ECONOMIC ANALYSIS OF MARKETING AND POST-HARVEST LOSSES OF CASH CROPS : A COMPARATIVE ANALYSIS

THESIS

By

Shagun Katoch
(A-2020-30-007)

Submitted to

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CERTIFICATE – I

This is to certify that the thesis entitled **"Economic analysis of marketing and post-harvest losses of cash crops: a comparative analysis"** 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. Shagun Katoch (A-2020-30-007)** daughter of **Smt. Reeta Katoch** and **Sh. Ajmer Katoch** 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: November, 2022

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CERTIFICATE- II

This is to certify that the thesis entitled**, "Economic analysis of marketing and post-harvest losses of cash crops: a comparative analysis"** submitted by **Ms. Shagun Katoch (A-2020-30-007)** daughter of **Sh. Ajmer Katoch** 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.

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"Appreciation is the highest form of prayer, for it acknowledges the presence of good wherever you shine the light of your thankful thoughts." Recognition for some can be something insignificant written on a piece of paper. But in its true essence, it gives us an opportunity to remember and express our feelings for those we love and adore. Here I have a chance to say thank you to the people who touched me in one way or another with their little things.

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Place: Palampur.

Date: November, 2022 ***(Shagun Katoch)***

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LIST OF ABBREVIATIONS USED

Sr. No.	Abbreviation	Meaning
1.	No.	Number
2.	%	per cent
3.	/	Per
4.	et al.	et alii (and others)
5.	Ha	Hectare
6.	i.e.	id est (that is to say)
7.	Kg	Kilogram
8.	Q	Quintal
9.	Fig.	Figure
10.	*viz.*	videlicet (namely)
11.	Rs.	Rupees
12.	etc.	Etcetera
13.	SE	Standard Error
14.	Qty.	Quantity
15.	( )	Parentheses
16.	AES-I	Agro-ecological situation-I
17.	AES-II	Agro-ecological situation-II
18.	w.r.t	With respect to
19.	°	Degree
20.	amsl	Above mean sea level

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ABSTRACT

Himachal Pradesh offers enormous opportunities to practice cash crops mainly off-season as these have several unique and inherent advantages in terms of agro-climatic conditions and rich biodiversity. These crops offer greater hope for raising farmers out of the poverty due to higher marketable surplus and better prices at markets compared to other crops. Although farmers have succeeded on the production front, they have not achieved appreciably in terms of price realization for their produce. The intermediaries are depriving them of their due share of consumer's rupee. However, these cash crops are grown in every district of the state without any organized backup of post- harvest management techniques which lead to low productivity and high spoilage of these crops. Therefore, the present study was carried out to work out economic analysis of marketing and post-harvest losses of cash crops in Baijnath (AES-I) and Kangra (AES-II) blocks of district Kangra in the state. The study was based on primary data collected through survey method from 100 vegetable growers selected randomly from 5 randomly selected vegetable growing villages each in AES-I and AES-II. The major findings reveal that cropping pattern of the sample growers was dominated by vegetables as these accounted for 69.69 per cent and 66.04 per cent of the total cropped area in AES-I and AES-II, respectively. The cropping intensity was nearly 202 per cent in AES-I and 209 in AES-II. The total production of vegetables was more in AES-II (74.21 q) than AES-I (43.54 q). The marketable surplus of all the vegetable crops except potato was found to be more than 90 per cent of total production in AES-I while in AES-II, all the vegetables had more than 95 per cent of the marketable surplus. The total marketed surplus of all the vegetables was higher in AES-II (3076.45 q) as compared to AES-I (1388.19 q). Among all vegetables, total marketed surplus per farm was highest for cauliflower (341.50 q) in AES-I while it was highest for bottle gourd (579.33 q) in AES-II. There was post-harvest loss of 2.40 quintal per farm in all the vegetables grown in AES-I. Comparatively, the post-harvest loss in AES-II was 5.20 quintal per farm in all the vegetables. Tomato accounted for the maximum post-harvest loss which alone shared 35.83 per cent and 20.76 per cent of the total loss per farm in AES-I and AES-II, respectively. The independent variables included in the regression model explained about 70.01 to 93.81 per cent variation in the post-harvest losses of all major vegetable crops in both the agro-ecological situations. The growers followed three marketing channels for disposal of vegetables out of which channel I (Producer →Local trader → Retailer→ Consumer) was the most used channel in AES-I by more than 70 per cent of the growers while Channel II (Producer→ Commission agent-cum-wholesaler →Retailer →Consumer) was the most used channel for disposal of vegetables in AES-II by more than 68 per cent of the growers except okra. The producer's share in consumer rupee was found to be highest in channel-III (Producer-retailer-consumer) ranging from 74 to 81 per cent for all the vegetables in both AES-I and AES-II. High incidence of pest and diseases, lack of scientific storage facilities and unfavourable price received by growers were the important problems faced by the growers. Lack of storage facilities and high loss of produce during transportation were the important problems faced by the traders. The study suggested that small scale post-harvest processing infrastructure should be created in the study area as growers are sustaining huge post-harvest losses affecting returns accruing to them. The efforts should be made to reduce the pre-harvest disease/pest occurrence at growers' level by educating them.

(Shagun Katoch)
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1. INTRODUCTION

1.1 The background

In the process of agricultural development, agricultural marketing plays an important role. Due to modernization of agriculture, the producer knows the importance of marketing of agricultural commodities produced in the farm. The process of production is not complete until the product finds the place in the consumer's basket. Production is efficient not only on the basis of how best one produces but also on how well one markets the resultant product. Marketing therefore, occupies an integral part of the successful production and achieving self-sufficiency, improvement of marketing conditions to enable farmer to secure a fair share of the consumer's price is of utmost importance.

The agriculture sector needs well-functioning markets to derive growth, employment and economic prosperity in rural areas. In an open economy, agricultural marketing has become the key driver of agriculture sector. Although farmers have succeeded on the production front, they have not achieved appreciably in terms of price realization for their produce owing to their inaccessibility to efficient and scientific marketing systems. The middlemen, commission agents and traders are depriving them of their due share of consumer's rupee. As a result, the producer gets only 30 to 40 per cent of the final price, as compared to around 60 per cent in advanced countries. Moreover, the present marketing system is fragmented and poorly coordinated with inadequate infrastructure and supply chain involving high wastage and losses.

Agricultural commodities produced in the field have to undergo a series of operations such as threshing, transportation, processing, storage and distribution before they reach the ultimate consumer, and there are appreciable losses of outputs during these stages of their handling. The some quantity of outputs lost in these operations at all of these stages is referred to as "post-harvest losses". The production of most of the cash crops is seasonal and highly localized on account of location specific agro-climatic conditions in the country. The extremely perishable nature of

cash crops mainly vegetables and fruits results in inability on the part of producers to manage supply till assembling markets. Further, the large distances that separate the production area and the sub-optimal post- harvest technology management, a large proportion of cash crops is spoiled at various stages of post- harvest handling. In such crops, proper and scientific storage, packaging, transport and handling techniques are not adequate and hence, considerable amount of produce is wasted. According to some studies, the overall losses in these crops can be up to 25-30 per cent of total production (Puttalingamma 2015). Moreover, they are biologically active and carry out transpiration, respiration, ripening and other biochemical activities, which contribute for the deterioration in quality of the produce (Kumar et al. 2006).

There are numerous factors affecting post-harvest losses, from the soil in which the crop is grown to the handling of produce when it reaches the shop. The causes of these loss are varied with microbiological, mechanical and physiological factors. The other causes are inadequate harvesting, packaging, handling skills and refrigerated storage, as well as inadequate transportation. There is a wide range of post-harvest technologies that can be adopted to reduce losses throughout the process from field to fork. Both quantitative and qualitative food losses of extremely variable magnitude occur at all stages in the post-harvest system starting from harvesting to final delivery to the consumer. Post-harvest losses result not only in the loss of the actual crop, but also have an impact on the environment, resources, labour needed to produce the crop and livelihood of individuals involved in the production process. The damage to the product can be caused by exorbitant rain or excess irrigation in the form of decay of crop. Similarly, application of too little water that too in irregular way can lead to growth cracks. Too much fertilizer can harm the development and post-harvest condition of produce. Fruits and vegetables are living parts of plant and contain 65 to 95 per cent water. Water loss causes shrinkage and loss of weight. The rate at which water is lost, varies according to the product. Poor ventilation of produce also leads to the accumulation of carbon dioxide. When the concentration of carbon dioxide increases, it quickly ruins produce.

Quality loss occurs when the disease affects only the surface. Infection after harvest can occur at any time. It is usually the result of harvesting or handling injuries. In transit, the losses can result from using closed vehicles with no ventilation,

stacking patterns that block the movement of air and using vehicles that provide no protection from the sun.

In India, tropical, subtropical and temperate fruits and vegetables are grown with a high production. There is an urgent need for an organized approach to extend their shelf life during transportation and storage. The overall quality and condition of fresh produce cannot be improved after but can only slow down the rate of undesirable changes and faster deterioration. The modern techniques which are being used today to extend the storage life of fruits are controlled atmosphere (CA) storage, modified atmosphere packaging (MAP) and cold storage technologies.

1.2 The problem

Vegetables are important source of food and income. They can play a significant role in food and nutritional security as well as the poverty amelioration. Vegetables contribute largely to solve the food and nutritional problems of the country. India is the second largest vegetable producer in the world, sharing 12 per cent of total world vegetable production. But still, it fails to fulfill the basic requirement of ever-increasing population of the country because of low productivity and huge post-harvest losses from farmer's field to market and finally to consumers. The considerable gap between the gross production and net availability of vegetables has been felt due to heavy post-harvest losses (Singh et al. 2013). In its recent report "Global food losses and food waste" the FAO suggests that roughly one-third of food production for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year. Post-harvest loss in fresh fruits and vegetables is estimated at five to 25 per cent in developed countries and 20-50 per cent in developing countries. Post-harvest losses are caused by both external and internal factors. External factors are mechanical injury and parasitic diseases and internal factor is physiological deterioration. Various types of spoilage are physiological aging, spoilage due to insects or rodents, mechanical damage, chemical and enzyme spoilage, microbial spoilage etc., (Kumar et al. 2015).

1.3 Rationale for the study

Himachal Pradesh offers enormous opportunities to practice cash crops mainly off-season as these have several unique and inherent advantages in terms of agro-climatic conditions and rich biodiversity. These crops offer greater hope for raising farmers out of the poverty as the gestation period of vegetables varies from three to six months, higher marketable surplus and better prices at markets compared to other crops. However, these cash crops are grown in every district of the state without any organized backup of post- harvest management techniques. The state also suffers in respect of infrastructure, irrigation facilities, tiny and fragmented holdings, low to moderate accessibility to technology and low investment capacity of farmers. All this lead to low productivity and high spoilage of these crops.

Himachal Pradesh has earned much reputation by producing different seasonal and off- season vegetables. The production of vegetables which was 16.08 lakh MT in 2015-16 has gone up to 18.61 lakh MT in 2019-20 (Statistical outline of Himachal Pradesh year). Among various districts of Himachal Pradesh, Kangra is agriculturally the most predominant district in terms of cultivated area, irrigated area and number of cultivators. It has vast potential for commercialization of agriculture through vegetable farming that is highly remunerative and best suited to hills and to the labour abundant small sized land holdings in this district. But being fragile and perishable in nature, a substantial quantity of production is subjected to post-harvest losses at various stages of handling. Thus, vegetable commodities need quick and efficient marketing system and supply chain management.

Many studies have been carried out in the past on economics of production and marketing of cash crops mainly vegetables in Himachal Pradesh. Most of them either covering the production part or marketing aspects like costs and returns from vegetables, production and disposal pattern, market arrivals and price behavior, etc. and only a few studies on the estimation of post-harvest losses at different stages have been carried out in Himachal Pradesh. Since the post-harvest losses obviously have an impact both on micro and macro levels of the economy and hence, there was a need to study them. It is with this background, a detailed study was proposed to accomplish the following specific objectives.

1.4 Objectives of the study

1 To study the marketable surplus and extent of post-harvest losses in major cash crops of the study area,

2 to study the marketing system, price spread and role of marketing practices in enhancing marketing efficiency.

1.5 Significance of the study

The study on post-harvest losses in major cash crops at various stages of handling would help in assessing the extent and magnitude of losses and in identifying the factors responsible for such losses. This in turn would help in developing proper measures to reduce post-harvest losses at different stages from production point to consumption point. Under these circumstances, the reduction in post-harvest losses can help in increasing the availability of vegetables to a great extent without increasing the production. In the absence of reliable and near accurate estimates of post-harvest losses at different stages, the ways to evolve correct policies for minimizing such losses are difficult. The scientists and technologists would be guided by the findings of such studies in carrying out improvements in the crop production and post-harvest technologies aimed at minimizing these losses. The planners and the policy makers would be guided by the findings of such studies in formulating suitable policies that will help reducing the post-harvest losses.

An efficient marketing system ensures higher levels of income for the farmers and widens the markets for the produce by taking them to remote corners of the country. Prices have to play an important role in economic planning. The market intermediaries' play a vital role in price formulation, which in turn has a great bearing in the scale proceeds received by the producer-sellers. The intermediaries resort to various malpractices which aggravated the marketing problems, such as high commission charges, unauthorized deductions and lack of remunerative prices for the produce, ultimately leading to increased price spread and reduced share of the producer in consumer's rupee. Implementation or nutritional security programs, increase in purchasing power, shifts in food habits and growing international trade are bound to influence the domestic market in India. Redesigning the supply chain from

seed bed to consumer plate is the need of the hour. By checking losses through reducing multiple, handling of fresh produce and adding value at producer's end by sorting, grading, waxing, pre-cooling and improving storage, packaging and transportation systems, better economic returns to the growers can be ensured.

1.6 Organisation of the thesis

The entire study has been systematically presented and organised in five chapters. Chapter-1 (Introduction) describes the background, present scenario of the research problem and objectives of the study. Chapter-2 presents the comprehensive review of relevant research done in India, abroad and within the state related to present study of investigation. This is followed by Chapter-3 which presents the detailed methodology adopted for selection of respondents, collection and analysis of data. The results of the study categorized under different sections/sub sections have been presented and discussed with conclusion in Chapter-4. Finally, the major findings have been summarized along with some suggestions for improvement in Chapter-5. Additional information including the schedule as an instrument has also been given in the appendices for more clarification and understanding of interested researchers in the field of agriculture.

2. REVIEW OF LITERATURE

The foundation of a scientific enquiry is based upon the systematic investigation and validation of the facts. A thorough insight into the studies already conducted pertaining to the related research area, therefore, becomes imperative for conceptual clarity, development of sound methodology and for identifying the chronological changes and the critical gaps for further improvement in the research work. In this backdrop, the brief resume of relevant research work by various scholars on various aspects of post-harvest losses of vegetables and their marketing in India and abroad has been reviewed. Commensurate with the objectives of the present investigation, the review of literature has been categorized into the following main headings.

2.1 Post-harvest losses, assessment, causes and remedies.

2.2 Market surplus, costs, margins and efficiency.

2.1 Extent of post-harvest losses in vegetables

Gauraha (1997) made the economic assessment of post-harvest losses in vegetable crops in Bilaspur district of Madhya Pradesh. The study found that overall post-harvest loss for vegetable crops at the consumption end of the post-harvest distribution system was 17.26 per cent of the total harvested quantity. The estimated loss was 5.86 per cent, 10.59 per cent, and 0.81 per cent at farm, market and consumer levels, respectively. The maximum post-harvest loss was observed in tomato (32.64%) while the minimum loss was seen in bottle gourd (5.42%). The main factors responsible for post-harvest losses were identified and some remedial measures to reduce post-harvest losses were suggested.

Kumar and Arora (1999) analysed post-harvest management of vegetables in terms of grading, packaging, storage, transportation and sales pattern activities, prepared by sample vegetable growers. The major factors attributed to post-harvest losses in vegetables were improper handling of vegetables during grading, packing, marketing of the produce and lack of proper transportation and storage facilities in the market place.

Sharma et al. (1999) carried out a study on post-harvest losses of major vegetable crops in Himachal Pradesh. Harvesting and assembling operations were shown to be the largest source of post-harvest losses in all crops in all locations. Kangra had the largest percentage of tomato losses, while Solan had the lowest. The main causes for this were larger market places around Solan, such as Shimla, Chandigarh, and Delhi. In Kangra district, 15 per cent of the cauliflower was lost, while in Kullu district, 5 per cent of the cauliflower was lost. The radish crop had the lowest post-harvest losses of all the crops studied. The study discovered that there was lack of suitable material, poor storage facilities, and lack of infrastructure in terms of roads and vehicles which were the main reasons for post-harvest losses of vegetables.

Pal et al. (2002) investigated post-harvest losses in tomato, cabbage, and cauliflower. The study revealed that the total losses in tomato, cabbage, and cauliflower throughout various post-harvest activities were found to be 30.30 to 39.60 per cent, 24.90 to 30.40 per cent, and 28.60 to 35.10 per cent, respectively. The greatest number of losses happened during the transfer of goods from rural to urban markets. Lack of adequate packaging material, long distance transportation, poor road conditions and distant market were the major reasons of post-harvest losses in the selected crops.

Pandey et al. (2003) conducted a study on potato marketing and assessment of post-harvest losses in Nalanda district of Bihar. The study focused on the marketing system as well as on the post-harvest losses in terms of both physical and economic terms. The farm level had the largest substantial post-harvest losses (12.84%), followed by wholesale (12.40%), and retail level (9.45%). The losses were primarily caused by cuts, cracks, and infections. The entire economic loss was calculated out to be 5.67 per cent only.

Verma et al. (2003) carried out an assessment of post-harvest losses of vegetables in Varanasi district of Uttar Pradesh. The study worked out post-harvest losses of vegetables in both physical and economic terms at different levels during 1999-2000 and 2000-2001. The estimates were developed for losses at transportation, storage and sorting levels. The overall losses varied up to 20 per cent in tomato, cauliflower, cabbage and chilli. The estimated loss for tomato crop was highest at

farm level (20 %) followed by at retailer level (14 %) and lowest at wholesale level (10 %). During the sorting process, the maximum loss was observed during storage.

Kumar et al. (2004) estimated post-harvest losses in potato in Hooghly district of West Bengal in economic terms (gross and net losses) as well as in terms of the number and weight of damaged tubers at the farms, wholesale and retail levels. The data were collected from a sample of 30 farmers and 10 wholesalers and 16 retailers from Hooghly and Kolkata markets. The overall post-harvest losses on weight and number basis were estimated to be 29.40 per cent and 23.04 per cent, respectively. The overall gross and net economic losses were to the extent of 29.40 per cent and 16.21 per cent, respectively. The study stressed the importance of improving rural road conditions in order to avoid transportation delays as well as potato bruising during transportation owing to bumpy roads.

Verma and Singh (2004) assessed the post-harvest losses in vegetables in the states of Bihar and Orissa. Both quantitative and qualitative losses of extremely variable magnitude occurred at all stages of the post-harvest system, including harvesting, handling, storage, and marketing. The combined losses approached 20 per cent (tomato, cabbage, cauliflower and chilli). Maximum losses were observed at the retailer level for tomato, cabbage, cauliflower, and at the wholesale level for chilli. The losses caused by sorting and storage operations were found to be greater than those experienced during transportation.

Udas et al. (2005) investigated the post-harvest handling techniques of vegetables in eastern hills of Nepal. The study found that the post-harvest losses of cauliflower, cabbage, radish and tomatoes from the farmer's field to collection centers were six per cent, nine per cent, six per cent, and three per cent, respectively. The losses were primarily caused by spoiling, bruising, and trimmings in cauliflower and cabbage, radish breaking, and tomato rupturing and rotting. At the retailer level, the losses in cauliflower, cabbage, radish and tomatoes were 41 per cent, 34 per cent, 4.5 per cent, and 7 per cent, respectively. Inappropriate packaging was the primary cause of post-harvest losses. The other factors responsible for post-harvest losses were transportation and grading systems.

Kumar et al. (2006) revealed that post-harvest losses in vegetables in Karnataka were caused by improper harvesting, threshing and cleaning, drying, storage, transportation, processing, packaging, and distribution processes. At the field level, total post-harvest losses for onion and potato were estimated to be 6.21 kg/q and 7.34 kg/q, respectively. At the wholesale level, an additional 1.85 kg/q and 2.22 kg/q of output losses were found in onion and potato, accounting for 17.75 per cent and 17.12 per cent of total output losses, respectively. In onion and potato, the losses at the retail level were 2.36 kg/q (22%) and 3.41 kg/q (26.29%), respectively. As a result, farm losses accounted for about 60 per cent of overall post-harvest losses, while retail losses accounted for about 25 per cent. The study demonstrated that insufficient storage and transportation activities, together with adverse weather circumstances, increased post-harvest losses at the farm level in a positive and significant way.

Wadhwani and Bhogal (2006) analysed the vegetable production and post-harvest management in western regions of Uttar Pradesh. The study determined that the economic losses in vegetable crops were found to be caused by lack of processing and canning facilities, insufficient storage practices, and lack of proper transportation. The lack of availability of packaging materials at harvesting time, as well as their high cost, were the most significant issues that vegetable growers encountered. The study stressed the importance of educating vegetable growers about the scientific post-harvest techniques for lowering vegetable post-harvest losses.

Gauraha and Thakur (2008) conducted a study in Chhattisgarh on comparative economic analysis of post-harvest losses in vegetables and food grain crops. Post-harvest losses for vegetables and food grain crops towards the consumption and post-harvest distribution system were approximately 17.08 per cent and 8.60 per cent of the total quantity traded, respectively. The losses were caused by current post-harvest handling techniques and storage material regulations. Packing and transportation were found to be obsolete and directly led to post-harvest losses. The study suggested that implementing cost-effective post-harvest technical services such as field grading, cleaning, packaging in perforated plastic bags on corrugated fibre bases, pre-cooking, efficient transportation, and crop handling and re-handling

could reduce post-harvest losses. Furthermore, there was a great need to develop direct and group vegetable marketing in order to increase the producer's share of the consumer's rupee and to ensure the supply of fresh, high-quality vegetables to consumers at a reasonable price.

Kumar et al. (2008) conducted a study on marketing and post-harvest losses in cabbage and cauliflower in West Bengal. The leading cause of post-harvest losses in cabbage was the damage/rotting during transit from the farmer's field to the retailer's shop followed by damage from insect infestation, cracking of cabbage heads, and disease infection during the crop growing phase. Diseases throughout the crop growth stage were the leading cause of post-harvest losses in cauliflower, followed by losses due to harvesting of over-matured curds and damage during transportation.

Sharma and Singh (2008) calculated the magnitude of post-harvest losses at various levels of marketing for selected fruits and vegetables in Himachal Pradesh. The losses in selected fruits varied from 18.31 to 24.85 per cent of total yield. In the case of vegetables, losses varied from 18.98 to 28.25 per cent of total output. In most of the vegetables, losses were found to be higher at the production stage.

Tedesse (2009) conducted study on post-harvest losses of fruits and vegetables in horticultural state farms in Ethiopia. The study revealed that in most of developing countries, the area under horticultural crops expanded, productivity increased and total production doubled or tripled. But very little emphasis was given to post-harvest technology which is the vital sector of this industry. Four year’s production, post-harvest losses and per cent of post-harvest loss data for 10 major fruits and 10 major vegetable crops grown by the state farms in Ethiopia were presented in the study. Three years data of export operation were presented to illustrate the trend in post-harvest losses for major operational problems that led to these post-harvest losses.

Bdour (2010) calculated post-harvest losses for some vegetables in Jordan. At the retail level, the biggest percentages of losses were 14.00 per cent, 11.40 per cent, 13.30 per cent, and 12.50 per cent for tomato, cucumber, sweet pepper, and bean, respectively. Cucumber, sweet pepper, bean, and tomato all suffered total losses of 25.00 per cent, 23.90 per cent, 23.00 per cent, and 22.00 per cent, respectively. The

findings of the study revealed that farmers' lack of understanding about post-harvest technologies such as pre-cooling, washing and grading, sorting, and cold storage caused losses in vegetable crops. The study proposed implementing extension programs to instruct farmers on the use of post-harvest technologies. Furthermore, the study suggested that private marketing organizations should be established to handle post-harvest operations by directly contracting with farmers to market their products.

