and Kashmir. The investigation was undertaken among 120 on-campus trainees and 120 off-campus trainees of six selected villages. The trainees were selected randomly from each selected village. Two variables namely respondents socio-economic status and their levels of knowledge about the training programme were measured by utilizing pre-structured and pre-tested interview schedule. Findings of the study showed that 42 per cent of on-campus trainees had medium socio-economic status followed by low (35%) socio-economic status and only 23 per cent had high level of socio-economic status. However in case of off-campus trainees, 57 per cent had low socio-economic status followed by 40.0 per cent medium level and only 3 per cent possessed high level of socio-economic status. It was found that there was a significant difference between the on and off-campus trainees with regard to socio-economic status and knowledge about KVK training programmes.

Gupta and Verma (2013) studied the knowledge level of farm women. The study was undertaken with 90 farm women spread among ten purposively selected villages under five blocks under the domain of KVK, Jodhpur. The trainees were selected randomly from each selected villages. Level of knowledge about the Home Science technologies of the selected KVK and its impact were measured by utilizing pre-structured and pre-tested interview schedule. Findings of the study showed that majority of farm women (55.55%) had medium knowledge level. About 21.11 per cent of them had low knowledge level whereas 23.33 per cent had high knowledge. It was also revealed that 77.77 per cent respondents showed that KVK made an impact in the villages. The impact was seen in the programmes like smokeless chullah, supplementary nutrition, balanced diet & immunization campaigns. Some activities conducted by KVK like demonstrations, training camps and exhibitions had great to moderate impact on the respondents.

Kumari and Bangarva (2013) studied the activities of Krishi Vigyan Kendra on contact vis-à-vis non-contact farmers in Jhunjhunu District of Rajasthan. Two panchayat samities namely Jhunjhunu and Chirawa were select purposely. Three villages from each selected panchayat samiti and 60 contact and 60 non-contact farmers and six KVK functionaries were included in the sample for the study. Majority of the farmers (contact and non-contact farmers) had medium knowledge about activities undertaken by KVK. Impact of KVK in terms of knowledge level of contact farmers was found significant. It was found that the education, social participation, farm mechanization and economic motivation were associated significantly. Most important constraints perceived by the KVK functionaries in disseminating farm technology was lack of technical staff, lack of staff quarters and paucity of budget. Most important constraints perceived by the contact farmers in adopting farm technology was lack of availability of sufficient electricity while constraint perceived by the non- contact farmers was lack of information of latest farm technology.

Singh et al. (2013) conducted a study in the Krishi Vigyan Kendra, Bajura, Kullu, Himachal Pradesh in the years 2009 to 2011 to assess the impact of trainings on farmers' knowledge. The results revealed that farmers laid stress on the efficient use of water by micro-irrigation techniques followed by rainwater harvesting by constructing cemented/ poly-lined tanks, use of organic amendments of soil-water conservation, and in-situ moisture conservation techniques. Comparison of data before and after trainings revealed that there was an increase in percentage of farmers who adopted different components after completion of the trainings.

Cowan et al. (2015) examined the applicability of the induced innovation hypothesis in USA whether a change in relative input prices induced innovation to economize use of the increasingly expensive input for US public agricultural research. A reduced-form test was developed using input prices from the public research sector aimed at developing new technology to save specific agricultural inputs and variables to control for innovation marginal cost differences. Unlike demand-side studies that soundly rejected the induced innovation hypothesis for agriculture, support for the hypothesis was found for several input pairings through these tests of public agricultural research.

Singh et al. (2015) carried out a study on knowledge level and attitude of farm women training programmes under ATMA Project in district Tikamgarh of Madhya Pradesh. Four villages adopted by Krishi Vigyan Kendra, Tikamgarh during the year 2012-2013 were selected for the study. The sample consisted of 80 women trainees. The study revealed that the training programmes conducted on nursery management, animal husbandry and organic farming had been highly effective in inducing desirable changes in the attitude and knowledge level of women trainees. The study suggested that the attributes viz. family size, annual income, education, size of land holding, contact with extension agencies, scientific orientation, social participation and mass media exposure should be taken into consideration while conducting farm women training programmes.

Tandel et al. (2015) examined the extent of awareness about knowledge resource centre established by KVK, Navsari, Gujarat. Ten each adopted and non-adopted villages of Krishi Vigyan Kendra, Navsari were selected for the study. The results revealed that there was significant association between education and extent of awareness about knowledge resource centre established by KVK in adopted villages whereas, in noon-adopted villages significant association was found between education, social participation, extension participation and extent of awareness about knowledge resource centre established by Krishi Vigyan Kendra.

Hundal et al. (2016) studied the role of training in changing knowledge level among dairy farmers of Punjab. 138 farmers were interviewed with a pre-tested questionnaire before the start and after completion of training. The study revealed that 8.70 per cent, 30.40 per cent and 48.50 percent respondents were educated up to primary, matric and above matric level, respectively, whereas 12.50 per cent trainees were graduates. The awareness perceived by farmers about feeding, reproduction and disease management was higher after training. About 12.6±0.18 and 26.0±0.16 responses of farmers were found correct before and after training, respectively. Education only influenced the knowledge level of farmers regarding breeds of buffalo and cow where correct responses were higher for graduate farmers as compared to under matric ones. Therefore, it was concluded from the study that trainings played an effective tool to improve the knowledge and understanding of farmers.

Sahoo et al. (2016) conducted a study on institution based KVK intervention on promoting composite fish culture in rural Odisha. A sample of 42 fish farmers benefitted from KVK were surveyed to understand the adoption of scientific management practices, effectiveness of KVK activities and constraints faced by farmers. Majority of the farmers were of middle aged group, practicing grow-out culture by utilizing their own financial resources. The adoption was found to be higher after the intervention of KVK in the respective villages by practicing soil and water analysis, scientific stocking density, supplementary feeding techniques and other relevant practices to increase fish production. The respondents of the study perceived that the front-line demonstrations was the most effective method compared to other activities/services of KVK. Constraints faced in practicing aquaculture were high cost of feed, lack of financial support, poor retention of water in ponds, disease outbreak and issues related to lease period and value.

2.2 Extent of adoption of farm technology

Kanwar and Kherde (1997) carried out a study in Kangra district of Himachal Pradesh to assess the knowledge level of male and female respondents in paddy production practices. The results revealed that majority of the respondents were having high mean knowledge score as compared to female respondents. Variables like improved agricultural implements, informal sources of information, mass media exposure and attitude towards crop production had a positive and significant relationship with the knowledge of male respondents. However, in case of female respondents, only one variable i.e. extension contact had positive and significant relationship.

Sharma et al. (2000) assessed the extent to which trained farmers adopted recommended soybean and maize cultivation practices. They examined the relationship between the personal and socio-economic characteristics of farmers and their adoption level. Data were obtained through interviews from 70 farmers trained by Krishi Vigyan Kendra in Chhindwara, Madhya Pradesh. Results revealed that majority of the trained farmers completely adopted improved varieties, seed treatment, and cultural practices. Majority of the farmers partially adopted fertilizer application practices, while majority did not adopt plant protection measures. The study also confirmed that there was no association between the extent of adoption and farmers' age and size of land holding. On the other hand, annual income, level of education and social participation were found to be positively and significantly related to the extent of adoption of soybean and maize practices.

Singh et al. (2008) conducted a study to assess the perceived characteristics and adoption level of KVK trained trainees in vegetable crop production technology. The study was conducted during the year 2004-05 in Rampur district of Uttar Pradesh. The trained trainees were found to have high level of perceived characteristics of potato and tomato crop production technology, low level of perceived characteristics of chillies, capsicum and vegetable pea crop production technology. Krishi Vigyan Kendra trained trainees were having high level of adoption of chillies, potato and capsicum and low level of adoption in the tomato, vegetable pea and capsicum crop cultivation. The utilization of information sources were significantly associated with perception of vegetable crop production technology.

Kumbhare and Khonde (2009) studied the adoption behaviour and knowledge gain through trainings conducted by KVK. The study was conducted in seven villages of Wardha district of Maharashtra. The data were collected from 150 randomly selected farmers. The study revealed that 59 percent adopted the recommendation of KVK at medium level, whereas, other half of the sample population fell into the categories of low and high level with equal percentage i.e. 25 per cent each. The study also revealed that 66 percent respondents gained knowledge of improved practices at medium level, whereas, 20 per cent and 14 per cent respondents gained knowledge after training at low and high level respectively. The characteristics of the respondents like education, land holding, social participation, socio-economic status, and farmer's involvement in agricultural programmes were significantly correlated with the impact of KVK training on the adoption behaviour and knowledge gain of the farmers. Also the situational, psychological and communication variables showed significant relationship with the impact of training on adoption behaviour and knowledge gain.

Pandey et al. (2011) evaluated the adoption of the technologies given by KVK, Pratapgarh, Uttar Pradesh. The adoption trend was worked out with the education level of respondents. Out of 157 respondents, 35.02 per cent followed seed treatment practices, 17.69 per cent followed zero tillage technology and 16.97 per cent adopted the use of bio-fertilizers among the other agro-technologies disseminated. The adoption trend was also worked out with the education level of respondents. Active participation and adoption was found with the respondents having education above matriculation.

Sirohiya et al. (2012) examined the extent of adoption of chickpea (*Cicer arietinum* L.) production technology learnt through training programmes conducted by KVK, Jabalpur. 60 trained farmers and 60 untrained farmers from six villages were selected randomly for the investigation. The study revealed that trained farmers had higher extent of adoption of chickpea production technology and untrained farmers had medium extent of adoption of chickpea production technology.

Meena and Gupta (2013) studied about the adoption of garlic production technology. The study was carried out in Anta block of Baran district of Rajasthan. The data regarding gain in knowledge and adoption level about improved garlic production technologies were recorded under two heads i.e. knowledge before training and knowledge after training. The study revealed that farmers had gained knowledge about garlic production technology ranging from 11.70 per cent of land preparation to 80.0 per cent of seed treatment after training programmes. The study showed that none of the farmers were following the improved practices of garlic production like soil testing, soil treatment, seed treatment, seed rate and spacing before training programme whereas, after training programme, they adopted seed treatment (68.30%), seed rate and spacing (65 %), soil testing (51.70%) and soil treatment (36.70 %). The study also revealed that they were adopting the garlic production technologies ranging from 10.0 per cent of storage practices to 75.0 per cent of high yielding variety after training programmes.

Patel (2013) assessed the adoption and knowledge level of dairy farmers, performance of their dairy animals and constraints experienced by trainees and trainers in training, by interviewing 60 trainee dairy farmers, 60 non-trainee dairy farmers and 6 KVK trainers in Satna district of Madhya Pradesh. The results showed that 48.33 per cent, 48.33 per cent, 43.33 per cent and 45.00 per cent trainees had medium level of knowledge in breeding, feeding, management practices and overall improved dairy farming practices, respectively and 40 per cent trainees had low knowledge in healthcare practices. However, non-trainees had 50 per cent, 60 per cent, 56.67 per cent, 56.67 per cent and 53.33 per cent low level of knowledge in breeding, feeding, healthcare, management practices and overall improved dairy farming practices, respectively. High cost of commercial feed and low price of milk, inadequate availability of land for green fodder cultivation and repeat breeding problem were the serious constraints faced by dairy farmers in effective use of trainings conducted by KVKs in the study area.

Rathod et al. (2013) assessed adoption level of seed treatment in soybean. The study was conducted in Wardha district of Maharashtra where front line demonstrations on seed treatment in soybean were conducted by KVK on farmers' fields. It was found that seed treatment in soybean gave 56.93 per cent more yield as compared to untreated seed. Over 90 per cent respondents accepted that it met the felt need of farmers. All farmers stated that seed treatment was easy to understand and perform. Effect of technology was found visible to 100 per cent farmers. Regarding the impact on adoption, most of the respondents (68%) accepted the technology but were not able to adopt due to non-availability of planting material. Farmers gave feedback that with the low cost inputs, technology was very effective to increase the yield of soybean (100%) but the bio-products are not readily available in local area (100%). In the relational analysis, relative advantage and observability were positive and highly significant with the adoption of seed treatment whereas, complexity was negatively correlated with the adoption.

Sarada and Kumar (2013) examined the extent of knowledge and adoption of recommended production technology by cotton farmers. The study was conducted in Prakasam district of Andhra Pradesh, during 2011-12 to assess knowledge and adoption levels of cotton farmers. The data were collected from 120 cotton farmers distributed in 6 adopted villages of Krishi Vigyan Kendra. The study revealed that the majority of cotton farmers had good knowledge and high adoption levels on recommended Bt hybrids (100%), suitable soils (71.67% & 58.33%), sowing time (93.33% & 84.17%), seed rate and spacing (88.33% & 76.66%) and timely intercultural operations in cotton cultivation (81.67% & 71.67%). Whereas, those with the poor knowledge, adoption on fertilizers management, herbicides and need based pest management was low. The major constraints encountered by them were high cost of Bt cotton seed (100%), high cost of fertilizers and pesticides (95%), low market price (93.33%), more infestation of sucking pests (89.16%), inadequate capital (85%), lower yields (82.50%), and micro nutrient deficiencies (81.67%).

Biswas et al. (2014) evaluated ex-trainees of KVK for technology transfer and adoption of improved farming practices in Dinajpur district of West Bengal. They revealed that KVK primarily acted on lab to land technology delivery mechanism and worked through imparting training to rural stakeholders on improved farming practices. They revealed that majority of ex-trainees belonged to the category of small farmers group, young in the age of 20-30 years and belonged to low income group, scheduled caste category. Cultivation was the main occupation of majority of stakeholders to maintain their livelihood security. The study also showed that awareness generation through vocational trainings by KVK on various improved farming practices was efficiently done and all the imparted technologies were adopted by the stakeholders.

Krishnamoorthy (2014) conducted a study on enhancing flower productivity during off-season in jasmine (*Jasminum sambac*).The study was undertaken under Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vamban, Pudukkottai during 2009-2010 and 2010-2011. The treatments were T1 - pruning during November last week at 50 cm height and pinching after three months, T2 - pruning during July month followed by spraying of 2 per cent humic acid at 15 days intervals, T3 - pruning during July month and spraying of nitrobenzene 20 per cent @ 2.5ml/l along with tricontanol 0.2 per cent during November-April once in fifteen days. The variety under study was Ramanathapuram local and age of plant was five years old. Spraying of nitrobenzene 20 per cent @2.5ml/l along with tricontanol 0.20 per cent once in 15 days during November-April followed by pruning during July month recorded highest number of flower bearing shoots, number of leaves, flowering days, number of flowers, flower yield per plant, flower yield per hectare and benefit-cost ratio (2.85:1).

Kumar et al. (2014) conducted a study of small and marginal goat farmers to analyze the extent of adoption of improved and recommended technology by KVK in five blocks of Namakkal district of Tamil Nadu. Data regarding gain in knowledge, adopted level about improved livestock technologies in goat rearing and feeding of *Azolla* were recorded before and after training. The study indicated that very few farmers knew about the scientific method of goat rearing and *Azolla* feeding before training programme whereas, after training programme, farmers adopted the improved technology 78.30 per cent in housing, 70 per cent in breed awareness, 61.50 per cent in vaccination, 55 per cent in deworming, 69 per cent in green fodder production, 50 per cent in concentrate feed, 52 per cent in mineral mixture, 47 per cent in flushing and 35.50 per cent in azolla feeding. The overall adoption measure of technology by the farmers indicated that training had a significant impact in the uptake of new technologies.

Alagukannan et al. (2015) conducted a study to ascertain the knowledge gain and adoption level of technologies demonstrated through various interventions by KVK in Tuticorin district of Tamil Nadu. The data were collected through personal contacts (interview) with well-designed questionnaires. The data revealed that the gain in knowledge was more than 50 per cent for technologies like foliar application on banana (73 %), use of bunch cover (63%), drip irrigation (62%) and application of *Pseudomonas* (54%). Similarly, foliar application and soil application of neem cake and furadan recorded the highest extent of adoption, 66 and 53 per cent, respectively. This could be due to the easiness and effectiveness of technologies in field application and yield enhancement.

Rao et al. (2016) assessed the knowledge and adoption of improved production technologies of groundnut in Telangana. The KVK, Karimnagar, Telangana disseminated the improved groundnut production technologies to the farmers of district through village adoption, technology assessment, refinement, demonstrations and farmer field schools. An analysis was done in 15 adopted villages and 15 non-adopted villages to assess the increase in knowledge and adoption of groundnut technologies. The results indicated significant differences in level of knowledge and extent of adoption between farmers of KVK-adopted villages and non-adopted villages. The knowledge scores were high in 48 per cent of farmers from adopted villages whereas high knowledge scores were observed in 23 per cent of farmers from non-adopted villages. The extent of adoption was high in 45 per cent of farmers from adopted villages, whereas it was 27 per cent from non-adopted villages.

Reghunath and Kumar (2016) conducted a study in Kannaur district of Kerala to identify the perception of farmers on Innoavtions in Technology Dissemination (ITD) methods implemented by Kannaur Krishi Vigyan Kendra (KVK). They revealed that ITD was a part of agricultural extension system, concerned with transmitting information and knowledge of important agricultural technology from research to farmer. Majority of the farmers had medium level of perception on ITD methods followed by low level of perception.

Sharma et al. (2016) analysed the impact of trainings conducted by CSK HPKV on protected cultivation of vegetable crops in Bilaspur, Kangra, Kullu and Sirmaur districts of Himachal Pradesh during 2016-17. The results of the study showed that there was considerable improvement in the awareness level and adoption of recommended management practices after imparting training to the farmers. The considerable improvement was observed in the adoption of proper plant spacing, training/ pruning and environment management. They used Cobb-Douglas production function to quantify the contribution of training and revealed that area under protected cultivation, fertigation dose, labour and trainings were major factors in increasing polyhouse income.

Devi et al. (2017) assessed the impact of trainings and front-line demonstrations in black gram (*Vigna mungo*) cultivation. The study indicated that low, medium, and high level of knowledge after intervention of Krishi Vigyan Kendra was found to be 7 per cent, 51 per cent and 42 per cent, respectively. Highest knowledge regarding selected scientific innovations was found for irrigation management (63%), weed management (57%), integrated nutrient management (54%) integrated pest management (35%) and disease control (30%). The technology index indicated that there was feasibility of evolving technologies at the farmer's field.

Meena et al. (2017) studied the performance of FLDs (Front-Line Demonstrations) by KVK, Anta-Baran, Rajasthan on black gram in Hadauti region of Rajasthan. The extent of adoption level was recorded under two heads like; adoption before conducting and after conducting FLD. It was observed that there was 35.71 to 48 per cent increase in grain yield over local check and the average benefit-cost ratio was higher under demonstration as compared to control plots during the all years of study. The findings of the study also revealed that the increase in adoption level ranging from 13.34 per cent of storage & marketing to 56.19 per cent of improved and quality seed after conducting the FLD programmes. The majority of the respondent farmers expressed medium (51.43%) to the high (33.33%) level of satisfaction for extension services and performance of technology under demonstrations. The yellow mosaic virus and other diseases, high infestation of insect-pest, non-availability of improved and quality seed, lack of knowledge about black gram production technology and low income crop as compared to other regional crops were most important constraints in adoption of black gram production as perceived by the respondents.

Singh et al. (2018) carried out a study in Hindaun block of Karauli district of Rajasthan to analyse the extent of adoption of improved technology. The Hindaun block was purposively selected because of large number of farmer participation in KVKs training programme. The data regarding gain in knowledge and adoption level about improved guar (cluster bean) production technologies were recorded under two heads like; knowledge before training and knowledge after training. The findings of the study revealed that farmers gained knowledge about cluster bean production technology ranging from 13.75 per cent of land preparation to 70 per cent of high yielding varieties after training programmes. The study revealed that none of the farmers were following the improved practices of cluster bean production like soil testing, soil treatment, seed treatment, seed rate and spacing before training programme, whereas after training programme they were adopting seed treatment (86.25%), seed rate and spacing (62.50%), soil testing (52.50%) and soil treatment (36.25 %).

Guleria et al. (2019) evaluated the medium lift irrigation project in Bilaspur district of Himachal Pradesh. The study was carried out to examine the positive as well as negative aspects perceived by beneficiaries in the area. A sample of 90 beneficiary and 60 non-beneficiary farmer households was analyzed. It was found that there was still substantial adoption gap in the full adoption of scientific practices by both beneficiary and non-beneficiary farmers. However, after irrigation project, majority of the beneficiary farmers started adopting HYV seeds and proper irrigation scheduling for crops.

2.3 Impact of KVKs on production and farm income

Masanta and Biswas (2009) studied the effect of various nutrient management practices on productivity, soil fertility status and water use efficiency of french bean grown under homestead condition in Nadia district of West Bengal. The investigation was undertaken during the year 2007-08 to 2008-09 in an instructional farm of Nadia Krishi Vigyan Kendra as well as in farmer's field under the jurisdiction of Nadia Krishi Vigyan Kendra. The results revealed that integrated nutrient management approach like fertilizer management with organic manure as well as seed inoculation with *Rhizobium* culture along with 75 per cent of recommended dose of fertilizer increased the fresh pod yield, water use efficiency, economic returns and build up the soil fertility status by improving physio-chemical properties of soil significantly over the control plot where only chemical fertilizer was used.

Sharma et al. (2011) carried out impact assessment of wheat research in Himachal Pradesh and the contribution of CSK HPKV. Based upon the field survey of 20 villages in Kangra and Mandi districts, they found that wheat varieties HPW 184 and HPW 155 not only gave higher yields but were resistant to yellow rust and hill bunt. The overall returns on R&D investment came out to be Rs. 13.35 crores with benefit-cost ratio of 1.84. The adoption rate of these varieties was about 18 per cent. The gain could be enhanced provided these varieties are adopted on a large area.

Bairwa et al. (2012) estimated the yield gap through Front Line Demonstration in rapseed-mustard under tribal belt of Rajasthan. The study was carried out during rabi season 2006-07 to 2009-10 at farmer's field of five adopted villages of Dungarpur district. The results revealed that maximum seed yield was recorded during *rabi* 2007-08 with an increase of 40 per cent over local check. Improved variety (Bio 902) of rapeseed-mustard resulted in higher seed yield during four years of study ranging between 38.14 to 51.04 per cent more over local check. Recommended packages and practices of rapeseed-mustard gave higher value of yield attributes, net returns and B: C ratio as compared to local check over the years of study.

Chauhan (2012) examined the yield gap regarding scientific practices learnt through trainings and front-line demonstrations of chick pea (*Cicer arietinum*). The study was undertaken in Tapi district of South Gujarat. The results regarding overall knowledge of chick pea indicated that the low, medium and high level of knowledge before contact with KVK was 78 per cent, 16 per cent and 6 per cent, respectively and it was changed up to 8 per cent, 10 per cent and 82 per cent, respectively after contact with KVK. Regarding selected scientific innovations in chick pea knowledge level of found 87 per cent regarding new high yielding varieties, 8 per cent for integrated nutrient management, 81 per cent land configuration and 78 per cent seed rate, respectively. Majority of the farmers had low level of knowledge (76%) before contact with KVK. After contact with KVK, 84 per cent of the farmers had high level of knowledge. The 89 per cent of the farmer had adopted new high yielding variety followed by land configuration (85%), INM (83%), seed rate (82%).

Thakur et al. (2012) conducted a study in Himachal Pradesh to evaluate the impact of scientific technologies developed by CSK HPKV, Palampur. Based upon the field survey of 20 villages in Kangra and Mandi districts, it was found that wheat and rice varieties developed by CSK HPKV not only gave higher yields over common varieties both irrigated and unirrigated conditions but were also found resistant to diseases. Major interventions suggested were supply of certified seeds, efficient irrigation and water management, adoption of improved practices and nutrient management. The dairy keepers who were provided training by the university had good progeny of crossbred cows with higher productivity as compared to the non-beneficiary farmers.

Chauhan et al. (2013) conducted impact analysis of Front Line Demonstrations (FLDs) on gram (chickpea) in Shivpuri District of Madhya Pradesh. The KVK, Shivpuri conducted 116 Front Line Demonstrations (FLDs) on gram in six villages during 2007-08 to 2011-12 in *rabi* season. The study revealed that there was an appreciable increase in yield level ranging from 20.91 to 31.30 per cent in the demonstration plots of chickpea during years under study. Adoption of improved technology had significant impact on yield. Improved technology enhanced chickpea yield from 300 kg/ ha to 500 kg/ ha as compared to farmers practice with an overall increase of 28.18 per cent.

Lal et al. (2013) examined the effect of technological interventions on cumin yield at farmers' fields in Pali district of Rajasthan during rabi season of 2012-13. Front line demonstrations were carried out on cumin consisting two important varieties (GC-4 and RZ-209) with the scientific interventions *viz.*, line sowing, seed treatment (Bavistin @ 2.5 g/kg seed and *Trichoderma viride* @ 4 g/kg seed, to protect from soil born fungi) and application of recommended doses of nutrients (40 kg/ha each N and P) for balanced nutrition with appropriate plant protection schedule (two sprays of Malathion @ 0.2%, two sprays of dithane M-45 @ 0.2% and one spray of karathane @ 0.1%). Study revealed that overall 39.82% yield was increased over farmers' traditional practice under the FLD of improved variety with the technological interventions with the yield of 625 kg/ha. The overall average additional returns of Rs. 23075/ha was obtained under the demonstration fields with the maximum additional returns of Rs.26000/ha obtained due to higher grain yield.

Kumar et al. (2014) assessed yield gap and economics of chick pea cultivation in low hills of Himachal Pradesh. As many as 96 front line demonstrations were organized by KVK, Bilaspur. The yield performance, yield gap, technology gap, extension gap and technology index were analyzed for demonstration and control plots. The results revealed higher yields in demonstration plots than control plots. A technology index of 23.21 per cent was recorded in chick pea cultivation.

Singh et al. (2014) assessed the technological intervention for reducing the yield gap of chick pea (*Cicer arietinum* L.) in Sidhi district of Madhya Pradesh. Krishi Vigyan Kendra, Sidhi during 2007-2008 to 2009-2010 in three villages of Sidhi district. The highest grain yield (15.32 q/ha) was recorded in variety JG-226 during the year 2008-2009. In front line demonstration, it was 92.7 per cent higher yield over the farmers practice (7.95 q/ha), however, the lowest yield (10.20 q/ha) was recorded in FLD and 6.8 q/ha in farmers practice during the year 2007-2008. The average yield of chick pea increased by 62.42 per cent over farmers' practice, while the year-wise variation in yield increase was 49.8 to 92.7 per cent. The variation in per cent increase in the yield was found due to the lack of knowledge, and poor socio economic condition.

Karabhantanal et al. (2015) studied the impact of frontline demonstrations on integrated crop management in rainfed onion. Front line demonstrations on Integrated Crop Management (ICM) in rainfed onion with farmer participation were conducted in Bijapur district of Karnataka for three years during 2009-10, 2010-11 and 2011-12.

The results indicated that the average technology gap was highest in farmer's practice (43.33q/ha) compared to Integrated Crop Management demonstration plot (34.33q/ ha). The average technology index was lower in Integrated Crop Management plot compared to the check plot. Whereas, average adoption index was higher in Integrated Crop Management plot compared to the check plot. The increment in yield over check was 13.48 per cent. Improved practice (Integrated Crop Management) recorded higher net profit of Rs. 50653 with benefit cost ratio of 5.19 as against farmer practice wherein, the net profit was Rs. 43933 with B: C ratio of 4.4.

Meena et al. (2016) studied the performance of wheat variety Raj 4037 recommended through FLDs in Hadauti region of Rajasthan. FLDs on wheat were conducted by KVK, Anta-Baran, Rajasthan. The yield and economic performance of frontline demonstration, horizontal spread of technology, extent of adoption level and the extent of satisfaction level of respondent farmers over extension services and performance of demonstration was measured. It was observed that there was 11.47 to 16.26 per cent increase in grain yield over local check and the average benefit-cost ratio was higher under demonstration as compared to control plots during the all years of the study. It was estimated that the horizontal spread of Wheat Raj 4037 variety was from about 100 ha during 2008-09 to 1.32 lakh ha during the year 2014-15. It was concluded that frontline demonstration conducted under the close supervision of scientists was the important tool for extension to demonstrate newly released crop production and protection technologies.

Schimmelpfennig and Ebel (2016) studied cost savings from precision agriculture technologies on US corn farms. They revealed that the precision agricultural technologies (PA) technologies can decrease input costs by providing farmers with more detailed information and application control but adoption had been sluggish, especially for Variable-Rate Technologies (VRT). Combinations of PA technologies were considered as complements. They observed several patterns of PA technology adoption that showed different levels of costs. Also, VRT contributed additional production cost savings when added to soil mapping but not when done with yield mapping alone.

Thakur at al. (2016) studied the economic impact of front line demonstrations on cereal and pulse crops in Godda district of Jharkhand. Farm Science Centre known as Krishi Vigyan Kendra laid down front line demonstrations on maize, paddy and pigeon pea by introducing some new varieties and applying scientific practices in their cultivation. The productivity and economic returns of maize, paddy and pigeon pea in improved technologies were calculated and compared with the corresponding farmer's practices (local checks). All the three crops recorded higher gross returns, net return and benefit cost ratio in improved technologies as compared to the plots where farmers were using traditional practices in their cultivation. It was suggested that location-specific integrated approaches would be needed to bridge the productivity gap of the cereals and pulses grown in the district.

Ratna and Sharma (2017) examined the growth of dairy sector and quantified the impact of R&D investments in dairy sector in Himachal Pradesh by using structural growth model, decomposition analysis and economic surplus approach. The study revealed that milk yield of cow and buffalo increased significantly in the state over the years. The results of decomposition analysis of growth showed that increase in the milk production was more due to yield effect rather than population effect. The regression analysis revealed that 1 per cent increase in number of crossbred cows and artificial insemination would increase the total milk production by 0.64 and 0.90 per cent, respectively.

Acharya et al. (2018) examined the profitability of mushroom growers in Angul district of Bhubaneswar. Krishi Vigyan Kendra, Angul conducted 16 training programmes, 8 demonstrations including 78 beneficiaries, entrepreneurs meet, field days, exhibitions, mushroom *melas* etc over last 5 years covering technical, financial and marketing aspects of mushroom cultivation. In the year 2016-17, the mushroom production increased gradually and reached to 1288 MT and proved to be a promising enterprise for the district. Initially, 12 units were established with the adoption rate of 10 per cent in 2011 and later on increased to 72 units with adoption rate of 52 per cent. It was found that the perishable nature of commodity (60%) and non-availability of quality spawn (55.80%) were the main problems for entrepreneurship in mushroom farming.

Dhakad et al. (2018) studied the impact of Front Line Demonstrations (FLDs) on yield and economics of chick pea in tribal area of Madhya Pradesh. The study was carried out in *rabi* seasons in Madhya Pradesh during 2010-11 and 2011-12. It was revealed that the FLD recorded higher yield as compared to farmer’s local practice. It was found that the improved technology gave better gross returns, net returns with high benefit-cost ratio.

Singh et al. (2018) studied the effectiveness of trials and demonstrations on area and productivity of major crops in Morena district of Madhya Pradesh. The demonstration and awareness about the use of seeds of improved variety was found to be effective to improve the crop yield. The cultivated area and production of the crops recorded were found to be increased from 2012-13 to 2016-17 in the district before and after the dissemination and adoption of technology. Thus, on-farm trials and demonstrations were helpful in increasing the cropping intensity and yield potential (area) per ha to a great extant with increase in the income level of the farming community.

2.4 Problems and constraints in transfer of technology

Thakur and Sharma (1994) identified the constraints and suggested pertinent solutions to improve hill farming systems. They pointed out that lack of irrigation, low productivity of high yielding varieties (HYVs), low use of fertilizers, and bottlenecks in input supply and marketing system were responsible for sluggish growth in food grain production in Himachal Pradesh.

Lal and Kumar (2007) studied about the training needs of vegetable growers in Hamirpur district of Himachal Pradesh. The relevant data from 120 respondents were collected through personal interview techniques. Results of the study revealed that vegetable growers required high extent of training in improved seed and plant protection measure areas of vegetable cultivation. However, medium extent of training was required in manure and fertilizer management, sowing of crops, weed management, transplanting of seedlings and miscellaneous area. There was negative significant correlation between training needs of respondents with their socio-economic status, social participation, and knowledge of vegetable farming.

Pattnaik and Mishra (2008) examined the constraints in adoption of mushroom cultivation technology in Kendrapara district of Orissa. The sample consisted of 120 rural women adopted mushroom cultivation technology. The constraints as expressed by rural women were that mushroom was highly perishable, lack of marketing facility, infected spawn, non-possession of technological knowledge , low risk-bearing capacity, lack of technical guidance, lack of flow of information, lack of subsidy, lack of transport facilities.

Badodiya et al. (2011) conducted a study on organic farming in Morar block of Gwalior district. The total of 120 trained farmers were selected for the study. Only 7.50 per cent of the respondents had high perception in organic farming before participation of training and after the participation of training the figure increased up to 26.67 per cent. All the selected attributes of the trained farmers, except age, caste and size of family were found to have significant relationship with their perception of organic farming. High cost of inputs & difficult methods for preparation were major constraints experienced by the farmers.

Madhavan et al. (2016) conducted a study to identify the constraints faced by extension personnel in transfer of technologies and to know the suggestions for improvement of their work performance. A sample of 96 agricultural scientists was selected. It was observed that agricultural scientists faced most severe constraints of input supply, administrative aspects, social constraints and general constraints. Results revealed that majority of agricultural assistants faced medium level of constraints. Provision of training on advanced technologies was suggested by scientists.

Patel et al. (2016) assessed the constraints of extension personal in transferring of dairying technologies in Karnataka during 2014-15. A sample of 120 extension personnel from department of animal husbandry and veterinary services and Karnataka Milk Federation (KMF) was selected. The study revealed that major technological constraints expressed by respondents were, lack of appropriate technologies for transfer of technology followed by lack of participation of farmers in transfer of technology. In case of physical constraints, poor infrastructure facilities and lack of input supply for programmes implementation were important constraints. Inadequate staff strength and lack of proper policy transfer were main organizational constraints. The perceived communicational constraints included lack of access to research publication for field work and poor research-extension-farmer linkage and inadequate requirement benefits and unsatisfactory salary compared to work load were the important economic constraints.

Singla and Goel (2016) studied the socio-economic conditions and the constraints faced by farmers in cultivation of mushroom. The study was conducted on rural women of Patiala, Punjab. The study revealed that 72 per cent of women mushroom growers had improved their occupation followed by improvement in standard of living (64%), better saving (60%), knowledge and attitude (52%) and social status (24%). As perceived by the farm women, they faced the maximum constraints in value added items and minimum in lack of awareness in mushroom cultivation. Eighty eight per cent of the respondents stated that untimely supply of quality spawn and high cost of cultivation were the major constraints for successful mushroom entrepreneurship.

Nayaka et al. (2017) analyzed the constraints faced by farmers in adoption of INM in okra. The investigation was carried out to find out the effect of integrated nutrient management on growth and yield of okra, using high yielding variety in Navsari district of Gujarat. The KVK, Navsari demonstrated INM in okra in tribal area. Since five years, about 525 FLDs on INM okra were under taken. To know the impact of INM technology along with the constraints faced by the tribal farmers the attempt were made. FLDs on INM demonstrations have covered the way of healthier, long, least cost and sustainable production with maintaining the soil health. The results indicated that low, medium and high level of knowledge before contact with the KVK was 58 per cent, 33 per cent and 09 per cent, respectively. It was altered up to 21 per cent, 56 per cent and 23 per cent, respectively after contact with the KVK.

The foregoing review of different studies revealed the role of KVKs in transfer of farm technologies and augmenting farm production and income. Various studies have been conducted with a view point of extension advisory perspective. But, there are few studies to quantify the economic benefits accruing to farmers from the services provided by KVKs. There is also a need to study the impact of KVK trainings on management practices and the effect on the yield therefrom. It is also found that there has been no systematic study particularly in Himachal Pradesh to analyze the output/ outcome of KVKs. Thus, this study will be useful to fill this gap and assess the performance of a KVK through the case study.

3. MATERIALS AND METHODS

A sound methodology plays a vital role in the scientific investigation. Reliability and precision of the findings depends upon the methodology adopted. Materials and methods used directly influence the validity of research findings. A detailed description of the methodological procedure adopted to accomplish the objectives of the study along with the selection of study area, sampling design, analytical framework and tools employed to interpret the results of study. This chapter has been systematically described in following different sections:

3.1 Selection of study area

3.2 Sampling design

3.3 Data collection

3.4 Analytical framework

3.5 Limitations of study

3.1 Selection of study area

The present study was conducted in Kangra block of Himachal Pradesh. The aim of the study was to examine the adoption level of trainings provided by KVK to farmers and to study their impact on farmers' income. Therefore, the present study has been conducted in the command area of KVK, Kangra under CSK HPKV, Palampur. Fig. 3.2 and 3.3 show the map of different districts and location of study area (Kangra block).

3.2 Sampling design

Two stage stratified random sampling design was employed to select the villages and farm households in Kangra block. In the first stage, 6 villages (3 adopted by KVK for transfer of technology and 3 non-adopted) were selected randomly from Kangra block. To examine the impact of KVK, two groups of farmers were formed; one the beneficiaries (who have been provided KVK trainings/ services) and the other non-beneficiaries (who have not received KVKs trainings/ services). A sample of sixty farmers was selected randomly comprising 30 from intervention (beneficiaries) group and 30 from control (non-beneficiaries) group. Sampling plan has been presented through Fig. 3.1.