Saeed and Khan (2010) conducted study on the post-harvest losses of tomato in markets of Lahore and evaluated that the deterioration of the produce due to packing material was 25 per cent, transportation system was 10 per cent, means of distribution was five per cent, exceeding post-harvest losses up to 30 per cent and sometimes the whole lot was lost. Time lag in transportation, bulky packing in the traditional wooden crates wrapped with papers caused high humidity making the microclimate favorable for microflora and this led to post-harvest losses.

Sharma (2011) estimated post-harvest losses in major vegetables grown in Uttarakhand. At producer level, the post-harvest losses were found maximum in tomato (15.16%) followed by French bean (11.06%), and minimum in radish (3.89%). At the retail level also, tomato registered maximum losses, followed by okra, chilli, pea and radish. Across different stages, the losses were found maximum at the grower level in all the vegetables, except capsicum. The loss of vegetables at the grower level resulted from lack of knowledge about proper post-harvest management. The most important cause of post-harvest losses was harvest at inappropriate maturity, resulting in erratic ripening and poor quality. The study suggested urgent need of training the vegetable growers on scientific post-harvest techniques, if the vegetable production has to be sustained on a profitable basis in the region.

Thakur et al. (2011) conducted a study on the economic assessment of post-harvest losses in vegetables in Banaskantha, Sabarkantha, and Mehsana districts of Gujarat. At the farm level, the total post-harvest losses ranged from 12.06 per cent in cabbage to 17.64 per cent in brinjal, while at the market level, it was highest in the case of brinjal (17.58 %). Bird damage was only found in brinjal and tomato, whereas, crushed fruit damage was only observed in cabbage, cauliflower, and tomato, and ranged from 1.56 per cent to 4.12 per cent. At wholesalers' level, faulty packing, lack

of care during transportation, and the use of inappropriate vehicles were the key causes of post-harvest losses, whereas, at retailers' level, incorrect packing materials, and transportation vehicles were major causes.

Changule et al. (2011) carried out a study on economic evaluation of post-harvest losses in tomato in Latur district of Maharashtra. The study reported that the post-harvest losses occurred during collection, sorting, packaging and transportation. These losses occurred at farm level due to lack of storage facilities and improper handling. Storage of tomato was practiced neither at farm level nor at the trader level over a period of time. The overall post-harvest losses were estimated to 35 kg per quintal of tomato. The post-harvest losses in the market network were observed in each and every stage of handling. Plastic crates were used for long distant transportation and packing losses were found minimum in the packing materials like plastic crates.

Dutta and Hazarika (2013) carried out an analysis of vegetable production, utilization pattern and post-harvest losses in Jorhat district of Assam. The total post-harvest loss of vegetables in the study area was found to be 14.93 per cent of the total marketed surplus, out of which 2.43 per cent of the loss occurred at the farmer level and 12.50 per cent occurred at the market level. Medium farmers suffered the most post-harvest losses, both at the farm level and at the market level due to a lack of adequate storage and transportation facilities.

Singh et al. (2013) conducted a study on marketing and post-harvest loss assessment of vegetables in Varanasi district of Uttar Pradesh. The study found that the post-harvest losses in vegetables ranged from 9.47 per cent to 26.57 per cent depending on the stage of marketing. Tomatoes suffered the most losses (26.57 %), followed by brinjal (16.64 %), cauliflower (14.76%), cabbage (11.92 %), and chilli (9.47 %). The highest losses in various vegetables were seen at the whole-sale level of marketing, followed by the retail market, and finally at farmer's field. After vegetable harvesting, marketing techniques such as storage, packaging, and sorting were monitored at farm, wholesale and retail levels of marketing. Transportation was an essential factor, and losses in vegetables were noted at all levels of the marketing process due to inappropriate handling and transportation means selection.

Devkota et al. (2014) conducted a study on assessment of fruit and vegetable losses at major wholesale markets in Nepal. The study revealed that the lack of cold storage facilities was the primary cause of produce loss, followed by inappropriate packing, poor handling of the produce, and finally the poor quality of the food. The findings showed that rotting caused 51 per cent of the loss, while mechanical damage and physiological loss caused 22 per cent and 27 per cent of the loss, respectively. The main source of mechanical damage to the product was poor road facilities combined with rough handling of the commodities and packaging during loading and unloading, as well as unscientific stacking of fruit packages one on top of the other.

Singh et al. (2014) revealed that harvested fruits and vegetables required adequate and advanced post-harvest processing technologies for minimizing the qualitative as well as quantitative losses after harvesting. Nearly 40 per cent fruits and vegetables got wasted every year due to improper handling, storage, packaging and transportation. The wastage of fruits and vegetables in huge amount due to non-implementation of advance post-harvest technological approaches also reduced the per capita availability of fruits and vegetables. The study suggested that intensive emphasis was required to develop the advance post-harvest technologies for improving the global food security by enriching the economy of agricultural produce of the world with minimal losses of consumable fruits and vegetables.

Kumar et al. (2015) from their study on the level of physical post-harvest losses of major vegetables in Varanasi, Uttar Pradesh discovered that post-harvest losses were highest in tomato (22.01 %) and lowest in cabbage (8.25 %) Tomato and okra suffered the most losses during harvesting, whereas, pea suffered the most losses during handling and transportation. At the grading and packaging step, the remaining vegetables, namely brinjal, cabbage, and cauliflower suffered the most loss. At trader level, the largest losses were estimated during the handling and transit stage in most of the crops, except cauliflower. Okra had the most loss during the selling stage. Harvesting at an inopportune maturity caused uneven ripening and low quality, which was a major cause of post-harvest losses. Improper grading, packing, lack of storage and inadequate transportation facilities were all factors that contributed to the problem.

Kumari et al. (2015) carried out the research in Bihar on the economic aspects of demand, supply, and post-harvest losses of important fruits and vegetables. The study found that post-harvest losses of fruits ranged from 22 to 30 per cent of the gross production. In the case of vegetables, it was around 39 per cent for tomato and 18 to 22 per cent for cauliflower of gross production. Huge post-harvest losses were caused by a careless attitude toward post-harvest losses, a lack of quality consciousness, the absence of food processing units, and the lack of efficient cold storage facilities. The study stressed the importance of establishing innovative techniques to encourage fruit and vegetable growers to embrace post-harvest technology while preparing their crops for market.

Paliwal et al. (2015) investigated post-harvest losses in the marketing of major vegetables in Allahabad district of Uttar Pradesh. At producer level, post-harvest losses were highest in tomato (18.77%), followed by onion (17.69 %), okra (13.63 %), chilli (13.42 %), cauliflower (11.80 %), brinjal (11.69 %), pumpkin (5.41 %) and minimum in potato (4.48 %). Tomato suffered the greatest loss at the retail level, followed by okra, chilli, and pumpkin. All vegetables, with the exception of pumpkin, showed significant losses at the producer level. The lack of information about adequate post-harvest management led to these vegetable losses at the grower level. Grading errors, improper packing, lack of storage, and insufficient transportation facilities all contributed to the problem. Harvesting at an inopportune maturity, which resulted in uneven ripening and low quality was one of the most common causes of post-harvest losses.

Puttalingamma (2015) analysed the post-harvest losses of fruits and vegetables and found that spoiling was caused mostly by microbiological attack, auto-oxidation, and insect pest attack. As a result of incorrect handling, storage, and microbial contamination, roughly 25 to 30 per cent of the yield was lost after harvest. Their study suggested that the modern ways aimed at preserving the freshness and nutritional value of vegetables had revolutionized vegetable processing technology but they had not yet been widely used due to a lack of infrastructure and unfavourable economics for small-scale operations.

Sagar et al. (2015) conducted an economic analysis of post-harvest losses in different marketing channels of vegetables in Mandya district of Karnataka. The study discovered that per quintal losses in tomato and brinjal crops were highest at the producer level, ranging from 10.02 kg to 13.65 kg, 8.84 kg to 8.76 kg, respectively. The study emphasized the use of enhanced grading, packaging, storage, and transportation methods, as well as the integration of agricultural and marketing extension systems to convey post-harvest technologies to vegetable growers in order to reduce post-harvest losses.

Bosha et al. (2016) assessed post-harvest losses and handling practices in Ethiopia. The study showed losses of 153.29 kg of cereal crops, 102.19 kg of fruit crops, 181.86 kg of vegetable and 556.13 kg of cash crops. The maximum number of households lost 30 per cent of fruits, 10 per cent of vegetables and 60 per cent cash crops. Post-harvest losses varied among crop types and handling practices. They suggested that the reduction of losses could contribute to food and nutritional security, hence attention should be given towards improving post-harvest handling practices.

Sharma (2016) investigated the economics of post-harvest losses of onion in Jodhpur district of Rajasthan. The study revealed that the highest aggregate post-harvest losses (24.47 kg/q) were found at the producer level due to faulty storage, lack of adequate transportation, improper market handling of the produce, rotted bulbs, poor packing facilities and injury during harvesting. The total supply chain losses were estimated to be 30.87 kg/q (79.27 %) with the majority of losses occurring at the farm level and remaining occurring at the wholesale and retail levels.

Singh and Chauhan (2018) conducted study in Chhota Bhangal, one of the remotest area of district Kangra, Himachal Pradesh. The study revealed that the total physical post-harvest loss of 18.97 kg / q equivalent to monetary loss of Rs 462 was found to be maximum in broccoli followed by cauliflower with a physical loss of 18.96 kg / q (Rs 331/q) and cabbage with a physical loss of 18.38 kg / q (Rs 250/q). The functional analysis revealed that inadequate storage significantly affected the post-harvest losses.

Adam et al. (2020) examined on-farm post-harvest losses for three vegetable crops (onion, tomato, and pimento) in Senegal and the potential economic benefits associated with reducing the post-harvest losses. Household survey data were used to quantify the on-farm post-harvest losses for these vegetables at different stages between harvest and sale or consumption. A multi-market model was used to simulate the effect of eliminating vegetable post-harvest losses on the total value of vegetable supply and international trade of vegetables at the national level. The study suggested that on average 30 per cent of vegetable production was lost on-farm and was, therefore, unavailable for sale or consumption. The study indicated that both private costs to farmers and public costs to the government related to such post-harvest losses reductions would need due consideration when prioritizing between investments in the agricultural sector and beyond.

Madushan and Perera (2020) carried out the mapping of post-harvest losses in perishable supply chains through system dynamics in Sri Lanka. The research showed that lack of communication platforms, poor practices in handling vegetables, weather conditions and the number of intermediaries affected more towards post-harvest losses. Their study suggested that to reduce post-harvest losses, the government should invest more in awareness programs for the actors in the supply chain and relevant infrastructure. The research found that inability to control the transpiration and respiration process of the harvested vegetables, unawareness of the issues among the value chain actors and operational inefficiencies were the main causes for post-harvest waste.

Rudin et al. (2021) conducted a study to assess the factors that contributed to post harvest losses of farm produces in Nkwanta District, Volta Region, Ghana. The study indicated that about 87.20 per cent of the total respondents experienced post-harvest losses and there were five salient factors that influenced post-harvest losses. Difficulties in market accessibility related factors was the most important factor of all. The other important factors accountable for post-harvest losses were lack of knowledge and technology related factors, lack of storage facilities and poor packaging, the poor road network, and labour cost. They recommended that different trainings related to post-harvest handling of produce should be made available for

farmers along with the establishment of the factories and storage facilities in order to reduce post-harvest losses by way of processing and storage of the excess produce at the local level.

2.2 Marketable surplus, marketing system, price spread and marketing efficiency

Bhupal (1989) examined the price spread, marketing margins and operational efficiency of vegetable marketing structure in Delhi. The study discovered that the primary supply chain was producer-commission agent-retailer-consumer for beans, cabbage, brinjal and tomatoes. It was found that the producer earned 66 per cent of the rupee from the consumer, while commission agents and merchants were receiving five per cent and 28 per cent, respectively.

Dahiya et al. (1991) studied marketing of seed potatoes in Shimla which focused on the arrival and off take patterns by variety and grade, trends in export, dynamics in price determination of seed potatoes, retailers marketing margins and the constraints in marketing. The study identified the factors influencing price determination, oligopolistic control of private traders in market and the need for collection of accurate area and production statistics. The study offered action plan by way of suggestion for overcoming the marketing problems and improving marketing efficiency.

Prasad (1993) investigated the marketing channels and price spread in marketing of vegetables in two agricultural markets in Bihar. The study analysed that village sales were quite common in Jamshedpur market, whereas, cooperative marketing was used to transact a large percentage of vegetables in Ranchi. Because of the high margins charged by the intermediaries, the price spread of the major vegetables was estimated to be larger, implying increased marketing costs and a wide price spread.

Shyamsunder and Achoth (1996) investigated the price spread in marketing of onion in Kokar district of Jharkhand and discovered that the producer received the highest net price per quintal in channel-II (Producer-wholesaler-retailer-consumer) and the lowest in channel-1 (Producer-village level trader-wholesaler-retailer-consumer). The study suggested that channel-II was more efficient than the other

channels and proposed that cooperative marketing societies should be supported in the research area in order to increase onion growers' negotiating power and free them from the grip of intermediaries.

Bonny (1996) reported that in commercial vegetable production, market demand and market facilities decided the income of farmers in Trichur district of Kerala. Majority of the farmers rated inadequate marketing as an important constraint experienced by them. The study revealed that the maximum sale of vegetables was through local market and through intermediaries which marginalized their profit. Moreover, the perishability and low keeping quality of vegetables warranted immediate local disposal of the produce even at low prices. Thus, poor storage, inadequate post- harvest marketing facilities were the major problems.

Costa et al. (1996) analysed the economic effects of post-harvest losses for tomatoes in Brazil in particular during transport and marketing. The three main players in the marketing chain found to be: producer, middle man and retailer. The retailer had the most bargaining power as they pay higher prices for better quality. The variations in price, quantity, revenue and margins in relation to the increase in transport and marketing losses were also analyzed along with changes in demand and supply elasticities.

Sharma (1999) investigated the layout of vegetable markets in Brahmaputra Valley of Assam and discovered that the vegetables selling system was flawed. They showed that the markets were oligopolistic in nature in several cases. The market was dominated by a few market intermediaries, and producers/sellers had little power over setting prices and deciding the quality of their products. The study revealed that the producers/sellers were frequently exploited by traders due to a lack of effective product grading and standards, as well as a lack of sufficient market knowledge.

Bunga (2001) analysed the market structure for vegetables in East Nusa Tenggara, Indonesia. The relationship among channel members, the price of vegetables, the marketing margins and marketing efficiency were examined. It was concluded that all the market participants run their business efficiently. However, the transportation was still a major constraint to vegetable marketing.

Singh et al. (2002) studied the potato marketing pattern in Agra district of UP. Their study revealed that the marketed surplus of potato was as high as 87.96 per cent of total output, which varied from 82.48 per cent on small farm size group to 91.82 per cent on large farm size group. It was also observed that across the farm size groups, per quintal net price received at all places and time was the highest on large farm size group followed by medium and small farm size groups, respectively in decreasing order. The storage charges, transportation charges and cost of gunny bags were the important cost items in total cost of marketing on all categories of farms.

Gandhi and Namboodiri (2002) analysed the efficiency of fruit and vegetable marketing in wholesale markets in Ahmedabad. The use of open auction as a market transaction technique was limited, and the majority of the trade was conducted through hidden bidding or simple transactions. Transportation costs and commission were the most important cost components among the various cost components. The study also found that increasing direct contact with farmers, increasing the number of buyers and sellers in the market, promoting the use of open auction at the market, and improving/adding facilities and services like cold storage, transparency and access to internal and external market information could all help to improve efficiency.

Singh et al. (2004) analyzed the cost structure and marketing efficiency of two most important off-season vegetables of the state of Himachal Pradesh, namely, tomato and pea. The study analyzed the costs and returns, existing vegetable marketing system and its efficiency. The study found that the farmers faced problems with respect to production and marketing practices. There were differences between the farm categories growing a particular vegetable and also between the farmers growing different vegetables. The standardization of the grades and packing materials, and timely availability of transport to distant markets were suggested. The analysis of grower's responses further pointed out the need for strict implementation of market regulations as such measures were expected to improve producer's share by curbing the tendency of various market intermediaries in resorting to different malpractices.

Wadhwani and Bhogal (2004) conducted the study to estimate the marketed surplus of principle vegetables and examine the present status of post-harvest management of important vegetables grown in western Uttar Pradesh. The study

revealed that the marketed surplus was more than 95 per cent in vegetables like bottle gourd, pumpkin, tomato, cauliflower, carrot and radish. Lower marketed surplus in case of potato, okra and pumpkin was due to more on-farm consumption of these vegetables than other vegetables.

Huq et al. (2005) examined the marketable surplus of potato using the Cobb-Douglas type functional form. The data were gathered from a sample of 108 potato growers from three areas in Bangladesh. They found that the marketable surplus of potato was approximately 82 per cent of which 22 per cent was sold at the time of harvest. The regression coefficient of the total production of potato confirmed that total production was the best predictor in determining the level of marketable surplus. The elasticity of sale with respect to total production was more than unity. They suggested that emphasis should be given to increasing yield through the use of improved technology (irrigation, fertilizer) and a hybrid seed with a short maturation period.

Gajbhiye et al. (2008) studied the economics of post-harvest losses of various vegetables in Nagpur district of Maharashtra. The study calculated marketing costs, marketing margins, and price spread in vegetable marketing, as well as post-harvest losses at various stages. The data on marketing costs, market margins, price spread, and losses were collected from 15 wholesalers and retailers from Nagpur vegetable. The highest total marketing cost was observed in tomato (43.64%), followed by cabbage (35.31%), cauliflower (31.37%), okra (23.31%), and chilli (22.09%).

Shelke (2009) analysed the economics of price spread in the marketing of main vegetables at the Prabhani market in Maharashtra. The study concluded that during the peak period of arrivals of vegetables such as spinach, okra, bean, cabbage, and bitter gourd, wholesale and retail prices were significantly reduced. There was a significant pricing differential between wholesale and retail level. The retailer's net share varied from 12 to 41 per cent, while the producer's net share varied from 42 to 57 per cent. The study also discovered that selling vegetables directly to consumers rather than wholesalers could benefit producers greatly, increasing their portion of the consumer's price to 95.85 per cent from 55.35 per cent.

Baba et al. (2010) studied the marketed surplus and price spread of vegetables in Kashmir valley. It was found that the producers' share was inversely proportional to the number of intermediaries across multiple marketing channels. The study showed that the net price obtained by the producers was relatively greater where the produce was directly sold to consumers or retailers.

Patel et al. (2013) examined the marketing cost, price spread and marketing efficiency of tomato and brinjal in North Gujarat. The study found that the total marketing cost incurred in case of tomato was more (Rs 93.32/q) as compared to the brinjal (Rs 33.31/q). The producer's share in consumer's rupee was almost similar for both the commodities i.e., Rs. 50.97 and Rs. 50.81, respectively. The marketing efficiency was 1.04 and 1.03 in tomato and brinjal, respectively.

Devkota and Sharma (2014) analysed the conduct and performance of the vegetable marketing system in Kangra District of Himachal Pradesh. The study found that due to lack of storage facilities, majority of producers sold their produce shortly after harvest. Despite the fact that the law mandates that the price of produce be determined by an open auction, commission agents were the ones who set the price in the study market. The study also discovered that the marketing methods used in the research area did not meet the standards set forth in the Market Regulation Act. Open auction, grading, market charges, and recording sale earnings were not in accordance with the ideal system.

Omar and Hoq (2014) investigated marketing efficiency, price spread, marketing costs and margins in marketing of potato in four districts of Bangladesh namely, Bogra, Jamalpur, Rangpur, and Munshigonj. The marketing efficiency was measured using six performance indicators. The study found that the growth rate of actual prices, area, yield, and production rose with time due to increased consumer demand.

Basu et al. (2019) analysed the marketing efficiency of prominent vegetable marketing channels in Nadia District of West Bengal. The study implied that in case of local marketing channel and marketing through middlemen, the producer share in consumers’ rupees and marketing efficiency was higher in case of brinjal, cabbage,

cauliflower, pointed gourd, etc, while the same was lower in spinach, onion, garlic, chilli, and pumpkin. The problems of price fluctuation, credit sale, high commission charges, lack of storage facilities, high transportation cost, excessive wastage during low marketing demand, etc, were faced by the farmers. They suggested the concept of the modern supply chain that could be developed with a view of the benefit of both farmers as well as ultimate consumers.

Paudel et al. (2020) carried out the study to analyse the economics of production and marketing of major vegetables in Parsa district of Nepal. Out of five major vegetables under study, average cost of production per kattha was found highest for pointed gourd (Rs. 11551.50) lowest for okra production (Rs. 6071/kata). The benefit-cost ratio of all the vegetables was higher than three which implied that vegetable farming in the study area was profitable farm business. Producers-wholesalers- retailers-consumers was the most used marketing channel. Market margins of cauliflower, okra, brinjal, chilli and pointed gourd were Rs. 13/kg, Rs. 7.73/kg, Rs. 7.86/kg, Rs. 28.07/kg and Rs. 8.69/kg, respectively. They suggested the need for proper storage facilities, training related to vegetable farming, insect pest management, and subsidies on regular basis, and mechanization and modernization of the farming system through the introduction of technological knowledge and modern farm practices to overcome the problems.

The comprehensive review of literature presented in the foregoing sections indicated that many studies related to post-harvest losses and marketing of vegetables have been conducted. However, in Himachal Pradesh few studies have been undertaken on post-harvest losses of vegetables which estimated it between 18.98 to 28.25 per cent of the total production. The present study therefore, is a step to bridge the information gap which would be helpful in tailoring the policies relating to reduction of post-harvest losses of vegetable crops in the state.

3. MATERIALS AND METHODS

A sound and systematic technology is a pre-requisite for any scientific enquiry. In fact, precision, reliability, validity and acceptability of the scientific findings depend solely on the methodology adopted for investigation of a phenomenon. The selection and application of appropriate methodology bears more relevance in socio-economic studies based on the sample surveys. The selection of representative sample at the first instance and thereafter derivation of the plausible estimates invariably depends upon the methodology adopted. In connection with this, the present chapter describes in detail the methodological procedure followed to accomplish the stated objectives of the study along with selection of the study area, sampling design and analytical framework employed in the study. Keeping this in view, the present chapter has been carefully planned and different aspects of the methodology in the present study are described under the following sections:

3.1 Selection of the study area

The study was conducted in Kangra district of Himachal Pradesh. This area was purposely selected because the district has the highest number of cultivators and total cropped area among all the districts of the state. The district has vast potential for production, marketing and export of cash crops. Moreover, the cultivation of all season as well as off-season vegetables in most of niche areas of the district is going on in a big way with the creation of assured micro and minor irrigation facilities in most of the villages by the State Department of Agriculture and Japan International Cooperation Agency-Official Development Assistance (JICA-ODA). The details of the location of the study area in Himachal Pradesh have been indicated through a map of Himachal Pradesh and Kangra district (Figures 3.1 & 3.2).