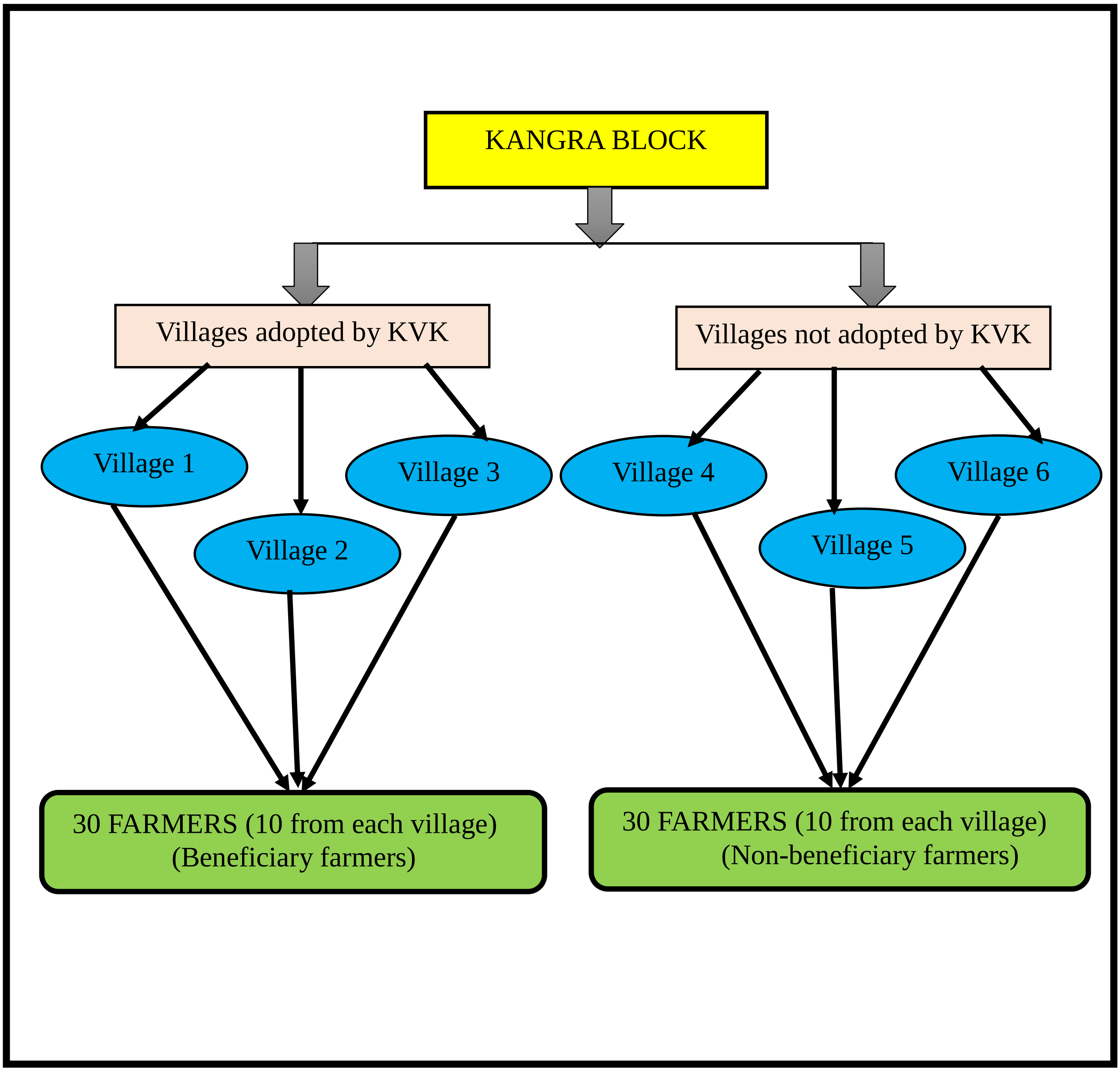

Fig. 3.1 Flow diagram showing sampling plan

Study area map:

Fig. 3.2 Map of Himachal Pradesh showing different districts

Fig. 3.3 Map of Kangra district showing Kangra block (study area)

Data collection

Keeping in view the objectives of study, both primary and secondary data were collected. The primary data for the present study were collected from sample farmers on well-designed schedules. Survey schedule has been presented in Appendix I. Secondary data were collected from Annual Reports of KVK, extension officials and scientists serving in the KVK Kangra.

Primary data

The primary data were collected from the sample households. Primary data from sample farmers were collected using survey schedules prepared on the aspects of:

Demographic parameters - age, family size and structure, sex ratio, education and occupation

Farm physical inventories - farm buildings, land holdings, farm machinery and implements, livestock inventory, etc.

Farm resource utilization - cropping pattern, input use pattern and farm labour

Farm production - crop yields, animal productivity and production, and production of other enterprises.

Economic aspects - cost of inputs, wages, prices of products/ by-products, income from farm and non-farm sources.

Technological impact - perception and adoption of technical management practices.

Problems and constraints faced by farmers.

Secondary data

The secondary data were collected from KVK, Kangra and various published sources like Statistical Outline of Himachal Pradesh 2017-18, Statistical Abstract of Himachal Pradesh, 2017-18 and Annual Season and Crop Report, 2010-11. The data from KVK, Kangra were collected on the following aspects:

- Background of KVK Kangra
- Activities of KVK Kangra for improving farm production/ income.

- Role of KVK and inputs/ services provided to farmers.
- Awareness level and extent of adoption of improved technology in crops and livestock production.

3.4 Analytical framework

The primary and secondary data collected were tabulated and classified for further analysis. In order to achieve the objectives of study, the tabulated data were further analyzed by tabular and statistical methods.

Tabular method

The primary data collected on survey schedules were tabulated to work out averages, indices, ratios and percentages. Tabular technique was employed to study family structure, demographic features, cropping pattern, input-use pattern, crop production and yields, livestock production and production of other enterprises. The following concepts were used to derive the results:

Cropping intensity: Cropping intensity is the index of multiple cropping on farm.

$$\text{Cropping intensity (\%)} = \frac{\text{Total cropped area}}{\text{Net sown area}} * 100$$

Technological gap: The technological gap is the gap between actual input use and recommended input use.

$$\text{Technological gap (\%)} = \frac{A_i - R_i}{R_i} * 100$$

where, A_i = Actual use in quantity of i^{th} input

R_i = Recommended quantity of i^{th} input

The information on recommended technology of crops was taken from the Package of Practices (*Kharif*, *Rabi* and Vegetable crops) published by CSK HPKV, Palampur.

The costs and returns for major crops grown in study area were estimated by taking into consideration the variable cost of cultivation. The variable cost of cultivation was estimated for major crops by taking following items into consideration:

1. Value of seed or planting material
2. Value of FYM

3. Value of fertilizers
4. Value of plant protection chemicals
5. Charges on bullock labour and owned/ hired machinery
6. Wages of human labour
7. Interest on working capital @ 8 per cent per annum for half of the crop period

Total variable cost (excluding family labour) = Total of all actual expenses in cash and kind incurred in production of crops + interest on working capital

Total variable cost (including family labour) = Total of all actual expenses in cash and kind incurred in production of crops + imputed wages of family labour + interest on working capital

The gross returns (per hectare) for major crops was worked out as under:

Gross returns = $Y_m * P_m + Y_b * P_b$

where,

Y_m = Yield of main product

P_m = Price of main product

Y_b = Yield of by-product

P_b = Price of by-product

Net returns over variable cost = Gross returns – total variable cost

Statistical Analysis

Mean difference: Mean difference was computed to examine the difference between different parameters realized on beneficiary farms and non-beneficiary farms to know the impact of KVK. To test the significance, t-test was employed for mean differences of two samples, *viz.*, beneficiaries and non-beneficiaries. To check the equality of variances of two independent samples, F-test was employed as:

$$F = \frac{S_i^2}{S_j^2}$$

where, S_i^2 = Larger variance out of the two samples

S_j^2= Smaller variance out of the two samples

Sample variance (S^2) was computed as;

$$S^2 = \frac{1}{n-1}(x - \bar{x})^2$$

where, S^2 = Variance of sample observations

n = Number of sample observations

x = Sample observations

$\bar{x}$ = Mean of sample observations

The significance of F shows unequal variances of the crop productivity on two sample farms. Thus, t-test was employed as:

$$t_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

To check the significance, t was computed (as theoretical t value is not applicable to independent samples of this nature). The formula used for t_{tab} is as follows:

$$t_{tab} = \frac{\frac{S_1^2}{n_1}(t_{n_1} - 1) + \frac{S_2^2}{n_2}(t_{n_2} - 1)}{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

where, $\bar{X}_1$= Mean of sample observations on beneficiary farms

$\bar{X}_2$= Mean of sample observations on non-beneficiary farms

S_1^2= Variance of sample on beneficiary farms

S_2^2= Variance of sample on non-beneficiary farms

n_1 = Number of sample values on beneficiary farms

n_2 = Number of sample values of non-beneficiary farms

$t_{n_1} - 1$= theoretical value at n_1-$_1$ degrees of freedom

$t_{n2} - 1$= theoretical value at n_2-$_1$ degrees of freedom

Herfindahl Index: It is the sum of squares of the proportion of individual crop grown on a cropped area. With an increase in the diversification, the sum of squares of the proportion decreases and index also decreases. Halagundegowda et al. (2015) measured the extent of shift in cropping pattern in different agro-climatic zones of Karnataka. The mathematical formula for calculating the index is as follows:

Herfindahl Index = $\sum p_i^2$

where, $p_i = A_i / \sum A_i$ which is, proportion of i^{th} crop ($\sum A_i$) in cropped area

Simpson Index: Simpson index of diversification is used for measuring the dispersion of crop/ enterprise in a particular cropped area. The mathematical formula for calculating the index is as follows:

Simpson Index = $1-\sum p_i^2$

where, $p_i = A_i / \sum A_i$ which is, proportion of i^{th} crop in cropped area

Entropy Index: Entropy Index constitute a positive measure of diversification. The entropy index is feasible direct measure of diversification having a logarithmic character. The entropy index increases with an increase in diversification and vice-versa. The entropy index can be calculated with the formula:

Entropy Index = $\sum_i p_i * \log (1/p_i)$

where, p_i = the proportion of i^{th} crop

Principal component analysis

Principal component method was used as a tool of data reduction and computation of management indices. Based upon the status of adoption of different components of technologies, technology index was computed using the PCA method (Pennobaliswamy 2010). The management practices for crops and livestock are enlisted hereunder in Table 3.1.

Table 3.1 Management practices for crops and livestock

Cereals and vegetables	Livestock management
Timely sowing	Housing
Line sowing/transplanting	Lighting
Recommended seed rate	Recommended green fodder
Recommended spacing	Recommended dry fodder
Recommended FYM	Recommended concentrates
Basal NPK	Recommended mineral mixtures
Split dose of fertilizers	Dehorning
Recommended use of weedicides	Deworming
Hand weeding	Daily cleaning and washing
Proper irrigation scheduling	Water trough availability
Recommended pesticides/ insecticides	Washing before milking
Other specific operations:	Control of ectoparasites
Earthing up	Adopting artificial insemination
Staking	Proper sanitation and hygiene
Rouging	

Technology index was calculated as:

$$P_i = \sum_{j=1}^{n} a_{ij} x_j$$

where, P_i = Principal components (i= 1,2,………..m)

a_{ij} = Loadings of j^{th} technology on i^{th} principal component (j= 1,2,………..n)

x_j = Measure of i^{th} component technology/practices based on contribution to component variability

The technological index score (TIS) was computed as:

$$TIS = \sum_{i=1}^{m} w_i P_i$$

where, w_i = Weight assigned to i^{th} principal component on the basis of per cent variation to total variation (i= 1,2,……m)

TIS = Technological index score

$$MI = \frac{\text{Actual TI} - \text{Minimum TI}}{\text{Maximum TI} - \text{Minimum TI}} * 100$$

where, MI = Management index in the study area

The composite technological adoption/management index for a crop/enterprise group (cereal crops, vegetable crops and livestock, etc.) was computed as follows:

$$CMI = \sum p_j * MI_j$$

where, CMI = Composite management index of enterprise group under consideration,

p_j = Proportion of j^{th} enterprise in a group and MI_j is the management index of j^{th} enterprise computed through principal component method as above.

According to technological management index, respondents were categorized into four adoption categories i.e. high (above 75%), moderate (50-75%), low (25-50%) and very low (below 25%) adoption.

Regression analysis:

Both linear and Cobb-Douglas type of production functions were tried to study the factors affecting the adoption behaviour of improved management and the factors affecting productivity of crops, dairy animals and farm income. But, on the basis of goodness of fit (R^2), linear regression model was found to be better fit. The coefficient of multiple determination (R^2) was calculated to examine 'goodness of fit' of regression model. The adjusted R^2 was worked out to avoid the influence of number of variables on goodness of fit. ($\bar{R}^2$) Adjusted R^2 tested with the help of F-test as under:

$$F_{(K-1,N-K)} = \frac{\bar{R}^2}{1-\bar{R}^2} * \frac{N-K}{K-1}$$

where, N = number of observations

K = Number of parameters estimated from the model

And was compared with theoretical F-value at selected significance level (1% or 5%).

To study the factors affecting management and impact of KVK, the following regression model was used:

$$MI = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u$$

where, MI = Management index derived through PCA given earlier

X_1 = Age of respondent (years)

X_2 = Farming experience (years)

X_3 = Number of schooling years

X_4 = Dummy variable (1 for beneficiaries, 0 otherwise)

u = Random term

b_0 = Intercept

b_1, b_2, b_3 and b_4 are the regression coefficients showing change in management index as a result of unit change in corresponding explanatory variables.

Factors affecting productivity and the impact of KVK for different crops were also studied by carrying out the regression analysis. The linear regression model specified as under:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u$$

where, Y= Productivity of crop (q/ha)

X_1 = Seed quantity (kg/ha)

X_2 = Per cent irrigated area under crop

X_3 = Fertilizer consumption (kg/ha)

X_4 = FYM (q/ha)

X_5 = Dummy variable (1 for beneficiaries, 0 otherwise)

u = Random term

b_0 = Intercept

b_1, b_2, b_3, b_4 and b_5 are the regression coefficients showing change in productivity as a result of unit change in the corresponding explanatory variables

Similarly, factors affecting productivity of milch animals and impact of KVK on milch animals were also studied by carrying out the regression analysis as specified below:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u$$

where, Y = Milk productivity (l/day/animal)

X_1 = Green fodder (kg/day/animal)

X_2 = Concentrates (kg/day/animal)

X_3 = Labour (hours/day/animal)

X_4 = Dummy variable (1 for crossbred, 0 otherwise)

X_5= Dummy variable (1 for beneficiaries, 0 otherwise)

u = Random term

b_0 = Intercept

b_1, b_2, b_3, and b_4 are the regression coefficients showing change in productivity of dairy animals as a result of unit change in corresponding explanatory variables

Note: For buffalo, the dummy for breed was not used as no improved breed was found in the study.

The regression analysis was also carried out to analyze the factors affecting farm income and the contribution of KVK in enhancing farm income in the study area. Following form of linear regression model was used:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u$$

where, Y=Farm income from all sources (Rs./farm)

X_1 =Irrigated area (ha/farm)

X_2 = Area under vegetable crops (ha/farm)

X_3 = Milch animals (number/farm)

X_4 = Dummy variable for KVK (1 for beneficiaries, 0 otherwise)

u = Random term

b_0 = Intercept

b_1, b_2, b_3, and b_4 are the regression coefficients showing change in farm income as a result of unit change in the corresponding explanatory variables

In all these regression models, the coefficients were tested for statistical significance by using t-test as follows:

$$t - \text{value} = \frac{b_i}{\text{Standard error } (b_i)}$$

Problems and constraints

The problems and constraints faced by sample farmers were tabulated and percentages of farmers reporting the particular problems were worked out for beneficiaries and non-beneficiaries. To find out the difference in the severity of these problems across beneficiary and non-beneficiary farms, Chi-square test (Test of homogeneity) was employed using the following formula:

$$\chi^2 = \sum_{i=1} \frac{(O_i - E_i)^2}{E_i}, \text{ (n-1) (c-1) df}$$

where, O_i = Observed frequency of problems confronted by i^{th} farmer

E_i = Expected frequency of problems of i^{th} farmer

n= Number of frequencies

c= Number of constraints

df = Degrees of freedom

3.5 Limitations of the study

The present study has been carried out systematically using scientific methodology. The study was based on information collected from the selected sample farmers of selected villages of Kangra block. Stratified random sampling design was used to obtain a representative sample of farmers. The data collected from farmers were based on their memory power and their past experiences. Due care was taken to obtain the information and cross-checking the same. Since, farmers were not maintaining any records, therefore, possibility of few slips from the memory of sample farmers cannot be ruled out. The study was conducted on a micro-level in a block by selecting a representative sample. However, the findings cannot be generalized at macro level due to limitation of small sample. Although the methodology adopted for the study and the findings may be applicable to similar studies in Himachal Pradesh.

4. RESULTS AND DISCUSSION

This chapter has been developed on the basis of results obtained from the analysis of data collected in the study area. The results have been described systematically and logically under the following sub-heads:

4.1 Description of study area and KVK Kangra

4.2 Socio-economic characteristics of sample households

4.3 Farm inventories

4.4 Land utilization and cropping pattern

4.5 Impact of KVK on input use pattern in crops and livestock production

4.6 Impact of KVK on management practices and adoption of technology

4.7 Impact of KVK on productivity of crops and dairy animals

4.8 Economics of crops and other farm enterprises

4.9 Composition of farm and household income and role of KVK in enhancing farm income

4.10 Problems and constraints

4.1 Description of study area and KVK Kangra

4.1.1 General description about Kangra District

The knowledge about study area leads to a better investigation by considering different aspects of socio-economic spectrum. Himachal Pradesh is situated in lower Himalayan region with numerous mountain ranges and rich natural resources. Himachal Pradesh is spread over 55,673 sq. km with 12 districts and 79 blocks (Anonymous 2017-18). Himachal Pradesh has 89 per cent of its population in rural areas and mostly dependent on agriculture, which is more compared to the national average of 68 per cent. About 9 per cent of the gross state domestic product comes from agriculture and its allied sectors (Anonymous 2017-18).

Out of all the districts in Himachal Pradesh, Kangra is situated in the eastern part of Himachal Pradesh spread over an area of 5776 sq. km. It is situated in Western Himalayan region between 31^{o}2/N to 30 ^{o}05/N and 75^{o}/E to 75 ^{o}45/E. The district is located at an altitude varying between 650 to 1800 m above mean sea level. The district has some plain areas touching Gurdaspur district of Punjab in the West, Una and Hamirpur districts of Himachal Pradesh to the South. The regions of Kangra district have been classified on the basis of topography, rainfall, vegetation, soils and temperature. The entire district is divided into five sub-mountain regions viz. Pirpanjal, Dhauladhar, Kangra valley, Kangra Shivalik and Bias basin. Kangra district is located at an elevation ranging between 650-1800 m above mean sea level. Kangra district comprises of 15 developmental blocks, 748 panchayats (Anonymous 2017-18) in the district. The geography of District ranges from mountains (Pirpanjal) to foothills (Shivalik).

Table 4.1 shows the demographic features of District Kangra vis-a-vis Himachal Pradesh as per census 2011. Kangra district has a total population of 15, 10,075 which is about 22 per cent of the total population of Himachal Pradesh. Majority of the population resides in rural areas. The population density in Kangra district is 263 inhabitants per sq. km as compared to 123 at the state level. Sex ratio in the Kangra district is 1095 which is higher as against sex ratio of the entire state (972). This district has 3,19,365 scheduled caste and 84,564 scheduled tribe population accounting for 18.47 and 21.56 per cent of the total population of scheduled caste and scheduled tribe of the state, respectively. The literacy rate in Kangra district is quite high (85.67%) as compared to the state (82.80%). The male literacy was 91.49 per cent and the female literacy was 80.02 per cent.

4.1.2 Land utilization, size of holding and cropping pattern

Land is the most important asset for agricultural production. Land use pattern for Kangra district and Himachal Pradesh for the year 2011-12 has been presented in the following Table 4.2.

Table 4.1 Demographic characteristics of Kangra district vis-à-vis Himachal Pradesh, census 2011

S. No.	Particulars	Unit	Kangra	Himachal Pradesh
1.	Total population			
	Persons	number	15,10,075	68,64,602
	Male	number	7,50,591	34,81,873
	Female	number	7,59,484	33,82,729
	Rural population	number	14,23,794	61,76,050
	Urban population	number	86,281	6,88,582
	Scheduled castes population	number	3,19,385	17,29,252
	Scheduled tribes population	number	84,564	3,92,126
	Density	per square kilometre	263	123
	Sex ratio	(Females/1000 males)	1095	972
2.	Literacy			
	Male	per cent	91.49	89.53
	Female	per cent	80.02	75.93
	Total	per cent	85.67	82.80

Source: Statistical Yearbook of Himachal Pradesh, 2017-18

Table 4.2 Land utilization pattern in Kangra district and Himachal Pradesh, 2011-12

S. No.	Particulars	Kangra		Himachal Pradesh	
		Area ('000 ha)	Area (%)	Area ('000 ha)	Area (%)
1.	Total geographical area (village papers)	577.68	100.00	4575.57	100.00
2.	Forests	232.52	40.25	1126.12	24.61
3.	Barren and unculturable land	14.85	2.57	777.48	16.99
4.	Land put to non-agricultural uses	77.67	13.44	349.80	7.65
5.	Culturable wasteland	28.20	4.88	121.67	2.66
6.	Area under pasture/ grazing	87.86	15.21	1510.43	33.01
7.	Land under miscellaneous tree crops, etc.	8.27	1.44	63.67	1.39
8.	Fallow land	11.456	2.17	54.15	1.67
9.	Net sown area	115.75	20.04	549.96	12.02
10.	Total cropped area	209.41	-	931.86	-
11.	Gross irrigated area *	69.56	32.63	192.07	20.46
12.	Cropping intensity (%)	-	184	-	173

* Gross irrigated area per cent to total cropped area
Source: Statistical Abstract of Himachal Pradesh, 2017-18

This table reveals that the district has a geographical area of 577.68 '000 ha according to village papers and accounted for 12.62 per cent of the reported geographical area of the state. Out of total geographical area, net sown area accounted for 20.04 per cent as against 12.01 per cent at the state level. In this district, 13.44 per cent area was put to non-agricultural uses that was surprisingly higher than at the state level (7.64%). Kangra district also had higher proportion of irrigated area (32.63%) as compared to the state as a whole (20.46%). The cropping intensity of Kangra district was also higher (184%) as compared to the state (173%).

Table 4.3 Distribution of operational holdings by size class of holdings in Kangra district and Himachal Pradesh, 2010-11

S. No.	Particulars	Kangra		Himachal Pradesh	
		Number	%	Number	%
1.	Marginal (less than 1 ha)	180170	76.37	670425	69.79
2.	Small (1-2 ha)	32691	13.85	174596	18.17
3.	Semi-medium (2-4 ha)	16184	6.84	84868	8.83
4.	Medium (4-10 ha)	6046	2.60	27606	2.87
5.	Large (10 ha and above)	813	0.34	3270	0.34
	Total	235904	100.00	960765	100.00

Source: Statistical Abstract of Himachal Pradesh, 2017-18

The Table 4.3 clearly shows the preponderance of marginal land holdings in Kangra district accounting for 76.37 per cent of the total holdings in comparison to 69.97 per cent at the state level. The small holdings accounted for 13.85 per cent in Kangra district and 18.17 per cent in Himachal Pradesh. This clearly shows that more than 90 per cent of the holdings were marginal and small in Kangra district.

Table 4.4 Cropping pattern in Kangra district and Himachal Pradesh, 2010-11

S. No.	Particulars	Kangra		Himachal Pradesh	
		Area (ha)	Area (%)	Area (ha)	Area (%)
1.	Cereals and millets	192597	90.35	762346	81.22
2.	Pulses	3079	1.45	31618	3.38
3.	Vegetable crops	3181	1.49	41188	4.39
4.	Other crops	14305	6.71	103353	11.01
5.	Total cropped area	213162	100.00	938505	100.00

Source: Annual Season and Crop Report, 2010-11

The cropping pattern in Kangra district also reveals the dominance of cereal crops accounting for 90.35 per cent of the cropped area. Maize and rice in *kharif* and wheat in *rabi* were found to be the predominant crops of this district (Table 4.4). The lowest area was allocated under pulses (1.45%) that was even lower than proportion of area under pulses in the state (3.38%). The proportion of cropped area allocated to vegetable crops was also quite low (1.49%) as compared to the state as a whole (4.39%).

Besides crop production, livestock is also an integral part of farming in Kangra district. Cattle population accounted for about 45 per cent, while, buffalo population accounted for 18.60 per cent of the total livestock population. The proportion of goat population was 25.17 per cent while sheep constituted 10.51 per cent of the livestock population in Kangra district (Livestock census 2012). The composition of livestock in District Kangra vis-à-vis Himachal Pradesh has been given in Appendix II.

4.1.3 Krishi Vigyan Kendra (KVK) Kangra –activities and achievements

Krishi Vigyan Kendra (KVK) is an innovative science-based institution which undertakes vocational trainings of farmers, farm women and rural youth, conducts on-farm research for technology refinement and front-line demonstrations to demonstrate latest agricultural technologies to farmers as well as extension workers. The KVK functions on the principles of collaborative participation of scientists, subject matter experts, extension workers and farmers. The main purpose of KVK is to impart learning through work experience to farmers. The syllabus and programme of KVK is adjusted according to the felt needs of farmers, resources and potential for agricultural growth in a particular region. “teaching by doing” and “learning by doing” are the main methods of imparting skill training to farmers.

Initially, the emphasis was mainly on human resource development of farmers and extension workers through training, but recently there has been a shift in the approach of KVK. Now, the KVKs also participate in the process of agricultural technology development and refinement. Emphasis is also given to employment generation to bring out equality of opportunities for deprived farmers and traditionally backward areas of the country.

Therefore, KVK is an approach developed by ICAR to transfer new technologies from laboratory to farmers to increase productivity and farm income of farmers of the country. Taking into consideration the needs of farmers, to know about new technological methods and their implementation on their farms, ICAR granted the sanction for establishment of KVKs (Farm Science Centres). The actual implementation of KVKs took place in 1993.

In Himachal Pradesh, 12 Krishi Vigyan Kendras have been established. Out of these, 8 KVKs are under Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya (CSK HPKV), Palampur and the remaining 4 are under Dr. Y. S. Parmar University of Horticulture and Forestry, Solan.

KVK Kangra came into existence on January 19, 2000 with 100 per cent financial assistance from ICAR. Total land area of KVK Kangra is 8.64 hectare. Out of this, 5 hectare is under cultivation. The operational area of KVK Kangra covers five blocks of Kangra district namely, Dehra, Kangra, Bhawarna, Nagrota Bagwan and Nagrota Surian. Infrastructural buildings of KVK Kangra include administrative building, demonstration units, dairy unit, polyhouse, fencing, rain water harvesting system, threshing floor, farm godown and farmers' hostel. As on June 30, 2018, there were six scientists from different disciplines and 11 supporting and ministerial staff.

KVK Kangra performs on-farm testing to identify new technologies pertaining to the geographical locations. KVK extension personnel provide trainings so that the new technologies discovered are in the reach of farmers. Priority thrust areas for KVK Kangra are the diversification through cultivation of high value cash crops, developing and refining new technologies for nursery production, healthy management of milch animals, proper weed control, promotion of organic inputs, promotion of soil water conservation techniques and integrated nutrient management. The KVK is also entrusted with the task of popularization of small farm tools to reduce drudgery. KVK Kangra has been actively performing the extension activities from the year 2000 with respect to all mandates and objectives to be fulfilled by KVK as per the recommendations of ICAR. KVK Kangra plays an active role in terms of transfer of technologies to farmers. The data pertaining to activities to be performed, actually performed and targets achieved regarding technical achievements in the years

2010-11, 2013-14 and 2016-17 were collected from KVK Kangra and has been presented through Tables 4.5 and 4.6.

Table 4.5 Front-line demonstrations conducted by KVK

Year	Number of FLDs			Number of farmers		
	Targets	Achievement	Target achieved (%)	Target	Achievement	Target achieved (%)
2010-11	20	25	125.00	70	124	177.14
2013-14	30	32	106.67	250	280	112.00
2016-17	20	21	105.00	320	405	126.56

Table 4.5 shows the front-line demonstrations (FLDs) carried out by KVK, Kangra. It can be seen that KVK Kangra has made remarkable progress with respect to FLDs. In all the years under consideration, KVK Kangra has superseded the targets with respect to number of FLDs and number of farmers. The target set for covering the number of farmers was superseded to the extent of about 177 per cent in 2010-11, 112 per cent in 2013-14 and 126 per cent in 2016-17. There has been consistent increase in the number of farmers for conducting FLDs.

Table 4.6 further shows the FLDs conducted on various crops/ farm enterprises under various thematic areas and number of farmers covered. It is clear from the table that 45, 71 and 117 farmers participated in FLDs conducted for cereals in 2010-11, 2013-14 and 2016-17, respectively. FLDs in cereals were conducted on promising hybrids (rice) and improved varieties of crops. To popularize vegetable crops, KVK Kangra has initiated vegetable interventions through laying out demonstrations on improved and high yielding varieties, integrated nutrient and integrated pest and disease management. During 2010-11, 23 farmers participated that increased to 172 in 2013-14 and 46 in 2016-17. In FLDs on pulses, the number of farmers was 89 in 2010-11, 69 in 2013-14 and just 16 during 2016-17. With respect to oilseeds, 93, 100 and 90 farmers participated during the three years under consideration. Around 15 demonstrations were conducted for fodder production. In dairying, KVK Kangra conducted demonstrations with respect to interventions such as balanced ration and mineral supplements. As many as 9, 10 and 26 dairy keepers were selected for such type of demonstrations. To supplement farm income, the demonstrations on oyster mushroom production were conducted that included 75 farmers in 2013-14 and 50 in 2016-17. KVK Kangra has also laid out demonstrations with respect to value addition and post-harvest management of farm products under which 45 farmers were selected during 2016-17.

Table 4.6 Front-line demonstrations conducted by KVK Kangra under different thematic areas

S. No.	Component	2010-11	2013-14	2016-17
1.	Cereals (hybrid, timely sown variety)	45	71	117
2.	Pulses (improved variety, balanced fertilizer and suitable plant protection	89	69	16
3.	Oilseeds (improved variety and balanced fertilizer)	93	100	90
4.	Fodder (improved grass)	-	15	15
5.	Vegetables (improved and high yielding varieties, IPM, IDM and IPDM)	23	172	46
6.	Dairy (mineral mixture and uromol bricks)	9	10	26
7.	Oyster mushroom (production and marketing)	-	75	50
8.	Home science (value addition techniques)	-	-	45

On-farm trials (OFTs) are conducted with an objective to predict the outcomes of different management practices under different environmental conditions and cropping systems. On-farm trials help in examining and monitoring the technology to be used in different locations. The progress through On-farm trials made during different years by KVK Kangra has been shown in Table 4.7.

Table 4.7 On-farm trials conducted by KVK Kangra

Year	Number of OFTs			Number of farmers covered		
	Target	Achievement	Target achieved (%)	Target	Achievement	Target achieved (%)
2010-11	10	13	130.00	40	52	130.00
2013-14	10	12	120.00	40	50	125.00
2016-17	10	11	110.00	40	56	140.00

It is clearly visible from the table that target earmarked for number of OFTs to be conducted during different years was 10 under which 40 farmers were to be covered. It is pleasing to note that KVK Kangra has exceeded this target. In case of number of OFTs, the achievement was 130 per cent during 2010-11, 120 per cent during 2013-14 and 110 per cent during 2016-17. This implies that KVK Kangra has been performing well with respect to objective of on-farm trials.

It can be seen from Table 4.8 that maximum number of on-farm trials regarding varietal evaluation conducted were 8 during 2010-11 and 5 each during 2013-14 and 2016-17. These varietal evaluation trials were conducted mainly on cereals and vegetable crops. With respect to Integrated Disease Management (IDM), on-farm trials were not conducted during the year 2010-11. However, during the year 2013-14 and 2016-17, on-farm trials on IDM were conducted for cereals and vegetable crops. With respect to Integrated Pest Management, only one trial was conducted in 2010-11 and no further trials were conducted in the subsequent years. Two on-farm trials for assessment of value addition were conducted during 2013-14 and 2016-17. Regarding weed management, one trial was conducted in the year 2016-17. In total, eleven on-farm trials were conducted for technology assessment. In this way, total of 9 OFTs were conducted during 2010-11 and 2013-14 while 11 OFTs during 2016-17. This implies that there is a need to increase number of OFTs on different thematic areas and new OFTs on organic farming, Zero-Budget Natural Farming and Integrated Nutrient Management need to be included in the KVK programmes.

Table 4.8 On-farm trials assessed by KVK Kangra

	Cereals			**Vegetables**			**Fruits**			**Total**		
Thematic areas	2010-11	2013-14	2016-17	2010-11	2013-14	2016-17	2010-11	2013-14	2016-17	2010-11	2013-14	2016-17
Varietal evaluation	3	2	2	5	3	3	-	-	-	8	5	5
Integrated Disease Management	-	-	1	-	2	1	-	-	-	-	2	2
Integrated Pest Management	1	-	-	-	-	-	-	-	-	1	-	-
Value addition	-	-	-	-	1	1	-	1	1	-	2	2
Mushroom production	-	-	-	-	-	-	-	-	1	-	-	1
Weed management			1									1
Total	4	2	2	5	6	5	-	1	1	9	9	11

Trainings

KVK Kangra has been conducting number of trainings as a medium to disseminate knowledge and awareness about new technologies developed so as to improve farm productivity. Trainings are being conducted on-farm as well as off-farm. Table 4.9 reveals the target and achievement of training courses conducted by KVK.

Table 4.9 Trainings conducted by KVK Kangra

	Number of training courses			Number of participants in trainings		
Year	**Target**	**Achievement**	**Target achieved (%)**	**Target**	**Achievement**	**Target achieved (%)**
2010-11	40	43	107.50	1500	1310	87.33
2013-14	75	76	101.33	2500	2912	116.48
2016-17	115	119	103.48	4000	4222	105.55

The target fixed for training courses was 40, 75 and 115 during the years 2010-11, 2013-14 and 2016-17. Like other activities, the achievement of KVK Kangra with respect to training was found quite remarkable both in terms of trainings conducted and number of farmers trained.

It can be seen from Table 4.10 that KVK Kangra conducted on-campus trainings on different thematic areas for benefit of farming community. The number of trainees for crop production training were 413 (2010-11), 137 (2013-14) and 680 (2016-17). In case of dairy, 39 and 21 on-campus trainees participated during the year 2013-14 and 2016-17, respectively. For poultry, 58 farmers participated in trainings conducted during 2010-11 though no trainings were conducted regarding poultry management. With regard to production of inputs like vermi-compost and other organic manures, there were 156 trainees during 2013-14 and 93 during 2016-17. Plant protection is an important thematic area of training and as many as 162 farmers were trained during 2013-14 followed by 66 during 2016-17. With respect to capacity building and group dynamics, KVK Kangra trained maximum number of farmers during 2013-14 (624) and 2016-17 (135). For women empowerment and home management, maximum number of trainees participated during 2013-14 (125) followed by 2016-17(107) and 2010-11(49). In this way, overall, as many as 562, 1243 and 1102 farmers were trained in on-campus trainings conducted during 2011-12, 2013-14 and 2016-17, respectively.

Table 4.10 Number of farmers trained by KVK Kangra through on-campus trainings

Year	Crop production	Dairy	Poultry	Production of inputs at site	Plant protection	Capacity building and group dynamics	Women empowerment	Total
2010-11	413	-	58	-	26	16	49	562
2013-14	137	39	-	156	162	624	125	1243
2016-17	680	21	-	93	66	135	107	1102

KVK Kangra also conducted off-campus trainings in different thematic areas. The information regarding off-campus trainings has been presented in Table 4.11.

Table 4.11 Number of farmers trained by KVK Kangra through off-campus trainings

Year	Crop production	Soil health	Dairy	Plant protection	Women	Agroforestry	Total
2010-11	189	-	79	361	269	-	898
2013-14	595	63	40	184	203	30	1115
2016-17	311	41	33	111	180	27	703

It can be seen from this table that in on-campus trainings conducted with regard to crop production, highest number of trainees participated in 2013-14 (595). While, in soil health and management trainings, 63 and 41 farmers were trained during 2013-14 and 2016-17. Regarding dairy management, number of off-campus trainees declined with the passage of time showing the shortage of manpower. With respect to plant protection, 361, 184 and 111 farmers were trained during the years 2010-11, 2013-14 and 2016-17. For women empowerment, maximum number of trainees participated in the year 2010-11(269) followed by 2013-14 (203) and 2016-17(180) in which the women trainees were imparted training about value addition, post-harvest management etc. In the recent years, some off-campus trainings have also been conducted in the field of agroforestry. In total, 898, 1115 and 703 farmers were trained through off-campus trainings during 2010-11, 2013-14 and 2016-17.

In the recent year, KVK Kangra has also initiated trainings on rainwater harvesting to farmers, rural youth and extension functionaries of the department of agriculture. Information regarding trainings on rainwater harvesting for vegetable-polytube irrigation facilities were imparted to different clienteles during 2016-17 has been presented in Table 4.1

Table 4.12 Trainings on rainwater harvesting during the year 2016-17

	Number of training activities			Number of participants		
Clientele	**Target**	**Achievement**	**Target achieved (%)**	**Target**	**Achievement**	**Target achieved (%)**
Farmers	80	59	73.75	2000	2194	109.70
Rural youth	10	14	140.00	200	242	121.00
Extension functionaries	2	5	250.00	100	122	122.00
Total	92	78	84.78	2300	2558	111.21

It can be noticed that during 2016-17, KVK organized 78 trainings on rainwater harvesting against the target of 92. The target could not be achieved due to lesser number of trainings organized for farmers. However, the achievement was more than the target in case of rural youth and extension functionaries. It can also be noticed that against the target of 2300 trainees, as many as 2558 farmers and field functionaries were imparted training on rainwater harvesting. The number of trainees who participated in each category exceeded the target that also reveals good progress made by KVK.

Other multifarious extension activities performed by KVK Kangra include field days, *Kisan Mela, Kisan Goshthi*, exhibition, film shows, workshops, soil test campaigns, mobile clinics, soil health camps, celebration of important days like '*Kisan* Day' etc. It can be seen that maximum number of extension activities (4449) performed by KVK were in the year 2013-14 followed by the year 2016-17 (2734) and 2010-11

(1800) while the number of extension literature lectures conducted by KVK was highest (2386) in the year 2013-14.

Table 4.13 Other extension activities conducted by KVK Kangra

(number)

Extension activity	**2010-11**	**2013-14**	**2016-17**
Field days	5	7	3
Kisan mela	-	4	3
Kisan ghosthi	-	6	1
Exhibition	1	4	5
Film show	-	15	11
Method demonstrations	10	25	40
Farmers seminar	-	-	4
Workshop	-	6	-
Group meetings	-	2	10
Lectures as resource persons	58	36	52
Newspaper coverage	23	28	46
Radio talks	8	7	25
TV talks	4	4	7
Popular articles	4	7	16
Extension literature	4	2386	12
Advisory services	124	415	960
Scientist visit to farmer's field	220	55	43
Farmers visit to KVK	1328	1236	1350
Diagnostic visits	-	89	40
Exposure visits	-	56	48
Ex-trainees sammelan	1	3	2
Animal health camp	-	-	2
Agri-mobile clinic	-	4	1
Farm science club conveners meet	-	5	8
SHG conveners meetings	-	18	16
Mahila mandal meetings	-	26	10
Celebration of important days	10	5	19
Total	1800	4449	2734

***Kisan* mobile advisory**

With the Information and Communication Technology revolution, *Kisan* mobile advisory has emerged as a unique programme. This programme was initiated on July 16, 2013. Table 4.14 shows the progress made through *kisan* mobile advisory.

Table 4.14 *Kisan* mobile advisory services of KVK Kangra

(number)

Year	Type of messages						Text messages	Farmers covered
	Crop	Livestock	Marketing	Awareness	Other enterprise	Any other		
2013-14	90	7	-	10	7	9	123	1000
2016-17	65	5	5	10	18	20	123	1000

During the years 2013-14 and 2016-17, 123 messages were delivered to 1000 farmers (each year) through their mobile phones. Text messages sent to farmers were regarding crop production, livestock production, marketing, other enterprises and general awareness of the interest of farmers.

The above description clearly shows that KVK Kangra is rendering appreciable service to farmers in the field of transfer of technology, creating awareness about new technology and training farmers in diverse areas of agriculture and rural development.

4.2 Socio-economic characteristics of sample households

Socio-economic profile of the study area provides insight about the social characteristics of the community. It is necessary to understand the socio-economic profiles of respondents playing catalytic role in adoption of farm technologies. This section describes the major socio-economic features like family size and structure, land holdings and utilization pattern, details of farm inventories, etc.

4.2.1 Family size and structure

Most of the farm activities are performed by the family members, therefore, size and structure of the family play a crucial role in socio-economic well-being and development of agriculture. The size of farm family also displays the availability of workforce which in turn affects the earning capacity of the farm family. However, with the nuclearisation of families, the availability of farm labour has decreased. Family size and structure on beneficiary and non-beneficiary households have been displayed in Table 4.15.

Table 4.15 Family size and structure of sample households

S. No.	Particulars	Beneficiaries	Non-beneficiaries
1	Average family size (no.)	4.97	5.00
2	Family composition (%)		
i.	Male	50.34	54.67
ii.	Female	49.66	45.33
3	Family structure (%)		
i.	Joint	43.33	46.67
ii.	Nuclear	56.67	53.33

The average family size on beneficiary farm family was 4.97 comprising of 50.34 per cent males and 49.66 per cent females. On the other hand, the average family size of non-beneficiary households was 5 members comprising of 54.67 per cent males and 45.33 per cent females. About 57 per cent and 53.33 per cent sample households had nuclear family structure in case of beneficiary and non-beneficiary farmers. This clearly shows dominance of nuclear families in the study area.

4.2.2 Age-wise distribution

It is a well-known fact that the age of a worker is an important factor regarding decision-making ability and work experience. In the context of cultivation, the age of the head of the household is very important because it has a bearing on his capacity to work, to take risk and adopt new technological innovations on his farm. Taking this into consideration, the age distribution of heads of farm has been given in Table 4.16.

It can be visualized from the table that majority of the heads (70%) of beneficiary farm families were in the matured age group of 41-60 that was higher than the proportion on non-beneficiary farms (53.34%).

Table 4.16 Age-wise distribution of heads of families on sample farms

(number)

S. No.	Age (years)	Beneficiaries	Non-Beneficiaries
1	25-40	4	7
		(13.33)	(23.33)
2	41-60	21	16
		(70.00)	(53.34)
3	Above 60	5	7
		(16.67)	(23.33)
	Total	30	30
		(100.00)	(100.00)

Note: Figures in parentheses indicate percentages in total of each category

The age distribution of family members of sample households in different categories has been presented in the Table 4.17. The proportion of total family members in the working age group of 16-60 years was found to be 76.51 per cent and 71.33 per cent on beneficiary and non-beneficiary farms, respectively. The proportion of female members in the working age group was 77.02 per cent and 73.52 per cent on beneficiary and non-beneficiary farms, respectively while the proportion of male members in working age group (16-60 years) were 76 per cent and 69.51 per cent on beneficiary and non-beneficiary farms. From this information, it is clearly evident that there was higher proportion of female working members as compared to male members.

Table 4.17 Age-wise distribution of family members in the study area

(per cent)

S. No.	Age group (years)	Beneficiaries			Non-beneficiaries		
		Male	Female	Total	Male	Female	Total
1	Less than 5	4.00	5.41	4.70	4.88	1.47	3.33
2	5 to 10	1.33	2.70	2.01	4.88	5.88	5.33
3	10 to 15	9.33	4.05	6.71	8.54	5.88	7.33
4	16 to 30	29.33	32.43	30.87	29.26	16.18	23.33
5	31 to 60	46.67	44.59	45.64	40.24	57.35	48.00
6	More than 60	9.34	10.82	10.07	12.20	13.24	12.68
	Total persons	100.00	100.00	100.00	100.00	100.00	100.00
		(75)	(74)	(149)	(82)	(68)	(150)

Note: Figures in parentheses show total number of persons in respective columns

4.2.3 Educational status

Educational level plays a pivotal role in the scientific management and adoption of new recommended technologies on farms. The educational status of family members is one of the most important factors to determine the ability of farmers to acquire skills, to adopt new technologies and innovations with entrepreneurial skills. Education helps farmers to incorporate scientific practices and technological tools into their day-to-day farm activities. Education is also important for maintaining farm records and adopt prudent marketing strategies to raise income.

It can be seen from Table 4.18 that the literacy rate of heads of sample households was 93.33 per cent in case of beneficiaries and 73.33 per cent in case of non-beneficiaries. A good number of heads were matriculate among beneficiaries (36.67%) as compared to non-beneficiaries (20%). The proportion of heads with education level of graduation and above was quite low i.e. 3.33 per cent in case of beneficiaries while there was no head having education up to graduation level and above. There were more proportion of illiterate heads of the families in case of non-beneficiary families. Almost equal proportion of heads of the families had acquired primary and middle level education.

Table 4.18 Educational status of heads of sample households

(per cent)

S. No.	Qualification	Beneficiaries	Non-beneficiaries
1.	Illiterate	6.67	26.67
2.	Primary	23.33	23.33
3.	Middle	26.67	30.00
4.	Matriculation	36.67	20.00
5.	Senior Secondary	3.33	0.00
6.	Technical Diploma	0.00	0.00
7.	Graduate and above	3.33	0.00
	Total	100.00	100.00
		(30)	(30)
	Literacy rate (%)	93.33	73.33

Note: Figures in parentheses indicate total number of respondents in each category

The results of educational status of family members has been shown in Table 4.19. It can be seen that a small proportion of members were illiterate in case of beneficiary farms (6.99%) compared to non-beneficiary farms (16.44%). There was predominance of members educated up to matriculation in case of beneficiary farms (23.78%) followed by middle standards (20.28%). However, in case of non-beneficiary farms, majority of the members (27.40%) were educated up to primary standards followed by middle standards (21.92%). The proportion of members educated up to graduation and post-graduation levels were also higher on beneficiary farms. It was observed that there was remarkable difference in the education status of male and female members.

Table 4.19 Educational status of family members on sample households

(per cent)

S. No.	Qualification	Beneficiaries			Non-beneficiaries		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
1	Illiterate	4.11	10.00	6.99	8.86	25.37	16.44
2	Primary	9.58	25.71	17.48	24.05	31.34	27.40
3	Middle	21.92	18.57	20.28	21.52	22.39	21.92
4	Matriculation	32.88	14.28	23.78	18.99	8.95	14.38
5	Senior Secondary	10.96	12.86	11.89	8.86	4.48	6.85
6	Technical Diploma	1.37	-	0.70	2.53	-	1.37
7	Graduation	15.07	12.86	13.99	15.19	5.97	10.96
8	Post-graduation and above	4.11	5.71	4.89	-	1.49	0.68
	Total persons	100.00 (73)	100.00 (70)	100.00 (143)	100.00 (79)	100.00 (67)	100.00 (146)
	Literacy rate (%)	95.89	90.00	93.01	91.14	74.63	83.56

4.2.4 Occupational and employment pattern of family members

The occupation and employment pattern of a family tells about the economic activities carried out by family members which provides means of livelihood to them. It indicates the earning capacity and scale of income of a family which is reflected in the economic conditions and standard of living of family members. The data collected in the study area regarding occupation and employment pattern of family members was analyzed. The occupation is classified into main and subsidiary occupation. Main occupation includes the activities in which a member uses most of his time. Subsidiary occupation refers to the activity in which a member is engaged partially and performs a part time job.

The detailed employment pattern divided into sub categories of main and subsidiary occupation have been presented in the Table 4.20. It can be seen from the table that 74.47 per cent and 74.19 per cent of total 94 and 93 working members were engaged in agriculture as their main occupation on beneficiary farms and non-beneficiary farms, respectively. In beneficiary households, about 4 per cent and 7.45 per cent of total working members were employed in government services and private services, respectively. However, only 1.08 and 5.38 per cent members were employed in government and private services, respectively in case of non-beneficiary households. A higher proportion (9.67%) of members were working as labourers (daily paid workers) in case of non-beneficiary households as compared to beneficiary households (5.32%). In subsidiary occupation, about 25 per cent members of both beneficiary and non-beneficiary households were engaged in agriculture. Daily paid workers were 5.32 per cent of total working members in case of beneficiary households, which was higher than 4.30 per cent of daily paid workers on non-beneficiary households. A high proportion of both beneficiary and non-beneficiary members were not having subsidiary occupation. It can be concluded that agriculture was the mainstay of sample farmers in the study area.

Table 4.20 Occupational and employment pattern of family members

(per cent)

S. No.	Particulars	Beneficiaries	Non-beneficiaries
	Main		
1	Agriculture	74.47	74.19
2	Government service	4.26	1.08
3	Private service	7.45	5.38
4	Pensioner	3.18	2.15
5	Business	5.32	7.53
6	Labour	5.32	9.67
	Total	100.00	100.00
		(94)	(93)
	Subsidiary		
7	Agriculture	25.53	24.73
8	Private service	1.06	0.00
9	Business	1.06	0.00
10	Labour	5.32	4.30
11	No subsidiary	67.02	70.97
	Total	100.00	100.00
		(94)	(93)

Figures in parentheses show the total number of working persons in each category

4.3 Farm inventories and land utilization

The structure and value of farm assets indicate economic status of a farm household. It is an important tool to determine the soundness of a farm. Without adequate investment, one cannot make considerable contribution towards agriculture in the society. A typical farm household makes diverse investment on farm buildings, farm machinery, farm implements, livestock and mushroom enterprises. The investment on farm inventories is a good indicator of capital formation and adoption of latest recommended technologies in agriculture. Therefore, the data about the farm inventories and investment pattern of farm households have been analyzed and presented in this section.

4.3.1 Investment pattern on farm buildings

Table 4.21 Investment pattern on buildings on sample farms

(Rs./farm)

S. No.	Particulars	Beneficiaries	Non-beneficiaries
1.	Residential buildings	968333	875000
		(92.46)	(94.67)
2.	Cattle shed	37767	25250
		(3.61)	(2.73)
3.	Storehouse	40733	23767
		(3.89)	(2.57)
4.	Vermi-compost shed	467	283
		(0.04)	(0.03)
	Total investment	1047300	924300
		(100.00)	(100.00)

Note: Figures in parentheses indicate percentages to total in each category

The investment made on buildings, cattle sheds, stores and vermi-compost sheds has been analyzed and presented in Table 4.21. It is noticeable from the table that major investment was on residential buildings that accounted for 92.46 per cent of total investment of Rs. 9,68,333 followed by cattle sheds (3.61%), storehouses (3.89%) and vermi-compost sheds (0.04%) in case of beneficiary farms. On the other hand, non-beneficiary farmers also incurred maximum investment on residential buildings (94.67%) followed by cattle sheds (2.73%) and storehouses (2.57%). All the farmers had decent residential buildings and most of these were *pucca*, while the cattle sheds were of mixed type. It was quite visible that the economic status of farmer can be judged from his size of investment on farm buildings. The total investment on farm buildings was found to be Rs. 10,47,300 per farm and Rs. 9,24,300 per farm on beneficiary and non-beneficiary farms, respectively.

4.3.2 Investment on farm machinery

The investment on farm tools, implements and machinery are amongst the basic requirements for accomplishing different agriculture based farm operations. In order to increase/maintain the scale of operation of agricultural enterprises, there is a need to invest on need-based farm tools and machinery. A farm household possessing enough amount of agricultural tools and implements is regarded as a self-reliant farm household who is capable of performing the farm activities efficiently. The inventory as well as investment on farm tools and machinery was analyzed and presented in Table 4.22.

Table 4.22 Inventory and investment on farm implements and machinery on sample farms

S. No. Particulars	Beneficiaries			Non-beneficiaries		
	No./ farm	Rs./ farm	%	No./ farm	Rs./ farm	%
A Major implements/ Machinery						
1. Tractor	0.03	13333	35.71	0.03	1000	4.28
2. Power tiller	0.30	18300	49.02	0.26	17500	74.97
3. Chaff-cutter	0.43	1917	5.13	0.40	1867	8.00
4. Thresher	0.03	500	1.34	0.00	-	0.00
5. Sprayer/ duster	0.67	1433	3.85	0.63	1317	5.64
6. Water pump	0.63	257	0.69	0.53	237	1.01
Sub-total	2.10	35740	95.74	1.87	21920	93.90
B Minor implements						
1. Plough	-	33	0.09	-	-	-
2. Spade	1.43	269	0.72	1.26	241	1.03
3. Hoe	1.30	238	0.64	1.17	212	0.91
4. Rake	1.13	197	0.53	0.97	183	0.79
5. Large sickle	2.53	437	1.17	2.40	431	1.85
6. Small sickle	2.97	169	0.45	2.83	157	0.67
7. Axe	1.07	246	0.66	1.00	199	0.85
Sub-total	10.47	1589	4.26	9.63	1423	6.10
Total	12.57	37329	100.00	11.50	23343	100.00

The total investment on farm implements and machinery on a sample farm of beneficiaries was higher (Rs. 37,329/farm) as compared to non-beneficiary sample farm (Rs. 23,343/farm). The use of bullock labour was quite low, thus, only 0.09 per cent of investment was made by beneficiary farmers on plough among minor farm implements. Most of the farmers used to hire the tractor on hourly basis to perform farm activities such as ploughing, sowing and threshing. The highest investment was made on power tiller (49.02%) followed by tractor (35.71%) and chaff-cutter (5.13%) among the major implements used by beneficiaries. The investment on minor implements by beneficiaries were between 0 to 2 per cent. On the other hand, non-beneficiaries had mainly invested on power tiller (74.97%) followed by chaff-cutter (8.00%), sprayer (5.64%) and tractor (4.28%). The investment on minor implements was 4.26 per cent. It was revealed that the investment made on minor implements was also low on non-beneficiary farms (6.10%). In this way, main investment was on major implements and machinery ranging from 94-96 per cent in the study area.

4.3.3 Livestock inventory and investment

Livestock rearing is an integral part of farming in hill areas. It not only provides farmers with livestock products such as milk, meat, wool, etc., to fulfil their family requirements and market demand but also complements agriculture by providing critical input FYM for agriculture. The size of livestock unit depends on availability of feed and fodder, human labour and family needs of a farmer. The livestock inventory on sample households was analyzed and has been presented in Table 4.23. It can be seen that the average number of livestock population with beneficiary farmers was (1.45) that was slightly higher than reared by non-beneficiary farmers (1.40). The proportion of improved cow was higher on beneficiary farms (17.93%). The proportion of local cow was almost same on both the category of farms. It is also noticed that the proportion of buffalo was much higher on non-beneficiary farms. The proportion of young stock (heifers and calves) was found much higher on beneficiary farms. The proportion of bullocks have become rare in the study area as most of the operations were found through use of tractor power. No sheep, goat and poultry birds were found in the study area.

The investment pattern given in Table 4.24 shows that the investment on livestock was remarkably higher on beneficiary farms. And the total investment was Rs. 1,14,117/farm as compared to Rs. 73,658/farm on non-beneficiary farms. This clearly shows that beneficiary farms had better breeds of animals. The major investment was on improved cows and buffaloes on both type of farms. The investment on buffalo accounted for more than half of the investment on beneficiary farms.

Table 4.23 Livestock inventory on sample farms

		Beneficiaries		Non-beneficiaries	
S. No.	**Particulars**	**Number/farm**	**%**	**Number/farm**	**%**
A	Local cow				
	Milking	0.30	20.69	0.27	19.06
	Dry	-	-	0.03	2.38
	Sub-total	0.30	20.69	0.30	21.44
B	Improved cow				
	Milking	0.23	15.86	0.10	7.14
	Dry	0.03	2.07	0.03	2.39
	Sub-total	0.26	17.93	0.13	9.53
C	Buffalo				
	Milking	0.23	15.86	0.33	23.81
	Dry	-	-	0.17	11.90
	Sub-total	0.23	15.86	0.50	35.72
D	Bullocks	0.13	8.96	0.10	7.14
E	Heifers				
	Cow	0.10	6.90	0.10	7.14
	Buffalo	0.10	6.90	0.07	4.76
	Sub-total	0.20	13.79	0.17	11.90
F	Calves				
	Cow	0.23	15.86	0.07	4.76
	Buffalo	0.10	6.90	0.13	9.52
	Sub total	0.33	22.76	0.20	14.28
	Total livestock	1.45	100	1.40	100.00

Table 4.24 Value of livestock inventory on sample farms

S. No.	Particulars	Beneficiaries Rs./farm	%	Non-beneficiaries Rs./farm	%
A	Local cow				
	Milking	11222	(9.83)	8625	(11.71)
	Dry	-	-	2500	(3.39)
	Sub-total	11222	(9.83)	11125	(15.10)
B	Improved cow				
	Milking	23714	(20.79)	17667	(23.98)
	Dry	12000	(10.52)	10000	(13.58)
	Sub-total	35714	(31.30)	27667	(37.56)
C	Buffalo local				
	Milking	58000	(50.82)	16600	(22.54)
	Dry	-	-	9800	(13.30)
	Sub-total	58000	(50.82)	26400	(35.84)
D	Heifers				
	Cows	1667	(1.46)	1333	(1.81)
	Buffaloes	2333	(2.04)	2000	(2.72)
	Sub-total	4000	(3.50)	3333	(4.52)
E	Calves				
	Cows	714	(0.63)	675	(0.92)
	Buffaloes	967	(0.85)	1125	(1.53)
	Sub total	1681	(1.47)	1800	(2.44)
F	Bullocks	3500	(3.07)	3333	(4.52)
	Total livestock	114117	(100.00)	73658	(100.00)

4.4 Land utilization and cropping pattern

4.1.1 Size of holding and land utilization pattern

Land inventory is considered to be the most important aspect of agricultural production. Adoption of different farm enterprises on a single farm depends upon the size of land holding of a farmer that ultimately contributes to the economic welfare of farmer. Details of land holding and its utilization pattern of different farmers were collected, analyzed and presented in Table 4.25.

It is quite evident that in the study area, all the farmers were marginal farmers with land holding size of less than one hectare per farm. In case of beneficiaries, average size of land holding of a farmer was 0.46 hectare per farm out of which 80.43 per cent was owned land and 19.57 per cent was leased-in land. In case of non-beneficiaries, the average size of land holding was 0.38 hectare per farm out of which 0.36 hectare i.e. 95.44 per cent owned and 4.56 per cent was leased-in land. It was observed that entire land holding of beneficiary farms was irrigated. *Kuhls* were the main source of irrigation in the study area. Out of average land holding of 0.38 hectare of a non-beneficiary farmer, 70.88 per cent was irrigated and remaining 29.12 per cent was unirrigated.

Out of the total holding, 97.82 per cent was the cultivated land on beneficiary farms in comparison to 92.11 per cent on non-beneficiary farms. Culturable wasteland ranged from about 2-3 per cent on both the farms. However, the proportion of fallow land was more on non-beneficiary farms that was mainly due to unirrigated holding and some fields were kept fallow.

Table 4.25 Land inventory on sample farms

(ha/farm)

S. No.	Particulars	Beneficiaries	Non-beneficiaries
	Land inventory		
1.	Owned land	0.37	0.36
		(80.43)	(95.44)
2.	Leased-in land	0.09	0.02
		(19.57)	(4.56)
	Total land holding (1+2)	0.46	0.38
		(100.00)	(100.00)
	Total irrigated area	0.46	0.27
		(100.00)	(70.88)
	Total unirrigated area	0.00	0.11
		(0.00)	(29.12)
	Land utilization		
1.	Cultivated land	0.45	0.35
		(97.82)	(92.11)
2.	Fallow land	0.00	0.02
		(0.00)	(5.26)
3.	Culturable wasteland	0.01	0.01
		(2.18)	(2.63)
	Total land holding	0.46	0.38
		(100.00)	(100.00)

Note: Figures in parentheses show the percentages to total in each category

4.4.2 Cropping pattern

Cropping pattern is the distribution of total cropped area allocated to different crops in a particular agricultural year. The cropping pattern depends on farmers' decisions governed by various factors such as availability of resources, productivity levels, expected profits and the technological support from the institutions like KVK.

Table 4.26 shows the cropping pattern adopted on beneficiary and non-beneficiary farms. It was observed that in case of beneficiary farms, the highest proportion of area was under paddy (25.86%) followed by vegetable crops (13.53%) in *kharif* season. In case of non-beneficiary farms, the highest proportion of area was under paddy (26.47%) followed by maize (17.61%). In *rabi* season, maximum area was allocated under wheat crop by both beneficiary (28.27%) and non-beneficiary farms (40.23%). Like *kharif* season, the beneficiary farms also allocated more proportion of area under vegetable crops (15.69%) as compared to non-beneficiary farms (3.63%) in *rabi* season. However, the cropping intensity was found to be almost similar (about 197%) in case of beneficiary and non-beneficiary, respectively.

Table 4.26 Cropping pattern on sample farms

(per cent)

S. No.	Particulars	Beneficiaries	Non-beneficiaries
A	***Kharif***		
1.	Maize	5.98	17.61
2.	Paddy	25.86	26.47
3.	Fodder	4.66	2.10
4.	Vegetables	13.53	3.51
	Sub total	50.03	49.69
B	***Rabi***		
	Wheat	28.27	40.23
1.	Barley	0.45	1.06
2.	Mustard	0.08	1.06
3.	Oats	2.93	2.98
4.	Berseem	2.55	1.35
5.	Vegetables	15.69	3.63
	Sub total	49.97	50.31
C	Total Cropped area	100.00	100.00
D	Net sown area	(0.45)	(0.35)
E	Cropping intensity (%)	197.78	197.14

Figures in parentheses show total cropped area and net sown area in hectare

4.4.3 Extent of diversification

Diversification of farming with high-value crop has become a major policy initiative in Himachal Pradesh. KVK Kangra has also formulated different activities for diversification of agriculture. To examine the impact of KVK on extent of diversification, the diversification indices like Herfindahl Index, Simpson Index and Entropy Index were computed. The results have been depicted in Table 4.27. In terms of Herfindahl index, extent of diversification was higher on beneficiary farms which is revealed by the low value of Herfindahl index (0.1629) as compared to non-beneficiary farms (0.2653). Simpson index value also confirmed higher degree of diversification on beneficiary farms with an index of 0.8370 against 0.7350 on non-beneficiary farms. The Entropy Index which is a feasible direct measure of diversification having a logarithmic character was also revealed that beneficiary farms were more diversified. Therefore, these three measures clearly pointed towards higher degree of diversification on beneficiary farms adopted by KVK.

Table 4.27 Extent of crop diversification on beneficiary and non-beneficiary farms

S. No.	Index of diversification	Beneficiaries	Non-beneficiaries
1.	Herfindahl Index	0.1629	0.2653
2.	Simpson Index	0.8370	0.7350
3.	Entropy Index	0.9959	0.7418

4.5 Impact of KVK on input use pattern in crops and livestock production

Agricultural inputs, particularly seed, farm yard manure, fertilizer, plant protection chemicals, labour play an evident role in enhancing production and productivity of crops. The use of these inputs depends upon the nature of crops grown, irrigation facilities and scale of production of crops. The input use pattern also displays the adoption of technology on farm. The input use pattern and impact of KVK on adoption of new technologies on farm, for different crops was analyzed and the results are presented in this section.

4.5.1 Input use pattern in *kharif* crops

The input use pattern exhibits the adoption of technology on the farm. The input pattern for cereals and fodder of *kharif* season in irrigated conditions has been presented in Table 4.28. It can be inferred from the table that in the production of cereals and fodder crops, different levels of seed, FYM, fertilizer, chemicals and human labour were used. A noticeable difference was found in the quantities of inputs used by beneficiary and non-beneficiary farmers.

Generally, seed rate used was higher than recommended by non-beneficiary farmers in maize, paddy and *kharif* fodder. For maize crop, non-beneficiary farmers used 25.65 kg/ha seed which was higher as compared to seed rate used by beneficiary farmers (22.33 kg/ha). In paddy crop, seed rate used by beneficiary farmers was 39.10 kg/ha in comparison to 47.93 kg/ha used by non-beneficiary farmers. Among fertilizers, urea and IFFCO were mainly used in the study area. Beneficiary farmers applied NPK at the rate of 184.42 kg/ha, 176.70 kg/ha and 53.10 kg/ha while, non-beneficiary farmers applied NPK at the rate of 171.60 kg/ha, 189.75 kg/ha and 29.63 kg/ha for maize, paddy and *kharif* fodder. Therefore, there was no major difference in the use of fertilizers especially for maize and paddy crops. Farm yard manure was also applied almost at the same rate by beneficiary and non-beneficiary farmers, obviously due to same number of animals kept on these farms. The expenditure on chemicals for plant protection was quite low particularly on non-beneficiary farms. All the farm operations were carried out by employing family labour. The labour used was also more on beneficiary farms and that might be due to adoption of better management practices.

Table 4.28 Input use pattern for *kharif* crops on sample farms under irrigated conditions

(per ha)

S. No.	Particulars	Maize		Paddy		Sorghum + Pearl Millet (Fodder)	
		Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries
1.	Seed (kg)	22.33	25.65	39.10	47.93	80.64	86.12
2.	FYM (q)	88.05	88.31	77.47	76.56	92.09	57.79
3.	Fertilizers (kg)						
i	N	98.68	94.30	95.77	105.56	37.62	19.63
ii	P	57.16	51.53	53.95	61.69	10.32	5.00
iii	K	28.58	25.77	26.98	22.50	5.16	5.00
	Total NPK	184.42	171.60	176.70	189.75	53.10	29.63
4.	Chemicals (Rs.)	2383	2067	2291	1980	210	83
5.	Tractor power (hrs)	12.71	12.44	19.15	18.66	13.32	9.74
6.	Human labour (days)	84.23	80.74	91.59	80.00	60.00	55.00

The input use pattern for maize, paddy and fodder (sorghum + pearl millet) in unirrigated conditions has been presented in the Table 4.29. Under unirrigated conditions, only non-beneficiary farmers were present in the study area.

Table 4.29 Input use pattern for *kharif* crops on non-beneficiary farms under unirrigated conditions

(per ha)

S. No.	Particulars	Maize	Paddy	Sorghum + PM (Fodder)
1.	Seed (kg)	35.85	55.81	120.25
2.	FYM (q)	92.45	74.26	80.36
3.	Fertilizers (kg)			
i	N	79.09	-	-
ii	P	21.82	-	-
iii	K	10.91	-	-
	Total NPK	111.82	-	-
4.	Chemicals (Rs.)	-	-	-
5.	Tractor power (hrs)	13.79	16.36	12.82
6.	Human labour (days)	80.00	80.00	58.00

It is clear from the table that under unirrigated conditions, farmers used the seed at 35.85, 55.81 and 120.25 kg/ha for maize, paddy and fodder crops, respectively, which was higher than the recommended seed rates. It was noticed that both hybrid and local varieties of seeds were used on non-beneficiary farms under unirrigated conditions. Among fertilizers, NPK was applied only for maize crop. Plant protection chemicals were not applied on non-beneficiary farms. Per hectare use of tractor was found to be higher in paddy (16.36 hours), followed by maize (13.79 hours) and fodder (12.82 hours). Family labour used was around 80 mandays for maize and paddy crop.

Table 4.30 Input use pattern for summer vegetable crops on sample farms under irrigated conditions

(per ha)

		Okra		Chillies		Tomato		Capsicum		Cucumber	
S. No.	**Particulars**	**Beneficiaries**	**Non-Beneficiaries**	**Beneficiaries**	**Non-Beneficiaries**	**Beneficiaries**	**Non-Beneficiaries**	**Beneficiaries**	**Non-Beneficiaries**	**Beneficiaries**	**Non-Beneficiaries**
1.	Seed (kg)	17.69	24.56	1.12	1.57	0.23	0.30	0.27	0.19	3.41	3.93
2.	FYM (q)	102.71	96.61	174.07	166.67	121.74	116.00	100.00	96.00	104.26	98.15
3.	Fertilizers (kg)										
i	N	58.55	60.00	65.19	60.17	90.95	116.00	100.33	92.60	71.54	108.59
ii	P	50.10	34.71	55.70	48.00	63.87	64.00	42.67	38.40	53.33	48.00
iii	K	25.05	17.36	27.85	24.00	31.94	32.00	21.33	19.20	26.67	24.00
	Total NPK	133.70	114.21	148.74	132.17	186.76	212.00	164.33	150.2	151.54	180.59
4.	Chemicals (Rs.)	7729	5356	5778	4500	6087	-	4500	-	6447	4815
5.	Tractor power (hrs)	15.02	14.58	13.70	13.33	13.04	13.00	12.50	12.00	13.94	13.42
6.	Human labour (days)	258.00	228.00	208.00	200.00	250.00	224.00	225.00	204.00	220.00	190.00

S. No.	Particulars	Brinjal Beneficiaries	Brinjal Non-Beneficiaries	Beans Beneficiaries	Beans Non-Beneficiaries	Bitter gourd Beneficiaries	Bitter gourd Non-Beneficiaries	Bottle gourd Beneficiaries	Bottle gourd Non-Beneficiaries
1.	Seed (kg)	0.69	0.73	81.95	88.33	6.07	6.80	5.94	6.43
2.	FYM (q)	110.05	81.25	95.12	85.00	92.59	80.00	97.24	91.43
3.	Fertilizers (NPK) (kg)								
i	N	79.45	91.25	38.99	34.07	74.60	72.00	62.91	74.00
ii	P	49.61	44.00	79.61	70.40	50.54	44.80	49.27	44.00
iii	K	24.80	22.00	39.80	35.20	25.27	22.40	24.64	22.00
	Total NPK	153.86	157.25	158.40	139.67	150.41	139.20	136.82	140.00
4.	Chemicals (Rs.)	5772	4125	5015	-	5547	-	5926	4743
5.	Tractor power (hrs)	13.68	13.13	13.41	13.33	13.02	13.20	12.66	12.57
6.	Human labour (days)	245.00	236.00	209.00	217.00	222.00	212.00	210.00	203.00

73

Table 4.30 displays the input use pattern of summer vegetable crops, *viz.*, okra, chillies, tomato, capsicum, cucumber, brinjal, beans, bitter gourd and bottle gourd. It was found that the beneficiary farmers used mostly hybrid or improved seeds for vegetable crops. While, non-beneficiary farmers were found to use both improved and local seeds. During survey, it was noticed that beneficiary farmers were well aware of the seeds of hybrid/ improved varieties. Quantity of seed used by beneficiary farmers was lower than the seed rate used by non-beneficiary farmers for all summer vegetable crops. However, beneficiary farmers used higher quantity of FYM in vegetable crops as compared to non-beneficiary farmers. It was noticed that there was no major difference in the use of NPK fertilizers among beneficiary and non-beneficiary farmers particularly in summer vegetable crops. It was also seen that majority of the farmers used NPK nutrients in the form of urea and IFFCO fertilizers. The use of NPK varied from 133kg/ha to 187kg/ha on beneficiary farms and 114 kg/ha to 212 kg/ha on non-beneficiary farms.

The vegetable growers also incurred substantial expenditure (Rs. 5000-6000/ha) on summer vegetables that might be due to more incidence of disease and pests in vegetable crops. Per hectare tractor use was in the range from 12-13 hours. The use of human labour ranged from 190-258 mandays per hectare for summer vegetables. There were noticeable differences in the use of critical inputs on beneficiary and non-beneficiary farms that might be due to the awareness created by KVK Kangra through demonstrations and trainings.

4.5.2 Input use pattern in *rabi* crops

Input use pattern for *rabi* crops, *viz.*, wheat, barley, fodder crops (oats and berseem) has been presented in Table 4.31. A noticeable difference was found in the quantities of inputs used by beneficiary and non-beneficiary farmers. The seed rate used by non-beneficiary farmers was higher in wheat, barley and *rabi* fodder crops (oats and berseem). For wheat crop, non-beneficiary farmers used 108.59 kg/ha seed which was higher as compared to seed rate used by beneficiary farmers (102.89 kg/ha). NPK requirement of crops were fulfilled through application of urea and IFFCO fertilizers in the study area. NPK application rate varied from 72 kg/ha to 172 kg/ha on beneficiary farms. On the other hand, NPK use ranged between 69 kg/ha to 142 kg/ha on non-beneficiary farms. Farm yard manure was applied almost at the same rate on beneficiary and non-beneficiary farms. The expenditure on chemicals for plant protection of *rabi* crops was higher on beneficiary farms in comparison to non-beneficiary farms. Per hectare tractor use ranged between 11 to 13 hours. The family labour used on beneficiary farms was also found to be higher due to adoption of better management practices.

Table 4.31 Input use pattern for *rabi* crops on sample farms under irrigated conditions

(per ha)

S. No.	Particulars	Wheat		Barley		Oats		Berseem	
		Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries	Beneficiaries	Non-Beneficiaries
1	Seed (kg)	102.89	108.59	110.38	124.48	104.86	116.15	25.37	27.22
2	FYM (q)	98.03	95.63	41.67	37.50	81.25	76.04	76.32	75.56
3	Fertilizers (kg)								
i	N	98.43	83.57	65.22	66.5	41.24	39.13	33.76	35.06
ii	P	49.09	39.12	23.20	24.00	22.22	20.00	26.00	25.60
iii	K	24.55	19.56	11.60	12.00	11.11	10.00	13.00	12.80
	Total NPK	172.07	142.25	100.02	102.5	74.57	69.13	72.76	73.46
4	Chemicals (Rs.)	2588	2005	942	613	840	630	700	625
5	Tractor power (hrs)	13.09	12.81	12.50	12.50	12.36	11.46	13.90	13.61
	Human labour (days)	72.26	77.23	67.18	61.71	68.68	63.54	69.30	63.80

Input use pattern for *rabi* crops grown by non-beneficiary farmers under unirrigated conditions have been presented in Table 4.32. Quantity of seed used per hectare in unirrigated conditions was higher than the seed used in irrigated conditions. The high seed rate was used to compensate poor germination. It was found that farmers used improved varieties as well as home retained local seeds. Farm yard manure was applied according to number of dairy animals available on non-beneficiary farms. Among fertilizers, NPK was applied only in wheat crop under unirrigated conditions. Plant protection chemicals were not applied to cereal and fodder crops. Human labour used was quite low due to less agricultural operations being carried out on non-beneficiary farms under unirrigated conditions.