Figure 3.1: Depiction of the study district in Himachal Pradesh

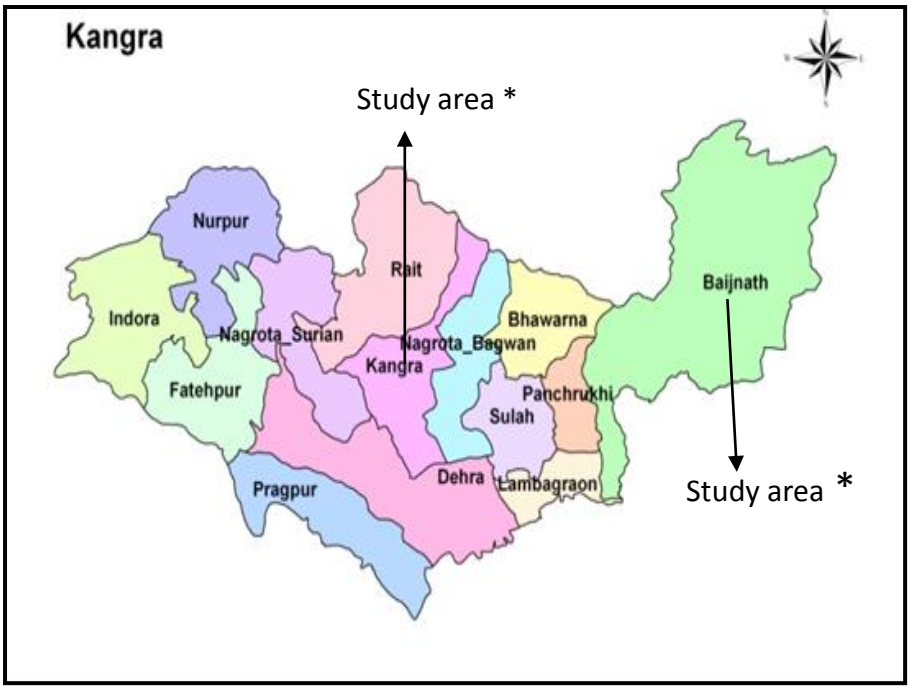

Figure 3.2: Depiction of selected blocks in district Kangra

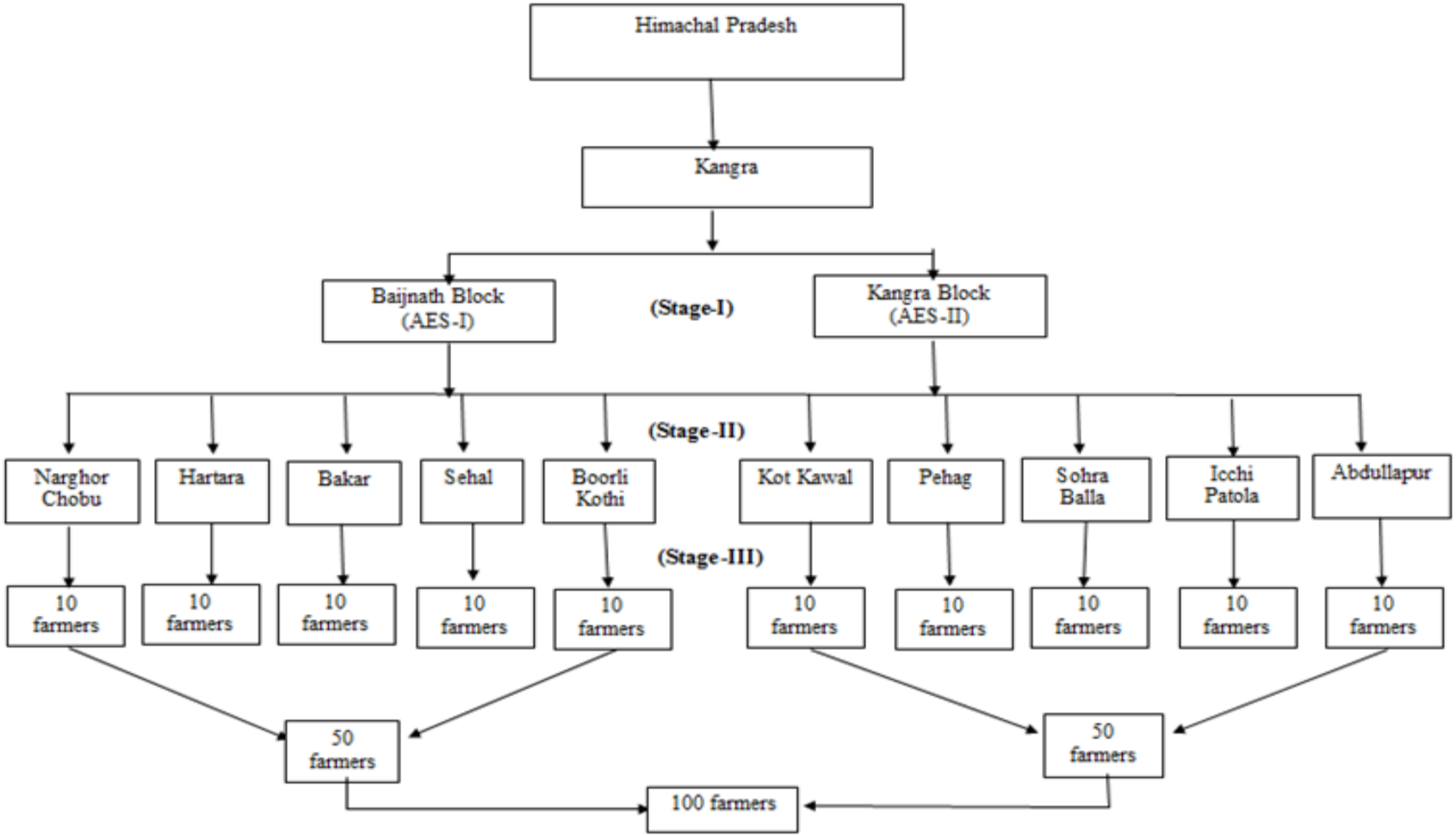

Fig. 3.3 Sampling plan of the study

3.2 Sampling design

Three stage random sampling technique was adopted for selecting representative/sample farm households. The sampling design is composed of the following steps:

3.2.1 Selection of blocks (Stage I) : In the first stage of sampling, a list of blocks where vegetables are being grown commercially was prepared. From this list, the blocks were segregated into two categories based on the similarities of agro-climatic and ecological conditions. Thereafter from each category, one block was randomly selected for the comparative study. The blocks so selected were Baijnath (AES-I) and Kangra (AES-II).

3.2.2 Selection of villages (Stage II) : The prominent vegetable growing villages were identified in the selected blocks in consultation with the officials of State Agriculture Department. A sampling frame of villages was prepared separately for the selected blocks, then an equal sample of 5 villages from each sampling frame was drawn, thus making total sample of 10 villages.

3.2.3 Selection of sample farm households (Stage-III) : In third stage of sampling, a list of vegetables growing farmers was prepared separately for each selected village under AES-I and AES-II with the consultation of village extension officer (agriculture). An equal sample of 10 farmers from the list of farmers of each sample village was drawn randomly, thus, making a total sample of 100 farmers (Table 3.1).

In addition to this, a manageable sample of 30 market functionaries was also drawn from Baijnath and Kangra market to study the post-harvest losses and marketing of vegetables (Table 3.2).

Table 3.1 Distribution of sample farm households

(Number)

Sr. No.	Name of village	No. of farm households
1	Narghor Chobu	10
2	Hartara	10
3	Bakar	10
4	Sehal	10
5	Boorli Kothi	10
6	Kot Kawal	10
7	Pehag	10
8	Sohra Balla	10
9	Icchi Patola	10
10	Abdullapur	10
Total	**10**	**100**

Table 3.2 : Distribution of market functionaries

(Number)

Sr. No.	Market functionary	Baijnath market	Kangra market
1.	Local trader	5	5
2.	Commission agent-cum-wholesaler	5	5
3.	Retailer	5	5
	Total	15	15

Plate 3.1: Data collection from vegetable growers

3.3 Data collection

The present study was primarily based on primary data which were collected through survey method. A comprehensive survey schedule was prepared in order to collect comprehensive data from the sample farm households (Appendix-I). The pre-testing of survey schedule was done by personally contacting the vegetable growers in the nearby areas to examine the relevance of framed questions and the shortcomings. Thereafter the schedule was modified accordingly by incorporating the lacking information/questions before conducting the main survey. Personal contact on a specially designed and pre-tested schedule was used to obtain primary data on the socio-demographic parameters such as family size, age, education, occupation, the economic parameters such as land holdings, farm assets, cropping pattern, production of different vegetable crops grown, post-harvest losses, marketable surplus, marketed surplus, marketing channels, costs and margins and marketing problems, etc., (Plate 3.1).

The secondary data which includes information on area, production and yield of crops, information on population, infrastructure and other socio-economic aspects of the study area were collected from various published and unpublished sources.

3.4 Analytical tools and models

To achieve the stated objectives of the study different analytical tools were employed for data analysis and interpretation of the results so obtained.

The simple tabular analysis involving averages, ratios, and percentages has been used extensively. Regression analysis was also used to investigate the factors that influenced the post-harvest losses of vegetable crops at farm level in the study area.

3.4.1 Demographic and crop indices

The following types of indices were worked out:

1. Sex-ratio (females per 1000 males) $= \frac{\text{Total population of females}}{\text{Total population of males}} \times 1000$

2. Literacy rate (per cent) $= \frac{\text{Total number of literate persons}}{\text{Total population excluding non school going below 5 years of age}} \times 100$

3. Cropping intensity (per cent) $= \frac{\text{Total cropped area}}{\text{Net sown area}} \times 100$

4. Dependency ratio w.r.t. total workers $= \frac{\text{No. of dependents in the family}}{\text{No. of active workers}}$

3.4.2 Marketable and marketed surplus

The marketable and marketed surplus were obtained as follows:

$MS_1 = Q – (C + F)$

$MS_2 = Q – (C + F) - L$

Where,

MS_1 = Marketable surplus

MS_2 = Marketed surplus

Q = Vegetable production in a season

C = Home consumption of the vegetable during the season

F = Kind payments, gifts during the season

L = Losses of the vegetable during the season

3.4.3 Post-harvest losses and factors affecting post-harvest losses of vegetables

Information about post-harvest losses was obtained from the vegetable growers as well as market functionaries during different operations such as:

i Harvesting

ii Assembling

iii Sorting/grading/cleaning

iv Packing

v Transportation

vi Storage and pest infestation

vii Disease occurrence during vegetable growth period

The total post-harvest losses were estimated as sum of all these using the following formula:

$$P_{Li} = \sum_{i=1}^{n}(F_{Li} + T_{Li}) \qquad i=1,2,3\ldots\ldots n$$

where,

P_{Li} = Total post-harvest losses in i^{th} crop (kg/q)

F_{Li} = Total post-harvest losses in i^{th} crop at farm level (kg/q)

T_{Li} = Total post-harvest losses in i^{th} crop at trader's level (kg/q)

n = No. of vegetables

Functional analysis was carried out to examine the factors affecting post-harvest losses in vegetables at farm level. Post-harvest losses at farm level was defined as a function of several socio-economic factors like age of the farmer, his education, number of working family members, total production of selected vegetable crops etc. The following multiple linear regression model was used in the present study.

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + \mu$$

where,

Y = Post-harvest loss at farm level in quintals per hectare

X_1 = Age of the respondent in years

X_2 = Education of the respondent in schooling year

X_3 = Output of particular vegetable in quintals per hectare

X_4 = Number of working family members

X_5 = Pre-harvest disease occurrence during crop growth period in terms of per cent area infested

X_6 = Adverse weather condition dummy [value '1' for inadequate and '0' otherwise

b_0 = Intercept

$b_1 - b_6$ = Regression coefficients

μ = Random term

The relationship of dependent variable (Y) with age of the respondent (X_1), education of the respondent (X_2) and number of working family members (X_4) was hypothesized to be negative. It was assumed that as the age of the farmer increases his experience in post-harvest handling also increases and in turn helps to reduce post-harvest losses. The level of education is another variable that can exert influence on post-harvest losses. The educated farmers would be in a better position to have access to the knowledge of post-harvest operations and thus helps to reduce post-harvest losses. The number of working family members also influenced the post-harvest losses. Higher the number of working family members, lower would be the post-harvest loss.

The relationship of Y (post-harvest losses) with production of vegetable (X_3), area under diseases during crop growth period (X_5) and adverse weather conditions (X_6) was hypothesized to be positive. It was assumed that the farmers are not likely to pay full attention for post-harvest operations when large quantity of output is produced. In such cases his managerial skills might become a limiting factor and lead to higher post-harvest losses. Area infested with diseases during crop growth period also influenced post-harvest losses as such type of deterioration further increased after harvest and leads to increased losses after harvest. To examine the influence of adverse weather conditions on post-harvest losses, a dummy variable was included among explanatory variables. This variable was expected to have positive association with post-harvest losses.

The regression coefficients (b_i's) were tested for their significance using 't' test at 1and 5 per cent level of significance.

$$T = \frac{b_i}{SE\ (b_i)}$$

where,

SE (b_i) = Standard error of the i^{th} regression coefficient

Coefficient of multiple determination (R^2) was computed to know the extent to which dependent variable got affected by all the explanatory variables. As the number of variables in the function increases, the value of R^2 also increased. Therefore, to overcome this problem, adjusted coefficient of multiple determination ($\bar{R}^2$) was estimated as follows:

$$\bar{R}^2 = 1 - (1 - R^2). \left[\frac{N-1}{N-K}\right]$$

where,

$\bar{R}^2$ = Adjusted coefficient of multiple determination

R^2 = Coefficient of multiple determination

N = Number of sample observation used in the model

K = Number of parameters estimated from the sample

The significance of $\bar{R}^2$ was tested with the help of F –test as under:

$$F = \frac{\bar{R}^2/K-1}{(1-\bar{R}^2)/(N-K)} \sim F\ (K-1)\ (N-K)\ df$$

where,

N = Number of sample observations used in the model

K = Number of b_i parameters (including constant term b_0)

3.4.4 Marketing channels

Marketing channels are defined as the chain of intermediaries through whom the various commodities pass from producer to consumers. Various marketing channels patronized by the vegetable growers for the marketing of vegetables in the study area were examined by personal survey of market functionaries involved in the marketing process.

3.4.5 Marketing costs and margins

1. At farmer's level

This includes the costs incurred on different operations performed by the farmers after harvesting/picking of the vegetables. This involves assembling. cleaning, grading, packing, transportation from point of assembling to the point of selling, loading, unloading, and commission paid to the intermediaries, etc.

2. At market level

This includes costs incurred by different intermediaries on different marketing operations like packing, loading, unloading, transportation, commission paid to other intermediaries (if any) and other costs including auction, market fee, etc.

3. Total cost of marketing

The total cost incurred on marketing either in cash or in kind by the farmer/seller and by various traders involved in the sale and purchase of the vegetables till these reach the ultimate consumer was computed by using the formula:

$$TC_i = C_{pi} + \sum_{j=1}^{n} MC_{ij}$$

where,

TC_i = Total cost of marketing of i^{th} vegetable (Rs./q)

C_{pi} = Cost incurred by farmer in marketing of i^{th} vegetable (Rs./q)

MC_{ij} = Cost incurred by j^{th} trader in marketing of i^{th} vegetable (Rs./q)

n = Number of traders

4. Marketing margins

The total marketing margins were computed by using the following formula:

$$M_r = \sum_{i=1}^{n} (Si - Pi) \qquad i = 1, 2, 3...n$$

where,

M_r = Total marketing margin (Rs./q)

S_i= Sale price of i^{th} crop (Rs./q)

P_i = Purchase price of i^{th} crop (Rs./q)

n = No. of traders involved in marketing channel

3.4.6 Price spread

Price-spread is the difference between the price paid by the consumer and the price received by the producer for an equivalent quantity/quality of the farm product. The price-spread for different marketing channels of vegetables was worked out by estimating the marketing costs involved in moving the product from the place of production to the place of consumption and aggregate margins of various middlemen involved in the marketing process.

1. **Farmer's price**

   This is the net price received by the farmers at the time of first sale and was computed as follows:

$$P_r = P_s - P_c$$

   where,

   P_r= Net price received by the farmer (Rs./q)

   P_s= Farmer's selling price (Rs./q)

   P_c= Cost incurred by the farmer in marketing (Rs./q)

2. **Farmer's share in consumer rupee**

   Farmer's share in consumer's rupee was computed by using following formula:

$$F_r = \frac{P_r}{C_p} \times 100$$

   where,

   F_r = Farmer's share in consumer's rupee (per cent)

   P_r = Farmer's price for the vegetable (Rs./q)

   C_p= Price paid by consumer or sale price of retailer (Rs./q)

3.4.7 Marketing efficiency

Marketing efficiency indicates the movement of goods from farmer to consumer at the lowest possible cost, consistent with the provision of services desired by the consumer. It is the ratio of value of output to marketing inputs. An increase in this ratio represents improved efficiency and a decrease denotes reduced efficiency. Marketing efficiency of different marketing channels has been worked out by using Shepherd's formula (Acharya and Agarwal 2004).

$$ME = \frac{V}{I} - 1$$

where,

ME = Marketing efficiency index

V = Value of produce sold in Rs./q (consumer's price)

I = Total marketing cost and marketing margins in Rs./q

3.4.8 Problems or constraints faced by growers and traders

To know the constraints in cultivation and marketing of vegetables, Garrett's ranking technique was employed. Basically it gives the change of orders of constraints and advantages into numerical scores. The major advantage of this technique as compared to simple frequency distribution is that the constraints are arranged based on their importance from the point of view of respondents. Hence, the same number of respondents on two or more constraints may have been given different rank. Garrett's formula for converting ranks into per cent is given by:

$$\text{Percent position} = \frac{100 \times (R_{ij} - 0.5)}{N_j}$$

where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = Number of factors ranked by j^{th} individual

The per cent position of each rank was converted into scores referring to the table given by Garrett and Woodsworth (1969). For each factor, the scores of individual respondents were added together and divided the total number of the respondents for whom scores were added. These mean scores for all the factors were

arranged in descending order ranks were given and most important factors were identified. Finally, these problems were clubbed into high, medium and low severity levels under different aspects as follow:

Mean ($\bar{X}$) plus standard error and above	:	High
Mean ($\bar{X}$) plus/ minus standard error	:	Medium
Mean ($\bar{X}$) minus standard error	:	Low

3.4 Limitations of the study

The present study was subjected to following limitations.

1. Proper farm records and accounts were not maintained by growers. The data for the present investigation were collected by using personal interview method and information so collected was based on memory and past experience of the respondents.
2. Efforts have been made to extract the exact information by using cross-checks and pre-testing of the survey schedule in the study area but still, the possibility of a few slips from the memory of the respondents could not be ruled out.
3. Agriculture being a biological phenomenon is subjected to a number of uncertainties from natural hazards, price fluctuations, market conditions and institutional factors. Hence the best estimates may prove fallacious.
4. The study was confined to a particular geographical. Hence necessary precautions ought to be taken for any generalizations from its findings and its application to other areas.

4. RESULTS AND DISCUSSION

This chapter holds immense importance and focuses on the results obtained based on the research conducted in the study area. In the present chapter, the results are presented on different aspects such as socio-economic status, cropping pattern, land use pattern, production and disposal of produce, post-harvest losses of vegetables, marketing systems and constraints in production and marketing of vegetable crops in the form of tables and figures by giving possible scientific explanation and supportive evidence based on the available literature. The results of the study have been presented systematically under the following broad headings:

4.1 Description of the study area

4.2 Socio-economic characteristics of sample households

4.3 Land utilization and cropping pattern

4.4 Production, utilization and surplus of vegetables

4.5 Post-harvest losses of vegetables

4.6 Marketing of vegetables

4.7 Problems and constraints

4.1 Description of the study area

The knowledge of general features of the study area helps in conceiving different aspects of area. Kangra district, one of the most picturesque valley of lower Himalayas, lies along the southern escapement of the Shivalik Western Himalayan range between 31°2’ to 32°5’ N and 75° to 77°45’ E and is throughout broken into massive confusion of hills and valleys. The valley, sheltered by the sublime Dhauladhar range, is green and luxuriant. The altitude of the district ranges from 427 to 6401 m amsl. It is encapsulated in the North by the districts Chamba and Lahaul & Spiti, in the South by Hamirpur and Una, in the East by Mandi and in the West by Gurdaspur district of Punjab. The district has considerable diversity in its soil,

physiography, land use patterns and cropping systems. The district is endowed with a wide network of numerous perennial streams, famous river Beas which flows through the district covering a distance of about 94 kilometers. These rivers and streams are the major sources of irrigation that irrigate the valley. Kangra valley is a strike valley and extends from the foot of the Dhauladhar range to the south of river Beas. The major physiographic units found in the district are:

- Wet sub-temperate zone.
- Humid sub-temperate zone.
- Humid sub-tropical zone and
- Sub humid subtropical zone.

Table 4.1 Himachal Pradesh and Kangra district at a glance

Sr. No.	Particulars	Himachal Pradesh	Kangra	Per cent of H.P.
1	Area (sq. km)	55673	5739	10.31
2	Tehsils (No.)	109	19	-
3	Sub-tehsils (No.)	63	15	-
4	Development blocks (No.)	80	15	-
5	Population (No.)	6864602	1510075	21.99
6	Rural population (No.)	6176050	1423795	23.05
7	Urban population (No.)	688552	86281	12.53
8	Total cropped area (ha)	959223	239922	-
9	Net sown area (ha)	547556	116800	-
10	Cropping intensity (%)	175.18	205.41	-
11	Food grain production (’000 MT)	1594.23	37.72	2.36
12	Vegetable production (’000 MT)	1860.06	167.36	8.99
13	Sex-ratio (Female per 1000males)	972	1012	-
14	Literacy rate (%)	82.80	85.67	-
	Male	89.53	91.49	-
	Female	75.93	80.02	-
15	Rainfall (mm)	1232.20	1920.0	-

Source: Statistical Abstract of Himachal Pradesh (2021-22), Economics and Statistics Department, Govt. of HP, India.

The salient features of Kangra district are presented in Table 4.1. The table shows that Kangra has the population of 15,10,075 persons. A majority of population of the district lives in rural areas. In comparison to the state, the sex ratio is higher (1012 females for 1000 males). Overall, the literacy rate is 85.67 per cent, which is higher than the state average (82.80%). The cropping intensity is 205.41 per cent which is more than the state cropping intensity of 175.18 per cent.

4.2 Socio-economic profile of sample farm households

The socio-economic features of farmers affect the organization and management of farms as well as the production and marketing supply of different farm commodities to a large extent. Therefore, it is essential to study the existing socio-economic status of the sample farm households. This section tries to shed light on the socio-economic conditions of the sample farm households in the study area. The information on socio-economic parameters viz., size of family, educational status, ownership of land, cropping pattern, etc. have been analysed and presented in the following sub sections:

4.2.1 Profile of head of the family

The decision-making, planning, and management of the different tasks, whether domestic or agricultural, falls mostly on the shoulders of the family heads. The age groups to which the head of the family belong, are crucial since they reveal their level of exposure to technology and awareness. Table 4.2 represents the profile of head of the family of sample farm households. It includes age, education and occupation detail of the head of the family. It can be seen from the table that in Agro-ecological situation-I (AES-I), the majority of the respondents i.e., 36 per cent were between the age of 41 and 60 years, whereas, in Agro-ecological situation (AES-II), about 50 per cent of the respondents were in the age group of 41-60 years. In terms of education in AES-I, on the sample farm households, the fraction of the heads of the families studied up to secondary level was highest (30.00%) followed by matriculation (28.00%) and middle level (18.00%). In AES-II, 34 per cent of heads of the families had studied up to matriculation followed by secondary level (32.00%) and middle level (14.00%). Agriculture was the main occupation of majority of the heads in both AES-I (72.00 %) and AES-II (70.00%), while service/job was reported

as the main occupation by the 28 per cent and 30 per cent of the heads/respondents in AES-I and AES-II, respectively.

Table 4.2 Profile of head/respondent of the family of sample farm households (Number)

Sr. No.	Particulars	AES-I			AES-II		
1	Age (years)	Male	Female	Total	Male	Female	Total
I	26-40	14 (31.82)	01 (16.67)	15 (30.00)	06 (12.50)	01 (50.00)	07 (14.00)
II	41-60	16 (36.36)	02 (33.33)	18 (36.00)	25 (52.08)	-	25 (50.00)
III	Above 60	14 (31.82)	03 (50.00)	17 (34.00)	17 (35.42)	01 (50.00)	18 (36.00)
2	Education						
I	Primary	05 (11.37)	03 (50.00)	08 (16.00)	04 (8.33)	01 (50.00)	05 (10.00)
II	Middle	07 (15.90)	02 (33.33)	09 (18.00)	07 (14.58)	-	07 (14.00)
III	Matriculation	14 (31.82)	-	14 (28.00)	16 (33.34)	01 (50.00)	17 (34.00)
IV	Secondary	14 (31.82)	01 (16.67)	15 (30.00)	16 (33.34)	-	16 (32.00)
V	Graduation	04 (9.09)	-	04 (8.00)	05 (10.41)	-	05 (10.00)
3	Occupation (Main)						
I	Agriculture	32 (72.72)	04 (66.66)	36 (72.00)	34 (70.83)	01 (50.00)	35 (70.00)
II	Service/Job	12 (27.78)	02 (33.34)	14 (28.00)	14 (29.17)	01 (50.00)	15 (30.00)
4	Occupation (Subsidiary)						
I	Agriculture	12 (27.27)	02 (33.33)	14 (28.00)	14 (29.17)	01 (50.00)	15 (30.00)
II	Shopkeeper	11 (25.00)	01 (16.67)	12 (24.00)	17 (35.42)	-	17 (34.00)
III	Driver	10 (22.73)	-	10 (20.00)	07 (14.58)	-	07 (14.00)
IV	No occupation	11 (25.00)	03 (50.00)	14 (28.00)	10 (20.83)	01 (50.00)	11 (22.00)
	Total	44 (100.00)	06 (100.00)	50 (100.00)	48 (100.00)	02 (100.00)	50 (100.00)

Note: Figures in parentheses indicate percentages to the total.