The input use pattern for various vegetable crops grown during *rabi* season has been presented in Table 4.33. It was found that the seeds used by farmers to grow vegetables were hybrid/improved seeds. Seed rate used in various crops 0.49 kg/ha for cabbage, 0.60 kg/ha for cauliflower, 130.58 kg/ha for peas and 24.18 kg/ha for onion. Non-beneficiary farmers used higher quantity of seed per hectare as compared to

Table 4.32 Input use pattern for *rabi* crops on non-beneficiary farms under unirrigated conditions

(per ha)

S. No.	Particulars	Wheat	Barley	Oats	Berseem
1	Seed (kg)	119.43	35.71	123.21	29.50
2	FYM (q)	79.30	30.36	67.86	67.50
3	Fertilizers (kg)				
i	N	71.50	-	-	-
ii	P	37.33	-	-	-
iii	K	18.67	-	-	-
	Total NPK	127.50			
4	Chemicals (Rs.)	-	-	-	-
5	Tractor power (hrs)	12.10	12.50	11.79	13.75
6	Human labour (days)	43.88	54.73	58.82	60.00

Table 4.33 Input use pattern for winter vegetable crops on sample farms under irrigated conditions

(per ha)

		Cabbage		Cauliflower		Peas		Onion	
S. No.	Particulars	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
1	Seed (kg)	0.49	0.62	0.60	0.65	130.58	150.00	24.18	22.31
2	FYM (q)	112.26	110.00	139.38	133.33	127.96	120.95	235.29	215.38
3	Fertilizers (kg)								
i	N	79.21	75.24	106.23	101.88	53.54	55.26	72.84	118.44
ii	P	63.09	60.80	56.44	55.22	61.20	53.89	39.11	65.60
iii	K	31.55	30.40	28.22	172.54	30.60	26.95	19.55	32.80
	Total NPK	173.85	166.44	190.89	329.64	145.34	136.10	131.50	216.84
4	Chemicals (Rs.)	7603	6525	6636	5275	6333	4125	5751	4200
5	Tractor power (hrs)	12.15	12.08	13.68	13.73	13.40	12.38	13.89	13.38
6	Human labour (days)	266.00	274.00	287.00	290.00	257.00	261.00	279.00	206.00

beneficiary farmers while the use of farm yard manure and NPK fertilizers were almost same on both beneficiary and non-beneficiary farms. Farmers incurred an expenditure ranging from Rs. 4,000 to 6,000/ha on plant protection chemicals to protect the crops from insect-pest and diseases. Per hectare use of tractor power ranged between 12 to 13 hours. It was observed that the beneficiary farmers used more farm labour as compared to non-beneficiary farmers for vegetable production. A remarkable difference in the input use of winter vegetable crops was observed due to adoption of better management practices by beneficiary farmers.

Table 4.34 Input use pattern for winter vegetable crop (peas) under unirrigated conditions on sample farms

(per ha)

S. No.	Particulars	Peas
1	Seed (kg)	171.43
2	FYM (q)	128.57
3	Fertilizers (kg)	
i	N	-
ii	P	-
iii	K	-
	Total NPK	-
4	Chemicals (Rs.)	-
5	Tractor power (hrs)	12.86
6	Human labour (days)	210

Input use pattern for winter vegetable crop under unirrigated conditions has been presented in Table 4.34. It was found that peas was the only main crop grown under unirrigated conditions in the study area. The other vegetables like bottle gourd, bitter gourd etc., were grown on a very small scale for self-consumption. The quantity of seed used per hectare for pea crop was 171.43 kg/ha. Farm yard manure applied was 128.57 q/ha on non-beneficiary farms under unirrigated conditions. It was observed that NPK nutrients and chemicals for plant protection were not applied. Tractor hours used were around 12 hours per hectare. Farm labour used was 210 mandays per hectare.

4.5.3 Technological gap in use of critical inputs

Due to intervention of KVK, the technological gap between recommended and actual use is expected to narrow down, thereby, increasing the crop yields. Moreover, through KVK interventions, the farmers would adopt improved package of practices.

Seed

Seed is the most critical input for crop production. Technological gap in seed use by beneficiary farmers and non-beneficiary farmers was calculated using seed actually used on farm and recommended seed rate. Results regarding technological gap in seed use for *kharif* crops have been presented in Table 4.35.

It can be seen from the table that gap in the seed rate was higher on non-beneficiary farms and it was 28.25 per cent in maize and 36.93 per cent in paddy implying thereby, that the farmers were using excess seed. On the other hand, gap in excess seed use was around 11.64 per cent in maize and 39.10 per cent in paddy. However, in fodder crop, farmers were using excess seed from 46-60 per cent. The technological gap in seed use of summer vegetable crops was found to be higher on non-beneficiary farms as compared to beneficiary farms. The gap in excess seed use was found to the extent of 53 per cent on beneficiary farms and 100 per cent over recommended on non-beneficiary farms. However, seed use was deficit by 9 per cent in cucumber on beneficiary farms and 24 per cent seed deficit in capsicum on non-beneficiary farms. In general, the technological gap was found to be positive in *kharif* crops which indicated the excess use of seed by both beneficiary and non-beneficiary farmers.

Table 4.35 Technological gap in seed rate for *kharif* crops on sample farms

(kg/ha)

S No.	Crop	Recommended rate	Beneficiaries Adopted rate	Beneficiaries Technological gap (%)	Non-beneficiaries Adopted rate	Non-beneficiaries Technological gap (%)
1.	Maize	20.00	22.33	11.64	25.65	28.25
2.	Paddy	35.00	39.10	11.71	47.93	36.93
3.	Sorghum + Pearl Millet	55.00	80.64	46.62	86.12	56.58
4.	Vegetables					
i.	Okra	17.50	17.69	1.10	24.56	40.34
ii.	Chilli	1.00	1.12	11.85	1.57	56.67
iii.	Tomato	0.15	0.23	53.62	0.30	100.00
iv.	Capsicum	0.25	0.27	6.67	0.19	-24.00
v.	Cucumber	3.75	3.41	-9.03	3.93	4.69
vi.	Brinjal	0.63	0.69	8.76	0.73	15.08
vii.	Beans	75.00	81.95	9.27	88.33	17.78
viii.	Bitter gourd	5.00	6.07	21.35	6.80	36.00
ix.	Bottle gourd	5.00	5.94	18.83	6.43	28.57

Technological gap in seed use for *rabi* crops has been presented in the Table 4.36. It can be seen from the table that technological gap in seed use was comparatively low on beneficiary farms as against non-beneficiary farms. The excess seed was used over recommended and the excess seed use gap in cereal and fodder crops ranged from 1 per cent to 10 per cent on beneficiary farms and 8 per cent to 25 per cent on non-beneficiary farms. It was found that the gap in excess seed use for winter vegetable crops was quite low on beneficiary farms (2-20%) as compared to non-beneficiary farms (3-70%). It was clearly evident that the beneficiary farmers had better knowledge about recommended seed quantity. Sharma KD (2017) also stressed the need for production and distribution of improved seeds in Himachal Pradesh for which he suggested that agricultural university and state seed firms should collaborate to increase the supply of improved seeds of crops.

Table 4.36 Technological gap in seed rate for *rabi* crops on sample farms

(kg/ha)

			Beneficiaries		**Non-beneficiaries**	
S. No.	***Rabi* crops**	**Recommended rate**	**Adoption rate**	**Technological gap (%)**	**Adoption rate**	**Technological gap (%)**
1.	Wheat	100.00	102.89	2.89	108.59	8.59
2.	Barley	100.00	110.35	10.35	124.48	24.48
3.	Oats	100.00	104.86	4.86	116.15	16.15
4.	Berseem	25.00	25.37	1.48	27.22	8.88
5.	Winter vegetables					
i.	Cabbage	0.50	0.51	2.00	0.62	3.33
ii.	Cauliflower	0.50	0.59	18.00	0.65	30.00
iii.	Peas	125.00	130.58	4.46	150.00	20.00
iv.	Onion	11.75	14.18	20.68	20.30	72.77

Farm Yard Manure (FYM)

FYM is an important input to increase and sustain soil fertility. The technological gap in the use of farm yard manure for *kharif* crops was calculated and the results have been presented in Table 4.37.

Table 4.37 Technological gap in the use of FYM for *kharif* crops on sample farms (q/ha)

S. No.	*Kharif* crops	Recommended rate	Beneficiaries		Non-beneficiaries	
			Adoption rate	Technological gap (%)	Adoption rate	Technological gap (%)
1.	Maize	100.00	88.05	-11.95	88.31	-11.69
2.	Paddy	50.00	77.47	-84.51	76.56	-84.68
3.	Sorghum+ Pearl Millet	100.00	92.09	-7.91	92.64	-7.36
4.	Summer vegetables					
i	Okra	100.00	102.71	2.71	96.61	-3.39
ii	Chilli	250.00	174.07	-30.37	166.67	-33.33
iii	Tomato	200.00	121.74	-39.13	116.00	-42.00
iv	Capsicum	250.00	100.00	-60.00	96.00	-61.60
v	Cucumber	100.00	104.26	4.26	98.15	-1.85
vi	Brinjal	100.00	110.05	10.05	81.25	-18.75
vii	Beans	200.00	95.12	-52.44	85.00	-57.50
viii	Bitter gourd	100.00	92.59	-7.41	80.00	-20.00
ix	Bottle gourd	100.00	97.24	-2.76	91.43	-8.57

It can be seen from the table that FYM, on an average, was applied less than the recommended doses for *kharif* cereals, fodder and summer vegetable crops. The technological gap in FYM use on beneficiary and non-beneficiary farms was around 11 per cent, 84 per cent and 7 per cent in maize, paddy and *kharif* fodder, respectively. However, in case of summer vegetable crops, the deficit in the use of farm yard manure was observed to the extent of 1 per cent to 60 per cent on both beneficiary and non-beneficiary farms.

Table 4.38 Technological gap in the use of FYM for *rabi* crops on sample farms (q/ha)

S. No.	*Rabi* crops	Recommended rate	Beneficiaries		Non-beneficiaries	
			Actual used	Technological gap (%)	Actual used	Technological gap (%)
1.	Wheat	150.00	98.03	-34.65	95.63	-36.25
2.	Barley	100.00	41.67	-58.33	37.50	-62.50
3.	Oats	150.00	81.25	-45.83	76.04	-49.31
4.	Berseem	100.00	76.32	-23.68	75.56	-24.44
5.	Winter vegetables					
i	Cabbage	200.00	112.26	-43.87	110.00	-45.00
ii	Cauliflower	100.00	139.38	39.38	133.33	33.33
iii	Peas	200.00	127.96	-36.02	120.95	-39.53
iv	Onion	250.00	235.29	-5.88	215.38	-13.85

The technological gap in use of FYM in *rabi* crops has been presented in Table 4.38. Almost similar gap in cereal and fodder crops in the use of farm yard manure was found on both beneficiary and non-beneficiary farms. The per cent gap in the use of

FYM varied from 23 per cent to 62 per cent in *rabi* cereal and fodder crops. However, in case of winter vegetable crops, a technological gap of 5 per cent to 45 per cent was found. The gap in the use of FYM in different crops was due to less number of livestock units available per farm in the study area. Thakur et al (2008) reported that the farmers were using less quantity of FYM than the recommended level which ultimately affected the crop production.

Fertilizer (NPK) use

Application of nitrogen, phosphorus, potassium is one of the most important inputs in agriculture. The technological gap between actual rate adopted and recommended rate of NPK was computed for different crops.

Table 4.39 Technological gap in use of NPK nutrients in *kharif* on sample farms

(kg/ha)

S. No.	Crop	Recommended rate	Beneficiaries		Non-beneficiaries	
			Actual rate	Technological gap (%)	Actual rate	Technological gap (%)
1.	Maize					
	Nitrogen	120	98.68	-17.77	94.3	-21.42
	Phosphorus	60	57.16	-4.73	51.53	-14.12
	Potassium	40	28.58	-28.55	25.77	-35.58
	Total NPK	220	184.42	-16.17	171.6	-22.00
2.	Paddy					
	Nitrogen	90	95.77	6.41	105.56	17.29
	Phosphorus	40	53.95	34.88	61.69	54.23
	Potassium	40	26.98	-32.55	22.5	-43.75
	Total NPK	170	176.7	3.94	189.75	11.62
3.	Sorghum+Pearl Millet					
	Nitrogen	90	37.62	-58.20	19.63	-78.19
	Phosphorus	45	10.32	-77.07	5.00	-88.89
	Potassium	45	5.16	-88.53	5.00	-88.89
	Total NPK	180	53.10	-70.50	29.63	-83.54

Table 4.39 displays the technological gap in use of NPK nutrients for maize, paddy and *kharif* fodder. Per cent gap in deficit use of NPK in maize crop was 16 per cent on beneficiary farms and 22 per cent on non-beneficiary farms. In paddy crop, 3 per cent and 11 per cent excess use of NPK was found on beneficiary and non-beneficiary farms, respectively. However, in case of fodder crop, more deficit in the use of NPK was found on both beneficiary and non-beneficiary farms. This gap in use of NPK

fertilizers was observed due to lack of awareness and technological knowledge about fertilizer doses required for the crops.

Table 4.40 Technological gap in use of NPK nutrients in summer vegetable crops on sample farms

(kg/ha)

S. No.	Crops	Recommended rate	Beneficiaries		Non-beneficiaries	
			Actual rate	Technological gap (%)	Actual rate	Technological gap (%)
1	Okra					
	N	60	58.55	-2.42	62.14	3.56
	P	50	50.1	0.20	34.71	-30.58
	K	50	25.05	-49.90	17.36	-65.28
	Total NPK	160	133.7	-16.44	114.21	-28.62
2	Chillies					
	Nitrogen	75	65.19	-13.08	60.17	-19.77
	Phosphorus	75	55.7	-25.73	48	-36.00
	Potassium	40	27.85	-30.38	24	-40.00
	Total NPK	190	148.74	-21.71	132.17	-30.44
3	Tomato					
	Nitrogen	90	90.95	1.06	116	28.89
	Phosphorus	60	63.87	6.45	64	6.67
	Potassium	30	31.94	6.47	32	6.67
	Total NPK	180	186.76	3.76	212	17.78
4	Capsicum					
	Nitrogen	100	100.33	0.33	92.6	-7.40
	Phosphorus	75	42.67	-43.11	38.4	-48.80
	Potassium	40	21.33	-46.67	19.2	-52.00
	Total NPK	215	164.33	-23.56	150.2	-30.14
5	Cucumber					
	Nitrogen	60	71.54	19.23	108.59	80.98
	Phosphorus	50	53.33	6.66	48.00	-4.00
	Potassium	50	26.67	-46.66	24.00	-52.00
	Total NPK	160	151.54	-5.29	180.59	12.87

6	Brinjal					
	Nitrogen	75	79.45	5.93	91.25	21.67
	Phosphorus	50	49.61	-0.78	44.00	-12.00
	Potassium	50	24.8	-50.40	22.00	-56.00
	Total NPK	175	153.86	-12.08	157.25	-10.14
7	Beans					
	Nitrogen	50	38.99	-22.02	34.07	-31.86
	Phosphorus	100	79.61	-20.39	70.40	-29.60
	Potassium	50	39.8	-20.40	35.20	-29.60
	Total NPK	200	158.4	-20.80	139.67	-30.16
8	Bitter gourd					
	Nitrogen	60	74.6	24.33	72.00	20.00
	Phosphorus	50	50.54	1.08	44.80	-10.40
	Potassium	50	25.27	-49.46	22.40	-55.20
	Total NPK	160	150.41	-5.99	139.20	-13.00
9	Bottle gourd					
	Nitrogen	60	62.91	4.85	74.00	23.33
	Phosphorus	50	49.27	-1.46	44.00	-12.00
	Potassium	50	24.64	-50.72	22.00	-56.00
	Total NPK	160	136.82	-14.48	140.00	-12.50

Technological gap in the use of NPK for summer vegetable crops has been presented in the Table 4.40. It was found that total NPK gap was found to be in the range of 4 per cent to 22 per cent on beneficiary farms and 10 per cent to 30 per cent on non-beneficiary farms. It was also observed that potassium was the most deficit nutrient followed by phosphorus applied on beneficiary and non-beneficiary farms. This clearly shows unbalanced use of NPK nutrients even on beneficiary farms. On the whole, a deficit in the use of fertilizers in vegetable crops was found higher as compared to cereal crops in the study area. This might be due to the fact the farmers focused on vegetable production more as compared to cereal production. Suman (2017) also reported that there is a need to educate the vegetable growers about the importance of balanced use of NPK and its effect on crop productivity.

Table 4.41 Technological gap in use of NPK in *rabi* crops on sample farms

(kg/ha)

			Beneficiaries		Non-beneficiaries	
S.No.	**Crops**	**Recommended rate**	**Actual rate**	**Technological gap (%)**	**Actual rate**	**Technological gap (%)**
1	Wheat					
	Nitrogen	120	98.43	-17.98	83.57	-30.36
	Phosphorus	60	49.09	-18.18	39.12	-34.80
	Potassium	30	24.55	-18.17	19.56	-34.80
	Total NPK	210	172.07	-18.06	142.25	-32.26
2	Barley					
	Nitrogen	60	65.22	8.70	66.5	10.83
	Phosphorus	20	23.20	16.00	24	20.00
	Potassium	0	11.60	100.00	12	100.00
	Total NPK	80	100.02	25.02	102.5	28.12
3	Mustard					
	Nitrogen	60	60.75	1.25	51.29	-14.52
	Phosphorus	40	24.00	-40.00	22.86	-42.85
	Potassium	40	12.00	-70.00	11.43	-71.43
	Total NPK	140	96.75	-30.89	85.58	-38.87
4	Oats					
	Nitrogen	70	41.24	-41.08	39.13	-44.10
	Phosphorus	40	22.22	-44.45	20	-50.00
	Potassium	40	11.11	-72.23	10	-75.00
	Total NPK	150	74.57	-50.28	69.13	-53.91
5	Berseem					
	Nitrogen	25	33.76	35.04	35.06	40.24
	Phosphorus	60	26.00	-56.67	25.6	-57.33
	Potassium	0	13.00	100.00	12.8	100.00
	Total NPK	85	72.76	-14.40	73.46	-13.57

Technological gap in use of NPK for *rabi* cereal and fodder crops have been presented in Table 4.41. It was observed that, the gap deficit in NPK use for wheat crop was higher on beneficiary farms (18.06%) as compared to non-beneficiary farms (32.26%). However, there was excess use of NPK in case of barley crop on both beneficiary and non-beneficiary farms. Per cent deficit gap in the use of NPK was almost 50 per cent and 14 per cent for oats and berseem fodder on both beneficiary and non-beneficiary farms.

Table 4.42 Technological gap in use of NPK in winter vegetable crops

(kg/ha)

S.No.	Crops	Recommended rate	Beneficiaries Actual rate	Beneficiaries Technological gap (%)	Non-beneficiaries Actual rate	Non-beneficiaries Technological gap (%)
1	Cabbage					
	Nitrogen	120	79.21	-33.99	75.24	-37.30
	Phosphorus	75	63.09	-15.88	60.80	-18.93
	Potassium	60	31.55	-47.42	30.40	-49.33
	Total NPK	255	173.85	-31.82	166.44	-34.73
2	Cauliflower					
	Nitrogen	120	106.23	-11.48	101.88	-15.10
	Phosphorus	75	56.44	-24.75	55.22	-26.37
	Potassium	60	28.22	-52.97	172.54	187.57
	Total NPK	255	190.89	-25.14	329.64	29.27
3	Peas					
	Nitrogen	50	53.54	7.08	55.26	10.52
	Phosphorus	60	61.20	2.00	53.89	-10.18
	Potassium	30	30.60	2.00	26.95	-10.17
	Total NPK	140	145.34	3.81	136.10	-2.79
4	Onion					
	Nitrogen	60	72.84	21.40	118.44	97.40
	Phosphorus	35	39.11	11.74	65.60	87.43
	Potassium	25	19.55	-21.8	32.80	31.20
	Total NPK	120	131.5	9.58	216.84	80.70

Table 4.42 depicts the technological gap in NPK use for winter vegetable crops. It was observed that the deficit gap in use of NPK was almost similar for cabbage on both beneficiary and non-beneficiary farms. There was deficit of 25.14 per cent in NPK use in cauliflower on beneficiary farms and excess use on non-beneficiary farms (29.27%). While, excess use of NPK on beneficiary farms and deficit use of NPK on non-beneficiary farms was observed in case of pea crop. Per cent gap in excess use of NPK was about 10 per cent and 80 per cent for onion crop on beneficiary and non-beneficiary farms, respectively.

4.5.4 Use of critical inputs for dairy animals

The pattern of use of inputs in the maintenance of dairy animals and production of milk has been presented in Table 4.43. It can be seen from the table that on beneficiary farms, 58 quintal green fodder per animal per lactation was fed to buffalo, 55 quintal to improved cow and 51 quintal to local cow. Maximum quantity of dry fodder was fed to buffalo followed by improved cow and local cow. Concentrates provided to livestock varied from 5 to 15 quintal per animal per lactation. Highest expenditure for health care and mineral supplements for animals was incurred on buffalo by both beneficiary farmers and non-beneficiary farmers. Human labour used per animal per lactation was 65 mandays for buffalo, 59 for improved cow and 53 for local cow on beneficiary farms. On the other hand, for management of dairy animals, non-beneficiary farmers used 63 human labour days for buffalo, followed by 52 for cow improved and 49 for cow local. A remarkable difference in inputs for livestock feeding and management was found on beneficiary and non-beneficiary farmers. This clearly shows better management practices followed for livestock management by beneficiary farmers.

Table 4.43 Critical inputs for dairy animals

(per animal/lactation)

S No. Particulars	Beneficiaries			Non-beneficiaries		
	Cow local	**Cow improved**	**Buffalo**	**Cow local**	**Cow improved**	**Buffalo**
1. Green fodder (q)	51	55	58	42	46	47
2. Dry fodder (q)	15	16	18	10	12	14
3. Concentrates (q)	7	9	14	5	7	12
4. Minerals (Rs.)	750	675	780	450	579	690
5. Human labour (days)	53	59	65	49	52	63
6. Health care (Rs.)	540	615	665	375	560	680

4.6 Impact of KVK on management practices and adoption of technology

Scientific management practices play important role in increasing farm production and productivity. It is a well-known fact that the potential of improved varieties of crops and improved breeds of animals can only be realized by adopting improved practices and management. Basic aim of extension agencies is to create awareness about the improved practices of crop production and livestock management to raise the productivity frontiers and to bridge the technological gap between potential yield and yield realized by the farmers. Therefore, this section has been devoted to analyze the impact of KVK on different management practices adopted by the farmers and impact of KVK in improving the adoption.

4.6.1 Impact of KVK on management practices (cereal crops)

The Principal Component Analysis (PCA) was employed to devise the crop management index and to evaluate the technological interventions carried out by KVK. The management index was computed based on improved management practices adopted by the farmers in the study area for different crops.

Maize

For maize crop, component factor loadings for different practices have been presented in Table 4.44. The component factor loadings represented the weights assigned to each practice/ variable in linear combination corresponding to each variable taken to explain the variability in management practices for crop production. First factor loading value of 0.28 of first component (P1) indicated the weight assigned to first variable of proper sowing. Second loading value 0.55 of first component (P1) explained the weight given to second variable of ridge and furrow making and so on. On the basis of factor loadings of each principal component, loadings of higher values indicated the variables that affected the management index. The variables that played significant role in extraction of management index for maize on beneficiary and non-beneficiary farms were recommended seed rate, application of split NPK, fungicide use, recommended NPK, recommended FYM, proper sowing and earthing up of soil.

Table 4.44 Principal component factor loadings for maize

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	0.284	-0.174	0.639	-0.017
2.	Ridge and furrow making	0.547	0.019	-0.018	-0.622
3.	Recommended seed rate	0.784	-0.039	-0.120	0.399
4.	Recommended spacing	0.644	-0.528	0.068	0.036
5.	Recommended FYM	0.049	0.691	0.017	-0.307
6.	Application of basal NPK	0.215	0.544	0.568	0.189
7.	Recommended NPK	0.313	0.698	-0.012	-0.002
8.	Split application of NPK	0.655	0.209	-0.265	0.480
9.	Fungicides use	0.720	0.000	-0.482	-0.048
10.	Hand weeding	-0.347	-0.382	0.102	0.262
11.	Earthing up	0.362	-0.020	0.570	0.171
12.	Irrigation at critical stages	0.614	-0.362	0.178	-0.433

The eigen values corresponding to all four principal components and variability associated with each component for maize crop have been presented in Table 4.45. It can be seen from table that the first eigen value (3.13) explained maximum variability (26.09%), second eigen value (1.89) explained second highest variability (15.77 per cent) followed by third eigen value (1.42) and fourth eigen value (1.19). It was found that cumulative 63.66 per cent variability was explained by the four principal components together. It was found that maximum variability was captured by first four eigen values and corresponding four components were selected for further analysis to compute the management index for maize crop.

Table 4.45 Eigen values and percentage of variation for maize

	P1	P2	P3	P4
Eigen value	3.131	1.892	1.420	1.195
Variability (%)	26.094	15.768	11.834	9.960
Cumulative (%)	26.094	41.863	53.697	63.657

Paddy

For paddy crop, component factor loadings for different practices have been presented in Table 4.46. On the basis of factor loadings of each principal component, variables that played significant role in the extraction of management index for paddy on beneficiary and non-beneficiary farms were recommended insecticides, weedicides, irrigation at critical stages, application of split NPK, hand weeding, proper sowing and recommended seed rate.

Table 4.46 Principal component factor loadings for paddy

S. No.	Variables	P1	P2	P3	P4	P5
1.	Proper sowing time	0.379	-0.332	-0.011	0.597	0.436
2.	Line sowing	-0.407	0.451	0.305	0.500	0.151
3.	Seed rate	-0.167	0.381	0.461	-0.103	0.536
4.	Recommended spacing	0.499	0.330	-0.120	0.342	-0.310
5.	Basal NPK	0.405	-0.307	-0.296	-0.449	0.442
6.	Recommended FYM	-0.715	0.142	0.106	0.088	0.119
7.	Recommended NPK	0.129	-0.267	0.670	-0.347	0.083
8.	Split NPK	0.564	0.137	0.376	-0.049	-0.337
9.	Weedicides	0.637	0.619	0.154	-0.097	0.073
10.	Hand weeding	-0.254	0.522	-0.580	-0.107	0.218
11.	Irrigation	0.593	-0.451	-0.019	0.361	0.199
12.	Recommended insecticides	0.705	0.563	-0.101	-0.103	0.166

The eigen values corresponding to all five principal components and variability associated with each component for paddy crop have been presented in the Table 4.47. It can be seen from table that the first eigen value (2.91) explained maximum variability (24.28%), second eigen value (1.95) explained second highest variability (16.23%) followed by third eigen value (1.38), fourth eigen value (1.23) and fifth eigen value (1.05). It was observed that cumulative 70.97 per cent variability was explained by the five principal components together. It was found that maximum variability was captured by first five eigen values and corresponding five components were selected for further analysis to compute the management index for paddy crop.

Table 4.47 Eigen values and percentage of variation for paddy

	P1	P2	P3	P4	P5
Eigen value	2.914	1.948	1.380	1.228	1.046
Variability (%)	24.286	16.234	11.501	10.234	8.715
Cumulative (%)	24.286	40.519	52.021	62.254	70.969

Wheat

For wheat crop, principal component factor loadings for different practices have been presented in Table 4.48. On the basis of factor loadings of each principal component, variables that played significant role in extraction of management index for wheat on beneficiary and non-beneficiary farms were recommended NPK, split NPK application, hand weeding, proper sowing, recommended spacing, application of basal NPK and proper sowing time.

Table 4.48 Principal component factor loadings for wheat

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	-0.187	0.703	0.069	0.472
2.	Line sowing	0.589	0.313	0.300	0.050
3.	Recommended seed rate	0.480	-0.490	0.303	0.256
4.	Recommended spacing	0.527	0.578	-0.277	-0.258
5.	Basal NPK	0.458	-0.165	0.439	-0.490
6.	Recommended NPK	0.743	-0.167	0.063	0.052
7.	Split application of NPK	0.702	-0.261	-0.170	0.226
8.	Weedicide use	0.396	0.235	-0.719	-0.054
9.	Hand weeding	0.616	-0.091	-0.357	-0.015
10.	Irrigation	0.400	0.342	0.377	0.510
11.	Recommended Insecticide use	0.160	0.539	0.395	-0.463

The eigen values corresponding to all four principal component and variability associated with each component for wheat crop have been presented for wheat crop in the Table 4.49. It can be seen from the table that first eigen value (2.87) explained maximum variability (26.07), second eigen value explained second highest variability (15.99) followed by third eigen values (1.43) and fourth eigen values (1.13). It was observed that cumulative 65.31 per cent of variability was explained by four principal components together. It was found that maximum variability was captured by first four eigen values and corresponding four components were selected for further analysis to compute the management index for wheat crop.

Table 4.49 Eigen values and percentage of variation for wheat

	P1	P2	P3	P4
Eigen value	2.867	1.760	1.430	1.128
Variability (%)	26.066	15.999	12.996	10.255
Cumulative (%)	26.066	42.065	55.061	65.315

Management indices of maize, paddy, wheat and overall cereals were calculated using the principal components and the results have been presented in Table 4.50.

In maize crop, 26.32 per cent beneficiary farmers were in very high adoption category (above 75% adoption). About 47 per cent of the beneficiary farmers were in category of high rate of adoption (50-75% adoption). About 37 per cent non-beneficiary farmers each had high and low rate of adoption.

In paddy crop, maximum proportion of beneficiary farmers (48.28%) were under high rate of adoption category followed by 41.38 per cent and 10.34 per cent beneficiary farmers under moderate and very high rate of adoption category, respectively. On the other hand, on non-beneficiary farms, 60 per cent farmers fell under the category of moderate category of adoption.

In wheat crop, 66.67 per cent beneficiary farmers were under high rate of adoption category followed by 20 per cent under very high adoption, respectively. On the other hand, 43.33 per cent non-beneficiary farmers fell under the category of high rate of adoption and 33.33 per cent under moderate category of adoption.

On the whole, the composite index of all cereals was computed. About 70 per cent beneficiary farmers had high rate of adoption. About 23 per cent were under moderate category of adoption. In case of non-beneficiary farmers, maximum proportion 76.67 per cent fell under the moderate rate of adoption category. It can be concluded that 70 per cent non-beneficiary farmers were under high rate of adoption category and 76.67 per cent non-beneficiary farmers under moderate rate of adoption category.

Based on sum of individual principal components with area under each crop, the average management index was computed. The average management index on beneficiary farms was 63.82 per cent for maize, 53.45 per cent for paddy and 65.49 per cent for wheat with an overall weighted index of 59.70 per cent. On the other hand, the management index for non-beneficiary farmers was 37.70 per cent for maize, 39.72 per cent for paddy and 43.01 per cent for wheat with an overall index of 36.43 per cent for all cereals. In this way, the adoption of improved practices is quite visible on beneficiary farms.

Table 4.50 Distribution of farmers according to management indices for cereal crops

(number)

Adoption category	Maize		Paddy		Wheat		(Weighted index) All cereals	
	Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
Very high (> 75%)	5	1	3	0	6	0	2	0
	(26.32)	(4.17)	(10.34)	(0.00)	(20.00)	(0.00)	(6.67)	(0.00)
High (50-75%)	9	9	14	0	20	13	21	4
	(47.37)	(37.50)	(48.28)	(0.00)	(66.67)	(43.33)	(70.00)	(13.33)
Moderate (25-50%)	5	5	12	18	4	10	7	23
	(26.32)	(20.83)	(41.38)	(60.00)	(13.33)	(33.33)	(23.33)	(76.67)
Low (<25%)	0	9	0	12	0	7	0	3
	(0.00)	(37.50)	(0.00)	(40.00))	(0.00)	(23.33)	(0.00)	(10.00)
Total	19	24	29	30	30	30	30	30
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Overall management index (%)	63.82	37.70	54.35	39.52	65.49	43.01	59.70	36.43

Figures in parentheses indicate per cent farmers in adoption category

Regression analysis has been carried out in order to analyze the factors for adoption of improved management practices and to segregate the impact of KVK on adoption of improved practices.

Table 4.51 Factors affecting improved management of cereal crops

Factors	Regression coefficients
Constant/ Intercept	21.3146
	(5.8084)
Farming experience (years)	0.0463
	(0.1949)
Age of head of the family (years)	0.1084
	(0.1232)
Education (number of schooling years)	-0.0175
	(0.0609)
Dummy for KVK	49.7634**
	(2.6209)
Adjusted R^2	0.8721**
F-value	13.70

**Significant at 1% level
Figures in parentheses show standard errors of respective values

The variables specified are farming experience (in years), age of the head of the family (in years), education of head of the family (number of schooling years) and a dummy variable for KVK. The results for regression presented in Table 4.51 which clearly shows that KVK has made a significant enhancement in the adoption of improved practices. The variables considered explained more than 87 per cent of the systematic variation in the model which was found to be significant at 1 per cent level of significance. KVK has been found the only significant variable in enhancing the adoption rate. This clearly shows that the adoption of improved management practices for cereal crops increased on beneficiary farms to the extent of 49.76 per cent over non-beneficiary farms. The other variables were found non-significant in which education surprisingly showed negative impact on adoption of technology. This might be due to the fact that educated persons are taking less interest in farming.

4.6.2 Impact of KVK on management practices (vegetable crops)

Okra

For okra crop, component factor loadings for different practices/variables have been presented in Table 4.52. The variables that played significant role in extraction of management index for okra on beneficiary and non-beneficiary farms were recommended NPK, recommended seed rate, split application of NPK, recommended insecticides use, recommended pesticides use, recommended spacing and proper sowing time.

Table 4.52 Principal component factor loadings for okra

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	-0.147	-0.310	0.313	0.725
2.	Line sowing	0.283	-0.533	-0.003	-0.116
3.	Seed rate	0.719	-0.427	0.130	0.193
4.	Recommended spacing	0.353	0.087	0.688	-0.020
5.	Recommended FYM	0.604	0.174	-0.018	-0.302
6.	Recommended dose of NPK	0.724	-0.379	-0.299	-0.166
7.	Split application of NPK	0.652	-0.116	0.068	-0.110
8.	Use of weedicides	0.229	0.772	-0.021	0.234
9.	Hand weeding	0.065	0.233	-0.722	0.468
10.	Earthing up	0.520	-0.144	0.126	0.517
11.	Irrigation at critical stages	0.631	-0.289	-0.305	0.024
12.	Recommended insecticides use	0.602	0.641	-0.026	0.024
13.	Recommended pesticides use	0.469	0.652	0.186	0.000

The eigen values corresponding to all four principal components and variability associated with each component for okra vegetable crop have been presented in Table 4.53. It was noticed that the first eigen value (3.37) captured maximum variability (25.89%), second eigen value (2.35) explained second highest variability (18.06%) followed by third eigen value (1.35) and fourth eigen value (1.25). It was found that the cumulative variability of 63.95 per cent was explained by four principal components together. It was observed that maximum variability was captured by first four eigen values and corresponding four components were selected for further analysis to compute the management index for okra crop.

Table 4.53 Eigen values and percentage of variation for okra

	P1	P2	P3	P4
Eigen value	3.366	2.348	1.349	1.252
Variability (%)	25.890	18.062	10.375	9.628
Cumulative (%)	25.890	43.952	54.327	63.955

Cucumber

For cucumber crop, component factor loadings for different improved practices have been presented in Table 4.54. On the basis of factor loadings of each principal component, the variables that played significant role in the extraction of management index for cucumber crop on beneficiary and non-beneficiary farms were irrigation at critical stages, staking, recommended spacing, hand weeding, recommended NPK and recommended seed rate.

Table 4.54 Principal component factor loadings for cucumber

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	0.679	-0.351	-0.002	0.122
2.	Ridge sowing	0.450	0.080	0.392	-0.498
3.	Seed rate	-0.183	0.167	0.741	0.371
4.	Recommended spacing	0.679	-0.088	0.401	-0.206
5.	Recommended FYM	0.310	-0.563	0.115	0.010
6.	Recommended dose of NPK	0.427	0.490	0.251	0.317
7.	Split application	-0.343	0.391	0.386	-0.217
8.	Use of pesticides	0.435	0.292	-0.134	-0.539
9.	Hand weeding	0.268	0.805	-0.179	0.186
10.	Staking	0.702	-0.203	-0.063	0.081
11.	Irrigation at critical stage	0.702	0.360	-0.278	0.295
12.	Recommended insecticide use	0.155	-0.399	0.149	0.361

The eigen values corresponding to all four principal components and variability associated with each component for cucumber vegetable crop have been presented in Table 4.55. It was observed that the first eigen value (2.82) explained maximum variability (25.53%), second eigen value (1.94) explained second highest variability (16.16%) followed by third eigen value (1.24) and fourth eigen value (1.14). It was found that the cumulative variability of 59.55 per cent was explained by four principal components together. Maximum variability was captured by first four eigen values and corresponding four components were therefore, utilized for further analysis of management index of cucumber.

Table 4.55 Eigen values and percentage of variation for cucumber

	P1	P2	P3	P4
Eigen value	2.824	1.940	1.242	1.14
Variability (%)	23.530	16.164	10.353	9.502
Cumulative (%)	23.530	39.694	50.048	59.55

Bottle gourd

For bottle gourd, component factor loadings for different practices have been presented in Table 4.56. On the basis of factor loadings of each principal component, variables that played significant role in extraction of management index for bottle gourd crop on beneficiary or non-beneficiary farms were proper sowing time, recommended seed rate, recommended FYM, split application of NPK, recommended spacing and use of weedicides.

Table 4.56 Principal component factor loadings for bottle gourd

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	0.859	0.186	0.024	0.084
2.	Seed rate	0.538	-0.467	0.365	0.007
3.	Recommended spacing	-0.383	0.197	0.384	0.657
4.	Recommended FYM	-.002	0.819	0.428	-0.141
5.	Recommended dose of NPK	0.525	-0.159	-0.456	0.214
6.	Split application	-0.238	0.650	-0.383	-0.162
7.	Weedicide	0.325	0.500	-0.215	0.642
8.	Hand weeding	-0.606	-0.514	-0.136	0.389
9.	Irrigation at critical stage	-0.168	-0.026	0.722	0.013
10.	Recommended insecticide use	-0.695	0.103	-0.271	-0.078

The eigen values corresponding to all four principal components and variability associated with each component for bottle gourd vegetable crop have been presented in Table 4.57. It can be noticed that the first eigen value (2.49) explained maximum variability (24.89%), second eigen value (1.89) explained second highest variability (19.35%) followed by third eigen value (1.48) and fourth eigen value (1.10). It was found that the cumulative variability of 70.04 per cent was explained by four principal components together. Maximum variability was captured by first four eigen values and corresponding four components were therefore, utilized for further analysis of management index of bottle gourd.