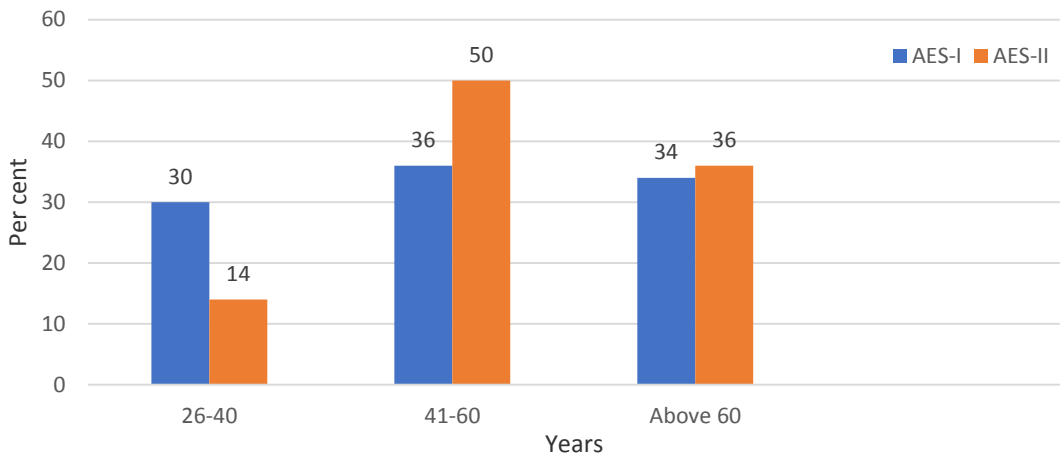

Fig. 4.1 Age-wise distribution of head of the family

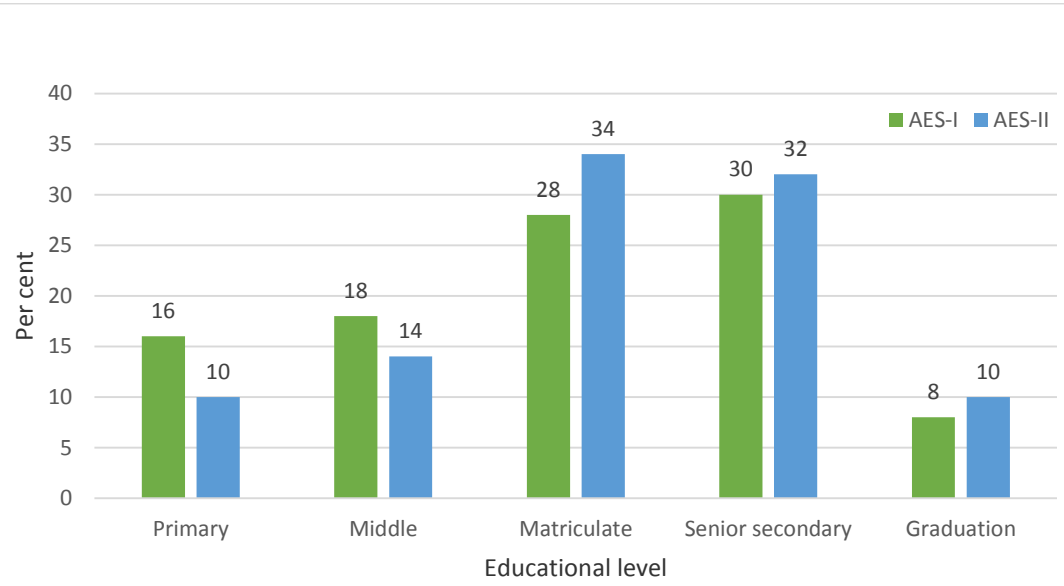

Fig. 4.2 Education level of head of the family

The proportion of heads, who had no secondary occupation were 28 per cent in AES-I and 22 per cent in AES-II and just a handful had secondary occupations such as business/trade and driver, etc. This table also presents that nearly 28 to 30 per cent of heads were having the agriculture as their secondary/subsidiary occupation. The details of age-wise distribution and education level of head of the family have been depicted through Figures 4.1 and 4.2.

4.2.2 Family size, structure and status

In the agriculture sector, family size and structure have a significant bearing on decision-making. Because agriculture is labour-intensive, the size of the family determines the size of the labour force as well as the well-being of that farm household. The family size and structure of sample farm households have been displayed in Table 4.3. The average family size in AES-I was five persons, according to the findings of the study. The number of males was two and females was three per household. The average family was composed of four adults and one child. As per the family structure information, 12 households (24.00%) had a nuclear family structure, compared to 38 (76.00%) households with a joint family structure. As per family status, 39 families (78.00%) were in the category of above poverty line and 11 families (22.00%) were below poverty line. In AES-II, average family size was four persons per household. The number of male and female was two each per household. The average family was composed of three adults and one child. As per the family structure information, 30 households (60.00%) had a nuclear family structure, compared to 20 (40.00%) households with a joint family structure. As per family status, 44 families (88.00%) were in the category of above poverty line and only 6 families (12.00%) were below poverty line.

4.2.3 Age and gender-wise classification

The age and gender distribution of a family unit can also be used to evaluate its dependency ratio and active workforce. Both of these are equally important from the perspective of policy making. A dependency ratio is primarily formed by individuals under the age of 15 and those over the age of 60 as a proportion of total population. The age-wise distribution of sample farm households is given in Table 4.4. This table illustrates that, dependency ratio w.r.t total workers was 0.59 in AES-I and 0.36 in AES-II. The dependency ratios of males and females were 0.86 and 0.42 respectively in AES-I, whereas, in AES-II, dependency ratio of males was 0.40 and in females, it was 0.34. Table also presents that more than 50 per cent of population was between 31-60 years of age in both AES-I and AES-II. The sex-ratio turned out to be 1191 in AES-I and 1267 in AES-II which indicated a high female population compared to the male population. The gender also influences

the access to land and capital assets which is having direct impact on farm production and productivity. The share of male and female in total population was observed to be 45.64 per cent and 54.35 per cent, respectively in AES-I and 44.10 per cent and 55.89 per cent, respectively in AES-II. The details of age-wise distribution of family members has also been depicted through Figure 4.3.

Table 4.3 Family size, structure and status of sample farm households

(Number)

Sr. No.	Particulars	AES-I	AES-II
1	Family members		
	a) Males per household	2.20	2.02
	b) Females per household	2.62	2.56
2	Average family size	4.82	4.58
	a) Adult	(76.35)	(82.10)
	b) Children	(23.65)	(17.90)
3	Family structure		
	a) Nuclear	12 (24.00)	30 (60.00)
	b) Joint	38 (76.00)	20 (40.00)
	c) Total	50 (100.00)	50 (100.00)
4	Family status		
	a) APL	39 (78.00)	44 (88.00)
	b) BPL	11 (22.00)	06 (12.00)
	c) Total	50 (100.00)	50 (100.00)

Note: Figures in parentheses indicate percentages to the total.

Table 4.4 Age-wise classification of the total population of sample farm households

(Number)

Sr. No.	Age group (Years)	AES-I			AES-II		
		Male	Female	Total	Male	Female	Total
1	Up to 15	38 (34.54)	19 (14.50)	57 (23.65)	23 (22.78)	18 (14.07)	41 (17.90)
2	16-30	11 (10.00)	20 (15.27)	31 (12.86)	18 (17.82)	21 (16.40)	39 (17.03)
3	31-45	29 (26.37)	42 (32.06)	71 (29.47)	32 (31.68)	48 (37.50)	80 (34.94)
4	46-60	19 (17.27)	30 (22.90)	49 (20.33)	22 (21.78)	27 (21.10)	49 (21.40)
5	Above 60	13 (11.82)	20 (15.27)	33 (13.69)	06 (5.94)	14 (10.93)	20 (8.73)
	Total	110 (100.00)	131 (100.00)	241 (100.00)	101 (100.00)	128 (100.00)	229 (100.00)
Sex ratio#			1191			1267	
Average no. of dependents		1.02	0.78	1.80	0.58	0.64	1.22
Average no. of workers		1.18	1.84	3.02	1.44	1.92	3.36
Dependency ratio w.r.t total workers		0.86	0.42	0.59	0.40	0.34	0.36

Note: Figures in parentheses indicate percentages to total.
#Number of females per thousand males

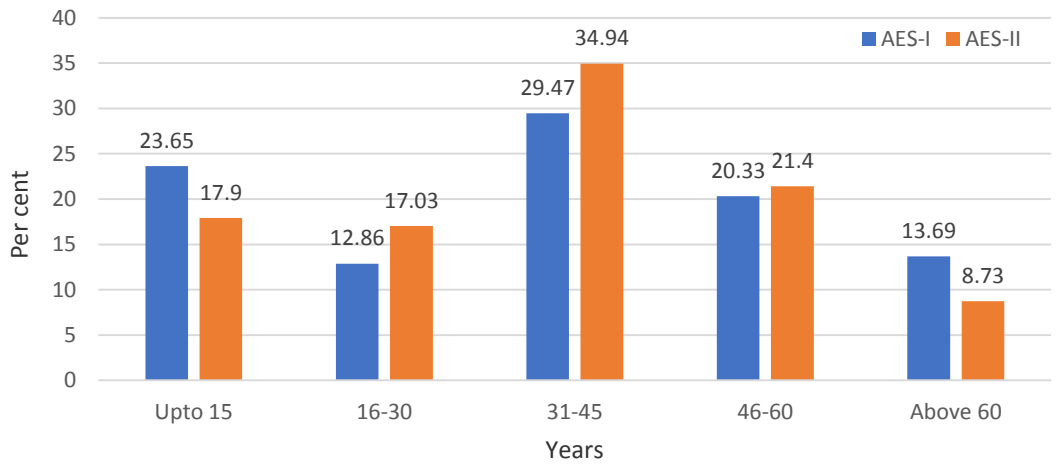

Fig. 4.3 Age-distribution of family members

4.2.4 Education status of family members

Education is essential not only for an individual's personal progression, but also for society's development. With this in mind, Table 4.5 shows the level of education of the family. It can be seen from the table that about two per cent of the family members in AES-I were illiterate, with female members accounting for the total illiteracy. However, no illiteracy was found in AES-II. Around 17 per cent of literate members had attained education up to the middle level followed by secondary level (15.35 %) and primary level (14.94 %) and members with education up to graduation and post-graduation were 12.86 per cent and 0.83 per cent, respectively in AES-I. In AES-II, around 21 per cent of the family members had attained education up to secondary level followed by middle level (19.65 %) and matriculation level (12.22 %). However, the proportion of members being graduates and post-graduates were 11.35 per cent and 2.18 per cent, respectively in AES-II. After examining the literacy rates of sample farmers in AES-I, it was found that the male literacy was hundred percent whereas female literacy was 96.29 per cent. However, no disparity was seen among male (100.00 %) and female literacy rates (100.00 %) in AES-II. In the sample farm households, the overall literacy rate was recorded to be 98.29 per cent in AES-I and 100.00 per cent in AES-II. The details of education status of family members have also been depicted through Figure 4.4.

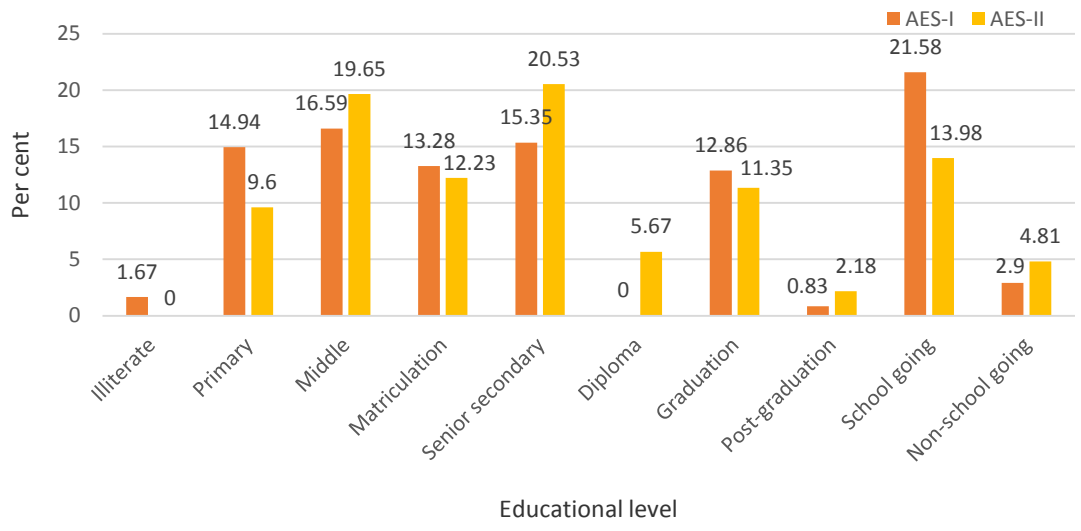

Fig. 4.4 Educational level of family members

Table 4.5 Educational status of family members

(Number)

Sr. No.	Particulars	AES-I			AES-II		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
1	Illiterate	-	04 (3.05)	04 (1.67)	-	-	-
2	Primary	11 (10.00)	25 (19.08)	36 (14.94)	09 (8.91)	13 (10.15)	22 (9.60)
3	Middle	16 (14.54)	24 (18.32)	40 (16.59)	20 (19.80)	25 (19.54)	45 (19.65)
4	Matriculation	13 (11.82)	19 (14.50)	32 (13.28)	10 (9.90)	18 (14.07)	28 (12.23)
5	Secondary	16 (14.54)	21 (16.03)	37 (15.35)	18 (17.82)	29 (22.66)	47 (20.53)
6	Diploma	-	-	-	08 (7.92)	05 (3.90)	13 (5.67)
7	Graduation	15 (13.64)	16 (12.21)	31 (12.86)	12 (11.89)	14 (10.94)	26 (11.35)
8	PG	01 (0.90)	01 (0.77)	02 (0.83)	02 (1.98)	03 (2.34)	05 (2.18)
9	SG	32 (29.10)	20 (15.27)	52 (21.58)	18 (17.82)	14 (10.94)	32 (13.98)
10	Non-school going*	06 (5.46)	01 (0.77)	07 (2.90)	04 (3.96)	07 (5.46)	11 (4.81)
	Total	110 (100.00)	131 (100.00)	241 (100.00)	101 (100.00)	128 (100.00)	229 (100.00)
Literacy rate (%)		100.00	96.92	98.29	100.00	100.00	100.00

Note: Figures in parentheses indicate percentages to total.
*Children below 5 years of age
PG – Post-graduates
SG – School going

4.2.5 Occupational pattern of family members

The occupational structure of the family has a direct influence on the household income and financial stability. The more developed a region is higher the prospects for employment and income for the family. However, in hilly areas, residents mostly depend on agriculture and allied occupations to supplement their income. Table 4.6 presents the occupational pattern of the working population of sample farm households. Agriculture was reported to be the primary source of income

for a large number of working persons i.e., 42.68 per cent in AES-I and 56.78 per cent in AES-II. The table shows that 43.06 per cent males and 42.35 per cent females were occupied in agriculture in AES-I as compared to 61.33 per cent males and 52.50 per cent females in AES-II. This shows that in AES-II, proportionately more males and females were engaged in agricultural activities. The table depicts that in AES-I, majority of the population of sample farm households was involved in agricultural activities followed by government service/pension (24.20 %), private job (14.01 %), labour (11.47 %) and business/trade (7.64 %). However, in AES-II, apart from agriculture and allied activities, other occupations were private job (14.84 %), government service/pension (13.54 %), labour (7.75 %) and business/trade (7.09 %).

Table 4.6 : Occupational pattern of working population of sample farm households

(No. of persons)

Sr. No.	Occupations	AES-I			AES-II		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
1	Agriculture andallied activities	31 (43.06)	36 (42.35)	67 (42.68)	46 (61.33)	42 (52.50)	88 (56.78)
2	Service/Pensioner	16 (22.22)	22 (25.89)	38 (24.20)	8 (10.67)	13 (16.25)	21 (13.54)
3	Shopkeeper	5 (6.94)	7 (8.24)	12 (7.64)	6 (8.00)	5 (6.25)	11 (7.09)
4	Private job	12 (16.67)	10 (11.76)	22 (14.01)	11 (14.67)	12 (15.00)	23 (14.84)
5	Labour	8 (11.11)	10 (11.76)	18 (11.47)	4 (5.33)	8 (10.00)	12 (7.75)
	Total	72 (100.00)	85 (100.00)	157 (100.00)	75 (100.00)	80 (100.00)	155 (1000.00)

Note: Figures in parentheses indicate percentages to the total.

4.2.6 Farm inventories and investment pattern

In this section, an attempt has been made to describe the sample household's farm inventory viz. livestock, farm buildings, farm implements and machinery under various sub-heads:

4.2.6.1 Inventory and investment on residential and farm buildings

The Table 4.7 presents the inventory and investment on residential and farm buildings of sample farm households. According to the table, out of total buildings, 59.57 per cent were residential buildings and 40.43 per cent were cattle sheds in AES-I while in AES-II, 57.89 per cent were residential buildings and 42.11 per cent were cattle sheds. In AES-I, 44.67 per cent residential buildings were *pucca* and 7.45 per cent each were *kuccha* and mixed type. Comparatively, 47 per cent residential buildings were *pucca*, 6 per cent were *kuccha* and 4 per cent were mixed type in AES-II. *Kuccha* type of cattle shed were more prominent in AES-I as compared to AES-II where mixed type of cattle shed were more common. This table further shows that residential buildings accounted for more than 95 per cent of the total investment made by sample households on buildings in AES-I and AES-II. The average investment on the buildings was higher in AES-II (Rs. 10,17,400 per farm) as compared to AES-I (Rs. 9,80,200 per farm).

Table 4.7 : Inventory and investment on residential and farm buildings

(per farm)

Sr. No.	Particulars	AES-I				AES-II			
		Number	Per cent	Value	Per cent	Number	Per cent	Value	Per cent
1	Residential House	1.12	59.57	945000	96.41	1.10	57.89	970000	95.35
	a) Kuccha	0.14	-	35000	3.57	0.12	-	30000	2.94
	b) Pucca	0.84	-	840000	85.70	0.90	-	900000	88.46
	c) Mixed	0.14	-	70000	7.14	0.08	-	40000	3.93
2	Cattle shed	0.76	40.43	35200	3.59	0.80	42.11	47400	4.65
	a) Kuccha	0.54	-	18900	1.93	0.10	-	3500	0.34
	b) Pucca	0.14	-	11900	1.21	0.18	-	15300	1.50
	c) Mixed	0.08	-	4400	0.45	0.52	-	28600	2.81
	Total	1.88	100.00	980200	100.00	1.90	100.00	1017400	100.00

4.2.6.2 Inventory and investment on farm machinery, tools and implements

Inventory of farm machinery and implements is a necessary and crucial component for any type of farming to get an economies of scale. The capital investment in farming plays an important role in increasing productivity of crop enterprises**.** The inventory and investment on farm implements and machinery have been presented in Table 4.8. The table indicates that in AES-II, a household in absolute numbers had 10.38 machinery/tools/implements on the farm which was higher than AES-I having 6.33 machinery/tools/implements. Among the major farm machinery, AES-I had highest number of chaff-cutter (2.53 %), whereas, AES-II had highest number of power tiller (2.50 %). In contrast to the major implements, minor implements were quite high in both the agro-ecological situations. It can be clearly seen from the table that among minor implements sickle had the highest share of 46.60 per cent in total inventory followed by hoe and spade in AES-I whereas hoe had the highest share of 32.38 per cent in total inventory followed by sickle and spade in AES-II. On average, per farm investment on the machinery was Rs. 16503 in AES-I and Rs.30127 in AES-II. It is interesting to note that the trend of major and minor implements got reversed when the value of implements is taken into account. The major implements account for about 93.80 per cent (AES-I) and 93.88 per cent (AES-II) despite their less number. It is mainly because the major implements were quite costly as compared to the minor tools used in farming.

4.2.6.3 Livestock inventory and investment

Livestock rearing is an age-old integral part of farming and holds distinct complementarily with crop production. Therefore, it is important to know the existing livestock on the sample farm households. The detailed description of the livestock kept by sample farm households is shown in Table 4.9. It may be observed from the table that the average size of the livestock unit was quite small in both the agro-ecological situations. The total number of livestock per farm was 1.42 and 1.91 in AES-I and AES-II, respectively, with cow being the most popular among the farmers. Among cattle, the majority was of improved breeds (Jersey, Holstein Friesian). The number of improved cows was 0.80, with in which milk cows accounted for 0.74 and dry cows accounted for 0.06 in AES-I whereas in AES-II, the number of improved

cows was 0.98, with in which milk cows accounted for 0.91 and dry cows accounted for 0.07. The data further reveals that the proportion of sheep and goat was higher in AES-II (15.18 %) than AES-I (10.56%). The table further indicates that 7.04 per cent and 9.42 per cent of the total livestock population accounted for heifers in AES-I and AES-II, respectively. The meager population of bullock, buffalo and calves may be attributed mainly to the fact that the average size of holding on the sample farms was quite low, therefore, they were not able to maintain larger units due to scarcity of fodder. Thus, it can be concluded that the sample households mainly rear milch animals, especially to meet the household requirement for milk and milk products. The total investment on livestock unit was more in AES-II (Rs. 29875/farm) than AES-I (Rs. 23290/farm).

Table 4.8 : Inventory of farm machinery, tools and implements on sample farm households
(per farm)

Sr. No.	Particulars	AES-I				AES-II			
		Number	Per cent	Value (Rs.)	Per cent	Number	Per cent	Value (Rs.)	Per cent
1	Major farm machinery	0.4	6.32	15480	93.80	0.76	7.32	28282	93.88
	a) Tractor	0.02	0.31	10000	60.60	0.03	0.29	15000	49.79
	b) Power tiller	0.10	1.58	4500	27.27	0.26	2.50	11700	38.84
	c) Chaff- cutter	0.16	2.53	792	4.80	0.25	2.41	1238	4.11
	d) Sprayer	0.12	1.90	188	1.14	0.22	2.12	344	1.14
2	Minor farm implements	5.93	93.68	1023	6.20	9.62	92.68	1845	6.12
	a) Plough	0.33	5.21	228	1.38	0.36	3.47	248	0.82
	b) Spade	0.70	11.06	175	1.06	1.85	17.82	463	1.54
	c) Hoe	1.00	15.80	200	1.21	3.36	32.38	672	2.23
	d) Rake	0.60	9.47	90	0.55	0.75	7.22	113	0.37
	e) Sickle	2.95	46.60	236	1.43	2.85	27.45	228	0.76
	f) Axe	0.35	5.54	95	0.57	0.45	4.34	122	0.40
	Total	6.33	100.00	16503.00	100.00	10.38	100.00	30127	100.00

Table 4.9 : Inventory and investment on livestock

(per farm)

Sr. No.	Particulars	AES-I				AES-II			
		Quantity (per farm)		Value (Rs/farm)		Quantity (per farm)		Value (Rs/farm)	
		Number	Per cent	Value	Per cent	Number	Per cent	Value	Per cent
1	Cow	1.00	70.42	19740	84.76	1.22	63.87	24130	80.77
i.	Local	0.20	14.08	2560	10.99	0.24	12.57	3060	10.24
a)	Dry	0.04	2.82	320	1.37	0.05	2.62	400	1.34
b)	In milk	0.16	11.27	2240	9.62	0.19	9.95	2660	8.90
ii.	Improved	0.80	56.34	17180	73.77	0.98	51.31	21070	70.53
a)	Dry	0.06	4.23	900	3.86	0.07	3.66	1050	3.51
b)	In milk	0.74	52.11	16280	69.90	0.91	47.64	20020	67.01
2	Buffalo	0.05	3.52	1320	5.67	0.07	3.66	1830	6.13
i.	In milk	0.03	2.11	900	3.86	0.04	2.09	1200	4.02
ii.	Dry	0.02	1.41	420	1.80	0.03	1.57	630	2.11
3	Bullocks	0.09	6.34	405	1.74	0.10	5.24	450	1.51
4	Heifers	0.10	7.04	700	3.01	0.18	9.42	1260	4.22
5	Calves	0.03	2.11	105	0.45	0.05	2.62	175	0.59
6	Sheep and goat	0.15	10.56	1050	4.51	0.29	15.18	2030	6.79
7	Poultry	0.07	4.93	17.5	0.08	0.05	2.62	12.5	0.04
	Total	1.42	100.00	23290.00	100.00	1.91	100.00	29875.00	100.00

4.2.6.4 Total farm investments of sample farm households

Total farm investments of sample farm households have been depicted through Table 4.10. In AES-I, total farm investment was Rs.1019993/farm whereas in AES-II, it was Rs.1077402/farm. The max proportion of investment in AES-I was on residential house and cattle shed (96.09 %) followed by farm livestock (2.29 %) and farm machinery (1.62 %). Similarly, also in AES-II, max proportion of investment was on residential house and cattle shed (94.43 %), followed by farm machinery (2.79 %) and then farm livestock (2.78 %).