Table 4.57 Eigen values and percentage of variation for bottle gourd

	P1	P2	P3	P4
Eigen value	2.489	1.935	1.479	1.10
Variability (%)	24.893	19.354	14.788	11.001
Cumulative (%)	24.893	44.247	59.035	70.037

Cabbage

For cabbage crop, component factor loadings for different practices have been presented in Table 4.58. The variables that played significant role in the extraction of management index of cabbage crop on beneficiary and non-beneficiary farms were hand weeding, split application of NPK, irrigation at critical stages, proper sowing time, use of weedicides, recommended spacing, recommended FYM and earthing up.

Table 4.58 Principal component factor loadings for cabbage

S. No.	Variables	P1	P2	P3	P4	P5
1.	Proper sowing time	0.219	0.678	-0.203	0.318	0.327
2.	Line sowing	0.016	0.267	0.035	0.79	-0.052
3.	Seed rate	0.386	-0.618	-0.318	0.107	0.319
4.	Recommended spacing	-0.077	-0.169	0.654	-0.168	0.461
5.	Recommended FYM	0.34	-0.203	0.209	0.513	-0.369
6.	Recommended dose of NPK	0.568	0.127	-0.012	-0.385	-0.091
7.	Split application	0.655	0.37	-0.082	-0.149	-0.478
8.	Use of Weedicides	0.133	0.641	0.334	-0.121	0.456
9.	Hand weeding	0.776	-0.1	0.264	0.113	0.162
10.	Earthing up	0.025	-0.186	0.641	-0.077	-0.345
11.	Irrigation at critical stage	0.644	-0.363	0.073	0.244	0.294
12.	Recommended insecticide use	0.577	0.021	-0.309	-0.369	0.021
13.	Recommended pesticide use	0.204	0.226	0.357	-0.043	-0.234

The eigen values corresponding to all five principal components and variability associated with each component for cabbage vegetable crop have been presented in Table 4.59. It can be noticed that the first eigen value (2.48) explained maximum variability (19.07%), second eigen value (1.77) explained second highest variability (13.65%) followed by third eigen value (1.44), fourth eigen value (1.43) and fifth eigen value (1.29). It was found that the cumulative variability of 64.71 per cent was explained by five principal components together. It can be seen from table that maximum variability was captured by first five eigen values and corresponding five components were therefore, utilized for further analysis of management index of cabbage.

Table 4.59 Eigen values and percentage of variation for cabbage

	P1	P2	P3	P4	P5
Eigen value	2.479	1.775	1.441	1.430	1.291
Variability (%)	19.068	13.653	11.084	11.002	9.932
Cumulative (%)	19.068	32.722	43.806	54.808	64.741

Cauliflower

For cauliflower crop, component factor loadings for different practices have been presented in Table 4.60. The variables that played significant role in the extraction of management index for cauliflower on beneficiary and non-beneficiary farms were recommended spacing, line sowing, split application of NPK, use of insecticides, irrigation at critical stages, use of pesticides, use of weedicides and proper sowing time.

Table 4.60 Principal component factor loadings for cauliflower

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	-0.371	-0.067	0.326	0.446
2.	Line sowing	0.632	-0.155	-0.233	0.314
3.	Seed rate	0.235	0.720	-0.080	-0.258
4.	Recommended spacing	0.721	-0.170	0.311	0.011
5.	Recommended FYM	0.263	0.336	0.162	0.699
6.	Recommended dose of NPK	0.026	0.345	0.480	0.028
7.	Split application	0.629	0.002	0.198	-0.210
8.	Use of Weedicides	-0.279	0.448	0.395	0.192
9.	Hand weeding	0.511	-0.522	0.365	-0.163
10.	Earthing up	0.389	0.139	-0.433	0.318
11.	Irrigation at critical stage	-0.002	0.515	-0.460	-0.165
12.	Recommended insecticide use	0.410	0.677	0.001	-0.069
13.	Recommended pesticide use	-0.040	0.289	0.640	-0.212

The eigen values corresponding to all four principal components and variability associated with each component for cauliflower vegetable crop have been presented in Table 4.61 It can be noticed that the first eigen value (2.24) explained maximum variability (17.24%), second eigen value (2.11) explained second highest variability (16.21%) followed by third eigen value (1.66) and fourth eigen value (1.14). It was found that the cumulative variability of 54.96 per cent was explained by five principal components together. It can be seen from table that maximum variability was captured by first four eigen values and corresponding four components were therefore, utilized for further analysis of management index of cauliflower.

Table 4.61 Eigen values and percentage of variation for cauliflower

	P1	P2	P3	P4
Eigen value	2.239	2.108	1.658	1.139
Variability (%)	17.226	16.213	12.752	8.764
Cumulative (%)	17.226	33.44	46.192	54.956

Peas

For pea crop, component factor loadings for different practices have been presented in Table 4.62. It was observed that the use of pesticides, split application of NPK, recommended seed rate, recommended NPK, earthing up, line sowing variables had higher values of factor loadings, were the variables that affected the management index of farming practices followed to grow peas crop.

Table 4.62 Principal component factor loadings for pea

S. No.	Variables	P1	P2	P3	P4
1.	Proper sowing time	-.730	-.066	.328	0.395
2.	Line sowing	.306	.114	.045	0.653
3.	Seed rate	.480	.617	-.276	-0.403
4.	Recommended spacing	-.466	.333	-.361	-0.128
5.	Recommended FYM	.140	-.092	-.499	0.35
6.	Recommended dose of NPK	-.190	.810	.255	0.126
7.	Split application	.698	-.179	-.050	0.476
8.	Hand weeding	.441	.084	-.664	0.014
9.	Earthing up	.535	-.052	.479	-0.062
10.	Irrigation at critical stage	.377	-.350	.437	-0.352
11.	Recommended insecticide use	-.102	.816	.187	0.135
12.	Recommended pesticide use	.711	.386	.328	0.054

The eigen values corresponding to all four principal components and variability associated with each component for pea crop have been presented in Table 4.63 It can be noticed that the first eigen value (2.76) explained maximum variability (22.97%), second eigen value (2.15) explained second highest variability (17.94%) followed by third eigen value (1.64) and fourth eigen value (1.28). It was found that the cumulative variability of 65.17 per cent was explained by four principal components together. It can be seen from table that maximum variability was captured by first four eigen values and corresponding four components were therefore, utilized for further analysis of management index of pea.

Table 4.63 Eigen values and percentage of variation for pea

	P1	P2	P3	P4
Eigen value	2.756	2.152	1.636	1.276
Variability (%)	22.967	17.936	13.631	10.634
Cumulative (%)	22.967	40.902	54.534	65.168

The management indices for major vegetable crops were computed and the results have been presented in Table 4.64.

In okra, around 37 per cent beneficiary farmers each had very high and moderate rate of adoption. The remaining 26.67 per cent beneficiary farmers had high rate of adoption. On the other hand, maximum proportion of non-beneficiary farmers (41.67%) were under low rate of adoption category. About 33 per cent and 17 per cent of non-beneficiary farmers were under moderate and high rate of adoption categories, respectively.

In cucumber, maximum proportion of beneficiary farmers (42.86%) were under high rate of adoption category, followed by 28.57 per cent and 25 per cent under moderate and very high rate of adoption categories while 58.33 per cent non-beneficiary farmers were under moderate rate of adoption category.

In bottle gourd, around 44 per cent beneficiary farmers were under moderate rate of adoption category. About 31 per cent and 18.75 per cent beneficiary farmers fell under high and very high rate of adoption categories. However, 100 per cent of the non-beneficiary farmers fell under moderate category of adoption.

In cabbage, maximum beneficiary farmers (46.67%) were under very high rate category of adoption. Around 30 per cent and 20 per cent beneficiary farmers fell under high and moderate rate of adoption categories. On the other hand, maximum proportion (36.36%) of non-beneficiary farmers were under low adoption category followed by 27.27 per cent each under high and moderate category of adoption.

In cauliflower crop, maximum proportion (48.28%) of beneficiary farmers fell under very high rate of adoption category. About 21 per cent and 17.24 per cent beneficiary farmers fell under high and moderate rate of adoption categories. On the other hand, 45.45 per cent of non-beneficiary farmers were under low category of adoption. Around 18 per cent of non-beneficiary farmers fell under each very high, high and moderate rate of adoption categories.

Table 4.64 Distribution of farmers according to management indices for vegetable crops

(number)

	Okra		Cucumber		Bottle gourd		Cabbage		Cauliflower		Peas		(Weighted index) All vegetables	
Adoption category	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
Very high (>75%)	11	1	7	0	3	0	14	1	14	2	5	1	6	0
	(36.67)	(8.33)	(25.00)	(0.00)	(18.75)	(0.00)	(46.67)	(9.09)	(48.28)	(18.18)	(27.78)	(12.50)	(20.00)	(0.00)
High (50-75%)	8	2	12	1	5	0	9	3	6	2	8	3	21	2
	(26.66)	16.67	42.86	8.33	(31.25)	(0.00)	(30.00)	(27.27)	(20.69)	(18.18)	(44.44)	(37.50)	(70.00)	(13.33)
Moderate (25-50%)	11	4	8	7	7	3	6	3	5	2	5	2	3	8
	(36.67)	33.33	28.57	58.34	(43.75)	(100.00)	(20.00)	(27.27)	(17.24)	(18.18)	(27.78)	(25.00)	(10.00)	(53.33)
Low (<25%)	0	5	1	4	1	0	1	4	4	5	0	2	0	5
	(0.00)	41.67	3.57	33.33	(6.25)	(0.00)	(3.33)	(36.36)	(13.79)	(45.45)	(0.00)	(25.00)	(0.00)	(33.33)
Total	30	12	28	12	16	3	30	11	29	11	18	8	30	15
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Overall management index	63.64	33.65	83.25	23.84	53.06	35.79	69.86	38.66	67.12	39.57	64.32	43.65	62.56	34.91

Note: Figures in parentheses indicate per cent farmers in adoption category

In pea, 44.44 per cent beneficiary farmers had high rate of adoption while 27.78 per cent beneficiary farmers each fell under very high and moderate adoption categories. However, 37.50 per cent non-beneficiary farmers were under high and 25 per cent each under moderate and low categories of adoption. It was observed that only 12.50 per cent of non-beneficiary farmers were under very high category of adoption.

The average management index on beneficiary farms was 63.64 per cent for okra, 83.25 per cent for cucumber, 53.06 per cent for bottle gourd, 69.86 per cent for cabbage, 67.12 per cent for cauliflower and 64.32 per cent for pea with an overall weighted index of 62.56 per cent. On the other hand, the management index was 33.65 per cent for okra, 23.84 per cent for cucumber, 35.79 per cent for bottle gourd, 38.66 per cent for cabbage, 39.57 per cent for cauliflower and 43.65 per cent for pea with an overall weighted index of 34.91 per cent for all vegetables on non-beneficiary farms. The adoption pattern of improved practices by beneficiary and non-beneficiary farmers has also been given in Appendix IV.

Regression analysis has been carried out to study the factors for adoption of improved management practices for vegetable crops and the results have been presented in Table 4.65.

Table 4.65 Factors affecting improved management of vegetable crops

Factors	**Regression coefficients**
Constant/Intercept	18.9314
	(10.6336)
Farming experience (years)	0.0228
	(0.3568)
Age of respondent (years)	-0.0728
	(0.2255)
Education (number of schooling years)	0.0930
	(0.1114)
Dummy for KVK	44.0763**
	(4.7981)
Adjusted R^2	0.6702**
F-value	13.7

**significant at 1 % level

Figures in parentheses show standard errors of respective values

The variables specified are farming experience (in years), age of the head of the family (in years), education of head of the family (number of schooling years) and a dummy variable for KVK. The KVK proved to be a significant factor in adoption of improved practices of vegetable production. The variables considered for factor analysis explained about 67 per cent of the systematic variation in model which was found to be significant at 1 per cent level of significance. It was found that the adoption of improved management practices for vegetable crops increased on beneficiary farms to the extent of 44.07 per cent over non-beneficiary farms. The other variables were found non-significant. This clearly shows positive impact of KVK trainings on adoption of better management practices by beneficiary farmers.

4.6.3 Impact of KVK on management practices for livestock

Local cow

For local cow, component factor loadings for different variables/practices have been presented in Table4.66. On the basis of factor loadings of each principal component, variables that played significant role in the extraction of management index of local cow on beneficiary and non-beneficiary farms were control of ectoparasites, washing before milking, concentrate feed, artificial insemination, housing and mineral mixture.

Table 4.66 Principal component factor loadings for local cow

S. No.	Variables	P1	P2	P3
1.	Housing	0.132	0.565	0.249
2.	Lighting	0.539	0.37	-0.678
3.	Green fodder recommended	0.552	-0.253	-0.531
4.	Dry fodder recommended	0.382	0.122	0.098
5.	Daily cleaning and washing	0.689	-0.057	-0.636
6.	Dehorning	0.498	-0.623	0.286
7.	Deworming	0.298	-0.445	0.155
8.	Mineral mixture	0.256	0.398	0.146
9.	Concentrates recommended	0.783	0.326	0.287
10.	Watering trough	0.506	0.207	0.114
11.	Washing before milking	0.783	-0.096	0.398
12.	Control of ectoparasites	0.865	0.086	0.369
13.	Adopting AI	0.5	0.661	0.064
14.	Proper sanitation and hygiene	0.379	-0.775	0.082

The eigen values corresponding to all three principal components and variability associated with each component for local cow have been presented in Table 4.67. It was found that the first eigen value (4.63) explained maximum variability (33.10%), second eigen value (2.52) explained second highest variability (17.97%) followed by third eigen value (1.774) and so on. It was found that the cumulative variability of 63.74 per cent was explained by three principal components together. It can be seen from table that maximum variability was captured by first three eigen values and corresponding three components were therefore, utilized for further analysis of management index of local cow.

Table 4.67 Eigen values and percentage of variation for local cow

	P1	**P2**	**P3**
Eigen value	4.634	2.516	1.774
Variability (%)	33.098	17.969	12.672
Cumulative (%)	33.098	51.067	63.739

Improved cow

For improved cow, component factor loadings for different practices/variables have been presented in Table 4.68. The variables that played significant role in differing the management index of cow improved of beneficiary or non-beneficiary farms were mineral mixture, daily cleaning and washing, recommended dry fodder, control of ectoparasites, proper sanitation and hygiene.

The eigen values corresponding to all two principal components and variability associated with each component for improved cow have been presented in Table 4.69 First eigen value (5.55) explained maximum variability (39.63%) per cent and second eigen value (3.64) explained second highest variability (25.99%) and so on. It was found that the cumulative variability of 65.61 per cent was explained by two principal components together. It can be seen from table that maximum variability was captured by first two eigen values and corresponding two components were therefore, utilized for further analysis of management index of improved cow.

Table 4.68 Principal component factor loadings for improved cow

S. No.	Variables	P1	P2
1.	Housing	-0.525	0.635
2.	Lighting	0.294	-0.09
3.	Green fodder recommended	0.047	0.357
4.	Dry fodder recommended	0.833	0.229
5.	Daily cleaning and washing	0.855	0.356
6.	Dehorning	0.229	0.541
7.	Deworming	-0.787	0.514
8.	Mineral mixture	0.963	0.073
9.	Concentrates recommended	-0.443	0.503
10.	Watering trough	0.194	0.023
11.	Washing before milking	-0.761	0.606
12.	Control of ectoparasites	0.519	0.798
13.	Adopting AI	-0.388	0.694
14.	Proper sanitation and hygiene	0.548	0.754

Table 4.69 Eigen values and percentage of variation for improved cow

	P1	P2
Eigen value	5.548	3.638
Variability (%)	39.626	25.988
Cumulative (%)	39.626	65.614

Buffalo

For buffalo, component factor loadings for different practices/variables have been presented in Table 4.70. On the basis of factor loadings of each principal component, the variables that played significant role in the extraction of management index for buffalo on beneficiary and non-beneficiary farms were watering trough, proper sanitation and hygiene, control of ectoparasites, daily cleaning and washing and recommended dry fodder.

Table 4.70 Principal component factor loadings for buffalo

S. No.	Variables	P1	P2	P3
1.	Housing	0.594	-0.314	0.394
2.	Lighting	-0.491	-0.143	0.605
3.	Green fodder recommended	0.297	0.69	0.217
4.	Dry fodder recommended	0.368	-0.427	0.746
5.	Daily cleaning and washing	0.266	0.434	0.697
6.	Dehorning	0.769	-0.128	-0.07
7.	Deworming	0.287	0.614	-0.26
8.	Mineral mixture	0.81	0.38	-0.156
9.	Concentrates recommended	0.068	0.355	0.168
10.	Watering trough	0.854	-0.266	-0.323
11.	Washing before milking	0.499	-0.579	-0.241
12.	Control of ectoparasites	0.773	-0.383	0.078
13.	Adopting AI	0.65	0.187	0.236
14.	Proper sanitation and hygiene	0.819	0.286	-0.043

The eigen values corresponding to all three principal components and variability associated with each component for buffalo have been presented in Table 4.71. First eigen value (4.89) explained maximum variability (34.94%), second eigen value (2.29) explained second highest variability (16.42%) per cent followed by third eigen value (1.96) and so on. It was found that the cumulative variability of 65.38 per cent was explained by three principal components together. It can be seen from table that maximum variability was captured by first three eigen values and corresponding three components were therefore, utilized for further analysis of management index of buffalo.

Table 4.71 Eigen values and percentage of variation for buffalo

	P1	P2	P3
Eigen value	4.892	2.299	1.962
Variability (%)	34.94	16.424	14.013
Cumulative (%)	34.94	51.364	65.377

Table 4.72 Distribution of farmers according to management indices for livestock

(number)

Particulars	Cow local		Cow improved		Buffalo		(Weighted index) All dairy animals	
	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
Very high (>75%)	2	1	3	1	3	2	8	4
	(33.33)	(16.67)	(60.00)	(50.00)	(60.00)	(28.57)	(53.33)	(30.77)
High (50-75%)	2	1	0	0	1	1	3	2
	(33.33)	(16.67)	(0.00)	(0.00)	(20.00)	(14.29)	(20.00)	(15.38)
Moderate (25-50%)	1	2	2	0	1	1	3	1
	(16.67)	(33.33	(40.00)	(00.00)	(20.00)	(14.29)	(20.00)	(7.69)
Low (<25%)	1	2	0	1	0	3	1	6
	(16.67)	(33.33)	(0.00)	(50.00)	0.00)	(42.85)	(6.67)	(46.15)
Total	6	6	5	2	5	7	15	13
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Overall management index	58.60	35.44	61.93	38.59	77.77	48.35	66.60	45.75

Note: Figures in parentheses indicate per cent farmers in adoption category

Management index for adoption of better technological operations in dairy management were calculated by using the individual principal component values. The results have been given in the Table 4.72.

For cow local, 33.33 per cent beneficiary farmers were under each very high (above 75% adoption) and high rate of adoption (50-75% adoption). About 17 per cent beneficiary farmers each were under moderate (25-50% adoption) and low (below 25% adoption) categories of adoption. In case of non-beneficiary farmers, 33.33 per cent each were under moderate (25-50% adoption) and low (below 25% adoption) categories of adoption, respectively. While, 16.66 per cent non-beneficiary farmers each were under very high (above 75% adoption) and high (50-75% adoption) adoption category.

For cow improved, 60 per cent beneficiary farmers had high (50-75% adoption) rate of adoption and the rest 40.00 per cent beneficiaries had moderate (50-75% adoption) rate of adoption. On the other hand, 50 per cent non-beneficiary farmers were under each very high (above 75% adoption) and low (below 25% adoption) rate of adoption categories.

For buffalo, 60 per cent beneficiary farmers fell under very high adoption (above 75% adoption), 20 per cent under high (50-75% adoption) and remaining 20 per cent under moderate (50-75% adoption) category of adoption while 42.85 per cent non-beneficiary farmers were under low (below 25% adoption) and 28.57 under very high rate of adoption (above 75% adoption). About 14 per cent of non-beneficiary farmers each were under high (50-75% adoption) and moderate (50-75% adoption) adoption category.

The average management index on beneficiary farms was 58.60 per cent for cow local, 61.93 per cent for cow improved and 77.77 per cent for buffalo with an overall weighted index of 66.60 per cent. On the other hand, the management index for non-beneficiary farmers was 35.44 per cent for low local, 38.59 per cent for cow improved and 48.35 per cent for buffalo with an overall index of 45.75 per cent for all dairy animals. In this way, the adoption of improved practices of livestock management were quite evident on beneficiary farms.

Table 4.73 Factors affecting improved livestock management

Particulars	**Regression coefficients**
Constant/ Intercept	36.6646
	(36.0995)
Farming experience (years)	0.8913
	(0.7534)
Age of head (in years)	-0.1775
	(0.6234)
Education (number of schooling years)	-0.1493
	(0.3711)
Dummy for KVK	28.1242*
	(13.1122)
Adjusted R^2	0.6517**
F-value	25.72

*Significance at 5% level

Figures in parentheses show standard errors of respective values

Results of regression analysis carried out to study the factors responsible for improved management of livestock have been presented in Table 4.73.The variables specified are farming experience (in years), age of head of family (in years), education of the head of family (number of schooling years) and dummy variable for KVK. The

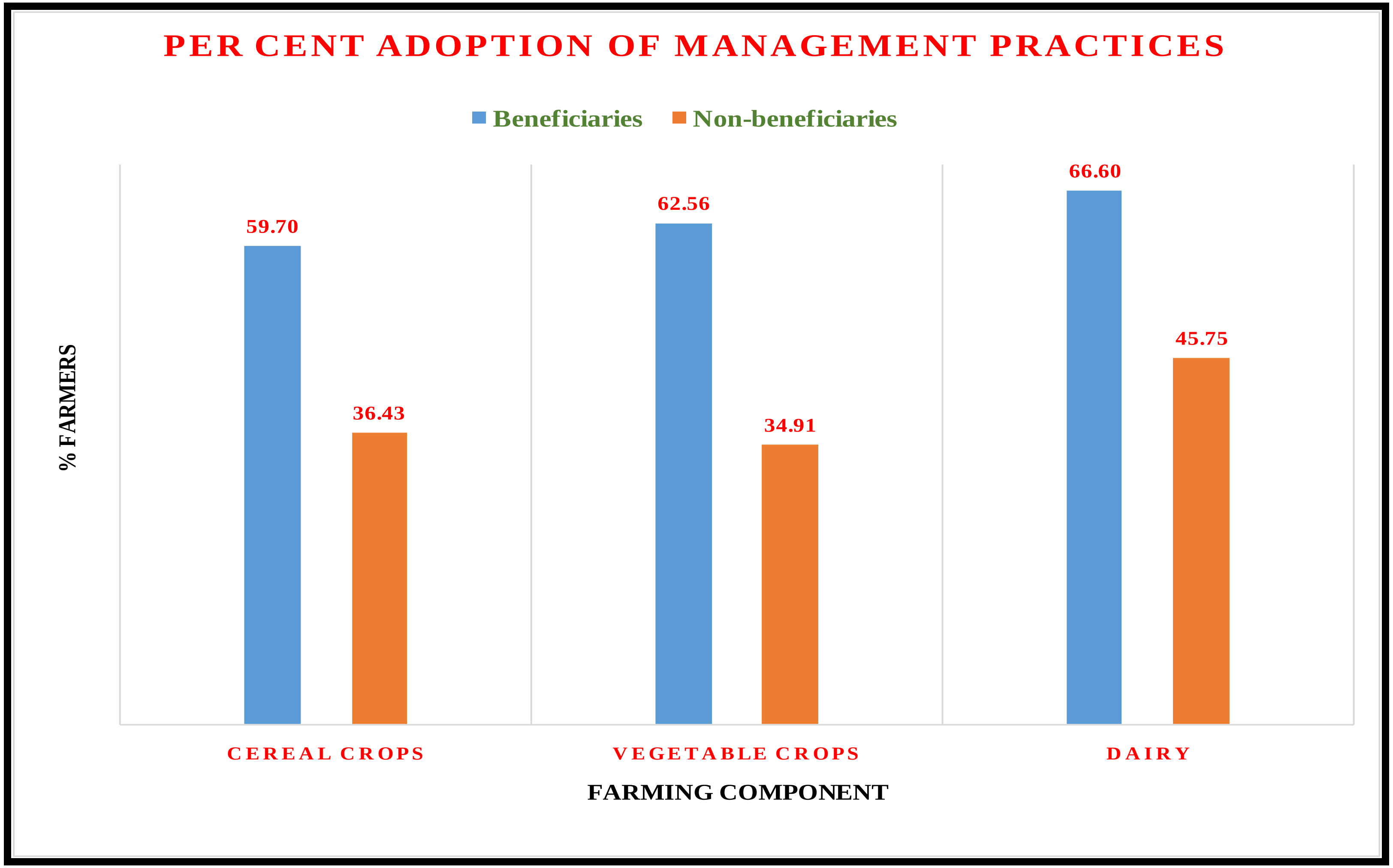

Fig. 4.1 Adoption of management practices on beneficiary and non-beneficiary farms

variables considered for factor analysis explained about 65 per cent of the systematic variation in model which was found statistically significant. It was found that the adoption of improved management practices for livestock management increased on beneficiary farms to the extent of 28.12 per cent over non-beneficiary farms. This clearly shows the positive impact of KVK trainings on adoption of better management practices by beneficiary farmers for rearing livestock.

4.7 Impact of KVK on productivity of crops and dairy animals

It is well known fact that adoption of technology and improved practices should lead to increase in the productivity of crops. All the efforts of extension agencies like KVK are directed towards enhancing productivity and farm production. The regression analysis was carried out to find the impact of various factors on productivity of crops and livestock. Factors were selected for analyzing their impact on better management practices which were reflected high productivity of crops. Dummy variable was taken as an explanatory variable whose values were assigned as 1 for beneficiary farmers, who had received trainings from KVK and 0 for non-beneficiary farmers, who had not received trainings from KVK. The results of regression analysis have been presented in this section.

4.7.1 Productivity of crops

The average yield obtained by beneficiary and non-beneficiary farms has been presented in Table 4.74. The average yield of maize on beneficiary was 30.56 q/ha and was significantly higher than the yield on non-beneficiary farms (21.40 q/ha). Similarly, the average yield of paddy crop was 32.30 q/ha in case of beneficiaries, which was significantly higher than the paddy yield grown by non-beneficiaries (20.13 q/ha). In case of fodder crops, the average yield sorghum + pearl millet was quite higher on beneficiary farms (276.60 q/ha) as compared to non-beneficiary farms 234.37 q/ha. However, the difference was found non-significant. In case of vegetables, the average yield of okra (75.75 q/ha), capsicum (66.67 q/ha), cucumber (99.70 q/ha), bitter gourd (123.52 q/ha), bottle gourd (148.71 q/ha) were found significantly higher than the average yields of these crops grown on non-beneficiary farms. The average yields of chillies (33.33 q/ha), tomato (173.91 q/ha), capsicum (66.67 q/ha), brinjal (219.14 q/ha) and beans (66.18 q/ha) were higher on beneficiary farms but these were not found significantly higher. In *rabi* season, average yield of

Table 4.74 Average yield of different crops on sample farms

(q/ha)

S. No.	Particulars	Beneficiaries	Non-beneficiaries	Mean Difference	t- cal	$t\text{-}tab_{0.05}$	$t\text{-}tab_{0.01}$
A.	***Kharif***						
1.	Maize	30.56	21.40	9.16* (4.35)	2.11	2.08	2.16
2.	Paddy	32.30	20.13	12.17** (2.74)	4.44	2.88	3.03
3.	Sorghum + Pearl Millet	276.60	234.37	42.23 (35.24)	1.19	2.2	2.81
4.	Vegetables						
i	Okra	75.75	47.16	28.59** (8.05)	3.55	2.13	2.83
ii	Chillies	33.33	23.00	10.33 (12.33)	0.83	2.05	2.65
iii	Tomato	173.91	124.00	49.91 (31.75)	1.57	2.05	2.78
iv	Capsicum	66.67	40.00	26.67* (5.87)	4.54	4.3	5.2
v	Cucumber	99.70	60.96	39.91** (12.82)	3.11	2.16	3.03
vi	Brinjal	219.14	150.00	69.14 (40.59)	1.70	2.80	3.12
vii	Beans	66.18	48.33	17.85* (8.58)	2.08	3.90	5.92
viii	Bitter gourd	123.52	86.00	37.52* (9.24)	4.06	3.82	5.92
ix	Bottle gourd	148.71	93.33	55.38* (13.49)	4.10	2.88	4.67
x	Pumpkin	257.58	-	-			
B	***Rabi***						
1	Wheat	27.07	19.91	7.17* (3.02)	2.37	2.08	2.76
2	Barley	54.17	43.75	10.42 (5.33)	1.95	4.3	6.93
4	Oats	151.92	148.96	2.96 (7.58)	0.39	2.15	2.63
5	Berseem	202.94	180.56	22.39 (18.74)	1.19	2.28	3.08
6	Vegetables						
i	Cabbage	167.92	113.6	54.32* (23.87)	2.28	2.20	2.81
ii	Cauliflower	119.14	86.86	32.28* (13.58)	2.38	2.37	2.83
iii	Peas	95.05	66.67	28.38** (6.60)	4.30	2.35	2.98
iv	Onion	160.78	116.92	78.48** (11.40)	6.88	2.80	3.69
v	Garlic	124.44	-	-			
vi	Radish	97.20	-	-			
vii	Turnip	177.20	-	-			
viii	Potato	110.00	-	-			

** Significant at 1% level

*Significant at 5% level

Figures shown in parentheses are standard errors wheat was found to be significantly higher on beneficiary farms (27.07 q/ha) as compared to non-beneficiary farms (19.91q/ha). Sharma et al. (2011) also confirmed high productivity of improved varieties released by CSK HPKV over local/common varieties of wheat grown by farmers in Himachal Pradesh. In case of barley and fodder crops (oats and berseem), there was no significance difference in the yield. In *rabi* vegetable crops, average yields of cabbage (167.92 q/ha), cauliflower (119.14 q/ha), peas (95.05 q/ha) and onion (160.78 q/ha) were significantly higher than on non-beneficiary farms. Therefore, it can be concluded that beneficiary farmers obtained significantly higher yields of crops that may be due to adoption of improved technology and management practices promoted by KVK.

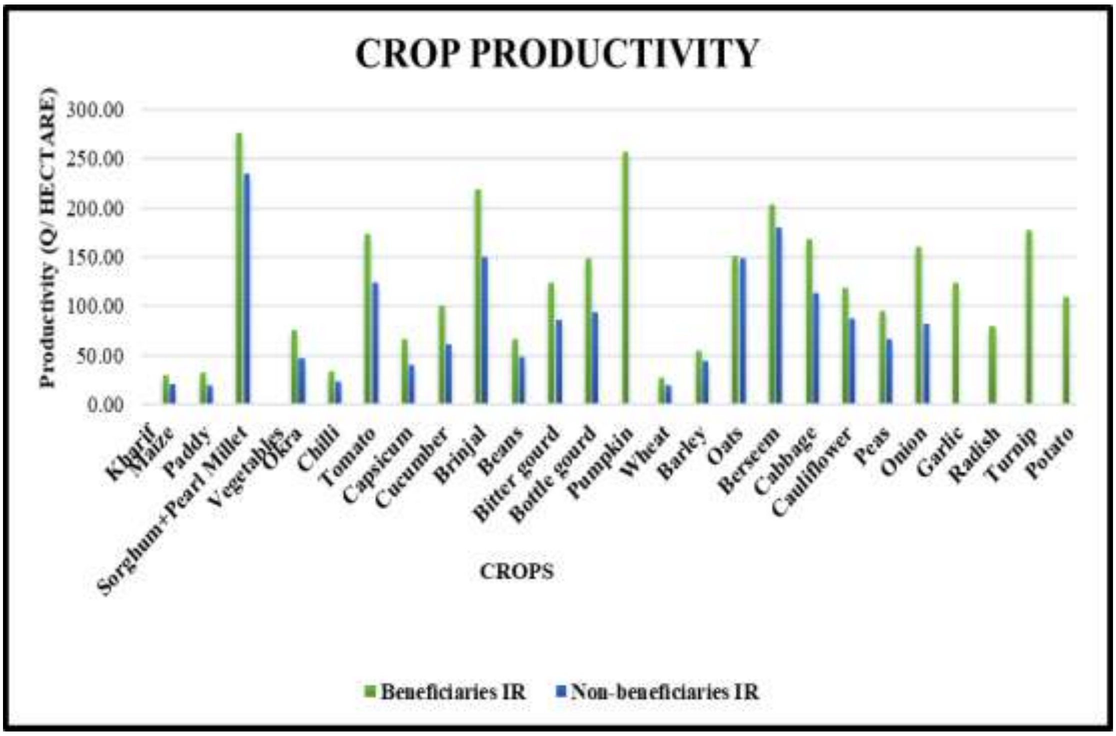

Fig. 4.2 Productivity of different crops on beneficiary and non-beneficiary farms

4.7.2 Factors affecting crop productivity of cereal crops

Regression analysis was carried out to find the relationship between productivity and selected factors including KVK on productivity of cereal crops. Selected factors for regression were seed quantity (kg/ha), per cent irrigated area under crop, consumption of NPK fertilizer (kg/ha), use of farm yard manure (q/ha) and dummy for KVK.

Regression coefficients with their standard errors for cereal crops have been presented in Table 4.75.

Table 4.75 Factors affecting productivity (q/ha) of cereal crops

Factors	Regression coefficients		
	Maize	**Paddy**	**Wheat**
Constant/Intercept	8.0116	3.1460	12.8961
	(4.4327)	(2.0473)	(4.3826)
Seed quantity (kg/ha)	-2.0940	0.0181	-0.0365
	(1.6084)	(0.1732)	(0.0208)
Irrigated area under crop (%)	0.1623	0.2014**	0.0493
	(0.1542)	(0.0641)	(0.0760)
Fertilizer NPK consumption (kg/ha)	0.0221*	0.0145	0.0102*
	(0.0099)	(0.0080)	(0.0049)
FYM (q/ha)	0.0351*	0.0160*	0.0140*
	(0.0151)	(0.0070)	(0.0058)
Dummy for KVK	11.5885**	10.9901**	11.2279**
	(2.3180)	(1.4644)	(1.3921)
Adjusted R^2	0.5866**	0.7251**	0.7505**
F-value	9.29	16.88	19.25

**Significant at 1% level
*Significant at 5% level
Figures in parentheses indicate standard errors of respective regression coefficients

It is clearly visible from table that significant factors in increasing the productivity of maize crop were consumption of NPK fertilizer, FYM applied and dummy for KVK while the seed quantity and per cent irrigated area were found to be statistically non-significant. It was revealed that 1 kg/ha increase in NPK consumption would increase the productivity of maize by 0.0221 q/ha. Similarly, increase in the use of FYM by 1q/ha would increase maize productivity by 0.0351 q/ha. The dummy for KVK was found to be 11.5885 that was highly significant at 1 per cent level of significance which implies that beneficiary farmers had obtained 11.5885 q/ha more yield than non-beneficiary farmers. The regression model explained about 59 per cent of the systematic variation that was found statistically significant at 1 per cent significance level.

In paddy crop, significant factors in increasing the productivity were per cent irrigated area under crop, FYM applied and dummy for KVK while the other factors were non-significant. It was revealed that 1 per cent increase in irrigated area under crop would increase the productivity of paddy by 0.2014 q/ha. Similarly, an increase in the use of FYM by 1q/ha would increase productivity of paddy by 0.0160 q/ha. The dummy for

KVK was found to be 10.9901 that was found highly significant at 1% level of significance which implies that the beneficiary farmers obtained 10.9901 q/ha more yield than non-beneficiary farmers. The regression model explained about 73 per cent of the systematic variation in the model which was found statistically significant 1 per cent significance level.

It was revealed that the consumption of NPK fertilizer, FYM application and dummy variable were statistically significant factors affecting productivity of wheat crop. It was found that with an increase of 1 kg/ha fertilizer consumption, the yield of wheat would increase by 0.0102 q/ha. Similarly, increase in the use of FYM by 1q/ha would increase productivity of wheat by 0.0140 q/ha. The dummy for KVK was 11.2279 which was statistically significant at 1 per cent level of significance. The dummy for wheat implies that 11.2279 q/ha yield more was obtained on beneficiary farms than non-beneficiary farms. The regression model explained almost 75 per cent of systematic variation in the model which was significant at 1 per cent level of significance.

4.7.3 Factors affecting productivity of major vegetable crops

Regression coefficients for major vegetable crops, *viz.*, okra, cucumber, bottle gourd, cabbage, cauliflower and pea were computed by factor analysis. Selected factors were seed quantity (kg/ha), per cent irrigated area under crop, consumption of NPK fertilizer (kg/ ha), use of farm yard manure (q/ha) and dummy variable for KVK. The results for regression analysis of major vegetable crops have been presented in Table 4.76.

It is clearly visible from table that significant factors in increasing the productivity of okra were fertilizer NPK consumption, FYM application and dummy for KVK. It was revealed that with increase of 1 kg/ha application of NPK fertilizer, the productivity of okra would increase by 0.0951 q/ha. Similarly, with an increase of 1q/ha in the use of FYM would increase okra productivity by 0.1245 q/ha. The dummy for KVK was found to be 68.3106 that was highly significant at 1% level of significance which implies that beneficiary farmers had obtained 68.3106 q/ha more yield than non-beneficiary farmers. The regression model explained about 58 per cent of the systematic variation in model that was found statistically significant at 5 per cent significance level.

Table 4.76 Factors affecting productivity (q/ha) of major vegetable crops on sample farms

Factors	Regression coefficients					
	Okra	**Cucumber**	**Bottle gourd**	**Cabbage**	**Cauliflower**	**Pea**
Constant/Intercept	5.0959	11.1362	10.8175	-10.5948	-3.2792	27.8516
	(47.4380)	(4.9337)	(17.2491)	(46.2913)	(24.3048)	(6.9642)
Seed quantity (kg/ha)	-0.5627	-1.0296	-2.7725	-7.7030	0.4152	-0.1043
	(1.6884)	(0.9151)	(3.0357)	(55.8833)	(24.3391)	(0.0315)
Irrigated area under crop (%)	-1.8337	1.1726	-1.4806	2.2058	2.9471	1.6545
	(2.0276)	(0.5986)	(1.0307)	(3.4874)	(2.4872)	(1.0526)
Fertilizer NPK consumption (kg/ha)	0.0951*	1.6469*	0.1042**	0.1603**	0.1466*	0.0549
	(0.0465)	(0.7964)	(0.0241)	(0.0775)	(0.0682)	(0.0397)
FYM (q/ha)	0.1245**	0.0173	0.1891**	0.1423*	0.0870*	0.0365*
	(0.0371)	(0.0090)	(0.0646)	(0.0571)	(0.0425)	(0.0170)
Dummy for KVK	68.3106**	27.9624**	32.6471**	66.4359*	46.9186**	31.8051**
	(15.3334)	(2.3165)	(6.7966)	(17.6310)	(13.9113)	(4.2902)
Adjusted R^2	0.5841*	0.9034**	0.8879**	0.5345*	0.5087*	0.9038**
F-value	9.83	36.60	19.00	7.80	7.04	37.58

**Significant at 1% level

* Significant at 5% level

Figures in parentheses indicate standard errors of respective regression coefficients

Regression results for cucumber indicated that NPK fertilizer and dummy variable were statistically significant factors responsible for increase in productivity of crop. Factors, *viz.*, seed quantity, FYM application and per cent irrigated area under crop were found statistically non-significant. It was found that 1 kg/ha increase in NPK application would increase the crop yield by 1.6469 q/ha. Dummy for KVK was found to be 27.9624 which was highly significant at 1 per cent level of significance. Dummy for KVK implies that 27.9624 q/ha yield was obtained more on beneficiary farms as compared to non-beneficiary farms. The regression model explained about 90 per cent of the systematic variation in model that was found statistically significant at 1 per cent significance level.

For bottle gourd, factors like NPK fertilizer consumption, FYM application and dummy variable for KVK were found significant. Whereas, factors like seed quantity and per cent irrigated area were found statistically non-significant. It was found that 1 kg/ha increase in fertilizer consumption would lead to increase in yield of crop by of 0.1042q/ha. Similarly, 1 q/ha increase in FYM application would increase the yield by 0.1891 q/ha. Dummy for KVK was 32.6471 which was found to be statistically significant and it implies that 32.6471 q/ha more yield was obtained on beneficiary farms over non-beneficiary farms. It was revealed that regression model explained about 89 per cent of the systematic variation in model that was found statistically significant at 1 per cent significance level.

For cabbage, factors like fertilizer NPK consumption, FYM application and dummy variable for KVK were found to significantly affect the yield of cabbage crop. Seed quantity and per cent irrigated area were found statistically non-significant. With an increase in 1 kg/ha application of fertilizer NPK, yield of crop would increase by 0.1603 q/ha. Similarly, 1 q/ha increase in FYM application would increase cabbage yield by 0.1423 q/ha. Dummy variable was 66.4359 which was found statistically significant at 5 per cent level of significance which implies that yield on beneficiary farms was 66.4359 q/ha more over non-beneficiary farms. The regression model explained about 53 per cent of systematic variation in model which was found statistically significant at 5 per cent significance level.

Regression coefficient values for cauliflower indicated that three factors namely, NPK fertilizer consumption, FYM and dummy variable were found to increase productivity of crop significantly. It was found that 1 kg/ha increase in fertilizer consumption would increase yield of crop by 0.1466 q/ha. Similarly, with an increase in FYM application by 1 q/ha, yield of crop would increase by 0.0870 q/ha. Dummy variable was found 46.9186 which implies that the yield of cauliflower was 46.9186 q/ha more on beneficiary farms over non-beneficiary farms. The regression model explained 50 per cent of systematic variation in the model which was found statistically significant at 5 per cent significance level.

For pea, only two factors, *viz.*, FYM application and dummy variable were found to be statistically significant. It was revealed that with 1 q/ha increase in FYM application, the yield of pea would increase by 0.0365 q/ha. Dummy variable was found 31.8051 which implies that the yield of pea crop was 31.8051 q/ha more on beneficiary farms than non-beneficiary farms. It was noticed that regression model explained about 92 per cent of systematic variation in the model which was found significant at 1 per cent significance level.

4.7.4 Productivity of dairy animals

Milk productivity of dairy animals have been presented in Table 4.77. It was found that milk productivity on beneficiary farms was higher as compared to non-beneficiary farms. About 6 litres and 4 litres per day per animal was the milk productivity of local cow on beneficiary and non-beneficiary farms, respectively. Per day per animal milk productivity of improved cow was 8.28 litres and 7.33 litres on beneficiary and non-beneficiary farms, respectively. However, a noticeable difference in per day per animal milk productivity of buffalo was observed on beneficiary (10 litres) and non-beneficiary farms (7.20 litres). Sharma et al. (2012) also studied the contribution of breeds, balanced feeding and health care practices in enhancing the productivity of milch animals.

Table 4.77 Milk productivity of dairy animals

(litres/day/animal)

S. No.	Dairy animal	Beneficiaries	Non-beneficiaries
1	Cow local	5.44	3.94
2	Cow improved	8.28	7.33
3	Buffalo	10.00	7.20

4.7.5 Impact of KVK on productivity of dairy animals

To find out the empirical relationship between milk productivity and certain factors selected, regression analysis was carried out.

Factors considered in regression analysis for milch cows were green fodder, dry fodder, concentrates, labour, dummy variable for breed and dummy variable for KVK. Dummy variable for breed were assigned value 1 for improved cow and 0 for local cow. Dummy variable for was assigned value 1 for beneficiary farmer who had received trainings about dairy management practices from KVK and 0 for non-beneficiary farmer who had not received any training. Results for regression analysis for cow have been presented in Table 4.78.

Table 4.78 Factors affecting productivity (litres/day/animal) of milch cow

Factors	Regression coefficients
Constant/Intercept	2.7022 (1.4733)
Green fodder (kg/day)	0.0720 (0.0617)
Concentrates (kg/day)	-0.3464 (0.1645)
Labour (hours/day)	1.3941 (0.6339)*
Dummy for breed	1.6931 (0.7532)*
Dummy for KVK	1.6317 (0.5872)*
Adjusted R^2	0.7305**
F-value	37.92

**Significant at 1% level
*Significant at 5% level
Figures in parentheses indicate standard errors of respective coefficients

It can be observed from the table that use of labour, dummy variable for breed and dummy variable for KVK were found significant. However, variables such as green fodder and concentrates were found non-significant. It was revealed that with an increase in use of labour by 1 hour/day in the maintenance of livestock, milk productivity would increase by 1.3941 litres per day. Similarly, with an increase in 1 improved breed animal on farm, the milk yield per farm would increase by 1.6931 litres per day. Dummy for KVK was 1.6317 which was found to be statistically significant which implies that milk yield obtained on beneficiary farms was 1.6317 litres per day more than on non-beneficiary farms. The regression analysis explained

73 per cent of systematic variation in the model which was found significant at 1 per cent level of significance. Ratna and Sharma (2017) also reported that an increase in number of crossbred cows and artificial insemination were the main factors for increase in milk production.

Table 4.79 Factors affecting milk productivity of buffalo

Factors	Regression coefficients
Constant/ Intercept	-1.9423
	(6.7202)
Green fodder (kg/day)	0.1256
	(0.1247)
Concentrates(kg/day)	0.5335
	(0.4559)
Labour (hours/day)	1.5125
	(2.4991)
Dummy for KVK	4.6711*
	(2.2636)
Adjusted R^2	0.5663
F-value	2.28

**Significant at 1% level
*Significant at 5% level
Figures in parentheses indicate standard errors of respective coefficients

Results of regression analysis to find out the empirical relationship between milk productivity of buffalo and factors selected have been presented in Table 4.79. Factors selected were green fodder, dry fodder, concentrates, labour and dummy variable for KVK. It was noticed that in case of buffalo, only one factor was significant i.e. dummy variable for KVK. Dummy for KVK was 4.6711 which was statistically significant and implies that the milk productivity of buffalo on beneficiary farms was more by 4.6711 litres per day over non-beneficiary farms. The regression model explained 56 per cent of systematic variation in the model though the adjusted R^2 was found non-significant.

4.8 Economics of crops and other farm enterprises

The ultimate aim of a farmer is to make his farm profitable with less cost of production. The economic analysis of enterprises play a vital role in analyzing the costs incurred during production process and benefits accrued to that component of farming. The cost of cultivation and economics of crops were estimated on the basis of input and output prices prevailing in the study area and the results have been present in this section. The prices of inputs used and prices of farm commodities/products have been given in Appendix III.

4.8.1 Economics of *kharif* crops

The cost of cultivation and economics of maize, paddy, fodder (sorghum + pearl millet) crops grown in the study area by beneficiary and non-beneficiary farmers have been presented in Table 4.80.

For maize crop, the variable cost of cultivation including family labour was higher (Rs. 47,636/ha) on beneficiary farms as compared to non-beneficiary farms (Rs. 44,964/ha). The major component of cost of cultivation was family labour followed by value of farm yard manure. The net returns over variable cost without family labour were higher on beneficiary farms (Rs. 26,826/ha) than non-beneficiary farms (Rs. 13,609/ha). The net returns over variable cost including family labour was Rs. 6,610/ha on beneficiary farms. However, net returns over variable cost including family labour on non-beneficiary farms came out to be negative (Rs. -5,769). This clearly depicts the impact of better management practices followed by beneficiary farmers.

For paddy crop, the variable cost of cultivation was found to be Rs. 52,995/ha and Rs. 49,992/ha including family labour on beneficiary and non-beneficiary farms. The major part of cost of cultivation was attributed to farm labour cost followed by value of FYM on sample farms. The net returns (excluding family labour) incurred from paddy crop were higher on beneficiary farms (Rs. 50,803/ha) as compared to non-beneficiary farms (Rs. 23,575/ha). The net returns including farm labour were obtained higher on beneficiary farms as compared to non-beneficiary farms.

Table 4.80 Economics of *kharif* cereal crops under irrigated conditions

(Rs./ha)

S. No.	Particulars	Maize		Paddy	
		Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
1	Seed	1786	2052	3910	4553
2	FYM	13208	13247	11620	11483
3	Fertilizers				
	Urea	1008	978	985	1157
	IFFCO	2143	1932	2023	1688
4	Chemicals	2383	2067	2291	1979
5	Tractor power	6355	6220	9575	9328
6	Sub total	26883	26496	30405	30188
7	Interest @ 8% p.a.	538	530	608	604
8	Total cost excluding family labour (7+8)	27420	27026	31013	30792
9	Family labour	20215	17938	21982	19200
	Total cost including family labour (9+10)	47636	44964	52995	49992
B	Gross returns (i+ii)	54246	40635	81816	54367
i	Main product	42784	29960	71060	44286
ii	By product	11462	10675	10756	10081
C	Net returns				
	Without family labour	26826	13609	50803	23575
	With family labour	6610	-5769	28821	4375

Economics of major summer vegetable crops were estimated and the results have been presented in Table 4.81.

For okra, variable cost of cultivation per hectare was Rs. 1,16,919 and Rs. 1,14,050 on beneficiary and non-beneficiary farms, respectively .The major portion of variable cost of cultivation of okra was farm labour cost followed by value of seed and value of FYM. Net returns excluding family labour were higher on beneficiary farms (Rs. 1,72,221/ha) as compared to non-beneficiary farms (Rs. 82,120/ha) while including family labour, the net returns were reduced to Rs.1,10301/ha and Rs. 27,400/ha on beneficiary farms and non-beneficiary farms, respectively.

The variable cost of cultivation computed for chillies was Rs.93,438/ha and Rs.89,019/ha for beneficiary farmers and non-beneficiary farmers, respectively while the net returns (excluding family labour) were Rs.89,802/ha and Rs.50,981/ha on beneficiary farms and non-beneficiary farms, respectively. Considering family labour in variable cost of cultivation, the net returns were higher on beneficiary farms (Rs. 85,320/ha) as against non-beneficiary farms (Rs. 32,000/ha).

For tomato crop, variable cost of cultivation was found quite high. Major component of cost of cultivation of tomato crop was attributed to family labour and value of FYM. Due to many intercultural practices, a large amount of farm labour was utilized. Net returns including family labour were Rs.1,19,240/ha and Rs.70,000/ha on beneficiary and non-beneficiary farms, respectively.

For capsicum, variable cost of cultivation (including family labour) incurred was Rs. 88,083/ha and Rs. 77,292/ha by beneficiary farmers and non-beneficiary farmers, respectively. The major components for expenditure in variable cost were family labour cost and value of FYM. Net returns obtained by beneficiary farmers were higher as compared to non-beneficiary farmers. It was observed that Rs.1,78,557/ha and Rs.82,708/ha were the net returns including family labour on beneficiary farms and non-beneficiary farms, respectively.

In cucumber crop, the cost of cultivation was estimated to be Rs.1,04,456/ha and Rs. 90,031/ha on beneficiary farms and non-beneficiary farms, respectively. Net returns without family labour were higher on beneficiary farms (Rs. 1,43,424/ha) as compared to non-beneficiary farms (Rs. 72,689/ha). Net returns over variable cost (including family labour) were found negative in case of non-beneficiary farms.

For brinjal, beneficiary farmers incurred the variable cost of cultivation of Rs.91,829/ha out of which, around Rs. 57,000/ha was the value of farm labour for both beneficiary and non-beneficiary farmers. After family labour, value of FYM contributed to high cost of production. It was found that net returns over variable cost were Rs. 1,86,101/ha and Rs. 1,23,187/ha for beneficiary farmers and non-beneficiary farmers, respectively.

The total variable cost for vegetable beans for both beneficiary and non-beneficiary farmers was around Rs. 90,000/ha. Net returns excluding family labour were higher in case of beneficiary farmers (Rs. 1,57,721/ha) than those for non-beneficiaries (Rs. 1,04,884/ha). Net returns over variable cost including family labour were Rs.1,07,561/ha and Rs. 52,804/ha for beneficiary farmers and non-beneficiary farmers.

In bitter gourd, variable cost of cultivation was Rs. 1,07,020 for beneficiary farmers and Rs. 98,996 non-beneficiary farmers, respectively. The net returns including family labour came out to be Rs.11,53,16/ha and Rs.55,834/ha on beneficiary and non-beneficiary farms, respectively. Net returns without family labour were estimated to be Rs.1,68,596/ha on beneficiary farms and Rs. 99,154/ha on non-beneficiary farms.

The total variable cost for bottle gourd was Rs.91,999/ha and Rs.90,809/ha on beneficiary and non-beneficiary farms, respectively. Mainly, total variable cost was high due to high value of farm labour, value of seed, value of FYM and value of fertilizers. Net returns from bottle gourd crop were estimated to be Rs.1,96,337/ha on beneficiary farms and Rs.1,07,239/ ha on non-beneficiary farms, respectively. Net returns over variable cost including family labour came out to be Rs. 1,45,937/ha and Rs.58,519/ha for beneficiary farmers and non-beneficiary farmers, respectively.

Table 4.81 Economics of summer vegetable crops under irrigated conditions

(Rs./ha)

S. No.	Particulars	Okra		Chillies		Tomato	
		Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
1	Seed	21231	29471	1119	1567	2765	3600
2	FYM	15407	14492	26111	25000	18261	17400
3	Fertilizers						
	Urea	519	641	578	550	874	1200
	IFFCO	1879	1302	2089	1800	2395	2400
4	Chemicals	7729	5356	5778	4500	6087	-
5	Tractor power	7511	7288	6852	6667	6522	6500
6	Sub total	54275	58549	42526	40083	36904	31100
7	Interest @ 8% p.a.	724	781	992	935	246	207
8	Total cost excluding family labour (7+8)	54999	59330	43518	41019	37150	31307
9	Family labour	61920	54720	49920	48000	60000	53760
	Total cost including family labour (9+10)	116919	114050	93438	89019	97150	85067
B	Gross returns (i+ii)	227220	141450	133320	92000	173000	124000
i	Main product	227220	141450	133320	92000	173000	124000
ii	By product	-	-	-	-	-	-
C	Net returns						
	Without family labour	172221	82120	89802	50981	135850	92693
	With family labour	110301	27400	85320	32000	119240	70000

		Capsicum		Cucumber		Brinjal	
		Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
1	Seed	4533	3230	23879	25381	685	725
2	FYM	15000	14400	15638	13222	16507	12188
3	Fertilizers						
	Urea	1100	1020	672	856	821	975
	IFFCO	1600	1800	2000	1320	1860	1650
4	Chemicals	4500	0	6447	1415	5772	4125
5	Tractor power	6250	6968	6968	6711	6842	6711
6	Sub total	32983	27418	55605	48905	32488	26373
7	Interest @ 8% p.a.	1099	914	371	326	541	440
8	Total cost excluding family labour (7+8)	34083	28332	55976	49231	33029	26813
9	Family labour	54000	48960	48480	40800	58800	56640
	Total cost including family labour (9+10)	88083	77292	104456	90031	91829	83453
B	Gross returns (i+ii)	266640	160000	199400	121920	219130	150000
i.	Main product	266640	160000	199400	121920	219130	150000
ii.	By product	-	-	-	-	-	-
C	Net returns						
	Without family labour	232557	131668	143424	72689	186101	123187
	With family labour	178557	82708	94944	31889	127301	66547

		Beans		Bitter gourd		Bottle gourd	
		Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
1	Seed	16390	17667	30338	34000	17825	19286
2	FYM	14268	12750	13889	12000	14587	13714
3	Fertilizers						
	Urea	119	100	585	720	580	750
	IFFCO	2985	2640	1895	1680	1848	1650
4	Chemicals	49	17	169	120	156	125
5	Tractor power	6707	6667	6509	6400	6329	6286
6	Sub total	40519	39840	53385	54920	41323	41811
7	Interest @ 8% p.a.	270	266	356	366	275	279
8	Total cost excluding family labour (7+8)	40789	40106	53740	55286	41599	42089
9	Family labour	50160	52080	53280	43680	50400	48720
	Total cost including family labour (9+10)	90949	92186	107020	98996	91999	90809
B	Gross returns (i+ii)	198510	144990	222336	154800	237936	149328
	Main product	198510	144990	222336	154800	237936	149328
	By product	-	-	-	-	-	-
C	Net returns						
	Without family labour	157721	104884	168596	99514	196337	107239
	With family labour	107561	52804	115316	55834	145937	58519

Economics of *kharif* crops under unirrigated conditions

The non-beneficiary farmers were also growing crops under unirrigated conditions. Economics of *kharif* crops under unirrigated conditions were estimated Results have been presented in Table 4.82.

For maize crop, total cost of cultivation was estimated to Rs. 43,990/ha, out of which, major components contributing were family labour, followed by value of FYM. It was observed that non-beneficiary farmers had no expenditure on chemicals for plant protection. Net returns from maize crop, excluding family labour were Rs. 9,774/ ha, while including family labour, net returns came out to be negative.

For paddy crop, total variable cost of cultivation came out to be Rs. 43,230/ha. The major components of variable cost included the cost of family labour, followed by value of FYM and value of tractor used. Without family labour, net returns from crop were Rs. 13,757/ha and including family labour, net returns were reduced to Rs.-4,644/ ha.

Table 4.82 Economics of *kharif* crops on non-beneficiary farms under unirrigated conditions

(Rs./ha)

S. No.	Particulars	Maize	Paddy
1	Seed	2689	5023
2	FYM	13868	11140
3	Fertilizers		
	Urea	818	-
	IFFCO	818	-
4	Chemicals	-	-
5	Tractor power	6895	8180
6	Sub total	25088	24343
7	Interest @ 8% p.a.	502	487
8	Total cost excluding family labour (7+8)	25590	24830
9	Family labour	18400	18400
	Total cost including family labour (9+10)	43990	43230
B	Gross returns (i+ii)	35364	38586
i	Main product	25214	28292
ii	By product	10150	10294
C	Net returns		
	Without family labour	9774	13757
	With family labour	-8626	-4644

4.8.2 Economics of *rabi* crops

Cost of cultivation for various *rabi* crops was estimated and the results have been presented in Table 4.83.

For wheat crop, total variable cost including family labour was almost similar on both beneficiary and non-beneficiary farms i.e. around Rs. 47,000 /ha. Out of total variable cost, major contributing components were family labour followed by value of FYM. Net returns (excluding family labour) obtained for wheat crop by beneficiary farmers and non-beneficiary farmers were Rs. 39,613/ha and Rs. 22,269/ha, respectively. It was observed that due to adoption of better management practices in the production of wheat crop, beneficiary farmers received better net returns as compared to non-beneficiary farmers. Sharma et al. (2011) also found that improved varieties of wheat gave additional net returns over local varieties.

Table 4.83 Economics of *rabi* cereal crops under irrigated conditions

(Rs./ha)

S. No.	Particulars	Wheat		Barley	
		Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
1	Seed	3087	3258	3311	3734
2	FYM	14704	14344	6250	5625
3	Fertilizers				
	Urea	1044	899	725	750
	IFFCO	1841	1467	870	900
4	Chemicals	2588	2005	942	613
5	Tractor power	6546	6406	6250	6250
6	Sub total	29810	28379	18348	17872
7	Interest @ 8% p.a.	596	568	367	357
8	Total cost excluding family labour (7+8)	30406	28947	18715	18229
9	Family labour	17344	18537	16125	14813
	Total cost including family labour (9+10)	47750	47483	34840	33042
B	Gross returns (i+ii)	70019	55430	80376	60925
i	Main product	46019	33830	59576	48125
ii	By product	24000	21600	20800	12800
C	Net returns				
	Without family labour	39613	26483	61661	42696
	With family labour	22269	7947	45536	27883

In case of barley crop, total variable cost of cultivation came out to be Rs.34,840/ha and Rs.33,042/ha on beneficiary farms and non-beneficiary farms, respectively. Major part of total variable cost to produce barley crop, was human labour followed by FYM value and tractor value. Net returns excluding human labour came out to be Rs. 61,661/ha on beneficiary farms and Rs. 42,696/ha on non-beneficiary farms.

Economics of *rabi* crops under unirrigated conditions

The variable cost of cultivation for various *rabi* crops under unirrigated conditions were computed. Results for variable cost of cultivation and economics have been presented in the following Table 4.84.

For wheat crop, total variable cost of cultivation came out to be Rs. 34,075/ha. Major components of variable cost included expenditure on farm labour and value of farm yard manure. Net returns were found to be Rs. 12,207/ha excluding family labour cost. However, by including family labour, cost of cultivation came out to be Rs. 1,675/ha.

Table 4.84 Economics of *rabi* crops on non-beneficiary farms under unirrigated conditions

(Rs./ha)

S. No.	Particulars	Wheat	Barley
1	Seed	2986	893
2	FYM	11895	4554
3	Fertilizers		
	Urea	750	-
	IFFCO	1400	-
4	Chemicals	-	-
5	Tractor power	6051	6250
6	Sub total	23082	11697
7	Interest @ 8% p.a.	462	234
8	Total cost excluding family labour (7+8)	23543	11931
9	Family labour	10532	13136
	Total cost including family labour (9+10)	34075	25067
B	Gross returns (i+ii)	35750	70307
i	Main product	22950	60707
ii	By product	12800	9600
C	Net returns		
	Without family labour	12207	58376
	With family labour	1675	45240

Table 4.85 Economics of winter vegetable crops under irrigated conditions

(Rs./ha)

		Cabbage		Cauliflower		Peas		Onion	
S. No.	Particulars	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	Non-beneficiaries
1	Seed	24528	30800	35753	39294	11752	13500	29020	26769
2	FYM	16840	16500	20908	20000	19194	18143	35294	32308
3	Fertilizers								
	Urea	725	684	1110	1059	399	457	759	1224
	IFFCO	2366	2280	2116	2071	2295	2021	1467	2460
4	Chemicals	7603	6525	6636	5275	6334	4125	5752	4200
5	Tractor power	6073	6040	6841	6863	6699	6190	6944	6692
6	Sub total	58135	62829	73363	74561	46674	44437	79235	73653
7	Interest @ 8% p.a.	969	1047	1223	1243	311	296	792	737
8	Total cost excluding family labour (7+8)	59104	63876	74586	75804	46985	44733	80028	74390
9	Family labour	63840	53760	68880	69600	61680	57840	64560	49440
	Total cost including family labour (9+10)	122944	117636	143466	137244	108665	102573	144588	123830
B	Gross returns (i+ii)	251880	170400	228080	173720	190100	13320	321560	233840
i	Main product	251880	170400	228080	173720	190100	13320	321560	233840
ii	By product	-	-	-	-	-	-	-	-
C	Net returns								
	Without family labour	192776	106524	153494	97916	143115	88587	241532	159450
	With family labour	128936	52764	84614	36476	81435	30747	176972	110010

For barley crop, it was observed that Rs.25,067/ha was the variable cost of cultivation. Net returns over variable cost including family labour were Rs. 45,240/ha while net returns excluding family labour was Rs. 58,376/ha on non-beneficiary farms under unirrigated conditions.

Economics of winter vegetable crops

Variable cost of cultivation and economics for winter vegetable crops have been presented in Table 4.85.

In case of cabbage crop, total variable cost of cultivation was Rs. 1,22,944/ ha and Rs. 1,17,636/ ha on beneficiary and non-beneficiary farms, respectively. Major components of total variable cost were the expenditure on farm labour followed by value of seed and farm yard manure. Net returns without family labour were higher on beneficiary farms (Rs.1,92,776/ ha) as compared to non-beneficiary farms (Rs. 1,06,524/ha).

In cauliflower, variable cost of cultivation was estimated to be Rs.1,43,466/ha and Rs.1,37,244/ha on beneficiary and non-beneficiary farms, respectively. Net returns obtained by beneficiary farmers (Rs. 1,53,494/ha) were found higher as against non-beneficiary farmers (Rs. 97,916/ha).

The variable cost of cultivation for peas crop was estimated to be Rs. 1,08,665/ha on beneficiary farms and Rs.1,02,573/ ha on non-beneficiary farms. The net returns obtained (excluding family labour) from the crop were Rs.1,43,115/ha and Rs. 88,587/ha by beneficiary farmers as against non-beneficiary farmers. Net returns (including family labour) were Rs.81,435 /ha and Rs. 30,747/ha on beneficiary and non-beneficiary farms, respectively.

For production of onion crop, the variable cost of cultivation was Rs.1,44,588/ha and Rs.1,23,830/ha in case of beneficiary and non-beneficiary farms, respectively. A total of Rs.24,15,32/ha and Rs. 15,94,50/ha were the net returns excluding family labour on beneficiary and non-beneficiary farms, respectively.

On the whole, beneficiary farmers earned more profit as compared to non-beneficiary farmers due to adoption of better management practices on their farms.

Economics of vegetable crops under unirrigated conditions on non-beneficiary farms

The economics of vegetable crop peas under unirrigated conditions was worked out. The results for variable cost of cultivation have been presented in the Table 4.86.

Table 4.86 Economics of vegetable crops on non-beneficiary farms under unirrigated conditions

(Rs./ha)

S. No.	Particulars	Peas
1	Seed	15429
2	FYM	19286
3	Fertilizers	
	Urea	-
	IFFCO	-
4	Chemicals	-
5	Tractor power	6429
6	Sub total	41143
7	Interest @ 8% p.a.	274
8	Total cost excluding family labour (7+8)	41417
9	Family labour	50400
	Total cost including family labour (9+10)	91817
B	Gross returns (i+ii)	114280
i.	Main product	114280
ii.	By product	-
C	Net returns	
	Without family labour	72863
	With family labour	22463

Total variable cost was estimated to be Rs. 91,817/ha including family labour cost. Net returns from peas crop excluding family labour came out to be Rs. 72,863/ha. However, net returns with family labour came out to be Rs.22,463/ha.

From this analysis of economics of crops, it was observed that though the cost of cultivation for different crops on beneficiary farms was relatively higher but at the same time, the gross and net returns were also remarkably higher than on the non-beneficiary farms. This clearly shows that the beneficiary farmers were benefitted substantially due to training and services of KVKs .as compared to non-beneficiary farmers leading to better management of crops, high productivity and better returns.

4.8.3 Economics of milch animals

Livestock rearing is an integral part of farmer’s economy. Livestock component acts as a complementary component in agriculture. The by-products of crop are used by livestock and the by-products of livestock is used in the farmers' fields as farm yard manure. This component provides round the year income and employment to farming families. Livestock economics of local cow, improved cow and buffalo were computed and the results have been presented in this sub-section.

Table 4.87 Economics of local cow on sample farms

(Rs./animal/lactation)

S No.	Particulars	Beneficiaries	Non-beneficiaries
1	Green fodder	8250	6253
2	Dry fodder	10500	7245
3	Concentrates	4860	3834
4	Minerals	750	450
5	Animal health care	540	375
6	Human labour	12720	11760
7	Total variable cost	37620	29917
8	Gross returns (i+ii)	47583	34986
i.	Value of milk	45696	33096
ii.	Value of dung	887	1890
9	Net returns	9963	5069

The variable cost has been worked out for local cow in Table 4.87. It can be seen from the table that total variable cost for local cow per animal per lactation on beneficiary farms was Rs. 37,620. In comparison to Rs.29, 917 on non-beneficiary farms. The major components of variable cost were human labour followed by dry fodder. It was found that gross returns per animal per lactation were higher on beneficiary farms (Rs. 47,583) than non-beneficiary farms (Rs. 34,986). The average net returns per animal per lactation were also higher on beneficiary farms (Rs. 9,963) as compared to non-beneficiary farms (Rs. 5,069).

Table 4.88 displays total variable cost for improved cow per animal per lactation. Total variable cost was found to be Rs.39,164 on beneficiary farms and Rs.33,670 on non-beneficiary farms. Gross returns over total cost incurred by beneficiary farmers was Rs. 71,542/animal/lactation. In case of non-beneficiary farmers, gross returns per animal per lactation was Rs. 63,555. The net returns observed per animal per lactation were higher on beneficiary farms (Rs. 32,378) as compared to non-beneficiary farms (Rs. 29,885).

Table 4.88 Economics of improved cow on sample farms

(Rs./animal/lactation)

S No	Particulars	Beneficiaries	Non-beneficiaries
1	Green fodder	7695	6885
2	Dry fodder	9720	8100
3	Concentrates	6299	5066
4	Minerals	675	579
5	Animal health care	615	560
6	Human labour	14160	12480
7	Total variable cost	39164	33670
8	Gross returns (i+ii)	83134	73817
i.	Value of milk	81144	71834
ii.	Value of dung	1990	1983
9	Net returns	32378	29885

Economics of buffalo on sample farms

As shown in Table 4.89 for buffalo, the total variable cost of livestock management per animal per lactation was Rs. 44,144 and Rs. 41,240 in case of beneficiary and non-beneficiary farms, respectively. Net returns of worth Rs.78,060 and Rs.41,555 per animal per lactation were observed by beneficiary and non-beneficiary farmers, respectively. It was concluded that buffaloes contributed a major role in farmer's income in the study area.

Table 4.89 Economics of buffalo on sample farms

(Rs./animal/lactation)

S No.	Particulars	Beneficiaries	Non-beneficiaries
1	Green fodder	7425	6780
2	Dry fodder	9450	9450
3	Concentrates	10224	8520
4	Minerals	780	690
5	Animal health care	665	680
6	Human labour	15600	15120
7	Total variable cost	44144	41240
8	Gross returns (i+ii)	122204	82795
i	Value of milk	120000	80640
ii.	Value of dung	2204	2155
9	Net returns	78060	41555
	Average yield (litres)	10.33	7.20

As explained earlier, beneficiary farmers adopted better management practices and feeding for milch animals. Most of the beneficiary farmers were also well aware of the formulation of maintenance and production rations as many of them were preparing balanced ration at home as guided by KVK experts. This might have led to higher productivity and income from milch animals reared by beneficiary farmers.

4.8.4 Economics of mushroom production

Mushroom production is an important supplementary source of income for farmers. Mushroom production plays an important role in providing employment and generating income opportunities. Mushroom production can also be adopted by landless farmers. The KVK has trained the farmers to produce oyster and white button mushrooms.

The cost of cultivation and economics for 100 compost bags of oyster mushroom was calculated and results have been presented in Table 4.90.

The cost of cultivation for 100 bags of oyster mushroom for one crop was estimated. It can be seen from the table 4.90 that total variable cost for production per 100 bags was estimated to be Rs. 7358 and Rs. 6804 including human labour cost, on beneficiary and non-beneficiary farms, respectively. Net returns from one crop of 100 bags of mushroom were estimated to be higher on beneficiary farms (Rs. 9540) as compared to non-beneficiary farms (Rs. 5015).

Table 4.90 Cost of cultivation for one crop of oyster (dhingri) mushroom

(Rs./100 bags)

Particulars	Beneficiaries	Non-beneficiaries
Oyster spawn (kg)	1020	1000
Compost bags	1250	1385
Labour charges	3306	2945
Electricity charges	500	409
Medicines	513	355
Packing material	600	600
Miscellaneous	120	110
Sub total	7309	6804
Interest @ 8% per annum	49	45
Total variable cost	7358	6849
Gross returns	16898	11864
Net returns	9540	5015

Table 4.91 Cost of cultivation for one crop of button mushroom

(Rs./100 bags)

Particulars	**Beneficiaries**	**Non-beneficiaries**
Compost bag including spawn	10000	10000
Labour charges	4884	4327
Electricity charges	553	483
Medicines	617	152
Packing material	600	600
Miscellaneous	782	456
Sub total	17436	16018
Interest @ 8% per annum	116	107
Total variable cost	17552	16125
Gross returns	32979	23800
Net returns	15427	7675

Results for cost of cultivation computed for one crop of button mushroom have been presented in Table 4.91. It can be seen from table that total variable cost of one crop of button mushroom per 100 bags was estimated to be Rs.17,436 and Rs.16,018 on beneficiary and non-beneficiary farms, respectively. Net returns over variable cost were Rs. 15,427 per 100 bags, which was higher on beneficiary farms, as compared to Rs. 7675 on non-beneficiary farms.

It was quite clear that productivity and income from both type of mushrooms were higher on beneficiary farms.

4.9 Composition of farm and household income and role of KVK in enhancing farm income

The ultimate aim of a farm family is raise its income and maintain stable livelihood standard which in turn determines the socio-economic status of a family. Therefore, the study of each component contributing to household income is very important. Household income is generally comprised of farm income and non-farm income.

4.9.1 Composition of farm income

Farm income was divided into three components, *viz.*, income from crops, income from dairy animals and income from mushroom production. The farm income was estimated as the value of crops and their by-products. It can be seen from the Table 4.92 that income from field crops (excluding vegetable crops) came out to be Rs.

39,939/farm on beneficiary farms and Rs. 28,215/farm on non-beneficiary farms, thereby, showing a significant mean difference of Rs.11724. Vegetable crops contributed substantial share of farm income (36.51%) on beneficiary farms while the share of income from vegetable crops was quite low on non-beneficiary farms (10.04%) and there was significant mean difference of Rs. 60,602 on beneficiary farms over non-beneficiary farms. Milch animals contributed substantial share of farm income (55%) on non-beneficiary farms as compared to beneficiary farms (33.64%). However, in absolute terms, beneficiary farmers obtained Rs. 17,931 more income from milch animals than non-beneficiary farmers though the mean difference was found non-significant. Income from mushroom production was Rs. 16,389/farm and Rs. 756/ farm on beneficiary and non-beneficiary farms, respectively. Total farm income was estimated to be Rs. 1,88,752/farm on beneficiary and Rs. 82,862 on non-beneficiary farms. This clearly shows that there was a significant mean difference of Rs. 1,05,890 in the farm income of beneficiary and non-beneficiary farmers.

Table 4.92 Composition of farm income on sample farms

(Rs./farm/annum)

S No.	Particulars	Beneficiaries	Non-beneficiaries	Mean difference	t-cal	t-tab $_{0.05}$	t-tab$_{0.01}$
1	Field crops	39939	28215	11724*	2.38	1.69	2.46
		(21.16)	(34.05)	(4930.47)			
2	Vegetable crops	68921	8319	60602**	6.78	1.69	2.46
		(36.51)	(10.04)	(8931.46)			
3	Dairy	63503	45572	17931	0.91	1.69	2.46
		(33.64)	(55.00)	(19601.77)			
4	Mushroom production	16389	756	15633	0.81	1.69	2.46
		(8.69)	(0.91)	(19211.17)			
	Total farm income	188752	82862	105890** (22823.83)	4.64	1.63	2.46

**Significant at 1% level
*Significant at 5% level

4.9.2 Factors affecting farm income and impact of KVK

To find out the relationship between factors affecting farm income and impact of KVK on farm income, regression analysis was carried out. The specified factors for regression were irrigated area, area under vegetable crops, number of milch animals and dummy variable for KVK.