Table 4.10 : Total farm investments of sample farm households

(per farm)

Sr. No.	Particulars	AES-I	AES-II
1	Residential house and cattle shed	980200.00 (96.09)	1017400.00 (94.43)
2	Farm machinery and implements	16503.00 (1.62)	30126.90 (2.79)
3	Farm livestock	23290.00 (2.29)	29875.00 (2.78)
	Total	1019993.00 (100.00)	1077401.90 (100.00)

Note: Figures in parentheses indicate percentages to the total.

4.3 Land inventory and cropping pattern

Agriculture is a land-based occupation in general. By far the most basic requirement for agriculture is land, and the whole occupation revolves around it. The size of a farmer's landholding seems to have a direct link with his or her social standing, but it also has a major effect on all the decisions made by a farmer in the production of any crop enterprise.

4.3.1 Distribution of land holding

The land inventory details and its utilization pattern on sample farm households have been presented in Table 4.11. It may be observed from this table that the average land holding on the sample farm households was low i.e., 0.37 ha in AES-I and 0.53 ha in AES-II. The irrigation facilities in both the agro-ecological situations were found to be good as more than 85 per cent of the total land holding was irrigated i.e., 85.56 per cent in AES-I and 86.37 per cent in AES-II. It was reported by the majority of the farmers that in the past they used to keep land fallow on account of lack of irrigation facilities, which improved a lot in the current scenario. The available land was being utilized for crop production, forest, pasture and grasslands, orchards and constructing buildings.

Among the different categories of land uses a high proportion of land in AES-I was allocated for the cultivation of crops which was estimated at 0.32 ha accounting for about 85 per cent of the total land holding. The important category with respect to the area was wasteland (fallow) which accounted for about 5.68 per cent of the total holding. The area under orchards, pastures & grasslands, culturable wasteland, buildings and forests, etc. were quite low i.e. 2.89, 2.36, 1.93, 0.97 and 0.97 per cent of the total land holding, respectively. In AES-II, cultivated land i.e. 0.48 ha accounted for about 90 per cent of the total land holding. The area under orchards was estimated at 0.02 ha accounting for 4.59 per cent of the total land holding. The area under wasteland (fallow), pastures & grasslands, forests, culturable wasteland and buildings, etc. were quite low i.e. 1.62, 1.36, 1.09, 1.05 and 0.53 per cent of the total land holding, respectively.

Table 4.11 : Land inventory and utilization pattern of sample farm households

(ha/farm)

Sr. No.	Particulars	AES-I			AES-II		
		IR	UIR	Total	IR	UIR	Total
1	Owned land	0.3148	0.0560	0.3708	0.4268	0.0780	0.5048
2	Leased-in	0.0232	0.0016	0.0248	0.0440	0.0016	0.0456
3	Leased-out	0.0224	-	0.0224	0.0120	0.0072	0.0192
4	Total landholding	0.3156	0.0576	0.3732	0.4588	0.0724	0.5312
5	Land utilization						
	I Cultivated land	0.2964	0.0216	0.3180	0.4460	0.0308	0.4768
		(93.90)	(37.50)	(85.20)	(97.21)	(42.54)	(89.76)
	II Culturable wasteland	0.0024	0.0048	0.0072	0.0032	0.0032	0.0056
		(0.76)	(8.34)	(1.93)	(0.70)	(4.42)	(1.05)
	III Pasture/Grassland	0.0004	0.0084	0.0088	0.0004	0.0068	0.0072
		(0.13)	(14.58)	(2.36)	(0.09)	(9.39)	(1.36)
	IV Orchard	0.0108	-	0.0108	0.0068	0.0176	0.0244
		(3.43)		(2.89)	(1.48)	(24.31)	(4.59)
	V Wasteland (Fallow)	0.0056	0.0156	0.0212	0.0024	0.0054	0.0086
		(1.78)	(27.08)	(5.68)	(0.52)	(7.46)	(1.62)
	VI Misc. (Forest, Grasses, Trees)	-	0.0036	0.0036	-	0.0058	0.0058
			(6.25)	(0.97)		(8.01)	(1.09)
	VII Area under buildings	-	0.0036	0.0036	-	0.0028	0.0028
			(6.25)	(0.97)		(3.87)	(0.53)
	Total	0.3156	0.0576	0.3732	0.4588	0.0724	0.5312
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Figures in parentheses indicate percentages to total.
IR= Irrigated; UIR= Unirrigated.

4.3.2 Cropping pattern

The cropping pattern of a region represents the allocation of total cropped area among various field crops during an agricultural year which indicates the relative importance of the crops. The cropping pattern of the sample farm households has been shown in Table 4.12. The cursory look at the table reveals that on average the total cropped area of the sample farm households was 0.6436 ha in AES-I and 0.9984 ha in AES-II, while the net cultivated area was 0.3180 ha in AES-I and 0.4768 ha in AES-II. The cropping intensity was 202.39 per cent and 209.39 per cent in AES-I and AES-II respectively.

The sample farmers were growing a wide range of field crops like cereals, vegetables and fodder crops. It can be observed from the table that the cropping pattern of the sample households was dominated by vegetables as these accounted for 69.69 per cent and 66.04 per cent of the total cropped area in AES-I and AES-II respectively. The main reason for cultivation of these vegetables as principal crops was that these crops are supplied to the countrywide markets, at such a point of time, when these are not available in the plains and so fetch lucrative prices. In *kharif* season, tomato, cucumber, okra, brinjal, bottle gourd and bitter gourd were the main vegetables grown by the farmers which accounted for 22.62 per cent of the total cropped area in AES-I and 28.50 per cent of the total cropped area in AES-II. In *rabi* season, the vegetables such as cabbage, cauliflower, radish and potato etc. were grown in 36.78 per cent and 25.84 per cent of the total cropped area in AES-I and AES-II respectively.

The area under food grains was higher (36.23 %) in AES-I than AES-II (27.04 %). The farmers have also grown fodder crops like sorghum, bajra in kharif and berseem and oats in rabi season. These fodder crops accounted for 7.40 per cent of the total cropped area in AES-I and 6.92 per cent of the total cropped area in AES-II.

4.3.3 Production and productivity of major vegetables on sample farm households

The production and productivity of different vegetables on sample farm have been worked and shown in Table 4.13. The total production of vegetables was more in AES-II (74.21 q) than AES-I (43.54 q). Among various vegetables, the per

farm production of tomato was highest (9.69 q/farm) in AES-I followed by cucumber (7.35 q/farm), cauliflower (7.23 q/farm), bottle gourd (4.65 q/farm) and potato (4.56 q/farm) while the production of bottle gourd was highest (15.50 q/farm) in AES-II, followed by tomato (12.43 q/farm), cauliflower (10.93 q/farm), cucumber (10.29 q/farm) and cabbage (9.36 q/farm). The cursory glance at the table further reveals that the productivity of all the vegetable crops in AES-I ranged between 89.70 q/ha (brinjal) to 244.70 q/ha (tomato) and in AES-II, it ranged between 91.66 q/ha (potato) to 250.60 q/ha (bottle gourd). The productivity of all the vegetables was comparatively more in AES-II as compared to AES-I.

Table 4.12 Cropping pattern on sample farm households

Sr. No.	Particulars	AES-I		AES-II	
		Area (ha)	**% of total cropped area**	**Area (ha)**	**% of total cropped area**
A	*Kharif*	0.3180	49.41	0.4768	47.85
	I. Maize	0.0288	4.47	0.0252	2.52
	II. Paddy	0.0720	11.19	0.0992	9.94
	III. Tomato	0.0396	6.15	0.0496	4.97
	IV. Cucumber	0.0660	10.25	0.0922	9.23
	V. Okra	0.0090	1.40	0.0182	1.82
	VI. Brinjal	0.0068	1.06	0.0256	2.56
	VII. Bottle gourd	0.0206	3.20	0.0644	6.45
	VIII. Bitter gourd	0.0036	0.56	0.0346	3.47
	IX. Other vegetables*	0.0500	7.77	0.0328	3.29
	X. Fodder (Chari/Bajra)	0.0216	3.36	0.0350	3.51
B	*Rabi*	0.3256	50.59	0.5216	52.24
	I. Wheat	0.1324	20.57	0.1456	14.58
	II. Cabbage	0.0436	6.77	0.0832	8.33
	III. Cauliflower	0.0734	11.40	0.1048	10.50
	IV. Radish	0.0340	5.28	0.0640	6.41
	V. Potato	0.0424	13.33	0.0060	0.60
	VI. Other vegetables**	0.0162	2.52	0.0840	8.41
	VII. Fodder (Barseem/Oats)	0.0260	4.04	0.0340	3.41
	Total cropped area	0.6436	100.00	0.9984	100.00
	Net cultivated area	0.3180		0.4768	
	Cropping intensity	202.39		209.39	

Note: Other vegetables* include capsicum, beans and sponge gourd.
Other vegetables** include onion, garlic, pea and broccoli.

Table 4.13: Production and productivity of major vegetables on sample farm households

Sr. No.	Particulars	AES-I		AES-II	
		Production (q/farm)	Productivity (q/ha)	Production (q/farm)	Productivity (q/ha)
1	Tomato	9.69	244.70	12.43	250.60
2	Cucumber	7.35	111.36	10.29	111.61
3	Okra	0.84	93.34	1.74	95.60
4	Bottle gourd	4.65	225.72	15.50	240.68
5	Bitter gourd	0.36	100.00	4.06	117.34
6	Brinjal	0.61	89.70	2.36	92.18
7	Potato	4.56	107.54	0.55	91.66
8	Cabbage	4.63	106.19	9.36	112.50
9	Cauliflower	7.23	98.50	10.93	104.29
10	Radish	3.62	106.47	6.99	109.21

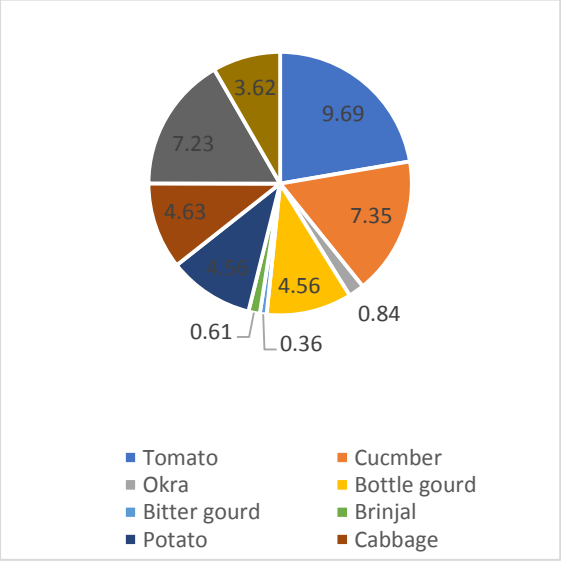

Fig.4.5 Production of vegetables in AES-I

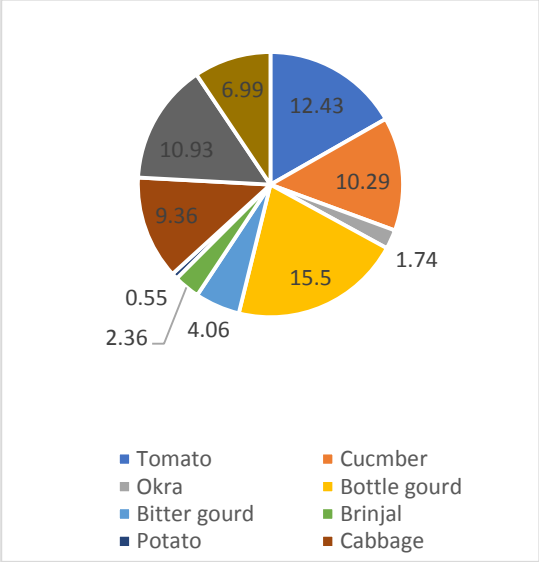

Fig.4.6 Production of vegetables in AES-II

4.4 Production, utilization and surplus of vegetables

The marketable surplus in agricultural sector in developing countries is of crucial importance because it leads to capital formation on the farm which may be invested on land, modern inputs and farm implements thereby increasing the overall productivity. The study of marketable surplus is of paramount importance for highly perishable vegetable commodities that are grown mainly for sale.

The detailed analysis of production, utilization, marketable and marketed surplus of vegetables in AES-I and AES-II is shown in Tables 4.14 and 4.15. The table reveals that among different *Kharif* season vegetable crops, the total production was highest for tomato (9.69 q/farm) in AES-I and bottle gourd (15.50 q/farm) in AES-II. In *Rabi*, the total production was highest for cauliflower in both the agro-ecological situations because of more area under cultivation as well as high productivity of this vegetable. However, AES-II reported higher production of cauliflower (10.93 q/farm) than AES-I (7.23 q/farm), followed by cucumber (10.29 q/farm in AES-II and 7.35 q/farm in AES-I), cabbage (9.36 q/farm in AES-II and 4.63 q/farm in AES-I) and radish (6.99 q/farm in AES-II and 3.62 q/farm in AES-I). Production of potato in AES-I was 4.55 q/farm. The production of bitter gourd, brinjal and okra in AES-II was 4.06, 2.36 and 1.74 q/farm, respectively

4.4.1 Marketable and marketed surplus

The pattern of utilization depicts that the farmer kept some proportion of vegetables for home consumption, kind payments to labourers and gifts to relatives and others. The per cent share of utilization to total production ranged from 0.83 per cent (radish) to 13.21 per cent (potato) in AES-I and 0.65 per cent (bottle gourd) to 2.12 per cent (brinjal) in AES-II. The utilization of all vegetables was higher in AES-I as compared to AES-II, except radish which had more utilization (1.14%) in AES-II than AES-I (0.83%).

The marketable surplus of all the vegetables except potato was found to be more than 90 per cent in AES-I. Similar results were observed by Singh and Chauhan (2018). In AES-II, all the vegetables had more than 95 per cent of the marketable surplus. Similar results were found by Wadhwani and Bhogal (2004) for bottle gourd, tomato, cauliflower and radish. Comparatively, there was a very small variation in

marketable surplus in both the agro-ecological situations. It was further noticed that the marketed surplus reduced to about 89 per cent of total production in case of tomato, about 91 per cent each in cucumber, bottle gourd and cauliflower in AES-II. However, in AES-I, it reduced to about 89 per cent in tomato, about 92 per cent each in cucumber and cabbage and 94 per cent in cauliflower. This was mainly due to post-harvest losses of vegetables because of their perishable nature. The marketed surplus can be increased further to a large extent by minimizing the losses and increasing the total production.

Table 4.14 : Production and utilization pattern of major vegetables in AES-I

(q/farm)

Sr. No.	Particulars	Vegetable crops					
		Cucumber	**Tomato**	**Potato**	**Cauliflower**	**Cabbage**	**Radish**
1	Total production	7.35 (100.00)	9.69 (100.00)	4.56 (100.00)	7.23 (100.00)	4.63 (100.00)	3.62 (100.00)
2	Utilization	0.08 (1.09)	0.20 (2.06)	0.60 (13.21)	0.08 (1.11)	0.08 (1.73)	0.03 (0.83)
i	Home consumption	0.07 (0.95)	0.17 (1.75)	0.58 (12.72)	0.06 (0.83)	0.07 (1.51)	0.03 (0.83)
ii	Gifts	0.0048 (0.07)	0.0212 (0.22)	0.0168 (0.37)	0.0150 (0.21)	0.0100 (0.22)	0.0026 (90.07)
iii	Kind payments	0.0022 (0.03)	0.0066 (0.07)	0.0056 (0.12)	0.0064 (0.09)	0.0038 (0.08)	0.0008 (0.02)
3	Marketable surplus (1-2)	7.27 (98.91)	9.49 (97.94)	3.96 (86.84)	7.15 (98.89)	4.55 (98.27)	3.59 (99.17)
4	Losses	0.53 (7.21)	0.86 (8.88)	0.23 (5.04)	0.32 (4.45)	0.30 (6.48)	0.16 (4.44)
5	Marketed surplus (3-4)	6.74 (91.70)	8.63 (89.05)	3.73 (81.80)	6.83 (94.44)	4.25 (91.79)	3.43 (94.73)

Note: Figures in parentheses indicate percentages to the total.

Table 4.15 : Production and utilization pattern of vegetables in AES-II

(q/farm)

Sr. No.	Particulars	Vegetable crops								
		Bottle gourd	**Cucumber**	**Tomato**	**Bitter gourd**	**Brinjal**	**Okra**	**Cauliflower**	**Cabbage**	**Radish**
1	Total production	15.50 (100.00)	10.29 (100.00)	12.43 (100.00)	4.06 (100.00)	2.36 (100.00)	1.74 (100.00)	10.93 (100.00)	9.36 (100.00)	6.99 (100.00)
2	Utilization	0.10 (0.65)	0.09 (0.87)	0.25 (2.01)	0.06 (1.48)	0.05 (2.12)	0.03 (1.72)	0.09 (0.82)	0.08 (0.85)	0.08 (1.14)
i	Home consumption	0.08 (0.52)	0.08 (0.78)	0.23 (1.85)	0.05 (1.23)	0.05 (2.12)	0.03 (1.72)	0.08 (0.73)	0.07 (0.75)	0.07 (1.00)
ii	Gifts	0.0212 (0.14)	0.0062 (0.06)	0.015 (0.12)	0.004 (0.10)	0.0026 (0.11)	0.0018 (0.10)	0.0028 (0.03)	0.004 (0.04)	0.0056 (0.08)
iii	Kind payments	0.0032 (0.02)	0.0020 (0.02)	0.0044 (0.04)	0.0038 (0.09)	0.0006 (0.03)	0.001 (0.06)	0.0038 (0.03)	0.005 (0.05)	0.0034 (0.05)
3	Marketable surplus(1-2)	15.40 (99.35)	10.20 (99.13)	12.18 (97.99)	4.00 (98.52)	2.31 (97.88)	1.71 (98.28)	10.84 (99.18)	9.28 (99.15)	6.91 (98.86)
4	Losses	1.27 (8.21)	0.84 (8.16)	1.08 (8.69)	0.09 (2.22)	0.05 (1.98)	0.04 (2.03)	0.86 (7.87)	0.61 (6.52)	0.36 (5.15)
5	Marketed surplus(3-4)	14.13 (91.15)	9.36 (90.96)	11.10 (89.30)	3.91 (96.31)	2.26 (95.90)	1.67 (96.24)	9.98 (91.31)	8.67 (92.63)	6.55 (93.69)

Note: Figures in parentheses indicate percentages to the total.

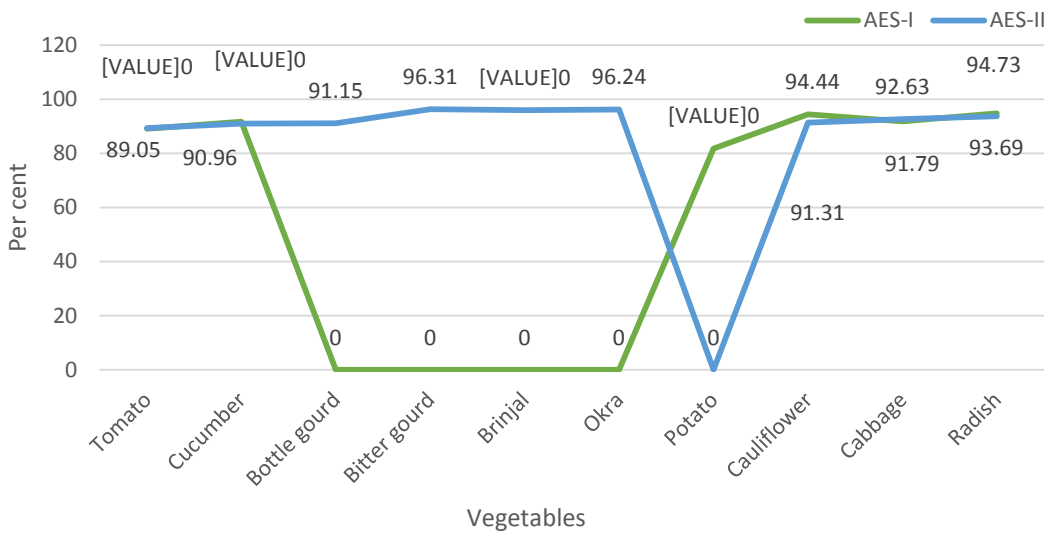

Fig. 4.7 Marketed surplus of vegetables in AES-I and AES-II

4.4.2 Total marketed surplus in different agro-ecological situations

The total marketed surplus of different vegetables produced by the sample vegetable growers has been worked out and presented in Table 4.16. The table indicates that the total marketed surplus of all the vegetables was higher in AES-II (3076.45 q) as compared to AES-I (1388.19 q).

In AES-I, the highest marketed surplus per farm was in case of tomato (8.63 q/farm) followed by cauliflower (6.83 q/farm), cucumber (6.74 q/farm) and cabbage (4.25 q/farm). However, the total marketed surplus was highest for cauliflower (341.50 q) in AES-I among all the vegetables. The quantum of marketed surplus per farm of all the vegetables increased with the size of holdings due to more acreage under these crops, better input use and efficient farm business management. It was highest for bottle gourd (14.13 q/farm) followed by tomato (11.10 q/farm), cauliflower (9.98 q/farm) and cucumber (9.36 q/farm) in AES-II. The total marketed surplus was highest for bottle gourd (579.33 q) among all the vegetables in AES-II.

Table 4.16 : Total marketed surplus of different vegetables produced by sample vegetable growers

Sr. No.	Vegetables	AES-I			AES-II		
		Marketed surplus per farm (q)	No. of growers	Total marketed surplus(q)	Marketed surplus per farm(q)	No. of growers	Total marketed surplus(q)
1	Tomato	8.63	29	250.27 (18.02)	11.10	38	421.80 (13.72)
2	Cucumber	6.74	49	330.26 (23.80)	9.36	50	468.00 (15.21)
3	Bottle gourd	-	-	-	14.13	41	579.33 (18.84)
4	Bitter gourd	-	-	-	3.91	33	129.03 (4.19)
5	Brinjal	-	-	-	2.26	29	65.54 (2.14)
6	Okra	-	-	-	1.67	28	46.79 (1.52)
7	Potato	3.73	36	134.28 (9.67)	-	-	134.28 (4.36)
8	Cauliflower	6.83	50	341.50 (24.60)	9.98	50	499.00 (16.22)
9	Cabbage	4.25	45	191.25 (13.78)	8.67	49	424.83 (13.80)
10	Radish	3.43	41	140.63 (10.13)	6.55	47	307.85 (10.00)
	Total			1388.19 (100.00)			3076.45 (100.00)

Note: Figures in parentheses indicate percentages to the total.