Table 4.93 Factors affecting farm income and impact of KVK

Factors	Regression coefficients
Intercept	-2175.19
	(13796.68)
Irrigated area (ha)	114126.04**
	(52635.81)
Area under vegetable crops (ha)	85935.97**
	(41800.79)
Milch animals (No.)	26005.63*
	(7759.37)
Dummy for KVK	66253.85*
	(15972.18)
Adjusted R^2	0.7119**
F-value	33.92

**Significant at 1% level
*Significant at 5%level
Figures in parentheses indicate standard errors of respective regression coefficients

Results for factor analysis of farm income have been presented in Table 4.93. It was observed that all the considered factors were significant in affecting the farm income of sample beneficiary farmers. With an increase in 1 ha irrigated area, the farm income would increase by Rs. 1,14,126. Similarly, with an increase in 1 ha area under vegetable crops, farm income would increase by Rs. 85,936. Also, with the addition of one milch animal, the farm income would increase by Rs. 26,006. Dummy for KVK was found significant at 5 per cent level which clearly shows the impact of KVK on farm income in the study area. Beneficiary farmers obtained Rs. 66,253 additional income over non-beneficiary farmers. All these coefficients were found statistically significant. The included explanatory variables explained about 71 per cent of the systematic variation in model which was found statistically significant at 1 per cent level of significance.

4.9.3 Composition of household income

Source-wise annual household income of beneficiary and non-beneficiary farmers have been presented in the Table 4.94. It can be seen from the table that the total annual household income per farm was estimated to be Rs.3,34,920 for beneficiary farmers and Rs.2,04,528 for non-beneficiary farmers, out of which farm income contributed 56.36 per cent and 40.51 per cent on beneficiary and non-beneficiary farms, respectively. The major sources of non-farm income were government services, private services and business. Non-farm income was Rs.1,46,168 and Rs.1,21,666 for beneficiary and non-beneficiary farms, respectively. It was observed that farm income contributed 56.36 per cent share which was higher than 40.51 per cent share on non-beneficiary farms. However, the per cent contribution of non-farm income was higher on non-beneficiary farms (59.49%) as compared to beneficiary farms (43.64%). Thus, it can be concluded that agriculture played a major role in enhancing the total household income of beneficiary farmers in the study area.

Table 4.94 Composition of annual household income on sample farms

(Rs./farm/annum)

S. No.	Occupation	Beneficiaries	Non-beneficiaries
A	**Farm Income**	188752	82862
		(56.36)	(40.51)
B	**Non-farm income**		
5	Government services	45000	15833
		(13.44)	(7.74)
6	Private services	34667	22333
		(10.35)	(10.91)
7	Pensioners	16667	17500
		(4.98)	(8.56)
8	Labour (Daily wage)	23667	32000
		(7.07)	(15.65)
9	Business	26167	34000
		(17.90)	(16.62)
	Sub-total (Non-farm income)	146168	121666
		(43.64)	(59.49)
	Total household income	334920	204528

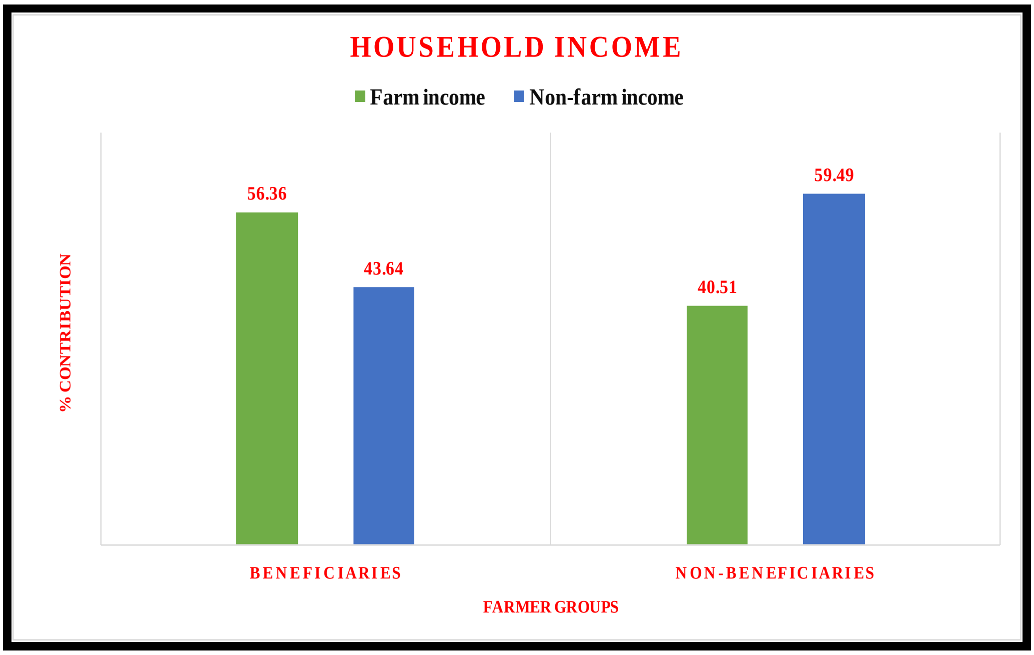

Fig. 4.3 Household income on beneficiary and non-beneficiary farms

4.10 Problems and constraints

Farmers in the study area faced a number of problems in crop production, livestock management and other enterprises. During survey, both beneficiary and non-beneficiary farmers reported number of problems. The problems and constraints faced by sample farmers in context of crop production, livestock management and mushroom production were analyzed and the results have been presented in this section.

Severity of problems faced was analyzed by using chi-square test. The results have been presented in Table 4.95.

Table 4.95 Problems faced by farmers related to field crops and vegetables

(per cent)

S. No.	Problems	Beneficiaries	Non-beneficiaries
1	No awareness about new technology	4.00	90.00
2	Poor extension services	10.00	76.67
3	Non-availability of seeds/planting material	50.00	83.33
4	Untimely supply of seeds	50.00	73.33
5	Costly seeds/ planting material	66.67	66.67
6	Higher risk under rainfed conditions	66.00	66.67
7	Poor quality of new variety	6.67	33.33
8	Not convenient to follow new technology	10.00	66.67

Calculated chi-square value of 27.06 was found to be significant at 1% level of significance with tabulated chi-square value of 18.475 at 7 degrees of freedom.

It can be seen from table that maximum proportion of beneficiary farmers faced the problem of costly seeds/planting material suggested by KVK while the problem regarding awareness about new technology was noticed to a small extent on beneficiary farms. On the other hand, 90 per cent non-beneficiary farmers reported lack of awareness about new technologies at ground level. The extent of poor extension services problem was higher (76%) on non-beneficiary farms as compared to beneficiary farms (10%). There were many problems like untimely supply of seeds, costly seeds and inconvenience in adopting new technology by farmers. The extent of severity of problems was higher among non-beneficiary farmers as compared to beneficiary farmers. It has been observed that non-beneficiary farmers faced the problem of poor extension services, due to which there was quite low adoption of new technologies on their farms. Calculated chi-square value of 27.06 was found to be significant showing the differential incidence of these problems on beneficiary and non-beneficiary farms.

Table 4.96 Problems faced by farmers related to livestock management

(per cent)

S. No.	Problems	Beneficiaries	Non-beneficiaries
1	No awareness about new technology	33.33	83.33
2	Poor extension services	16.67	80.00
3	Non-availability of feed	16.67	50.00
4	Costly feed	30.00	93.33
5	Poor quality of improved feed	3.33	53.33
6	Not convenient to follow new technology	30.00	93.33

Calculated chi-square value of 12.59 was found to be significant at 5% level of significance with tabulated chi-square value of 11.070 at 5 degrees of freedom.

From Table 4.96, it is clear that the proportion of non-beneficiary farmers who faced various problems like no awareness about new technology, poor extension services and non-availability of feed etc., was higher than beneficiary farmers. Calculated chi-square value (12.59) was found significant at 5% level of significance and this clearly shows that KVK has been working to improve milk production in the study area. (Patel 2013) reported that high cost of commercial feed and low price of milk, inadequate availability of land for green fodder cultivation and repeated breeding problems were the serious constraints faced by dairy farmers in effective use of trainings conducted by KVKs in the study area.

Table 4.97 Problems faced by farmers in mushroom production

(per cent)

S. No.	Problems	Beneficiaries	Non-beneficiaries
1	No awareness about new technology	46.67	73.33
2	Poor extension services	4.23	86.67
3	Non-availability of spawn and compost	10.00	73.33
4	Costly spawn and compost	6.67	56.67
5	Difficulty in maintaining temperature	16.67	73.33
6	Poor quality of spawn	2.12	26.67
7	Not convenient to follow new technology	20.00	70.00

Calculated chi-square value was 21.07 which was found to be significant at 1% level of significance with tabulated chi-square value of 16.812 at 6 degrees of freedom.

From Table 4.97, it is clear that in case of mushroom production, some beneficiary farmers (46%) faced lack of awareness about complete package of new technology. On the other hand, non-beneficiary farmers faced many problems like poor extension services, lack of awareness about new technology and non-availability of spawn etc. Poor extension services were also the main problem expressed by non-beneficiary farmers (87%).main problem faced in the study area. Calculated chi-square value of 21.07 was found to be significant at 1% level of significance which clearly shows the incidence of less problems faced by mushroom growers adopted by KVK. Sharma et al (2016) also confirmed that main problems faced by mushroom growers were non-availability of spawn bags and lack of awareness about new technology for mushroom production.

From the analysis, it is crystal clear that there was significant difference in the problems faced by beneficiary and non-beneficiary farmers in the production of crops, livestock and mushrooms. KVK has been instrumental in solving most of the problems of beneficiary farmers in the study area.

5. SUMMARY AND CONCLUSIONS

Introduction

Since independence, one of the major concerns in the process of technology transfer has been to explore the effective way of dissemination of new technologies fully integrating the view point of farmers. The moot questions have been to address the issues of where, how and what technologies are appropriate for adoption and compatible with their resource matrix. Different extension approaches have been adopted to disseminate the ideas and new technologies. As a result of this lag, there is a huge gap between the potential gain and the actual gain realized by the farmers. Therefore, to promote agricultural technology-led knowledge based agricultural development, the Government of India has taken various initiatives from time to time.

Many extension programmes have been implemented aiming the promotion of scientific agriculture by government in the country. The concept of KVKs was developed in 1974 when the first KVK was established in 1974. These KVKs are serving the farming community by creating awareness through conducting demonstrations, training camps and field days/visits. Keeping in view the importance of technical know-how for farming community, this study was planned to analyze the impact of KVKs on adoption of farm technologies and income of farmers in Kangra district of Himachal Pradesh.

Objectives

1. To assess the role of KVK Kangra in terms of transfer of technologies and their adoption status at farm level.
2. To examine the impact of improved practices on resource use, productivity and farm income and measures to enhance outreach of KVK.

Methodology

The study was conducted in Kangra block where KVK, Kangra of CSK HPKV is located. The list of villages was compiled with the help of KVK, Kangra where extension activities were being carried out by the scientists. Two stage stratified random sampling design was employed to select the villages and farm households in

Kangra block. In the first stage, 6 villages (3 adopted by KVK for transfer of technology and 3 non-adopted) were selected randomly from Kangra block. The farmers were categorised into two groups, beneficiaries (who were provided with KVK trainings/services) and the other non-beneficiaries (who did not receive KVKs trainings/services). Sixty farmers were selected randomly comprising 30 beneficiary and 30 non-beneficiary farmers. Various statistical tools were used to interpret the results. Herfindahl, Simpson and Entropy indices were computed for examining the extent of diversification on sample farms. Principal Component method was used as a tool of data reduction and for computation of management indices. Economics of crops, livestock and other enterprises was worked out. Regression analysis was carried out to assess the impact of KVK trainings on crop yield, management practices and farm income.

Major findings

1. KVK has made a good progress in terms of the achievement of planned targets and as most of these targets were accomplished by way of FLDs, OFTs, trainings and the number of participants covered in various programmes of KVK.
2. The socio-economic survey revealed that the average family size in the study area was around 5 members on beneficiary and non-beneficiary households. The sex ratio was 987 on beneficiary farms and 829 females per thousand males on non-beneficiary farms.
3. The socio-economic survey further revealed that about 57 per cent and 47 per cent of farm households had nuclear family structure on beneficiary and non-beneficiary farm households, respectively. Majority of the heads fell under the category of working age group (40-60 years) on both the categories of households.
4. The literacy rate on beneficiary households was found to be higher (93.01%) than on non-beneficiary households (83.56%). There was striking difference in the literacy rates of males and females on particularly non-beneficiary households.

5. The occupational pattern in the study area revealed that about 74 per cent of the members of beneficiary and non-beneficiary households had agriculture (crops and dairy) as their main occupation and 26 per cent as subsidiary occupation.
6. Farm investment pattern showed that major part of investment was made on residential buildings on both beneficiary farms (92.46%) and non-beneficiary farms (94.67%). Investment on cattle sheds accounted for merely 3 to 4 per cent.
7. Per farm investment on farm implements and machinery was higher on (Rs. 37,329) beneficiary farms as compared to non-beneficiary farms (Rs. 23,343).
8. The sample farmers in study area reared mainly dairy animals. There were 20.69 per cent local cows and 17.93 per cent improved cows. The non-beneficiary farmers reared 35.71 per cent buffalo local followed by 21.43 per cent local cows. Average number of dairy animals varied between 1.40 and 1.45 animals per farm. The total investment on livestock component was Rs. 1,14,117 on beneficiary farms and Rs. 73,658 on non-beneficiary farms.
9. The average size of land holding was 0.46 ha and 0.38 ha on beneficiary and non-beneficiary farms, respectively almost all the farmers were marginal and small. Operational holding accounted for more than 90 per cent of the holding on both beneficiary and non-beneficiary farms.
10. Paddy (25.86%) in *kharif*, wheat (28.27%) in *rabi* and vegetables in both *kharif* (13.53%) and *rabi* (15.69%) were the main crops grown by beneficiary farmers. On the other hand, paddy (26.47%) followed by maize (17.61%) in *kharif* and wheat (40.23%) in *rabi* were the major crops grown on non-beneficiary farms. The cropping intensity was almost similar (197%) on both beneficiary and non-beneficiary farms.
11. Area under vegetable crops was higher and, thus, beneficiary farms were more diversified than non-beneficiary farms. This was also validated through Herfindahl, Simpson and Entropy indices.
12. It was observed that non-beneficiary farmers used higher seed rates than beneficiary farmers for production of maize, paddy, *kharif* fodder and summer vegetables. The same pattern was observed in case of wheat, barley, *rabi* fodder and winter vegetables grown on sample farms. In general, the seed rate used for crops was more than the recommended seed rates more so on non-beneficiary

farms. NPK fertilizer application in the form of urea and IFFCO was higher on beneficiary farms than on non-beneficiary farms. It was also observed that the expenditure on chemicals for plant protection was also higher on beneficiary farms. Per hectare human labour employment in all the crops was relatively higher on beneficiary farms as compared to non-beneficiary farms.

13. It is clear from the study that the beneficiary farmers used almost judicious quantity of seed input on their farms. Therefore, the technological gap for seed rate was lower on KVK adopted farms as compared to non-beneficiary farms.
14. Technological gap assessed in terms of actual used rate and recommended rates of farm yard manure revealed deficit use on both the beneficiary and non-beneficiary farms. The deficit in FYM application varied from 7 to 85 per cent in cereal crops and 2 to 60 per cent in vegetable crops.
15. It was found that in cereal and fodder crops (*kharif* and *rabi*), the actual rate of NPK fertilizers applied was less than the recommended doses on both beneficiary and non-beneficiary farms. The deficit in NPK use was only up to 30 per cent in case of vegetable crops. Excess use of NPK fertilizers was found for some of the winter crops.
16. Principal component analysis indicated the management/adoption of improved practices for beneficiary farmers were 59.70 per cent for cereals, 62.56 per cent for vegetables and 66.60 per cent for livestock production. Contrary to this, management/adoption indices were 36.43 per cent, 34.91 per cent and 45.75 per cent, respectively for non-beneficiary farms clearly showing the impact of KVK in the transfer of technology and package of practices.
17. Weighted adoption indices for livestock management on beneficiary farms and non-beneficiary farms were 66.60 and 45.75 per cent which clearly indicates adoption of better management practices in rearing dairy animals.
18. The results of regression analysis also showed that KVK played a significant role in improving adoption of better management practices for production of cereals, vegetable crops and milch animals.
19. Regression analysis carried out to study the factors affecting improved livestock management also confirmed the impact of KVK trainings on adoption of better management practices on beneficiary farms.

20. It was found that average yields of cereal crops (maize, paddy, wheat and barley), summer and winter vegetables were significantly higher on beneficiary as compared to non-beneficiary farms. The mean difference between yields obtained by beneficiary and non-beneficiary farmers was found statistically significant in maize, paddy, wheat, summer vegetables and winter vegetables.
21. Regression analysis carried out to study the effect of different factors on productivity of cereal and vegetable crops revealed that FYM, NPK fertilizers and dummy variable for KVK were the significant factors for higher productivity. Thus, the impact of KVK in enhancing crop productivity was quite visible.
22. Productivity of dairy animals was found in the range of 6 to 10 litres/day/animal on beneficiary farms and 4 to 7 litres/day/animal on non-beneficiary farms. The difference in productivities of dairy animals was attributed mainly to adoption of better management practices followed for livestock management on beneficiary farms. The dummy for KVK was the significant factor for raising the productivity of milch animals by 1.63 to 4.67 litres/day /animal for cow and buffalo, respectively on beneficiary farms.
23. The cost of cultivation and economics of cereals and vegetable crops revealed that the cost of cultivation was relatively higher on beneficiary farms which was mainly due to more use of critical inputs like fertilizers and human labour. The net returns were also quite high especially in case of summer and winter vegetable crops. The net returns from summer vegetable crops varied from Rs. 94,944/ha in case of cucumber to as high as Rs. 1,78,597/ha in capsicum on beneficiary farms. Contrary to this, the net returns over variable cost on non-beneficiary farms were found lower ranging from Rs. 27,400/ha from chillies to Rs. 82,708/ha rom cucumber crop. Similarly, in winter vegetable crops, the net returns varied from Rs. 81,435/ha in pea crop to as high as Rs.176,972/ha in case of onion on beneficiary farms. The net returns from winter vegetables on non-beneficiary farms varied from Rs. 30,747/ha from pea crop to Rs. 1,10,010/ha from onion. This clearly shows that gross and net returns from both summer and winter vegetables were remarkably higher on beneficiary farms as compared to non-beneficiary farms.

24. The beneficiary farmers also obtained higher net returns from milch animals. The net returns (over variable cost) per animal per lactation were Rs. 32,378 for improved cow and Rs. 78,060 for buffalo on beneficiary farms. Contrary to this, the net returns for improved cow and buffalo were Rs. 29,885 and Rs. 41,555, respectively per animal per lactation on non-beneficiary farms.
25. Farmers in the study area have also adopted production of oyster and button mushrooms for which KVK has provided training. It was found that beneficiary farmers earned better returns than non-beneficiary farmers. The net returns per 100 bags for oyster mushroom were Rs. 9,540 on beneficiary farms and Rs. 5,015 on non-beneficiary farms. Likewise, the net returns per 100 bags for button mushroom were Rs. 15,427 for beneficiary and Rs. 7,675 for non-beneficiary farms. This clearly shows the impact of KVK in enhancing the production and income from mushrooms.
26. Total farm income, on an average, was estimated to be Rs. 1,88,752 on beneficiary farms which was significantly higher than on non-beneficiary farms (Rs. 82,862). Moreover, the income from field crops and vegetable crops was found to be significantly higher on beneficiary farms as revealed by mean difference. The irrigated area, area under vegetable crops and KVK patronage were found to be the significant factors enhancing farm income. In nutshell, the KVK adopted farmers (beneficiaries) obtained Rs. 66,254 income over non-beneficiary farmers.
27. On an average, the total non-farm income was estimated to be Rs. 1,46,168 and Rs. 1,21,666 on beneficiary and non-beneficiary farms, respectively. In this way, the total household income on beneficiary farms was estimated to be Rs. 3,34,920/farm and Rs. 2,04,528/farm on non-beneficiary farms. The contribution of farm income in total household income was 56.36 per cent on beneficiary and 40.51 per cent on non-beneficiary households.
28. It was found that farmers, especially, non-beneficiary farmers in the study area faced more problems regarding crop production and livestock rearing. The extent of poor extension services was main problem followed by non-availability of quality seeds. Regarding mushroom production, lack of

awareness about new technology was the main problem faced mostly by non-beneficiary farmers.

Suggestions

- It is clear from the study that KVK has played vital role in improving the adoption of scientific management in the production of cereals, vegetables, fodder, livestock and mushrooms thereby, raising the farm income significantly. Therefore, there is a need to expand the outreach of KVK to those areas which have not been served so far. The emphasis should be laid on resource poor farmers having less irrigated area and poor economic status.
- It has been found that there still persists extension gaps in the adoption of improved practices. Therefore, it is suggested that concurrent feedback and opinions should be taken regarding the performance of disseminated technology/practices, variety adoption status, yield performance and farmers’ preferences.
- It may not be possible to expand the outreach of KVK to a larger area by adopting micro-level service approach for training households. There is a need to promote farmer groups for larger community training, collective production and organized marketing.
- To make farming more attractive and profitable, there is also need to include entrepreneurship training and record keeping so that farmers can effectively adopt improved technology and prepare business plans to enhance their incomes.
- So far, major focus of KVK activities has been on transfer of production technologies. Therefore, there is a need to include market-led extension for value addition and efficient marketing.
- There is also a need to prepare a comprehensive village level micro plan for holistic development of the area.

LITERATURE CITED

Acharya S, Satpathy B and Mishra I. 2018. Impact of training programmes on the profitability of mushroom growers in Angul district. *Journal of Odisha Krishi Vigyan* 6: 146-149

Ajrawat B and Kumar A. 2012. Impact of KVK training programme on socio-economic status and knowledge of trainees in Kathua district. *Journal of Krishi Vigyan* 1: 31-34

Alagukannan G, Velmurugan P and Kumar A. 2015. Impact of interventions on knowledge and adoption of improved technologies in banana cultivation. *Journal of Krishi Vigyan* 3: 54-58

Anonymous. 2018. Economics and Statistics Department, Himachal Pradesh

Anonymous. 2019. https://www.icar.org.in (20th May 2018)

Anonymous. 2019. Ministry of Statistics and Programme Implementation, Government of India

Ashalatha KV and Rajeshwari N. 2018. An overview on Farmers Suicides in India and Intervention to Curb. *International Journal of Current Microbiology and Applied Sciences* 7: 3032-3040

Badodiya SK, Yadav MK, Daipuria OP and Chauhan SVS. 2011. Impact of training programmes on adoption of organic farming practices. *Indian Research Jouranl Extension Education* 11: 42-45

Bairwa RK, Bhimawat BS, Verma SR, Meena NL and Meena RK. 2012. Bridging yield gap through Front Line Demonstration in rapeseed-mustard under tribal belt of Rajasthan. *Rajasthan Journal of Extension Education* 20: 194-197

Bar N, Mukopadhyay SD, Rout B and Prusty S. 2005. Constraints faced by Krishi Vigyan Kendra scientists in conducting training effectively for the tribals of Odisha in India – an overview. *Journal of Interacademicia* 19: 160-165

Binkadakatti JS. 2008. Impact of Krishi Vigyan Kendra (KVK) trainings on use of bio-fertilizers and bio-pesticides by tur farmers in Gulbarga district. M.Sc. thesis, University of Agricultural Sciences Dharwad

Biswas S, Singh AK and Mondal SK.2014. An assessment study on ex-trainees of KVK in awareness generation and adoption of improved agricultural practices in Dakshin Dinajpur of W.B. *Agricultural Science Digest* 34: 277-280

Chauhan NM. 2012. Impact and yield gap analysis of trainings and FLDs regarding scientific practices of chickpea (*Cicer arietinum*) *International Journal of Extension Education* 8: 44-47

Chauhan RS, Singh SRK, Mishra YD, Singh P, Bhargava MK and Singh HP. 2013. Impact analysis of Front Line Demonstrations (FLDs) on gram (chickpea) in Shivpuri district of Madhya Pradesh. *Journal of Community Mobilization and Sustainable Development* 8: 205-208

Cowan BW, Lee DG and Shumway CR. 2015. The induced innovation hypothesis and U. S. public agricultural research. *Agricultural Journal of Agricultural Economics* 97: 727-742

Devi MG, Kumar A and Kumar DS. 2017. Impact analysis of trainings and Front Line Demonstrations in black gram (*Vigna mungo*) cultivation. *Journal of Krishi Vigyan* 6: 97-100

Dhakad SS, Asati KP, Chouhan SS, Badaya AK, Kirar KS and Ambawatia GR. 2018. Impact of Front Line Demonstration on the Yield and Economics of Chickpea (*Cicer arietinum* L.) in Tribal Area of Madhya Pradesh, India. *International Journal of Current Microbiology and Applied Sciences* 7: 3662-3666

Guleria JS, Kumar A, Sharma KD and Katoch A. 2019. An Evaluation Study of Medium Lift Irrigation Project Bassi in Tehsil Shri Naina Deviji District Bilaspur, Himachal Pradesh. Department of Agricultural Economics, Extension Education & Rural Sociology, College of Agriculture, CSKHPKV Research Report No. 85

Gupta S and Verma S. 2013. Impact of KVK on knowledge level of farm women. *The Journal of Rural and Agricultural Research* 13: 87-89

Halagundegowda GR, Nagaraja MS and Meenakshi HK. 2015. Statistical Analysis on Factors Influencing on Shift in Cropping Patterns in different Agro-climatic zones of Karnataka. Asian Journal of Microbiology, Biotechnology and Environmental Sciences Paper 17: 1021-1026

Hundal JS, Chahal US, Kansal SK and Bhatti JS. 2016. Role of training in changing knowledge level among dairy farmers of Punjab. *The Haryana Veterinarian* 55:220-223

Indu, Kumar A and Kumari A. 2009. Use of extension methods in dissemination of new agricultural technology. *Agriculture Update* 4: 365-366

Kanwar P and Kherde RL. 1997. Assessment of knowledge level of male and female respondents of H.P. in paddy production practices. *Himachal Journal of Agricultural Research* 23: 95-100

Karabhantanal SS, Vastrad SM, Patil HB and Wali SY. 2015. Impact of Front Line Demonstration on Integrated Crop Management in rainfed onion. *Pest Management in Horticultural Ecosystems* 21: 42-45

Krishnamoorthy V. 2014. Enhancing flower productivity during off-season in jasmine (*Jasmine sambac). Journal of Krishi Vigyan 3*: 88-90

Kumar KS, Daisy M, Kumaravel V and Mohan B. 2014. Impact of KVK training on scientific method of goat rearing and feeding management of Azolla. *International Jouranl of Science, Environment and* Technology 3: 2287-2292

Kumar M, Sethy S and Gorai D. 2009. Krishi Vigyan Kendra - Kisan Club Linkage: an approach towards agricultural prosperity. *Indian Research Journal of Extension Education* 9: 76-79

Kumar S, Singh R, Sharma V, Choubey AK and Shah S. 2014. Yield gap and economics of chickpea (Cicer arietinumv L.) cultivation in low hills of Himachal Pradesh. *Himachal Journal of Agricultural Research* 40: 45-49

Kumari S, Bangarwa GS, Badhala BS, Ghaswa R and Rana SS. 2013. Association between knowledge level of contact and non-contact farmers about the activities undertaken by the Krishi Vigyan Kendra. *Journal of Extension Education* 18: 38-44

Kumbhare NV and Khonde SR. 2009. Impact of KVK training on farmers adoption behavior and knowledge gain. *Indian Journal of Extension Education* 45: 62-65

Lal G, Mehta RS, Singh D and Choudhary MK. 2013. Effect of technological interventions on cumin yield at farmer's field. *International Journal of Seed Spices* 3: 65-69

Lal M and Kumar A. 2007. Training needs of Hamirpur farmers in vegetable cultivation. *Himachal Journal of Agriculture Research* 33: 66-69

Madhavan MM, Tarde VJ and Patil SS. 2016. Constraints faced by the extension personnel in transfer of technologies. *International Journal of Agriculture Sciences* 13: 1198-1202

Masanta S and Biswas S. 2009. Effect of various nutrient management practices on productivity, soil productivity status and water use efficiency of french bean grown under homestead condition in Nadai district of West Bengal. *Journal of Crop and Weed* 5: 50-52

Meena KC and Gupta IN. 2013. Impact of KVK training programmes on adoption of garlic production technology. *Journal of Krishi Vigyan* 1: 41-43

Meena KC, Aswal S, Verma TC and Singh DK. 2017. Performance and impact of FLDs on black gram in Hadauti region of Rajasthan. *Contemporary Research in India* 7: 13-19

Meena KC, Lakhawat S and Gupta IN. 2016. Performance of Wheat Raj 4037 variety through FLDs in Hadauti region of Rajasthan. *International Journal of Science, Environment and Technology* 5: 1758-1764

Miller RL and Cox L. 2006. Technology transfer preferenes of researchers and producers in sustainable agriculture. *Journal of Extension* 44: 3RIB2

Nayaka P, Shah KA and Tandel BM. 2017. Impact and constraints analysis of farmers in adoption of INM in okra. *International Journal of Chemical Studies* 5: 109-111

Pandey Rakesh, Singh JB, Singh Sudhakar and Singh NK. 2011. Impact evaluation of training on the adoption of technology. *Agriculture Update* 6: 114-116

Patel D, Devi MCA, Parameswaranaik J, Dhodia AJ and Bhatt A. 2016. Constraints of extension personnel in transferring of dairying technologies in Karnataka. *Indian Journal of Dairy Science* 69: 214-219

Patel Rajkumar. 2013. Impact of trainings organized by Krishi Vigyan Kendra on dairy farming in Satna district of Madhya Pradesh. MVSc thesis National Dairy Research Institute

Pattnaik T and Mishra S. 2008. Constraints in adoption of mushroom cultivation technology. Asian Journal of Home Science 3: 86-89

Pennobaliswamy GR, Swamy BKN, Nagaraja N and Gouda MJC. 2010. Scale to assess the performance of Krishi Vigyan Kendra (KVKs). *Mysore Journal of Agricultural Sciences* 44: 130-138

Rao NV, Jain PK, Kumar NK and Reddy MJM. 2016. Impact of improved groundnut (*Arachis hypogaea* L.) production technologies on knowledge and adoption of farmers. *Journal of Oilseeds Research* 33: 226-231

Rathod MK, Tidke GR and Mandve PR. 2013. Impact of Front Line Demonstration on adoption of seed treatment in soybean. *Indian Research Journal Extension Education* 11: 72-77

Ratna Jayant and Sharma KD. 2017. Impact of Investment in Research and Development. *Indian Journal of Dairy Science* 70: 471-476

Reghunath N and Kumar NK. 2016. Farmers' perception on Innovations in Technology Dissemination (ITD) methods. *Journal of Extension Education* 28: 5633-5637

Sahoo PR, Ananth PN, Dash AK, Barik NK and Jayasankar P. 2016. Institution based intervention on promoting composite fish culture in rural Odisha: A case stusy of KVK-Khorda. *International Journal of Fisheries and Aquatic Studies* 4: 190-195

Sarada O and Kumar GVS. 2013. Knowledge and adoption of recommended production technology by cotton farmers. *The Journal of Research* ANGRAU 41: 54-60

Schimmelpfennig D and Ebel R. 2016. Sequential adoption and cost savings from precision agriculture. *Journal of Agricultural and Resource Economics* 41: 97-115

Sharma D, Kumar A and Guleria JS. 2016. Economic availability, technological gap and problems of mushroom cultivation in Mandi district of Himachal Pradesh. *Himachal Journal of Agricultural Research* 42: 47-54

Sharma HR, Sharma KD, Chauhan SK and Sharma HL. 2011. Impact assessment of wheat research in Himachal Pradesh. *Himachal Journal of Agriculture Research* 37: 198-209

Sharma KD, Pathania MS, Bala Brij and Gupta Manoj. 2016. Technological Intervention for Protected Cultivation of Vegetable Crops – Impact Assessment of Training (RKVY Project) Department of Agricultural Economics, Extension Education & Rural Sociology College of Agriculture CSK HPKV Palampur Research Report No. 81: 1-26

Sharma KD. 2017. Status of seed production and distribution in Himachal Pradesh. *Himachal Journal of Agriculture Research* 42: 162-169

Sharma TN, Singh RK and Sharma VB. 2000. Effect of adoption behaviour of trained farmers of Krishi Vigyan Kendra, Chhindwara, Madhya Pradesh. *JNKVV Research Journal* 34: 81-84

Singh B, Meena KC, Verma SR and Meena R. 2018. Impact of KVK training programmes on guar (cluster bean) production technology. *International Journal of Agriculture Innovations and Research* 6: 89-91

Singh D, Patel AK, Baghel MS, Singh A and Singh AK. 2014. Technological intervention for reducing the yield gap of chickpea (*Cicer arietinum* L.) in Sindhi district of MP. *International Journal of Advanced research in Management and Social Sciences* 3: 117-122

Singh D, Prakash S and Singh R. 2008. Impact of KVK on perceived characteristics of trained trainees in relation to vegetable crop production technology. *Progressive Agriculture* 8: 183-186

Singh Dan, Satya Prakash and Saroj PL. 2006. Impact on perceived characteristic and adoption level of trained trainees in Krishi Vigyan Kendra about plant protection measures. *Annals of Plant Protection Sciences* 14: 215-217

Singh Dhanbir, Sharma Vinod and Lal Ramesh. 2013. Impact of trainings on scaling up the knowledge and adoption of new/improved farm practices by farmers of Kullu district in Himachal Pradesh, India. *Indian Journal of Soil Conservation* 41: 299-303

Singh SP, Gautam SS and Bisht K. 2015. Impact assessment and effectiveness of farm women training programmes under ATMA project in district Tikamgarh of Madhya Pradesh. *Technofame- A Journal of Multidisciplinary Advanced Research* 4: 98-103

Singh SP, Singh R and Singh D. 2018. Impact of OFT and FLD to increase the area and productivity of major crops in Morena district of Madhya Pradesh. *The Journal of Rural and Agricultural Research* 18: 36-38

Singla R and Goel R. 2016. Impact of mushroom cultivation on socio-economic conditions of rural women of Patiala, Punjab. *International Journal of Farm Sciences* 6: 251-254

Sirohiya L, Singh DK and Agrawal SK. 2012. Impact of trainings on adoption of chickpea (*Cicer arietinum* L.) production technology. *Indian Journal of Extension Education* 48: 87-89

Suman RS. 2017. Extent of technological gap and its relationship with different characteristics of vegetable growers. Journal of Agri. Search 4: 223-225

Tandel BM, Shah KA and Prabhu Nayaka. 2015. KVK a knowledge resource centre; awareness among Navsari district farmers. *Agriculture Update* 10: 164-170

Thakur AP and Bhushan S. 2016. Economic impact of Front Line Demonstrations on cereal & pulse crops in Godda district of Jharkhand. *Journal of Economic and Social Development* 12: 106-111

Thakur DR, Saini AS and Sharma KD. 2008. Socio-economic impact of production technology on mountain agriculture – a study of Himachal Pradesh. (Financed by ICAR, New Delhi): Research Report Number – 46, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India

Thakur DR, Sharma KD, Chauhan SK, Kumar Virender. 2012. Visioning Policy Analysis and Gender (V- PAGe) under National Agricultural Innovation Project Department of Agricultural Economics, Extension Education & Rural Sociology College of Agriculture CSK HPKV Palampur Research Report No. 59: 1-42

Thakur DS and Sharma KD. 1994. Weaklings of agriculture in Himachal Pradesh – an introspection. *Himachal Journal of Agriculture Research* 10: 1-11

APPENDICES

Appendix I Survey schedule for sample farmers

Code No.

Department of Agricultural Economics, Extension Education & Rural Sociology
CSK HP Krishi Vishvavidyalaya, Palampur (H.P.) – 176062

Survey schedule

Title of research problem: Impact of Krishi Vigyan Kendras on adoption of Farm Technologies and Income of Farmers – A Case study of KVK Kangra

Objectives:
1. To assess the role of KVK Kangra in terms of transfer of technologies and their adoption status at farm level
2. To examine the impact of improved practices on resource use, productivity and farm income and measures to enhance outreach of KVK Kangra.

I. General information:

Name of Respondent		Father's Name	
Age (years)		Name of village	
Contact No.		Block	
Size of family		Type of family (Joint/Nucleus)	
Education		Religion	
Caste		Main Occupation	
Farming experience (yrs)		Subsidiary Occupation	
Veg. production experience			

II. Family features

Sr. No	Relation with the head of the family	Age (years)	Sex (M/F)	Education I/P/M/H/S/D/G/PG
1.				
2.				
3.				
4.				
5.				
6.				
7.				

Where, I- Illiterate, P-Primary, M- Middle, H- high, S- Senior secondary, D- Diploma, G- Graduation and PG- Post Graduation

III. Availability of major infrastructural facilities

S.No.	Particulars	Distance (km.)	No. of visits during a year	S. No.	Particulars	Distance (km.)	No. of visits during a year
1.	Primary school			11.	Market committee		
2.	Middle school			12.	BDO office		
3.	High school			13.	SMS agriculture		
4.	Secondary school			14.	Bank		
5.	College			15.	Link road		
6.	Health centre			16.	Market		
7.	Vety. Hospital			17.	Flour mill		
8.	Co-operative society			18.	Revenue office		
9.	Krishi Vigyan Kendra			19.	Milk Pasteurizing unit		
10.	Primary Agriculture Cooperative Society			20.	NGO		

IV. Occupational pattern of family members

Sr. No.	Occupation	Main			Subsidiary		
		No. of family members	Time devotion per annum (%)	Annual income (Rs.)	No. of family members	Time devotion per annum (%)	Annual income (Rs.)
1.	Agriculture						
	Field crops						
	Dairy						
	Horticulture						
	Allied activities						
2.	Off farm activities						
	Govt. Service						
	Private sector						
	Business / trade						
	Rural Artisan						
3.	Labourer						
4.	Other (Specify)						

V. Attachment to Krishi Vigyan Kendra:

Have you got training in KVK?	(Yes/No)
If Yes, then since how long?	
Who motivated you to take benefit of KVK?	
No. of visits to KVK in a year	
Purpose of visits	

VI.Land inventory and utilization (Bigha/Kanals):

S. No.	**Particulars**	Area (kanal)		
		Irrigated	Unirrigated	Total
1.	Owned Land			
2.	Leased-in Land			
3.	Leased-out Land			
4.	Total Holding (1+2-3)			
Land Utilization:				
1.	Cultivated Land			
2.	Orchard Land			
3.	Fallow Land			
4.	Cultivable wasteland			
5.	Land under Misc. Trees/grasses/forest			
6.	Permanent Pastures			
7.	Any others (grassland)			
8.	Total holding			

VII. Farm buildings and farm asset position

S. No	Particulars	No.	Type of building			Year of / construction	Present value (Rs)	Source of funds (P/L)
			Kuccha	Pucca	Mixed			
1.	Residential Building							
	Cattle Shed							
	Store house							
	Vermicompost Shed							
	Any other							

Note: P: Personal savings L: Loan from bank/relatives

VIII. Inventory farm machinery & implements

S.No.	Particulars	No.	Year of purchase	Present value (Rs)	Annual repairs	Source of fund (P/L)
A	**Major Implements**					
	Tractor					
	Power tiller					
	Chaff-cutter					
	Thresher					
	Sprayer/Duster					
	Water pump					
	Seed drill					
	Any other					
B	**Minor Implements**					
	Plough					
a.	Wooden					
b.	Iron					
	Spade					
	Hoe					
	Rake					
	Sickle					
a.	Local					
b.	Cerated					
	Axe					
	Planker					
	Any other					

IX.Livestock inventory and investment

S.No.	Particulars	No.	Breed	Annual production				Present value (Rs.)
				Milk (L)	Ghee (kg)	FYM (q)	Others	
1.	Cow local							
	a. In milk							
	b. Dry							
2.	Cow improved							
	In milk							
	b. Dry							
3.	Buffalo							
4.	Bullocks							
5.	Heifer							
	a. Cow							

	b. Buffalo							
6.	Calves							
	a. Cow							
	b. Buffalo							
7.	Goat							
8.	Sheep							
9.	Poultry							
10.	Others							

X. Fruit plantation

S.N.	Fruits crops	Area (kanal)	No. of bearing plants	No. of non-bearing plants	Production (q)	Marketing	
						Qty	Value
1.	Banana						
2.	Peach						
3.	Grapes						
4.	Fig						
5.	Mango						
6.	Guava						
7.	Citrus						
8.	Litchi						
9.	Jamun						
10.	Strawberry						
11.	Loquat						
12.	Walnut						

1. Are these plantation crops sole or mixed crops?

2. Crops for self-consumption or selling purpose?

XI. Cropping pattern

S.No.	Crop	Variety (Hybrid/Local)	Harvesting time (Week/Month)	Sowing time (Week/Month)	Area (kanal)		Prod^n (q)		Quantity sold (q)	Average price (Rs./kg)
					IR	RF	IR	RF		
	KHARIF SEASON									
1.	**Cereal crops**									
i.	Maize									
ii.	Paddy									
2. (a)	**Pulses (sole)**									
i.	Mash									
ii.	Green gram									
iii.	Rajmash									
2. (b)	**Pulses (mixed with cereals)**									
3.(a)	**Oilseeds (sole)**									
i.	Sesamum									
ii.	Soybean									
3. (b)	**Oilseeds mixed with cereals**									
4.	**Fodder**									
i.	Sorghum									

ii.	Pearl millet									
5.	**Vegetables & spice crops**									
i.	Bhindi									
ii.	Chilly									
iii.	Tomato									
iv.	Capsicum									
v.	Cucumber									
vi.	Brinjal									
vii.	Beans									
viii.	Sponge gourd									
ix.	Bitter gourd									
x.	Pumpkin									
xi.	Bottle gourd									
xii.	Potato									

Note: IR and RF represent Irrigated and Rainfed areas, respectively

S.No.	Crop	Variety	Harvesting time (Week/Month)	Sowing time	Area (bigha/Kanal)		Prod^{n}(q)		Quantity sold(q)	Average price(Rs./kg)
					IR	RF	IR	RF		
	RABI SEASON									
1.	**Cereal crops**									
i.	Wheat									
ii.	Barley									
2.(a)	**Pulses (sole)**									
	Gram (Lentil)									
2. (b)	**Pulses mixed with cereals**									
3.	**Oilseeds**									
	Mustard									
4.	**Fodder**									
i.	Oats									
ii.	Berseem									
5.	**Vegetables & spice crops**									
i.	Cabbage									
ii.	Cauliflower									
iii.	Peas									
iv.	Onion									
v.	Garlic									
vi.	Radish									
vii.	Carrot									
viii.	Turnip									
ix.	Potato									

Note: IR and RF represent Irrigated and Rainfed areas, respectively

XII. Input use and production of cereal, pulses, oilseeds, fodder crops (*kharif* crops)

Particulars	Maize		Paddy		Pulses*			Oilseeds		Fodder	
	HYV	Local	HYV	Local	Mash	Green gram	Rajmash	Sesamum	Soybean	Sorghum	Pearl Millet
Area (kanal)											
Seed and planting material											
Seed (Rs/kg)											
Variety											
Seed treatment (specify)											
Ploughing and sowing											
i. Bullock labour(days)											
ii. Tractor hire (hrs)											
Labour for field preparation (hrs.)											
Labour for sowing (hrs.)											
Soil treatment (specify)											
FYM (kg)											
Vermicompost (kg)											
Urea (kg)											
IFFCO (Kg)											
Others (kg)											
Labour for fertilizer application (hrs.)											
Transplanting labour (hrs.)											
Irrigation (No.)											
Labour (hrs)											
Labour for interculture operations (hrs)											
Plant protection (name &qty.)											
Fungicides (specify)											
Expenditure on fungicides(Rs.)											
Insecticides (specify)											
Expenditure on insecticides (Rs.)											
Labour for plant protection (hrs)											
Harvesting, threshing and yield											
i. Machinery (hrs)											
ii.Labour for harvesting (hrs.)											
iii. Labour for threshing (hrs)											
Extent of hired labour (%)											
Total Production (q)											
Price received (Rs.)											

Note: Note down the input use for mixed crops separately

XIII. Input use and production of cereal, pulses, oilseeds and fodder crops (*rabi* crops)

Particulars	**Wheat**		**Barley**		**Pulses***	**Oilseeds**	**Fodder**	
	HYV	Local	HYV	Local	Gram (lentil)	Mustard	Oats	Berseem
Area (kanal)								
Seed and planting material								
Seed (Rs/kg)								
Variety								
Seed treatment (specify)								
Ploughing and sowing								

i. Bullock labour(days)								
ii. Tractor hire (hrs)								
Labour for field preparation (hrs.)								
Labour for sowing (hrs.)								
Soil treatment (specify)								
FYM (kg)								
Vermicompost (kg)								
Urea (kg)								
IFFCO (Kg)								
Others (kg)								
Labour for fertilizer application (hrs.)								
Transplanting labour (hrs.)								
Irrigation (No.)								
Labour (hrs)								
Labour for interculture operations (hrs)								
Plant protection (name &qty.)								
Fungicides (specify)								
Expenditure on fungicides (Rs.)								
Insecticides (specify)								
Expenditure on insecticides (Rs.)								
Labour for plant protection (hrs)								
Harvesting, threshing and yield								
i. Machinery (hrs)								
ii.Labour for harvesting (hrs.)								
iii. Labour for threshing (hrs)								
Extent of hired labour (%)								
Total Production (q)								
Price received (Rs.)								

Note: Note down the input use for mixed crops separately

XIV. Input use and production of vegetable crops (summer vegetables)

Particulars	Okra	Chilli	Tomato	Capsicum	Cucumber	Brinjal	Beans	Bitter gourd	Bottle gourd	Pump	Potato	Turmeric
Area (kanal)												
Nursery Raising												
Size of bed												
FYM												
Seed rate												
Seed treatment												
Labour for sowing												
Time for nursery preparation												
Seed and planting material												
Main field preparation												
Seed (Rs/kg)												
Variety												

Seed treatment (specify)												
Ploughing and sowing												
i. Bullock labour(days)												
ii. Tractor hire hrs)												
Labour for field preparation (hrs.)												
Labour for sowing (hrs.)												
Soil treatment (specify)												
FYM (kg)												
Vermicompost (kg)												
Urea (kg)												
IFFCO (Kg)												
Others (kg)												
Labour for fertilizer application (hrs.)												
Transplanting labour (hrs.)												
Irrigation (No.)												
Labour (hrs)												
Labour for interculture operations (hrs)												
Plant protection (name &qty.)												
Fungicides (specify)												
Expenditure on fungicides (Rs.)												
Insecticides (specify)												
Expenditure on insecticides (Rs.)												
Labour for plant protection (hrs)												
Harvesting and yield												
i. Machinery (hrs)												
ii.Labour for harvesting (hrs.)												
Extent of hired labour (%)												
Total Production (q)												
Price received (Rs.)												

Note: Note down the prices of inputs prevailing in the area

XIV.Input use and production of vegetable crops (winter vegetables)

Particulars	Okra	Chilli	Tomato	Capsicum	Cucumber	Brinjal	Beans	Bitter gourd	Bottle gourd	Pump	Potato	Turmeric
Area (kanal)												
Nursery Raising												
Size of bed												
FYM												
Seed rate												
Seed treatment												
Labour for sowing												
Time for nursery preparation												
Seed and planting material												
Main field preparation												
Seed (Rs/kg)												
Variety												
Seed treatment (specify)												
Ploughing and sowing												
i. Bullock labour(days)												

ii. Tractor hire hrs)											
Labour for field preparation (hrs.)											
Labour for sowing (hrs.)											
Soil treatment (specify)											
FYM (kg)											
Vermicompost (kg)											
Urea (kg)											
IFFCO (Kg)											
Others (kg)											
Labour for fertilizer application (hrs.)											
Transplanting labour (hrs.)											
Irrigation (No.)											
Labour (hrs)											
Labour for interculture operations (hrs)											
Plant protection (name &qty.)											
Fungicides (specify)											
Expenditure on fungicides (Rs.)											
Insecticides (specify)											
Expenditure on insecticides (Rs.)											
Labour for plant protection (hrs)											
Harvesting and yield											
i. Machinery (hrs)											
ii.Labour for harvesting (hrs.)											
Extent of hired labour (%)											
Total Production (q)											
Price received (Rs.)											

Note: Note down the prices of inputs prevailing in the area

XVI. Fruit crop cultivation operations:

Particulars	**Fruit Crops**					
	Litchi	Mango	Guava	Citrus	Strawberry	Loquat
Area (kanal)						
Planting material						
No. of plants						
Variety						
Labour for basin making (hrs.)						
Labour for training/ pruning (hrs.)						
Soil treatment (specify)						
FYM (kg)						
Vermicompost (kg)						
Urea (kg)						
IFFCO (Kg)						
Others (kg)						
Labour for fertilizer application (hrs.)						
Labour Irrigation (hrs)						
Plant protection (name &qty.)						
Fungicides (specify)						
Expenditure on fungicides (Rs.)						
Insecticides (specify)						

Expenditure on insecticides (Rs.)						
Labour for plant protection (hrs)						
Harvesting and yield						
Labour for harvesting (hrs.)						
Extent of hired labour (%)						
Total Production (q)						
Production of mixed crops if any* (specify)						
Mixed crop						
Total production (q)						
Price receives (Rs.)						

Note 1: Note down the seed and inputs used for mixed crop with fruits
Note 2: Note down the prices of inputs prevailing in the area

XVII. Mushroom Cultivation

Particulars	Type of Mushroom					
	Oyster mushroom		Button mushroom		Paddy straw mushroom	
Preparation of compost						
Synthetic compost ingredients						
Natural compost ingredients						
Expenditure for compost preparation						
Size of tray						
Number of trays required						
Spawning of mushroom						
Spawn bags						
Casing of mushroom						
Pesticides, insecticides and formalin						
Electricity, water and fuel charges						
Polythene sheet						
Miscellaneous charges						
Harvesting time						
Production						
Post-harvest management						

XVIII. Poultry Farming:

Particulars	**Type of breed**					
Breed name	**Local breed**		**Improved breed**		**Others**	
	Qty	**Value**	**Qty**	**Value**	**Qty**	**Value**
Housing system(Open/ closed)						
Size of cage/ shed						
Water supply						
Chicks						
Strain (Improved/ local)						
Amount of strain						
Disinfection of strain						

Cost						
Feed						
Name						
Cost						
Vaccination						
Name						
Vaccine						
Disease Control/ Prevention						
Disease name						
Disease management						
Cost of disease management						
Hatchery management						
Bio-waste management						
Total sales						

XIX. Floriculture:

	Flowers							
Particulars	Rose		Marigold		Gladiolus		Chrysanthemum	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Area (kanal)								
Nursey raising								
Size of bed								
FYM								
Seed rate								
Seed treatment								
Labour for sowing								
Time for nursery preparation								
Seed and planting material								
Main field preparation								
Seed and planting material								
Seed (Rs/kg)								
Variety								
Seed treatment (specify)								
Ploughing and sowing								
i. Bullock labour(days)								
ii. Tractor hire (hrs)								
Labour for field preparation (hrs.)								
Labour for sowing (hrs.)								
Soil treatment (specify)								
FYM (kg)								
Vermicompost (kg)								

Urea (kg)								
IFFCO (Kg)								
Others (kg)								
Labour for fertilizer application (hrs.)								
Transplanting labour (hrs.)								
Irrigation (No.)								
Labour (hrs)								
Labour for interculture operations (hrs)								
Plant protection (name &qty.)								
Fungicides (specify)								
Expenditure on fungicides (Rs.)								
Insecticides (specify)								
Expenditure on insecticides (Rs.)								
Labour for pl protection (hrs)								
Harvesting and yield								
i. Machinery (hrs)								
ii. Labour for harvesting (hrs.)								
Extent of hired labour (%)								
Total Production (q)								
Price received (Rs.)								

Note: Note down the prices of inputs prevailing in the area

XX. Livestock Management:

Particulars	**Cow local**	**Cow improved**	**Buffalo local**	**Buffalo improved**	**Bullocks**
Housing (Open/ closed)					
Area					
No. of animals					
No. of ventilators in shed					
Feed and fodder					
Green fodder					
Dry fodder					
Silage					
Grains					
Mineral supplements					
Health care					
Dehorning					
Deworming					
Vaccination					
Disease Management					

Disease					
Medicines					
Milk production					
Price (Rs./ kg)					

XXI. Impact Assessment of training/ new technology/ variety of cereals

S. No.	Particulars	Maize			Paddy			Wheat			Barley		
		FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA
	Proper sowing time/transplanting time												
	System of Rice Intensification (SRI) method												
	Line sowing												
	Quick lime addition in soil before sowing												
	Ridge and furrow making												
	Seed Rate												
	Hybrid seed												
	Improved seed												
	Seed treatment												
	Recommended spacing												
	Recommended FYM (10-12t/ ha)												
	Application of FYM at sowing												
	Green manuring												
	Mulching												
	Application of basal NPK												
	Recommended dose of NPK												
a.	Irrigated conditions												
b.	Unirrigated conditions												
	Split application of NPK at proper stages												
	Use of biofertilizer												
	Use of weedicide												
	Proper hand weeding/ hoeing												
	Earthing up at proper stage												
	Irrigation available at critical stages												
	Recommended use of insecticide												
	Recommended use of pesticide												
	Mixed crop with pulses												
	Mixed crop with oilseeds												
	Harvesting at proper stage												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXII. Impact assessment of training/ new technology of pulses:

S. No.	Particulars	Mash			Green gram			Rajmash			Lentil		
		FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA
	Proper sowing time/transplanting time												
	Line sowing												
	Ridge and furrow making												
	Seed Rate												
	Hybrid seed												
	Improved seed												
	Seed treatment (Rhizobium)												
	Recommended spacing												
	Recommended FYM												
	Application of FYM at sowing												
	Green manuring												
	Mulching												
	Application of basal NPK												
	Recommended dose of NPK												
a.	Irrigated conditions												
b.	Unirrigated conditions												
	Split application of NPK												
	Use of weedicide												
	Proper hand weeding												
	Rogueing at proper stages												
	Irrigation available at critical stages												
	Recommended use of insecticide (weevil control)												
	Recommended use of pesticide												
	Mixed crop with cereals												
	Mixed crop with oilseeds												
	Harvesting at proper stage												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXIII. Impact assessment of training/ new technology of oilseeds:

S. No.	Particulars	Sesamum			Soybean			Mustard		
		FA	PA	NA	FA	PA	NA	FA	PA	NA
	Proper sowing time									
	Seed Rate									
	Hybrid seed									
	Improved seed									
	Seed treatment (Rhizobium)									
	Seed placement									
	Recommended spacing									
	Recommended FYM									
	Application of FYM at sowing									
	Green manuring									
	Mulching									
	Use of basal NPK									
	Recommended dose of NPK									
a.	Irrigated conditions									
b.	Unirrigated conditions									
	Split application of NPK at proper stages									
	Quick lime/ Rock phosphate/ Super									

	phosphate addition									
	Use of weedicide									
	Proper hand weeding									
	Rogueing at proper stages									
	Irrigation available at critical stages									
	Recommended use of insecticide									
	Recommended use of pesticide									
	Mixed crop with cereals									
	Mixed crop with pulses									
	Harvesting at proper stage									

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXIV. Impact assessment of training/ new technology of fodder:

S. No.	**Particulars**	**Sorghum**			**Pearl Millet**			**Oats**			**Berseem**		
		FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA
1.	Proper sowing time/transplanting time												
2.	Nursery raising time												
3.	Nursery preparation method												
4.	Seed Rate												
5.	Hybrid seed												
6.	Improved seed												
7.	Seed treatment (Vitavax/Rhizobium/salt solution)												
8.	Recommended spacing												
9.	Recommended FYM												
10.	Application of FYM at sowing												
11.	Green manuring												
12.	Mulching												
13.	Use of basal NPK												
14.	Recommended dose of NPK												
	Irrigated conditions												
	Unirrigated conditions												
15.	Split application of NPK												
16.	Irrigation available at critical stages												
17.	Harvesting cuts at proper stages												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXV. Perceived advantages of training/ new variety/technology (√Tick off)

Indicators	**Relative Ranking over local/old variety***					**Remarks or suggestions**
	1	2	3	4	5	
Good flour quality						
Bold grain						
Nutritive value						
More input responsive						
Suitable for early sowing						
Suitable for late sowing						
Disease resistance						
Early maturity						
High yielding						
High straw yield						
Less shattering losses						
Easy threshing						
Lodging resistance						

Note: Rank 1: Same as local 2: Fair 3: Good 4: Very good 5: Excellent

XXVI. Perceived impact of training/ new technology for summer vegetable crops:

S. No.	Particulars	Okra			Chilli			Tomato			Capsicum			Brinjal			Beans		
		FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA
	Proper sowing time/ transplanting time																		
2.	Early sowing/ late sowing																		
3.	Seed soaking in water before sowing																		
4.	Line sowing																		
5.	Ridge sowing																		
6.	Nursery sowing time																		
7.	Nursery preparation																		
8.	Distance from other fields for seed preparation																		
9.	Seed Rate																		
10.	Seed placement																		
11.	Hybrid seed																		
12.	Improved seed																		
13.	Seed treatment																		
14.	Field preparation (Ploughings)																		
15.	Recommended spacing																		
16.	Recommended FYM																		
17.	Application of FYM at sowing																		
18.	Green manuring																		
19.	Mulching																		
20.	Urea solution spray at planting time																		
21.	Application of basal NPK																		
22.	Recommended dose of NPK																		
a.	Irrigated conditions																		
b.	Non-irrigated conditions																		
23.	Top dressing																		
24.	Split application of NPK at proper stages																		
25.	Use of weedicide																		
26.	Proper hand weeding/ hoeing																		
27.	Covering of soil																		

28.	Staking with plastic threads																		
29.	Irrigation available at critical stages																		
30.	Recommended use of insecticide																		
31.	Recommended use of pesticide																		
32.	Harvesting at proper stage																		

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

S. No.	**Particulars**	**Bitter gourd**			**Bottle gourd**			**Pumpkin**			**Potato**			**Turmeric**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
1.	Proper sowing time/ transplanting time															
2.	Early sowing/ late sowing															
3.	Seed soaking in water before sowing															
4.	Line sowing															
5.	Ridge sowing															
6.	Nursery sowing time															
7.	Nursery preparation															
8.	Distance from other fields for seed preparation															
9.	Seed Rate															
10.	Seed placement															
11.	Hybrid seed															
12.	Improved seed															
13.	Seed treatment															
14.	Field preparation (Ploughings)															
15.	Recommended spacing															
16.	Recommended FYM															
17.	Application of FYM at sowing															
18.	Green manuring															
19.	Mulching															
20.	Urea solution spray at planting time															
21.	Application of basal NPK															

22.	Recommended dose of NPK															
a.	Irrigated conditions															
b.	Non-irrigated conditions															
23.	Top dressing															
24.	Split application of NPK at proper stages															
25.	Use of weedicide															
26.	Proper hand weeding/ hoeing															
27.	Covering of soil															
28.	Staking with plastic threads															
29.	Irrigation available at critical stages															
30.	Recommended use of insecticide															
31.	Recommended use of pesticide															
32.	Harvesting at proper stage															

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXVII. Perceived impact of training/ new technology for winter vegetable crops:

S. No.	**Particulars**	**Okra**			**Chilli**			**Tomato**			**Capsicum**			**Brinjal**			**Beans**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
1	Proper sowing time/transplanting time																		
	Early sowing/ late sowing																		
	Seed soaking in water before sowing																		
	Line sowing																		
	Ridge sowing																		
	Immediate irrigation after sowing																		
	Nursery sowing time																		
	Nursery preparation																		
	Distance from other fields for seed preparation																		
	Seed Rate																		
	Seed placement																		
	Hybrid seed																		

	Improved seed																		
	Seed treatment																		
	Field preparation(Ploughings)																		
	Recommended spacing in nursery																		
	Recommended spacing in main field																		
	Recommended FYM																		
	Application of FYM at sowing																		
	Green manuring																		
	Mulching																		
	Urea solution spray at planting time																		
	Recommended dose of NPK																		
a.	Irrigated conditions																		
b.	Non-irrigated conditions																		
	Top dressing																		
	Split application of NPK at proper stages																		
	Use of weedicide																		
	Proper hand weeding/ hoeing																		
	Covering of soil																		
	Alum solution spray																		
	Rogueing at proper stages																		
	Staking with plastic threads																		
	Irrigation available at critical stages																		
	Recommended use of insecticide																		
	Recommended use of pesticide																		
	Harvesting implement																		
	Harvesting at proper stage																		

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

S. No.	**Particulars**	**Radish**			**Carrot**			**Turnip**			**Potato**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
1	Proper sowing time/transplanting time												
	Early sowing/ late												

	sowing												
	Seed soaking in water before sowing												
	Line sowing												
	Ridge sowing												
	Immediate irrigation after sowing												
	Nursery sowing time												
	Nursery preparation												
	Distance from other fields for seed preparation												
	Seed Rate												
	Seed placement												
	Hybrid seed												
	Improved seed												
	Seed treatment												
	Field preparation(Ploughings)												
	Recommended spacing in nursery												
	Recommended spacing in main field												
	Recommended FYM												
	Application of FYM at sowing												
	Green manuring												
	Mulching												
	Recommended dose of NPK												
a.	Irrigated conditions												
b.	Non-irrigated conditions												
	Top dressing												
	Split application of NPK at proper stages												
	Use of weedicide												
	Proper hand weeding/ hoeing												
	Covering of soil												
	Rogueing at proper stages												
	Irrigation available at critical stages												
	Recommended use of insecticide												
	Recommended use of pesticide												
	Harvesting implement												
	Harvesting at proper stage												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXVIII. Perceived impact of training/ new technology for fruit trees:

S. No.	Particulars	Guava			Citrus			Mango			Litchi			Strawberry			Loquat		
		FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA	FA	PA	NA
	Sowing time																		
	Early sowing/ late sowing																		
	Propagation method(Seed/ budding/ stooling																		
	Ridge sowing																		
	Immediate irrigation after sowing																		
	Planting Rate																		
	Plant material placement																		
	Hybrid seed/ plant material																		
	Improved seed/ plant material																		
	Seed/ plant material treatment																		
	Field preparation(Ploughings)																		
	Recommended FYM																		
	Application of FYM at sowing																		
	Green manuring																		
	Mulching																		
	Recommended dose of NPK																		
a.	Irrigated conditions																		
b.	Non-irrigated conditions																		
	Top dressing																		
	Split application of NPK at proper stages																		
	Micro-nutrient application																		
	Use of weedicide																		
	Proper hand weeding/ hoeing																		
	Training and pruning at proper stages																		
	Irrigation available at critical stages																		
	Recommended																		

	use of insecticide																		
	Recommended use of pesticide																		
	Intercropping																		
	Harvesting at proper stage																		
P	Recommended remedial measure for physiological disorders																		

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXIX. Perceived impact of training/ new technology for flower crops

S. No.	**Particulars**	**Rose**			**Marigold**			**Gladiolus**			**Chrysanthemum**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
	Proper sowing time												
	Early sowing/ late sowing												
	Cuttings treatment with IBA/NAA												
	Immediate irrigation after sowing												
	Nursery preparation												
	Seed/ Corm Rate												
	Seed/ Corm placement												
	Hybrid seed												
	Improved seed												
	Field preparation(Ploughings)												
	Recommended spacing in nursery												
	Recommended spacing in main field												
	Recommended FYM												
	Application of FYM at sowing												
	Green manuring												
	Mulching												
	Recommended dose of NPK												
a.	Irrigated conditions												
b.	Non-irrigated conditions												
	Top dressing												
	Split application of NPK at proper stages												
	Use of weedicide												
	Proper hand weeding												
	Covering of soil												
	Hoeing												
	Staking												
	Pinching												
	Disbudding												
	De-shooting												
	Pruning												
	Irrigation available at critical stages												
	Recommended use of insecticide												

	Recommended use of pesticide												
	Harvesting implement												
	Harvesting at proper stage												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXX. Perceived advantages of new variety/technology for vegetable/ fruit crops/flowers: (√Tick off)

Indicators	**Relative Ranking over local/old variety***					**Remarks or suggestions**
	1	2	3	4	5	
Good vegetable/fruit/flower quality						
Nutritive value						
More input responsive						
Suitable for early sowing						
Suitable for late sowing						
Disease resistance						
Early maturity						
High yielding						
Less post-harvest losses						

***Note:** Rank 1: Same as local 2: Fair 3: Good 4: Very good 5: Excellent

XXXI. General impact on farming due to intervention in the village

Technology	**Yield enhanced (% over control)**	**Loss minimized (% over control)**	**Quality/value added (% over existing)**
Varietal improvement			
Nutrient/fertility management			
Intercultural practices			
Disease control			
Pest control			
Weed management			
Post-harvest practices			
Any other			

XXXII. Impact of training on mushroom cultivation:

S. No.	**Particulars**	**Oyster mushroom**			**Button mushroom**			**Paddy straw mushroom**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
1.	Room temperature recommended									
2.	Compost temperature recommended									
3.	Compost preparation									
a	Wheat straw									
b	Gypsum									
c	Wheat bran									
d	Chicken manure									
e	Urea									
f	Water									

g	Manual training									
h	Turnings									
i	Pasteurization									
4.	Casing of soil									
a	Coco-peat									
b	Formalin									
c	Polythene sheets									
5.	Harvesting at proper stage									
6.	Production									
7.	Price (Rs. /kg)									

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXXIII. Impact of training on poultry farming:

S. No.	**Particulars**	**Type of breed**					
		Local breed			**Improved breed**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**
1.	**Housing practices**						
	Floor size recommended						
	Litter material						
	Electric supply						
	Roofing material						
	Ventilation						
2.	Feeding practices						
	Balanced diet						
	Chick mash						
	Concentrates						
	By-products						
	Feed consumption pattern						
3.	Care of brooding hen						
	Insecticides						
	Dusting						
4.	Health care						
	Control of ticks, lice, fleas, mites						
	Vaccination						
	Cleanliness						
	Consultation by veterinary clinics						
5.	Production of eggs						
6.	Price (Rs./ kg)						

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

XXXIV. Impact of training on livestock production and management

S. No.	**Particulars**	**Cow local**			**Cow improved**			**Buffalo**			**Bullocks**		
		FA	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**	**FA**	**PA**	**NA**
1.	Proper feeding practices												
	Green fodder												
	Dry fodder												
	Silage												

	Grains/ concentrates												
	Mineral mixture												
	Uromol bricks												
2.	Management practices												
	Housing shed												
	Lighting												
	Water trough												
3.	Cleaning/grooming												
4.	Health care												
	Dehorning												
	Deworming												
	Vaccination												
	Taking animals to veterinary clinics												
5.	Disease/ disorders/ pest control												
6.	Disposal of unproductive animals												

Note: FA- Full adoption, PA- Partial adoption, NA- Non-adoption

1. Do you prepare your own livestock feed?

2. If yes, what is the proportion of grains used?

S. No.	Grains	Proportion		
		Feed 1	Feed 2	Feed 3
	Maize			
	Wheat			
	Soybean			
	Gram			
	Barley			
	Oilcake			
	Oilseeds (Tarameera)			
	Cottonseed			
	Cottonseed cake			

3. Have you got training from KVK to prepare your own livestock feed?

XXXV. Reasons for low adoption, if any

Reasons	**√Tick off**	**Suggestions for higher adoption**
No awareness about new technology		
Poor extension services		
Non-availability of seeds of improved variety		
Untimely supply of seeds		
Costly seeds		
Higher risk under rainfed condition		
Poor quality of new variety		
Not convenient to follow new technology		

Appendix II Livestock population in Kangra and Himachal Pradesh, livestock census 2012

S. No.	Particulars	Kangra		Himachal Pradesh	
		Number	Per cent	Number	Per cent
1	Cattle	359129	44.61	2149259	44.37
2	Buffalo	149719	18.60	716016	14.78
3	Sheep	84628	10.51	804871	16.62
4	Goat	202694	25.17	1119491	23.10
5	Others	8950	1.11	54794	1.13
	Total livestock	805120	100.00	4844431	100.00

Appendix III Prices of inputs and farm outputs

Sr. No	Particulars	Price per unit (Rs.)
A.	**Inputs**	
1.	**Seed**	
	Maize (kg)	80
	Paddy (kg)	100
	Wheat (kg)	30
	Barley (kg)	30
	Okra (kg)	1200
	Chilli (kg)	1000
	Tomato (kg)	12000
	Capsicum (kg)	17000
	Cucumber	7000
	Brinjal (kg)	1000
	Beans (kg)	200
	Bitter gourd(kg)	5000
	Bottle gourd(kg)	3000
	Cabbage(kg)	50000
	Cauliflower (kg)	60000
	Peas (kg)	90
	Onion (kg)	1200
2.	FYM (q)	150
3.	Urea (kg)	6
4.	NPK mixture (12:32:16) (kg)	12
5.	Tractor hire charges(per hour)	500
6.	Labour charges (per day)	240
7.	Concentrates (kg)	710
8.	Green fodder	150
9.	Dry fodder	700
10.	Mineral mixture(kg)	15

B.	**Farm output (per q)**	
	Maize	1400
	Paddy	2200
	Wheat	1700
	Barley	1100
	Okra	3000
	Chillies (green)	4000
	Tomato	1000
	Capsicum	4000
	Cucumber	2000
	Brinjal	1500
	Beans	3000
	Bitter gourd	1800
	Bottle gourd	1600
	Cabbage	1500
	Cauliflower	2000
	Peas	2000
	Onion	2000

Appendix IV (A) Frequency of adoption of management practices in cereal crops

(per cent)

S. No.	Particulars	Maize		Paddy		Wheat	
		Full adoption	Partial adoption	Full adoption	Partial adoption	Full adoption	Partial adoption
1	Timely sowing/ line sowing	78.95	21.05	89.66	10.34	86.67	13.33
2	Recommended use of seed	84.21	15.79	75.86	24.14	83.33	16.67
3	Hybrid seed use	100.00	0.00	100.00	0.00	100.00	0.00
4	Recommended spacing	73.68	26.32	75.86	24.14	83.33	16.67
5	Recommended use of FYM	52.63	47.37	62.07	37.93	73.33	26.67
6	Application of FYM at sowing	84.21	15.79	86.21	13.79	86.67	13.33
7	Application of basal dose of NPK	100.00	0.00	86.21	13.79	80.00	20.00
8	Split application of fertilizers	78.95	21.05	79.31	20.69	73.33	26.67
9	Intercultural practices	94.74	5.26	89.66	10.34	83.33	16.67
10	Recommended use of weedicides	47.37	52.63	75.86	24.14	80.00	20.00
11	Recommended use of pesticides/ insecticides	42.11	57.89	62.07	37.93	83.33	16.67
12	Farm fencing	52.63	47.37	75.86	24.14	86.67	13.33

Appendix IV (B) Frequency of adoption of management practices in vegetable crops

(per cent)

S. No.	Particulars	Okra		Cucumber		Bottle gourd	
		Full adoption	Partial adoption	Full adoption	Partial adoption	Full adoption	Partial adoption
1	Timely sowing/ line sowing	83.33	16.67	85.71	14.29	81.25	18.75
2	Recommended use of seed	76.67	23.33	78.57	21.43	87.50	12.50
3	Hybrid seed use	100.00	0.00	100.00	0.00	100.00	0.00
4	Recommended spacing	83.33	16.67	78.57	21.43	75.00	25.00
5	Recommended use of FYM	66.67	33.33	64.29	35.71	75.00	25.00
6	Application of FYM at sowing	93.33	6.67	71.43	28.57	81.25	18.75
7	Application of basal dose of NPK	73.33	26.67	78.57	21.43	87.50	12.50
8	Split application of fertilizers	80.00	20.00	78.57	21.43	75.00	25.00
9	Intercultural practices	73.33	26.67	71.43	28.57	81.25	18.75
10	Recommended use of weedicides	43.33	56.67	35.71	64.29	87.50	12.50
11	Recommended use of pesticides/ insecticides	86.67	13.33	92.86	7.14	75.00	25.00
12	Farm fencing	83.33	16.67	89.29	10.71	81.25	18.75
13	Harvesting at proper stage	100.00	0.00	71.43	28.57	87.50	12.50

(per cent)

S. No.	**Particulars**	**Cabbage**		**Cauliflower**		**Peas**	
		Full adoption	Partial adoption	Full adoption	Partial adoption	Full adoption	Partial adoption
1	Timely sowing/ line sowing	93.33	6.67	96.55	3.45	83.33	16.67
2	Recommended use of seed	86.67	13.33	89.66	10.00	66.67	33.33
3	Hybrid seed use	100.00	0.00	100.00	0.00	88.89	11.11
4	Recommended spacing	83.33	16.67	86.21	13.33	66.67	33.33
5	Recommended use of FYM	73.33	26.67	75.86	23.33	55.56	44.44
6	Application of FYM at sowing	86.67	13.33	89.66	10.00	83.33	16.67
7	Application of basal dose of NPK	86.67	13.33	89.66	10.00	66.67	33.33
8	Split application of fertilizers	80.00	20.00	82.76	16.67	77.78	22.22
9	Intercultural practices	86.67	13.33	89.66	10.00	66.67	33.33
10	Recommended use of weedicides	50.00	50.00	51.72	46.67	50.00	50.00
11	Recommended use of pesticides/ insecticides	83.33	16.67	86.21	13.33	72.22	27.78
12	Farm fencing	73.33	26.67	75.86	23.33	66.67	33.33
13	Harvesting at proper stage	100.00	0.00	100.00	0.00	100.00	0.00

Brief Biodata of Student

Name	: Bharti
Mother's Name	: Smt. Nirmla
Father's Name	: Sh. Arun Kumar
Date of Birth	28-01-1995
Permanent Address with Contact Number	Village Makrena, Near Railway Station, Joginder Nagar, Mandi, HP Contact No.-9736337899

Academic Qualification: (starting with 10th class)

Qualification	**Year**	**School/Board/University**	**Marks (%)**	**Division**
Matricultaion	2010	Himachal Pradesh Board of School Education	92.43	First
Senior Secondary	2012	Himachal Pradesh Board of School Education	84.80	First
B.Sc. (Hons.) Agriculture	2017	CSKHPKV, Palampur	77.30	First
M.Sc. (Agricultural Economics)	2019	CSKHPKV, Palampur	82.70	First

Fellowships/Scholarships/Gold medals/ Awards:	Certificate of Honour for securing OGPA of 7.73/10.00 in B.Sc. (Hons.) Agriculture CSK HPKV merit fellowship 2018-19 @ Rs. 2000 per month for securing highest OGPA of 8.27 in M.Sc. (Agricultural Economics) Award of NABARD Summer Internship Scheme (SIS) with effect from July 2018 to September 2018
Seminars/Symposia	Participation in Conference on Doubling Farmers' Income : Challenges and Strategies organized by Agrivision – Himachal Pradesh (April 23-24, 2018) Attended workshop on IPR Policy Guidelines and Operational Mechanism organized by IPR Cell, CSK HPKV Palampur (March 30, 2019)