4.5 Post-harvest losses of vegetables

The production of vegetable crops has increased considerably, primarily due to the development of new production technologies, but the effect is lessened because of substantial losses during post-harvest operations. The post-harvest losses are greatly influenced by the management and nature of the produce. Direct relationship is hypothesized between perishability and losses. In the present section, an attempt has been made to estimate the post-harvest losses in important vegetables of the study area.

4.5.1 Post-harvest losses in tomato

The post-harvest losses in tomato during different operations at farm and trader's level are presented in Table 4.17. The table depicts that total post-harvest losses in tomato were 10.08 kg/quintal in AES-I and 12.33 kg/quintal in AES-II. Further at farm level, it varied from 3.88 kg/quintal (38.49 %) in AES-I to 5.73 kg/quintal (46.47 %) in AES-II. At farm level highest loss was observed during harvesting (15.05 % in AES-I and 15.65 % in AES-II) followed by sorting/grading (13.49 % in AES-I and 15.00 % in AES-II). Kumar et al. (2015) also found that the most important cause of post-harvest losses in tomato was harvest at inappropriate maturity, resulting in erratic ripening and poor quality. However, at trader’s level, losses varied from 6.20 kg/quintal (61.51 %) in AES-I to 6.60 kg/quintal (53.53 %) in AES-II and the highest losses were during transit (27.78 % in AES-I and 19.47 % in AES-II) followed by loading/unloading (18.36 % in AES-I and 19.06 % in AES-II). The comparison across both the agro-ecological situations revealed that about 22 per cent more losses were found in AES-II during different operations at farm level as well as at trader’s level.

It is therefore concluded that poor knowledge of the farmers about proper post-harvest management of tomato, improper handling during harvest and long distance transportation contributed to the overall losses.

Table 4.17 : Post-harvest losses in tomato at different stages

Sr. No.	Particulars	AES-I		AES-II	
		Losses in kg/q	Per cent loss	Losses in kg/q	Per cent loss
1	At farm level	3.88	38.49	5.73	46.47
i	During harvest	1.52	15.08	1.93	15.65
ii	Assembling (mechanical injury + rotting)	0.61	6.05	1.08	8.76
iii	Sorting/grading/cleaning	1.36	13.49	1.85	15.00
iv	Packing	0.14	1.39	0.33	2.68
v	Losses during transit	0.25	2.48	0.54	4.38
2	At trader's level	6.20	61.51	6.60	53.53
i	Grading/sorting	1.55	15.37	1.85	15.00
ii	Loading/unloading	1.85	18.36	2.35	19.06
iii	Losses during transit	2.80	27.78	2.40	19.47
	Total loss (1+2)	10.08	100.00	12.33	100.00

4.5.2 Post-harvest losses in cucumber

The post-harvest losses in cucumber during different operations at farm level and trader's level are presented in Table 4.18. The table depicts that total post-harvest losses in cucumber were 9.64 kg/quintal in AES-I and 11.88 kg/quintal in AES-II. Further at farm level, it varied from 5.29 kg/quintal (54.88 %) in AES-I to 7.08 kg/quintal (59.63 %) in AES-II. At farm level, highest loss was observed during sorting/grading (18.57 % in AES-I and 17.66 % in AES-II) followed by assembling (15.98 % in AES-I and 15.22 % in AES-II) in both the agro-ecological situations. However, at trader’s level, losses were higher in AES-I than AES-II and varied from 4.35 kg/quintal (45.12 %) in AES-I to 4.80 kg/quintal (40.37 %) in AES-II and the highest losses were during transit (26.45 % in AES-I and 22.29 % in AES-II) followed by loading/unloading (11.41 % in AES-I and 10.93 % in AES-II) in both the agro-ecological situations. The comparison across both the agro-ecological situations revealed that overall losses were more in AES-II i.e., 23 per cent more losses than AES-I.

Therefore, it can be concluded that improper handling during different operations was the main reason of losses in cucumber at farm level. At trader’s level, lack of better transportation facilities along with improper methods of loading/unloading were the main factors for losses in cucumber.

Table 4.18 : Post-harvest losses in cucumber at different stages

Sr. No.	Particulars	AES-I		AES-II	
		Losses in kg/q	Per cent loss	Losses in kg/q	Per cent loss
1	At farm level	5.29	54.88	7.09	59.63
i	During harvest	1.19	12.34	1.69	14.21
ii	Assembling (mechanical injury + rotting)	1.54	15.98	1.81	15.22
iii	Sorting/grading/cleaning	1.79	18.57	2.10	17.66
iv	Packing	0.42	4.36	0.86	7.23
v	Losses during transit	0.35	3.63	0.63	5.30
2	At trader's level	4.35	45.12	4.80	40.37
i	Grading/sorting	0.70	7.26	0.85	7.15
ii	Loading/unloading	1.10	11.41	1.30	10.93
iii	Losses during transit	2.55	26.45	2.65	22.29
	Total loss (1+2)	9.64	100.00	11.89	100.00

4.5.3 Post-harvest losses in bottle gourd

The post-harvest losses in bottle gourd during different operations at farm level and trader’s level are presented in Table 4.19. The table shows that the total post-harvest losses in bottle gourd were 10.73 kg/quintal out of which 5.58 kg/quintal (52.00 %) of losses were at farm level as compared to 5.15 kg/quintal (48.00 %) of the losses at trader's level. At farm level, the loss of 1.55 kg/quintal (14.45 %) was observed during harvesting followed by 1.45 kg/quintal (13.51 %) of the losses during assembling. The next importance was losses during sorting/grading, transit and packing with respective losses of 11.56 per cent, 6.43 per cent and 6.06 per cent, respectively.

At trader's level maximum loss of 31.69 per cent was observed during transit followed by 8.39 per cent of losses during loading/unloading and 7.92 per cent during grading/sorting. Lack of better transportation facilities for traders aggravated the problem. Improper handling during loading/unloading and grating/sorting were other causes of losses.

Therefore, it can be concluded that improper handling during harvest and assembling, packing, sorting and transportation along with inadequate weather conditions during harvest were the main reasons for post-harvest losses of bottle gourd at farm level. At trader’s level, lack of better transportation facilities and improper handling during loading/unloading and grading/sorting were the main reasons for losses in bottle gourd.

Table 4.19 : Post -harvest losses in bottle gourd at different stages

Sr. No.	Particulars	AES-II	
		Losses in kg/q	Per cent loss
1	At farm level	5.58	52.00
i	During harvest	1.55	14.45
ii	Assembling (mechanical injury + rotting)	1.45	13.51
iii	Sorting/grading/cleaning	1.24	11.56
iv	Packing	0.65	6.06
v	Losses during transit	0.69	6.43
2	At trader's level	5.15	48.00
i	Grading/sorting	0.85	7.92
ii	Loading/unloading	0.90	8.39
iii	Losses during transit	3.40	31.69
	Total loss (1+2)	10.73	100.00

4.5.4 Post-harvest losses in bitter gourd

The post-harvest losses in bitter gourd during different operations at farm level and trader’s level are presented in Table 4.20. It can be seen from the table that the total post-harvest losses in bitter gourd were 6.39 kg/quintal out of which 1.69 kg/quintal (26.45 %) of losses were at farm level as compared to 4.70 kg/quintal (73.55 %) of the losses at trader's level. At farm level, the loss of 0.60 kg/quintal (9.38 %) was observed during sorting/grading followed by 0.45 kg/quintal (7.04 %) of the losses during harvest. The next importance was losses during assembling, and packing and during transit with respective losses of 6.58 per cent, 2.50 per cent and 0.94 per cent, respectively.

At trader's level maximum loss of 2.65 kg/quintal (41.74 %) was observed during transit followed by 1.30 kg/quintal (20.34 %) of losses during grading/sorting. The losses during loading/unloading were 0.75 kg/quintal (11.74 %).

So, it can be concluded that improper handling during harvest and assembling, packing, sorting and transportation along with inadequate weather conditions during harvest were the main reasons for post-harvest losses of bitter gourd at farm level. At trader’s level, lack of better transportation facilities like refrigerated vehicles and improper handling during loading/unloading and grading/sorting were the main reasons for losses in bitter gourd.

Table 4.20 : Post -harvest losses in bitter gourd at different stages

Sr. No.	Particulars	AES-II	
		Losses in kg/q	Per cent loss
1	At farm level	1.69	26.45
i	During harvest	0.45	7.04
ii	Assembling (mechanical injury + rotting)	0.42	6.58
iii	Sorting/grading/cleaning	0.60	9.39
iv	Packing	0.16	2.50
v	Losses during transit	0.06	0.94
2	At trader's level	4.70	73.55
i	Grading/sorting	1.30	20.34
ii	Loading/unloading	0.75	11.74
iii	Losses during transit	2.65	41.47
	Total loss (1+2)	6.39	100.00

4.5.5 Post-harvest losses in brinjal

The post-harvest losses in brinjal during different operations at farm level and trader's level are presented in Table 4.21. The table depicts that the total post-harvest losses in brinjal were 5.27 kg/quintal out of which 1.47 kg/quintal (27.89 %) of losses were at farm level as compared to 3.80 kg/quintal (72.11 %) of the losses at trader's level. At farm level, the highest loss of 0.53 kg/quintal (10.06 %) was observed during sorting/grading followed by 0.42 kg/quintal (7.97 %) of the losses during harvest. The next importance was losses during assembling and packing with respective losses of 0.33 kg/quintal (6.26 %) and 0.12 kg/quintal (2.28 %), respectively. The losses during transit were 0.07 kg/quintal (1.32 %).

At trader's level maximum loss of 2.30 kg/quintal (43.64 %) was observed during transit followed by 0.85 kg/quintal (16.13 %) of losses during sorting/grading. The losses during loading/unloading were 0.65 kg/quintal (12.33 %).

Table 4.21 : Post -harvest losses in brinjal at different stages

Sr. No.	Particulars	AES-II	
		Losses in kg/q	Per cent loss
1	At farm level	1.47	27.89
i	During harvest	0.42	7.97
ii	Assembling (mechanical injury + rotting)	0.33	6.26
iii	Sorting/grading/cleaning	0.53	10.06
iv	Packing	0.12	2.28
v	Losses during transit	0.07	1.32
2	At trader's level	3.80	72.11
i	Grading/sorting	0.85	16.13
ii	Loading/unloading	0.65	12.33
iii	Losses during transit	2.30	43.64
	Total loss (1+2)	5.27	100.00

It is therefore concluded that improper handling during harvest and assembling, packing, sorting and transportation along with inadequate weather conditions during harvest were the main reasons for post-harvest losses of brinjal at farm level. At trader's level, lack of better transportation facilities like refrigerated vehicles and improper handling during loading/unloading and grading/sorting were the main reasons for losses in brinjal.

4.5.6 Post-harvest losses in okra

The post-harvest losses in okra during different operations at farm level and trader's level are presented in Table 4.22. The table shows that the total post-harvest losses in okra were 6.13 kg/quintal out of which 1.28 kg/quintal (20.88 %) of losses were at farm level as compared to 4.85 kg/quintal (79.12 %) of the losses at trader's level. Kumar et al. (2015) also found similar results where okra had highest losses at trader's level. At farm level, the highest loss of 0.41 kg/quintal (6.69 %) was observed during sorting/grading followed by 0.40 kg/quintal (6.53 %) of the losses during harvesting. The next importance was losses during assembling and during transit with respective losses of 0.20 kg/quintal (3.26 %) and 0.16 kg/quintal (2.61 %), respectively. The losses during packing and due to pest infection were 0.11 kg/quintal (1.79 %).

At trader's level maximum loss of 2.45 kg/quintal (39.97 %) was observed during transit followed by 1.65 kg/quintal (26.92 %) of losses during sorting/grading. The losses during loading/unloading were 0.75 kg/quintal (12.23 %).

Table 4.22 : Post -harvest losses in okra at different stages

Sr. No.		Particulars	AES-II	
			Losses in kg/q	Per cent loss
1		At farm level	1.28	20.88
	i	During harvest	0.40	6.53
	ii	Assembling (mechanical injury + rotting)	0.20	3.26
	iii	Sorting/grading/cleaning	0.41	6.69
	iv	Packing	0.11	1.79
	v	Losses during transit	0.16	2.61
2		At trader's level	4.85	79.12
	i	Grading/sorting	1.65	26.92
	ii	Loading/unloading	0.75	12.23
	iii	Losses during transit	2.45	39.97
		Total loss (1+2)	6.13	100.00

So, it can be concluded that improper handling during harvest and assembling, packing, sorting and transportation along with inadequate weather conditions during harvest were the main reasons for post-harvest losses of okra at farm level. At trader's level, lack of better transportation facilities like refrigerated vehicles and improper handling during loading/unloading and grading/sorting were the main reasons for losses in okra.

4.5.7 Post-harvest losses in potato

The post-harvest losses in potato during different operations at farm level and trader's level are presented in Table 4.23. The table depicts that the total post-harvest losses in potato were 9.11 kg/quintal out of which 2.96 kg/quintal (32.49 %) of losses were at farm level as compared to 6.15 kg/quintal (67.51 %) of the losses at trader's level. At farm level, the loss of 1.07 kg/quintal (11.75 %) was observed during assembling followed by 0.65 kg/quintal (7.14 %) of the losses during harvest. The next importance was losses during sorting/grading and due to pest infection with respective losses of 0.60 kg/quintal (6.59 %) and 0.30 kg/quintal (3.29 %), respectively. The losses during packing and during transit were 0.18 kg/quintal (1.98 %) and 0.16 kg/quintal (1.76 %), respectively.

Table 4.23 : Post -harvest losses in potato at different stages

Sr. No.	Particulars	AES-I	
		Losses in kg/q	Per cent loss
1	At farm level	2.96	32.49
i	During harvest	0.65	7.14
ii	Assembling (mechanical injury + rotting)	1.07	11.75
iii	Sorting/grading/cleaning	0.60	6.59
iv	Packing	0.18	1.98
v	Losses during transit	0.16	1.76
vi	Quantity rotten due to pest infestation	0.30	3.29
2	At trader's level	6.15	67.51
i	Grading/sorting	0.65	7.14
ii	Loading/unloading	1.05	11.53
iii	Losses during transit	1.85	20.31
iv	Storage	2.60	28.54
	Total loss (1+2)	9.11	100.00

At trader's level maximum loss of 2.60 kg/quintal (28.54 %) was observed during storage followed by 1.85 kg/quintal (20.31 %) of losses during transit. The losses during loading/unloading and grading/sorting were 1.05 kg/quintal (11.53 %) and 0.65 kg/quintal (7.14 %), respectively. The losses during storage at trader's level were due to pest infection, rodent attack, moisture loss etc.

Therefore, it can be concluded that excessive rains during harvest, mechanical injuries during harvest, improper handling during various operations and pre-harvest disease occurrence like scab were the main reasons for post-harvest losses of potato at farm level. At trader's level, lack of better transportation facilities, lack of scientific storage facilities and improper handling during loading/unloading and grading/sorting were the main reasons for losses in potato.

4.5.8 Post-harvest losses in cauliflower

The post-harvest losses in cauliflower during different operations at farm level and trader's level are presented in Table 4.24. The table shows that total post-harvest losses in cauliflower were 9.39 kg/quintal in AES-I and 12.91 kg/quintal in AES-II. Further at farm level, it varied from 3.41 kg/quintal (33.44 %) in AES-I to 6.16 kg/quintal (47.69 %) in AES-II. At farm level, highest loss was observed during quantity rotten due to disease infestation (13.15 % in AES-I and 11.86 % in AES-II) followed by harvesting (7.88 % in AES-I and 10.31 % in AES-II) in both the agro-ecological situations. Kumar et al. (2008) also reported similar results that disease throughout the crop growth stage were the leading cause of post-harvest losses in cauliflower followed by losses due to harvesting of over-matured curds.

Table 4.24 : Post-harvest losses in cauliflower at different stages

Sr. No.	Particulars	AES-I		AES-II	
		Losses in kg/q	Per cent loss	Losses in kg/q	Per ce nt loss
1	At farm level	3.14	33.44	6.16	47.69
i	During harvest	0.74	7.88	1.33	10.31
ii	Assembling (mechanical injury + rotting)	0.29	3.04	0.64	4.95
iii	Sorting/grading/cleaning	0.32	3.41	1.18	9.14
iv	Packing	0.36	3.83	0.90	6.97
v	Losses during transit	0.20	2.13	0.58	4.46
vi	Quantity rotten due to disease infestation	1.24	13.15	1.53	11.86
2	At trader's level	6.25	66.56	6.75	52.31
i	Grading/sorting	0.90	9.58	1.05	8.14
ii	Loading/unloading	0.80	8.53	0.90	6.97
iii	Losses during transit	1.85	19.70	1.95	15.12
iv	Quantity rotten due to pest infestation	2.70	28.75	2.85	22.08
	Total loss (1+2)	9.39	100.00	12.91	100.00

However, at trader's level, losses varied from 6.25 kg/quintal (66.56 %) in AES-I to 6.75 kg/quintal (52.31 %) in AES-II and maximum loss of 28.75 per cent (AES-I) and 22.08 per cent (AES-II) was observed due to pest infestation followed by 19.70 per cent (AES-I) and 15.12 per cent (AES-II) of losses during transit. The comparison across the agro-ecological situations revealed that 37 per cent more losses were found in AES-II during different operations at farm level as well as at trader's level. Poor knowledge of the farmers about proper post-harvest management of cauliflower contributed to the overall losses. Bdour (2010) also reported post-harvest losses in vegetables due to lack of farmers' knowledge about post-harvest technologies, such as pre-cooling and cooled storage.

Thus, it can be concluded that pre-disease occurrence, improper handling during harvest and assembling, packing, sorting and transportation along with inadequate weather conditions during harvest were the main reasons for post-harvest losses of cauliflower at the farm level. At trader's level, lack of better transportation facilities like refrigerated vehicles, distant market and improper handling during grading/sorting and loading/unloading were the main reasons for losses in cauliflower.

4.5.9 Post-harvest losses in cabbage

The post-harvest losses in cabbage during different operations at farm level and trader's level are presented in Table 4.25. The table shows that total post-harvest losses in cabbage were 11.45 kg/quintal in AES-I and 12.51 kg/quintal in AES-II. Further at farm level, it varied from 4.90 kg/quintal (42.79 %) in AES-I to 5.41 kg/quintal (43.25 %) in AES-II. At farm level, highest loss of 2.89 kg/quintal (25.24 %) in AES-I and 3.69 kg/quintal (29.50 %) in AES-II was observed during sorting/grading/cleaning operation. Verma et al. (2003) also reported maximum post-harvest losses in cabbage during sorting process. The comparison between AES-I and AES-II reveals that losses in AES-II were high during different operations except for harvest and assembling operation where losses varied from 1.14 kg/quintal in AES-I to 0.60 kg/quintal in AES-II. The reason might be high production of the crop in AES-II which limits the better post-harvest management.

Table 4.25 : Post-harvest losses in cabbage at different stages

Sr. No.	Particulars	AES-I		AES-II	
		Losses in kg/q	Per cent loss	Losses in kg/q	Per cent loss
1	At farm level	4.90	42.79	5.41	43.25
i	During harvest	0.60	5.24	0.31	2.48
ii	Assembling (mechanical injury + rotting)	0.54	4.72	0.29	2.32
iii	Sorting/grading/cleaning	2.89	25.24	3.69	29.50
iv	Packing	0.41	3.58	0.50	4.00
v	Losses during transit	0.37	3.23	0.43	3.44
vi	Quantity rotten due to pest infestation	0.09	0.78	0.19	1.52
2	At trader's level	6.55	57.21	7.10	56.75
i	Grading/sorting	0.90	7.86	1.05	8.39
ii	Loading/unloading	0.95	8.30	1.20	9.59
iii	Losses during transit	2.75	24.02	2.70	21.58
iv	Quantity rotten due to pest infestation	1.95	17.03	2.15	17.19
	Total loss (1+2)	11.45	100.00	12.51	100.00

Losses during sorting/cleaning occurred as farmers had to remove the outer dried or diseased leaves in order to give a fresh look to their produce. As assembling operation was done on the field itself, improper handling followed by inadequate weather condition which was the main causes of losses during harvest and assembling operation. The pre-harvest disease occurrence in crop also increased the rotting after its harvesting. The damage during packaging was due to the practice of over-packing in cabbage crop.

At trader's level, the maximum loss of 2.75 kg/quintal (AES-I) and 2.70 kg/quintal (AES-II) was observed during transit which accounts for 24.02 per cent and 21.58 per cent of the total loss in cabbage in AES-I and AES-II, respectively. It was followed by losses due to pest infestation and losses during loading/unloading. Pal et al. (2002) also reported maximum losses in cabbage during transit. Comparatively, post-harvest losses in cabbage were more in AES-II than AES-I at farm level as well as at trader's level by 9.25 per cent.

To sum up, it can be concluded that poor pest management accompanied by improper at harvesting, assembling, packing and transportation and imperfect knowledge among farmers towards post-harvest losses were the main reasons for post-harvest losses of cabbage at farm level in the study area. At trader's level, poor

transportation facilities and improper handlings during grading/sorting were the main reasons for post-harvest losses of cabbage in the study area.

4.5.10 Post-harvest losses in radish

The post-harvest losses in radish during different operations at farm level and trader's level are presented in Table 4.26. The table shows that the total post-harvest losses in radish varied from 6.84 kg/quintal in AES-I to 8.38 kg/quintal in AES-II. Further at farm level, it varied from 3.09 kg/quintal (45.18 %) in AES-I to 4.08 kg/quintal (48.69 %) in AES-II. At farm level, maximum losses of 13.16 per cent in AES-I and 9.55 per cent in AES-II occurred during harvest. It was followed by losses during sorting/grading with respective losses of 8.63 per cent in AES-I and 9.43 per cent in AES-II. The comparison across different scenarios revealed that losses were more in AES-II during different operations except for harvest where losses were high in AES-I. The reason for fewer losses in radish during harvest and cleaning operations in AES-II might be due to better availability of labour during these operations and partly due to structure and nature of the crop.

Table 4.26 : Post-harvest losses in radish at different stages

Sr. No.	Particulars	AES-I		AES-II	
		Losses in kg/q	Per cent loss	Losses in kg/q	Per cent loss
1	At farm level	3.09	45.18	4.08	48.69
i	During harvest	0.90	13.16	0.80	9.55
ii	Assembling (mechanical injury + rotting)	0.41	5.99	0.59	7.04
iii	Sorting/grading/cleaning	0.59	8.63	0.79	9.43
iv	Packing	0.41	5.99	0.74	8.83
v	Losses during transit	0.53	7.75	0.75	8.95
vi	Quantity rotten due to pest infestation	0.25	3.65	0.42	5.01
2	At trader's level	3.75	54.82	4.30	51.31
i	Grading/sorting	0.70	10.23	0.50	5.97
ii	Loading/unloading	0.70	10.23	0.80	9.55
iii	Losses during transit	1.50	21.93	2.10	25.06
iv	Quantity rotten due to pest infestation	0.85	12.43	0.90	10.74
	Total loss (1+2)	6.84	100.00	8.38	100.00

Improper handling while harvest resulted into physical damage of edible part of radish which was the main cause of losses during this operation. During packing, over packing resulted into internal bruising within the packing bag and was the main reason for losses during this operation. The losses during washing, loading/unloading and transit were due to rough handling of the produce.

At trader's level, maximum loss of 21.93 per cent in AES-I and 25.06 per cent in AES-II were observed during transit followed by 12.43 per cent of the losses in AES-I and 10.74 per cent of the losses in AES-II due to pest infestation Comparatively, AES-II had more losses at different operations at trader's level than AES-I except the losses during grading/sorting of the produce. Comparatively, total losses were 22 per cent more in AES-II than AES-I.

It is therefore concluded that improper harvesting techniques, unfavourable weather condition during harvest, faulty methods of packing, and improper handling during different operations were the main reasons for post-harvest losses in radish at farm level. At trader's level, lack of better transportation facilities along with improper methods of loading/ unloading and physical injuries accompanied by warm conditions and moisture became vulnerable for pest infection and thus it was main reason for rotting and losses in radish.

To sum up, it can be concluded that for majority of the vegetables, maximum losses occurred at trader's level as compared to farm level. Improper harvesting techniques, unfavourable weather conditions during harvest, improper handling during different operations were the main reasons for the post-harvest losses in vegetables both at farm as well as at trader's level.

4.5.11 Factors affecting post-harvest losses of vegetables at farm level

To study the influence of different socio-economic factors of vegetable growers *viz-à-viz* productivity related factors on post-harvest losses of vegetables in the study area at the farm level, a multiple linear regression analysis was carried out. It was hypothesized that the factors like age, education and number of working family members have negative effect on post-harvest losses while factors like production, pre-harvest disease occurrence and adverse weather conditions have positive effect on post-harvest losses of vegetables. The estimated regression coefficients associated with all the selected variables have been presented in Table

4.27 and Table 4.28. F-ratio was significant in all the vegetable crops thereby indicating the good fit of the regression models**.**

4.5.11.1 Factors affecting post-harvest losses of tomato

In case of tomato crop, all the explanatory variables were found to be in conformity with the postulated hypothesis in AES-I but in AES-II, coefficients for five out of six explanatory variables were in conformity with the postulated hypothesis except pre-harvest disease occurrence. Table 4.27 shows that with one (1) unit increase in production, the post-harvest losses of tomato increased by 0.37 units in both the agro-ecological situations. The post-harvest losses in tomato were negatively and significantly conditioned by education of the head in both the agro-ecological situations and by the age of the family head in AES-I. With one (1) unit increase in education of the head, the post-harvest losses in tomato decreased by 0.1385 units in AES-I and 0.0735 units in AES-II. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 83.33 per cent in AES-I and 84.98 per cent in AES-II.

To sum up it can be concluded that post-harvest losses of tomato could be minimized by better handling and proper harvesting techniques.

4.5.11.2 Factors affecting post-harvest losses of cucumber

In case of cucumber, all the explanatory variables were found to be in conformity with the postulated hypothesis in both AES-I and AES-II. Table 4.27 depicts that with one (1) unit increase in production, the post-harvest losses of cucumber increased by 0.1153 units in AES-I and 0.1029 units in AES-II. The post-harvest losses in cucumber were negatively and significantly conditioned by number of working family members in AES-I and by the age of the family head in AES-II. With one (1) unit increase in no. of working family members, the post-harvest losses in cucumber decreased by 0.0382 units in AES-I and with one (1) unit increase in age of head of the family, post-harvest losses in cucumber decreased by 0.0164 units in AES-II. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 92.92 per cent in AES-I and 78.80 per cent in AES-II.

To sum up it can be concluded that post-harvest losses of cucumber could be minimized by better handling and proper harvesting techniques.

4.5.11.3 Factors affecting post-harvest losses of bottle gourd

In case of bottle gourd, all the explanatory variables were found to be in conformity with the postulated hypothesis except age of the head. Table 4.27 shows that with one (1) unit increase in production, the post-harvest losses of bottle gourd increased by 0.1476 units. The post-harvest losses were negatively and significantly conditioned by number of working family members and positively by production per hectare and pre-harvest disease occurrence. With one (1) unit increase in area under pre-harvest disease occurrence, the post-harvest losses in bottle gourd increased by 0.0903 units. With one (1) unit increase in number of working family members, the post-harvest losses decreased by 0.2330 units. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 84.81 per cent.

To sum up it can be concluded that post-harvest losses of bottle gourd could be minimized by better handling of produce, proper harvesting techniques and trainings to farmers about better post-harvest management.

Table 4.27 : Regression estimates of factors affecting post-harvest losses of the vegetables at farm level

Sr. No.	Explanatory variables	Tomato		Cucumber		Bottle gourd		Bitter gourd		Brinjal	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Intercept	1.4286	1.2806	-0.1928	0.5731	-	-1.1888	-	-0.0568	-	-0.8808
		(0.9560)	(0.5661)	(0.1917)	(0.3644)		(1.1565)		(0.1272)		(1.5365)
2	Age of the respondent (X_1)	-0.0229*	-0.0108	-0.0016	-0.0164**	-	0.0127	-	-0.0027*	-	-0.0072
		(0.0100)	(0.0060)	(0.0019)	(0.0041)		(0.0116)		(0.0011)		(0.0126)
3	Education of the family head (X_2)	-0.1385*	-0.0735*	-0.0092	-0.0109	-	-0.0419	-	-0.0024**	-	-0.0169
		(0.0521)	(0.0324)	(0.0079)	(0.0163)		(0.0497)		(0.0009)		(0.0606)
4	Production of output per hectare (X_3)	0.3785**	0.3774**	0.1153**	0.1029**	-	0.1476**	-	0.0453**	-	0.1132*
		(0.0392)	(0.0317)	(0.0067)	(0.0123)		(0.0120)		(0.0042)		(0.0525)
5	Number of working family members (X_4)	-0.0326	-0.0196	-0.0382*	-0.0075	-	-0.2330**	-	0.0100	-	0.0449
		(0.0757)	(0.0527)	(0.0139)	(0.0372)		(0.0804)		(0.0079)		(0.0706)
6	Pre-harvest disease occurrence (X_5)	0.0193	-0.1618	0.0267	0.0014	-	0.0903*	-	0.0120	-	0.3611**
		(0.1037)	(0.0454)	(0.0165)	(0.0303)		(0.0528)		(0.0162)		(0.1059)
7	Adverse weather condition dummy (X_6)	0.3723	0.2136	0.0102	0.1667	-	0.0471	-	0.0158	-	0.7565*
		(0.2870)	(0.2310)	(0.0123)	(0.2004)		(0.0771)		(0.0378)		(0.3748)
8	Coefficient of multiple determination (R^2)	0.8691	0.8682	0.9381	0.8139	-	0.8709	-	0.8855	-	0.7243
9	Adjusted $\bar{R}^2$	0.8333	0.8498	0.9292	0.7880	-	0.8481	-	0.8580	-	0.7070
10	F-value	24.33	23.60	36.02	31.35	-	38.22	-	32.22	-	5.82
11	Degrees of freedom	22	23	42	43	-	34	-	25	-	21

Note: Figures in parentheses indicate standard errors of coefficients.

** and * denote significance at 1.0 and 5.0 per cent, respectively.

4.5.11.4 Factors affecting post-harvest losses of bitter gourd

In case of bitter gourd, all the explanatory variables were found to be in conformity with the postulated hypothesis except number of working family members. It can be seen from the Table 4.27 with one (1) unit increase in production, the post-harvest losses of bitter gourd increased by 0.0453 units. The post-harvest losses were negatively and significantly conditioned by the age and education of the head and positively by production per hectare. With one (1) unit increase in age and education of the head, the post-harvest losses in bitter gourd increased by 0.0027 and 0.0024 units, respectively. The adjusted coefficient of multiple determination ($\overline{R}^2$)was found to be 85.80 per cent.

To sum up it can be concluded that post-harvest losses of bitter gourd could be minimized by better handling and proper harvesting techniques of produce.

4.5.11.5 Factors affecting post-harvest losses of brinjal

In case of brinjal, all the explanatory variables were found to be in conformity with the postulated hypothesis except number of working family members. It can be noted from the Table 4.27 that with one (1) unit increase in production, the post-harvest losses of brinjal increased by 0.1132 units. The post-harvest losses were positively and significantly conditioned by production per hectare, pre-harvest disease occurrence and adverse weather condition dummy. With one (1) unit increase in area under pre-harvest disease occurrence, the post-harvest losses in brinjal increased by 0.3611 units. With one (1) unit increase in adverse weather condition dummy, the post-harvest losses in brinjal increased by 0.7565 units. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 70.70 per cent.

To sum up it can be concluded that post-harvest losses of brinjal could be minimized by better handling of produce, proper harvesting techniques and trainings to farmers about better post-harvest management.

4.5.11.6 Factors affecting post-harvest losses of okra

In case of okra, all the explanatory variables were found to be in conformity with the postulated hypothesis. It can be seen from the Table 4.28 that with one (1) unit increase in production, the post-harvest losses of okra increased by 0.0214 units. The post-harvest losses were positively and significantly conditioned by production

per hectare and pre-harvest disease occurrence. With one (1) unit increase in area under pre-harvest disease occurrence, the post-harvest losses in okra increased by 0.0046 units. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 68.07 per cent.

To sum up it can be concluded that post-harvest losses of okra could be minimized by better handling and proper harvesting techniques of produce.

4.5.11.7 Factors affecting post-harvest losses of potato at farm level

In case of potato, all the explanatory variables were found to be in conformity with the postulated hypothesis except number of working family members. Table 4.28 shows that with one (1) unit increase in production, the post-harvest losses of potato increased by 0.0465 units. The post-harvest losses were positively and significantly conditioned by production per hectare and negatively and significantly conditioned by age and education of the head. With one (1) unit increase in the age of the head, the post-harvest losses in potato decreased by 0.0025 units. With one (1) unit increase in education of the head, the post-harvest losses in potato decreased by 0.0026 units. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 85.36 per cent.

To sum up it can be concluded that better harvesting techniques followed by proper handling of the produce could help to reduce the post-harvest losses of potato at farm level.

4.5.11.8 Factors affecting post-harvest losses of cabbage

In case of cabbage, all the explanatory variables were found to be in conformity with the postulated hypothesis in both AES-I and AES-II. It can be seen from the Table 4.28 that with one (1) unit increase in production, the post-harvest losses of cabbage increased by 0.1153 units in AES-I and 0.1211 units in AES-II. The post-harvest losses were negatively and significantly conditioned by the number of working family members in AES-I and by the education of the family head in AES-II. The increase in one unit of no. of family members was able to reduce the post-harvest losses by 0.0382 units in AES-I. With one (1) unit increase in education of family head, the post-harvest losses decreased by 0.0306 units in AES-II. The adjusted

coefficient of multiple determination ($\overline{R}^2$) was found to be 82.92 per cent in AES-I and 75.13 per cent in AES-II.

To sum up it can be concluded that post-harvest losses of cabbage could be minimized by better handling and proper harvesting techniques of produce.

4.5.11.9 Factors affecting post-harvest losses of cauliflower

In case of cauliflower, all the explanatory variables were found to be in conformity with the postulated hypothesis in AES-I but in AES-II, the coefficients for five out of six variables were on conformity with the postulated hypothesis except adverse weather conditions. Table 4.28 highlights that with one (1) unit increase in production, the post-harvest losses of cauliflower increased by 0.1086 units in AES-I and 0.0954 units in AES-II. The post-harvest losses were negatively and significantly conditioned by the age of the head in both AES-I and AES-II. With one (1) unit increase in age of the head, post-harvest losses decreased by 0.0120 units in AES-I and 0.0038 units in AES-II. Pre-harvest disease occurrence influenced the post-harvest losses of cauliflower positively and significantly. The study done by Kumar et al. (2008) also highlighted diseases during crop growth period as the main cause of post-harvest losses in cauliflower. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 83.58 per cent in AES-I and 84.97 per cent in AES-II.

To sum up it can be concluded that better harvesting techniques followed by proper handling of the produce could help to reduce the post-harvest losses of cauliflower at farm level.

4.5.11.10 Factors affecting post-harvest losses of radish

In case of radish, all the explanatory variables were found to be in conformity with the postulated hypothesis except number of working population and adverse weather condition dummy in AES-I and age of the head and adverse weather condition dummy in AES-II. The coefficients for four out of six variables were on conformity with the postulated hypothesis in both the agro-ecological situations. It can be seen from the Table 4.28 that with one (1) unit increase in production, the post-harvest losses of radish increased by 0.0681 units in AES-I and 0.0625 units in AES-II. The post-harvest losses were negatively and significantly conditioned by the age of the head and positively by production per hectare and pre-harvest disease occurrence in AES-I. The post-harvest losses in radish were positively and

Table 4.28 : Regression estimates of factors affecting post-harvest losses of the vegetables at farm level

Sr. No.	Explanatory variables	Okra		Potato		Cabbage		Cauliflower		Radish	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Intercept		0.0016 (0.0315)	-0.0653 (0.1259)	-	-0.1928 (0.1917)	-0.2277 (0.5729)	-0.0207 (0.4762)	0.0447 (0.1782)	-0.2581 (0.1783)	-0.9588 (0.2390)
2	Age of the respondent (X_1)		-0.0001 (0.0002)	-0.0025* (0.0011)	-	-0.0016 (0.0019)	-0.0055 (0.0042)	-0.0120* (0.0046)	-0.0038* (0.0019)	-0.0045* (0.0017)	0.0016 (0.0029)
3	Education of the family head (X_2)		-0.0008 (0.0011)	-0.0026** (0.0009)	-	-0.0092 (0.0079)	-0.0306* (0.0178)	-0.0220 (0.0176)	-0.0192* (0.0095)	-0.0007 (0.0072)	-0.0120 (0.0106)
4	Production of output per hectare (X_3)		0.0214** (0.0022)	0.0465** (0.0042)	-	0.1153** (0.0067)	0.1211** (0.0109)	0.1086** (0.0159)	0.0954** (0.0062)	0.0681** (0.0099)	0.0625** (0.0113)
5	Number of working family members (X_4)		-0.0022 (0.0018)	0.0162 (0.0078)	-	-0.0382* (0.0139)	-0.0122 (0.0319)	-0.0186 (0.0415)	-0.0046 (0.0150)	0.0186 (0.0107)	-0.0031 (0.0209)
6	Pre-harvest disease occurrence (X_5)		0.0046* (0.0021)	0.0063 (0.0150)	-	0.0267 (0.0165)	0.0523 (0.0613)	0.0859* (0.0338)	0.0113 (0.0135)	0.0836* (0.0236)	0.2177** (0.0366)
7	Adverse weather condition dummy (X_6)		0.0094 (0.0066)	0.0192 (0.0442)	-	0.0102 (0.0123)	0.1123 (0.1616)	0.0425 (0.1690)	-0.0754 (0.0712)	-0.0351 (0.0525)	-0.1832 (0.1084)
8	Coefficient of multiple determination (R^2)		0.7001	0.8819	-	0.8381	0.7824	0.8559	0.8681	0.7944	0.8526
9	Adjusted $\bar{R}^2$		0.6807	0.8536	-	0.8292	0.7513	0.8358	0.8497	0.7581	0.8293
10	F-value		28.74	31.12	-	25.02	25.17	42.57	47.16	21.89	36.63
11	Degrees of freedom		21	25	-	42	42	43	43	34	38

Note: Figures in parentheses indicate standard errors of coefficients.

** and * denote significance at 1.0 and 5.0 per cent, respectively.

significantly conditioned by production and pre-harvest disease occurrence in AES-II. With one (1) unit increase in area under pre-harvest disease occurrence, the post-harvest losses in radish will increase by 0.0836 units in AES-I and 0.2177 units in AES-II. The adjusted coefficient of multiple determination ($\overline{R}^2$) was found to be 75.81 per cent in AES-I and 82.93 per cent in AES-II.

To sum up it can be concluded that better harvesting techniques followed by proper handling of the produce could help to reduce the post-harvest losses of radish at farm level.

4.6 Marketing of vegetables

The marketing of vegetable crop is a complex process that comprises various practices carried out by different functionaries involved in marketing process. These marketing practices are indispensable, helping in creation of one or combination of time, place, form and possession utilities. In fact, the nature and kind of tasks carried out also demonstrate the development made in the marketing of agricultural commodities. Although it is also true that these functions/practices raise the price of the product, they also increase its value along the value chain, which is advantageous to both producers and consumers. Keeping this in view, the details of these functions have been given below.

4.6.1 Marketing practices/ functions

The marketing is not complete unless the commodities are made available in the form they are needed, at the time they are needed and at a place they are needed by the consumers. In making availability of these commodities from producers to consumers, several functions are performed by the growers and various functionaries involved in marketing process. These marketing practices are indispensable, helping in the creation of time, place, form and possession utilities. These marketing functions add to the cost but at the same time also enhance the value of the produce in the value chain benefiting both the producers and consumers. The following are main marketing functions performed for the disposal of vegetables in the study area.

Assembling

After picking/harvesting of vegetable produce, its assembling at one place is the foremost marketing practice/function performed by the farmer. The mode and place of assembling patronized by the sample vegetable growers has been presented in Table 4.29. Majority of the farmers in both AES-I and AES-II assembled their produce in the fields because of the higher additional cost that might incur to carry the produce to residential/storage places and location of some of the farms nearer to the road head. The harvested produce was assembled in fields by around 58 per cent of the vegetable growers in AES-I and 70 per cent in AES-II, whereas 42 per cent growers in AES-I and 30 per cent of growers in AES-II assembled their produce at their home. Devkota (2008) also found that owners of the produce assembled their commodities at farm level themselves.

Table 4.29 : Assembling of vegetables by sample vegetable growers

(Number)

Sr. No.	Place	AES-I	AES-II
1	At field	29 (58.00)	35 (70.00)
2	At home	21 (42.00)	15 (30.00)
	Total growers	50 (100.00)	50 (100.00)

Note: Figures in parentheses indicate percentages to total.

Cleaning/washing

Cleaning/washing operation was done to make the produce attractive and give fresh look. The proportion of vegetable growers following the cleaning and washing operations has been given in Table 4.30. The table shows that in case of tomato about 75 to 78 per cent of the vegetable growers across AES-I and AES-II performed cleaning operation by dipping tomatoes into the water. In case of cucumber, about 80 per cent of growers in AES-I and 82 per cent in AES-II washed their produce with water. For okra, no cleaning and washing operation was performed. In AES-II, about 79 per cent, 60 per cent and 62 per cent of the growers done the cleaning of bottle gourd, bitter gourd and brinjal, respectively. The crops like cauliflower, cabbage and radish were also cleaned before their disposal. The washing of radish was done by all

the growers. The cleaning of harvested potato tubers was also done by all the growers in AES-I.

Table 4.30: Proportion of vegetable growers following cleaning and washing of vegetables

(Per cent)

Sr. No.	Vegetable	AES-I	AES-II
1	Tomato	75.00	78.00
2	Cucumber	80.00	82.00
3	Bottle gourd	-	79.00
4	Bitter gourd	-	60.00
5	Brinjal	-	62.00
6	Okra	-	-
7	Potato	100.00	-
8	Cauliflower	81.00	85.00
9	Cabbage	59.00	67.00
10	Radish	100.00	100.00

Grading and sorting

Grading is one of the most important market functions from the market point of view as it helps to fetch higher price of produce. The grading of vegetables by the growers, as such, was not commonly practiced in the study area. However, instead of systematic grading, sorting of vegetables was practiced into different lots having uniform size. The mode and important characteristics considered during sorting and the proportion of growers following this practice for different vegetables has been given in Table 4.31.

Generally, sorting was done manually using family labour in almost all vegetables. In case of tomato, the major characteristics considered for sorting were size, colour and ripeness and it was practiced by 75 per cent of the vegetable growers in AES- I and 81 per cent of the growers in AES-II. Size and maturity were the characteristics considered for sorting cucumber, bottle gourd, bitter gourd and okra and was practiced by about 55 per cent to 60 per cent of the growers. Size, shape, insect/disease infection were the characteristics for sorting brinjal and potato and the proportion of farmers practicing sorting was comparatively higher in AES-I (89 %) than AES-II (57 %).

For cauliflower, curd colour, compactness, and mould growth and for cabbage, compactness of the head was the main characteristics considered for sorting. Similarly, length, shape and maturity were the major traits for sorting of radish. The proportion of farmers doing sorting of cauliflower, cabbage and radish was slightly more in AES-I than AES-II.

Table 4.31 : Major characteristics for grading/sorting of vegetables

Sr. No.	Vegetable	Per cent growers		Characteristics considered
		AES-I	AES-II	
1	Tomato	75.00	81.00	Size, colour, ripeness
2	Cucumber	62.00	60.00	Size, maturity
3	Bottle gourd	-	57.00	Size, maturity
4	Bitter gourd	-	58.00	Size, maturity
5	Brinjal	-	57.00	Size, shape, insect/disease infection
6	Okra	-	55.00	Size, maturity
7	Potato	89.00	-	Size, insect/disease infection
8	Cauliflower	65.00	61.00	Curd colour, compactness, mould growth
9	Cabbage	53.00	52.00	Compactness of head
10	Radish	60.00	53.00	Length, shape, maturity

Packaging

Packaging is one of the important and necessary functions performed in the marketing of the vegetables and to take it to the marketing channels. The mode and type of material used for packaging of vegetables has been given in Table 4.32. In the study area, packaging was done manually for all the vegetables. The plastic crates, plastic net bags, polythene bags, corrugated boxes and gunny bags were used as packing material for most of the vegetables. The capacity of gunny bag varied from 45 kg to 50 kg, whereas that of plastic net bag varied from 30 kg to 40 kg. Similarly, the capacity of plastic crates was 25 kg to 30 kg depending on type of vegetable. The capacity of the corrugated boxes used was to the extent of 20 kg to 30 kg. The cost of the packaging material varied according to their capacity. The average cost of plastic net bags, corrugated boxes, gunny bags and polythene bags were Rs 5, Rs 20, Rs 12 and Rs 6.

Storage

Scientific storage facilities in the study area were not available. Devkota (2008) also confirmed lack of scientific storage at farm level, compelling the vegetable growers to sell perishable commodities immediately after harvest. All the growers sold their produce immediately after harvest. In case of sale through commission agents, the growers were found to harvest their produce one day before disposing off and stored their surplus produce overnight in residential house. Whereas, in case of sale direct to retailers or to local traders, the harvesting of produce was done on the same day of marketing and thus no need of storage.

Table 4.32 : Mode of packaging of different vegetables

Sr. No	Vegetable	Material used	Capacity	Average cost of packaging material (Rs/unit)
1	Tomato	Plastic crate	25-30 kg	200-250
2	Cucumber	Polythene bag	15-20 kg	6
3	Brinjal	Polythene bag	15-20 kg	6
4	Okra	Polythene bag	15-20 kg	6
5	Bottle gourd	Polythene bag	20-25 kg	6
6	Bitter gourd	Polythene bag	15-20 kg	6
7	Cabbage	Plastic net bags	35-40 kg	5
8	Cauliflower	Carton/ Corrugated boxes	20-30 kg	20
		Plastic net bags	30-40 kg	5
9	Radish	Plastic net bags	15-20 kg	5
10	Potato	Gunny bags	45-50 kg	12

Transportation

Transportation is an indispensable marketing function at every stage right from the place of harvest to the point of consumption. The vegetable produce being highly perishable requires quick disposal to avoid spoilage and loss in quality. The different means of transportation opted by vegetable growers in the study area have been displayed in Table 4.33. Majority of the growers (52.50 %) in AES-I and (74.00 %) in AES-II used autorickshaw for transporting vegetables from road head/residential place to market. The tempos were also used for transporting vegetables by 41 per cent (AES-I) and 64 per cent (AES-II) of the growers. Scooter was also the other means of transportation used by the growers. The cost of transportation through scooter and autorickshaw were comparatively less than other means and it also varied according to the distance covered up to the markets.

Table 4.33 : Means of transportation opted by vegetable growers

Sr. No.	Means of transportation	Per cent growers		Cost of transportation (Rs/q)	
		AES-I	AES-II	0-5 km	6-20 km
1	Autorickshaw	52.50	74.00	20	30
2	Tempo	41.00	64.00	25	40
3	Scooter	15.00	20.00	10	-

Method of sale

After unloading the produce, the growers kept their lots in queues in front of commission agent-cum-wholesaler's shop for sale. Most of them had personal contacts with the commission agents. The system of open auction was found to be followed in fixing the prices of the lots. The auctioning time was fixed 6:00 am. in summers and 6:30 a.m. in winters. The minimum auctioning price was determined by the commission agents and there after the buyers set the prices. After auctioning, the weighing of the produce was done. The mode of payments to the growers who sold their produce through commission agent-cum-wholesaler and direct to retailers was cash payment and it was made on the same day and sometimes the payment was delayed to the next day**.** The mode of payment to the growers by local traders was through cash and payments were made immediately after handling over the produce or within a maximum of one week period. The mode of sale of vegetables through open auction and mutual agreement is shown in Table 4.34.

Table 4.34 : Mode of sale of vegetables

(Per cent vegetable growers)

Sr. No.	Vegetable	AES-I		AES-II	
		Open auction	Mutual agreement	Open auction	Mutual agreement
1	Tomato	35	65	75	25
2	Cucumber	27	73	55	45
3	Brinjal	-	-	50	50
4	Okra	-	-	47	53
5	Bottle gourd	-	-	65	35
6	Bitter gourd	-	-	55	45
7	Cabbage	35	65	70	30
8	Cauliflower	40	60	60	40
9	Potato	-	100	-	-
10	Radish	-	100	63	37

Harvesting of vegetables

Assembling of vegetables

Packaging of the vegetables

Plate 4.1: Glimpses of marketing practices/functions

4.6.2 Marketing channels for vegetables

Marketing channels play a vital role in disposal of the farm produce. These are the routes via which agricultural products travel from the producer to the final consumers. The movement in the entire marketing system is facilitated by several functionaries who are involved in the entire process. The kind and length of the channels chosen for sale have a significant impact on both the absolute and proportionate share of the producers in the rupee of the consumer. Therefore, it is crucial to analyse marketing channels in order to assess the behaviour, structure, and performance of the market and to suggest potential improvements to the current marketing system. Keeping this in view, the marketing channels patronized by the vegetable growers have been examined. In the study area, the following main marketing channels were identified for the disposal of vegetables (Fig. 4.5).

Channel I (Producer →Local trader → Retailer→ Consumer)

Channel II (Producer→ Commissionagent-cum-wholesaler →Retailer →Consumer)

Channel III (Producer→Retailer→ Consumer)

It is evident from the Table 4.35 that out of the three channels, channel I (Producer→ Local trader → Retailer → Consumer) was widely followed for marketing of almost all the vegetables in AES-I whereas in AES-II, channel II (Producer→ Commissionagent-cum-wholesaler →Retailer →Consumer) was the most used channel for marketing of almost all the vegetable crops. More than 71 per cent of the vegetable growers followed channel-I in AES-I whereas in AES-II, this channel was followed by less than 50 per cent of the vegetable growers (26 % to 42 %). In AES-II, more than 68 per cent of the vegetable growers followed channel-II for marketing of all vegetables except okra.

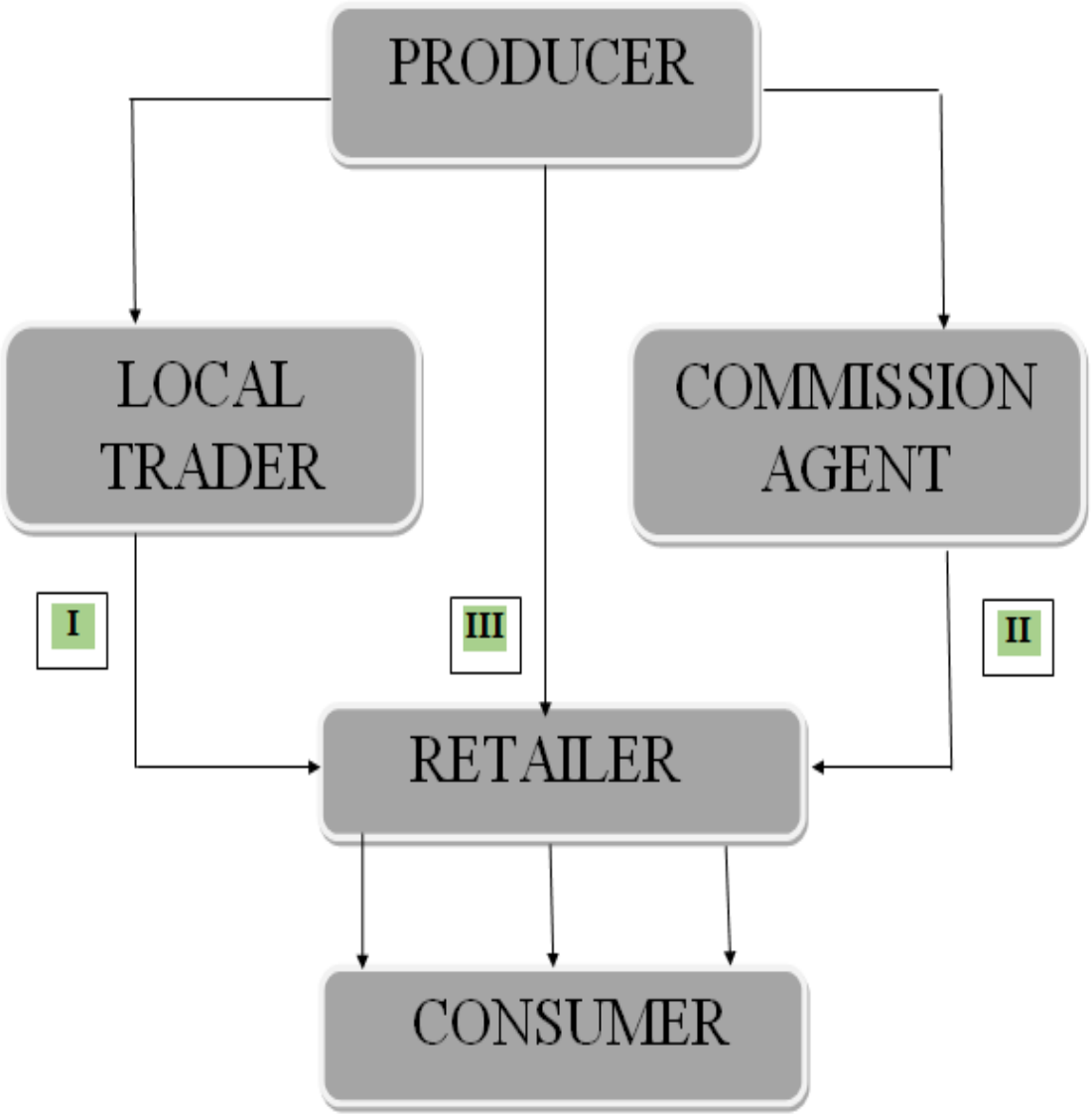

Figure 4.8 : Marketing channels for vegetables

4.6.3 Disposal of total marketed surplus

The proportion of total marketed surplus of different vegetables moved through the identified channels has been presented in Table 4.36. It can be seen from this table that in AES-I, in case of potato, around 81 per cent of the marketed surplus was disposed of by 83 per cent of the growers through channel-I followed by radish where about 71 per cent of the total marketed surplus was disposed of by 85.37 per cent of the growers, cabbage where 62.75 per cent of the total marketed surplus was disposed of by 71.11 per cent of the growers and tomato where 59.94 per cent of the total marketed surplus was disposed of by 75.86 per cent of the growers.

Since channel II was widely used for marketing of almost all vegetable crops in AES-II, 76 per cent of the total marketed surplus of brinjal was disposed of through this channel by 79.31 per cent of the growers followed by cabbage where 74.36 per cent of the total marketed surplus was disposed of by 69.39 per cent of the growers, cauliflower where 72.37 per cent of the total marketed surplus was disposed of by 68.00 per cent of the growers and bottle gourd where 70.60 per cent of the total marketed surplus was disposed of by 78.05 per cent of the growers.

Channel III was not that much significant because only 9-29 per cent of the total marketed surplus was disposed of through this channel in both AES-I and AES-II.

To sum up, it can be concluded that in AES-I, about 75 to 85 per cent of the farmers used channel I followed by 32 to 38 per cent of the farmers who used channel II and only 9 to 16 per cent of the farmers used channel III for marketing of the vegetables. In AES-II, channel II was patronized by 68 to 88 per cent of the farmers followed by 28 to 42 per cent farmers who used channel I and 21 to 28 per cent farmers who used channel III for marketing their produce.

Table 4.35 : Marketing channels patronized by vegetable growers

(Number)

Sr. No.	Vegetables	Channel I	Channel II	Channel III
1	Tomato			
	AES-I	22 (75.86)	11 (37.93)	4 (13.79)
	AES- II	11 (28.95)	26 (68.42)	8 (21.05)
2	Cucumber			
	AES-I	38 (77.55)	16 (32.65)	8 (16.33)
	AES-II	18 (36.00)	36 (72.00)	14 (28.00)
3	Bottle gourd			
	AES-I	-	-	-
	AES-II	16 (39.02)	32 (78.05)	11 (26.83)
4	Bitter gourd			
	AES-I	-	-	-
	AES-II	8 (24.24)	23 (69.69)	7 (21.21)
5	Brinjal			
	AES-I	-	-	-
	AES-II	9 (31.03)	20 (68.96)	6 (20.69)
6	Okra			
	AES-I	-	-	-
	AES-II	9 (32.14)	15 (53.57)	12 (42.85)
7	Potato			
	AES-I	30 (83.33)	-	13 (36.11)
	AES-II	-	-	-
8	Cauliflower			
	AES-I	42 (84.00)	17 (34.00)	5 (10.00)
	AES-II	21 (42.00)	34 (68.00)	11 (22.00)
9	Cabbage			
	AES-I	32 (71.11)	15 (33.33)	5 (11.11)
	AES-II	14 (28.57)	34 (69.39)	9 (18.37)
10	Radish			
	AES-I	35 (85.37)	-	8 (19.15)
	AES-II	18 (38.30)	35 (74.47)	13 (27.66)

Note: Figures in the parentheses show percentages to total number of growers of particular vegetable.

Channel-I : Producer-local trader-retailer-consumer
Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer
Channel-III : Producer-retailer-consumer

Table 4.36 : Marketed surplus routed through different marketing channels

(Per cent)

Sr. No.	Vegetables	Channel I	Channel II	Channel III	Total marketed surplus (q)
1	Tomato				
	AES-I	59.94	30.36	9.70	250.27
	AES-II	18.97	52.16	28.87	421.80
2	Cucumber				
	AES-I	51.47	33.39	15.14	330.26
	AES-II	10.82	66.24	22.94	468.00
3	Bottle gourd				
	AES-I	-	-	-	-
	AES-II	12.95	71.46	15.59	579.33
4	Bitter gourd				
	AES-I	-	-	-	-
	AES-II	23.25	55.81	20.94	129.03
5	Brinjal				
	AES-I	-	-	-	-
	AES-II	28.98	57.98	13.04	65.54
6	Okra				
	AES-I	-	-	-	-
	AES-II	24.59	43.31	32.10	46.76
7	Potato				
	AES-I	81.38	-	18.62	134.28
	AES-II	-	-	-	-
8	Cauliflower				
	AES-I	58.50	34.30	7.20	341.50
	AES-II	15.54	72.43	12.03	499.00
9	Cabbage				
	AES-I	62.75	26.14	11.11	191.25
	AES-II	12.24	75.99	11.77	424.83
10	Radish				
	AES-I	71.11	-	28.89	140.63
	AES-II	19.49	63.99	16.52	307.85

Note : Channel-I : Producer-local trader-retailer-consumer
Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer
Channel-III : Producer-retailer-consumer

4.6.4 Marketing costs and margins in the marketing of vegetables

Marketing costs are incurred by the producer as well as by the intermediaries to carry the produce from the place of its production to the ultimate consumer and for this reason, various middlemen or intermediaries charge a fee in exchange for performing their duties. This affects the producer's share in consumer's rupee directly, because higher the marketing cost and margin lesser will be the producer's share in consumer's rupee and vice-versa. Therefore, from both the producer's and the consumer's perspectives, it is crucial to evaluate marketing expenses and margins.

The total marketing costs and margins in the marketing of different vegetables has been analyzed and presented in Table 4.37. A close examination of the table reveals that the total marketing cost and margins in marketing of tomato varied from Rs. 460 per quintal (channel-III) to Rs. 694 per quintal (channel-I) in AES-I and from Rs. 504 per quintal (channel-III) to Rs. 663 per quintal (channel-I) in AES-II. The total marketing cost and margins in marketing of cucumber varied from Rs. 459 per quintal (channel-III) to Rs. 633.50 per quintal (channel-II) in AES-I and from Rs. 469 per quintal (channel-III) to Rs. 624 per quintal (channel-II) in AES-II. In case of cauliflower, the total marketing cost and margins varied from Rs. 450.05 per quintal (channel-III) to Rs. 703 per quintal (channel-II) in AES-I and from Rs. 494 per quintal (channel-III) to Rs. 654 per quintal (channel-II) in AES-II. Similarly, in cabbage, the total marketing cost and margins varied from Rs. 431.50 per quintal (channel-III) to Rs. 706 per quintal (channel-I) in AES-I and from Rs. 469 per quintal (channel-III) to Rs. 644 per quintal (channel-I) in AES-II. The total marketing cost and margins in marketing of radish in AES-I were Rs. 423.50 per quintal in channel-III and Rs. 665 per quintal in channel-I and in AES-II, it varied from Rs. 398 per quintal (channel-III) to Rs. 644 per quintal (channel-I).

However, the total marketing cost and margins in marketing of bottle gourd varied from Rs. 460 per quintal (channel-III) to Rs. 642 per quintal (channel-II). In bitter gourd, the total marketing cost and margins varied from Rs. 442 per quintal (channel-III) to Rs. 575 per quintal (channel-I). In case of brinjal, the total marketing cost and margins in marketing varied from Rs. 437 per quintal (channel-III) to Rs. 647

per quintal (channel-I). The total marketing cost and margins in marketing of okra varied from Rs. 418 per quintal (channel-III) to Rs. 618 per quintal (channel-I). Similarly, for potato, the total marketing cost and margins were Rs. 392 per quintal in channel-III and Rs. 635 per quintal in channel-II.

To sum up, it can be concluded that in both AES-I and AES-II, the total marketing costs and margins were least in channel-III, since this channel involved minimum number of the intermediaries for marketing of the vegetables.

Table 4.37 : Marketing costs and margins in the marketing of vegetables

(Rs./q)

Sr. No.	Vegetables	AES-I			AES-II		
		Channel-I	Channel-II	Channel-III	Channel-I	Channel-II	Channel-III
1	Tomato	694.00	674.40	460.00	663.00	646.00	504.00
2	Cucumber	622.00	633.50	459.00	592.00	624.00	469.00
3	Bottle gourd	-	-	-	600.00	642.00	460.00
4	Bitter gourd	-	-	-	575.00	567.00	442.00
5	Brinjal	-	-	-	647.00	585.00	437.00
6	Okra	-	-	-	618.00	558.00	418.00
7	Potato	635.00	-	391.50	-	-	-
8	Cauliflower	677.00	703.00	450.05	642.00	654.00	494.00
9	Cabbage	706.00	699.50	431.50	644.00	638.00	469.00
10	Radish	665.00	-	423.25	644.00	615.00	398.00

4.6.5 Price spread analysis

The economic efficiency of the marketing system is generally measured in terms of the analysis of marketing costs, marketing margins and price-spread of agricultural commodities. The analysis of price spread includes the breakup of price

paid by the ultimate consumers into marketing costs and margins of different market functionaries and the net price received by producers. It refers to the difference between the two prices, i.e., the price paid by the consumer and the price received by the producer**.**

4.6.5.1 Price spread for different vegetables through Channel-I

The detailed analysis of price spread in the marketing of vegetables through channel-I is represented through Table 4.38. It was found that in AES-I, growers retained the highest share of consumer's rupee in cauliflower (70.56 %), followed by radish (68.78 %), cabbage (68.48 %), tomato (66.79 %) and cucumber (65.82 %). The lowest share of consumer's rupee was received for potato (65.67 %). Similar results were observed by Chaudhary et al. (2017). In AES-II, growers got the highest share of consumer's rupee in case of bottle gourd (72.72 %), followed by cauliflower (72.09 %), okra (70.43 %), radish (70.04 %), brinjal (69.90 %), cabbage (69.90 %), tomato (69.58 %) and cucumber (68.51 %). The lowest share of consumer's rupee was received for bitter gourd (66.00 %). Comparatively, in AES-II, the growers retained more share of consumer's rupee for all the vegetables than AES-I. In both agro-ecological situations, the total marketing cost incurred at producer's level ranged between one to two per cent for most of the vegetables except radish where it accounted for less than one per cent of consumer's rupee. Packing charge was the main item of marketing cost borne by the growers as it accounted for 100 per cent of total marketing cost (Appendix III). The total cost of marketing paid by local trader accounted for about three to five per cent and transportation charges accounted for 37 to 48 per cent of cost paid by the local trader (Appendix VI). The local trader earned a net margin of 7 to 11 per cent. The various costs paid by retailers accounted for about two to four per cent. Out of the total marketing cost of retailer, losses during storage were the major item which accounted for 33 to 41 per cent of cost paid by retailer (Appendix VIII). Among the market functionaries, the margin of retailer was maximum and ranged between 9 to 13 per cent.

Table 4.38: Price spread for different vegetables through Channel-I

(Rs./q)

Sr. No.	Functionary	Tomato		Cucumber		Bottle gourd		Bitter gourd		Brinjal	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Net price received by the producer	1396 (66.79)	1517 (69.58)	1198 (65.82)	1288 (68.51)	-	1600 (72.72)	-	1122 (66.00)	-	1503 (69.90)
2	Marketing cost incurred by producer	28.00 (1.13)	26.00 (1.19)	35.00 (1.90)	30.00 (1.60)	-	24.00 (1.09)	-	30.00 (1.76)	-	30.00 (1.40)
3	Price paid by local trader	1424 (68.13)	1543 (70.77)	1233 (67.74)	1318 (70.10)	-	1624 (73.81)	-	1152 (67.76)	-	1533 (71.30)
4	Margin of local trader	215.25 (10.30)	200.00 (9.17)	195.00 (10.71)	180.00 (9.57)	-	175.00 (7.95)	-	180.50 (10.61)	-	210.00 (9.76)
5	Marketing cost incurred by local trader	101.50 (4.86)	106.00 (4.86)	94.00 (5.16)	102.00 (5.42)	-	97.00 (4.41)	-	94.50 (5.55)	-	94.75 (4.41)
6	Price paid by retailer	1740.75 (83.28)	1849 (84.81)	1522 (83.62)	1600 (85.10)	-	1896 (86.18)	-	1427 (85.29)	-	1837.75 (85.47)
7	Margin of retailer	265.00 (12.68)	250.00 (11.46)	219.00 (12.03)	205.00 (10.90)	-	230.00 (10.45)	-	198.00 (11.64)	-	240.00 (11.16)
8	Marketing cost incurred by retailer	84.25 (4.03)	81.00 (3.71)	79.00 (4.34)	75.00 (3.98)	-	74.00 (3.36)	-	72.00 (4.23)	-	72.25 (3.36)
9	Price paid by consumer	2090	2180	1820	1880	-	2200	-	1700	-	2150

Note: Figures in parentheses indicate percentages of consumer's price.
Channel-I : Producer-local trader-retailer-consumer.

Table 4.38 (cont.): Price spread for different vegetables through Channel I

(Rs./ q)

Sr. No.	Functionary	Okra		Potato		Cauliflower		Cabbage		Radish	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1.	Net price received by the producer	-	1472 (70.43)	1215 (65.67)	-	1623 (70.56)	1586 (72.09)	1534 (68.48)	1496 (69.90)	1465 (68.78)	1506 (70.04)
2.	Marketing cost incurred by producer	-	24.00 (1.15)	28.00 (1.51)	-	30.00 (1.30)	28.00 (1.27)	32.00 (1.42)	28.00 (1.30)	18.00 (0.85)	17.00 (0.79)
3.	Price paid by local trader	-	1496 (73.25)	1243 (67.18)	-	1653 (71.86)	1586.00 (72.09)	1566.00 (69.91)	1524.00 (71.21)	1483 (69.62)	1523 (70.83)
4.	Margin of local trader	-	195.00 (8.61)	205.50 (11.10)	-	240 (9.56)	195.00 (8.86)	245.50 (10.95)	207.00 (9.67)	245.00 (11.50)	222.00 (10.32)
5.	Marketing cost incurred by local trader	-	89.00 (4.25)	92.75 (5.01)	-	97.00 (4.21)	102.00 (4.63)	96.50 (4.30)	101.00 (4.72)	77.00 (3.61)	84.00 (3.90)
6.	Price paid by retailer	-	1780 (86.60)	1541.25 (83.31)	-	1970 (85.65)	1883.00 (85.59)	1908 (85.17)	1832.00 (86.77)	1805 (84.74)	1829 (85.06)
7.	Margin of retailer	-	240 (10.52)	238 (12.86)	-	260 (11.30)	250 (11.37)	260 (11.60)	240 (11.21)	270.70 (12.70)	270.50 (12.58)
8.	Marketing cost incurred by retailer	-	70.00 (3.34)	70.75 (3.82)	-	70.00 (3.04)	67.00 (3.04)	72.00 (3.21)	68.00 (3.17)	54.30 (2.54)	50.50 (2.34)
9.	Price paid by consumer	-	2090	1850	-	2300	2200	2240	2140	2130	2150

Note: Figures in parentheses indicate percentages of consumer's price.

Channel-I : Producer-local trader-retailer-consumer.

Table 4.39 : Price spread for different vegetables through Channel II

(Rs./q)

Sr. No.	Functionary	Tomato		Cucumber		Bottle gourd		Bitter gourd		Brinjal	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Net price received by the producer	1425.60 (67.88)	1504.00 (69.95)	1226.50 (65.94)	1276.00 (67.16)	-	1508.00 (70.13)	-	1183.00 (67.60)	-	1415.00 (70.75)
2	Marketing cost incurred by producer	148.40 (7.06)	143.00 (6.60)	158.50 (8.52)	153.00 (8.05)	-	142.00 (6.60)	-	147.00 (8.40)	-	146.00 (7.30)
3	Price paid by CA-cum-wholesaler	1574.00 (74.95)	1647.00 (76.60)	1385.00 (74.46)	1429.00 (75.21)	-	1650.00 (76.74)	-	1330.00 (80.00)	-	1561.00 (78.05)
4	Margin of CA-cum-wholesaler	97.00 (4.61)	90.50 (4.20)	83.00 (4.46)	73.50 (3.86)	-	99.50 (4.62)	-	80.00 (4.00)	-	84.75 (4.23)
5	Marketing cost incurred by CA-cum-wholesaler	77.00 (3.67)	74.50 (3.47)	71.00 (3.81)	75.50 (3.97)	-	65.50 (3.05)	-	60.00 (3.43)	-	63.25 (3.16)
6	Price paid by retailer	1748.00 (83.23)	1812.00 (84.27)	1539.00 (82.74)	1578.00 (83.05)	-	1815.00 (84.41)	-	1470.00 (87.43)	-	1709.00 (85.45)
7	Margin of retailer	220.25 (10.48)	195.50 (9.09)	180.5 (9.70)	170.00 (8.94)	-	201.00 (9.34)	-	170.00 (6.29)	-	175.50 (8.77)
8	Marketing cost incurred by retailer	131.75 (6.27)	142.50 (6.62)	140.50 (7.55)	152.00 (8.00)	-	134.00 (6.23)	-	110.00 (6.29)	-	115.50 (5.78)
9	Price paid by consumer	2100.00	2150.00	1860.00	1900.00	-	2150.00	-	1750.00	-	2000.00

Note: Figures in parentheses indicate percentages of consumer's price.

CA : Commission agent.

Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer.

Table 4.39 (cont.) : Price spread for different vegetables through Channel II

(Rs./q)

Sr. No.	Functionary	Okra		Potato		Cauliflower		Cabbage		Radish	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Net price received by the producer	-	1292.00 (69.83)	-	-	1697.00 (70.70)	1806.00 (73.41)	1620.50 (69.84)	1612.00 (71.65)	-	1500.00 (70.92)
2	Marketing cost incurred by producer	-	123.00 (6.65)	-	-	128.00 (5.33)	125.00 (5.08)	129.50 (5.58)	128.00 (5.68)	-	127.00 (6.00)
3	Price paid by CA-cum-wholesaler	-	1415.00 (76.48)	-	-	1825 (77.08)	1931 (78.50)	1750.00 (75.43)	1740.00 (77.34)	-	1627.00 (76.92)
4	Margin of CA-cum-wholesaler	-	83.55 (4.51)	-	-	135.00 (5.41)	101.50 (4.12)	128.00 (5.51)	110.5 (4.91)	-	109.50 (5.17)
5	Marketing cost incurred by CA-cum-wholesaler	-	61.45 (3.32)	-	-	62.00 (2.58)	62.50 (2.54)	55.00 (2.37)	53.50 (2.38)	-	58.50 (2.76)
6	Price paid by retailer	-	1560.00 (84.32)	-	-	2022 (85.08)	2095 (85.16)	1933.00 (83.31)	1904.00 (84.62)	-	1795.00 (84.86)
7	Margin of retailer	-	172.50 (9.32)	-	-	270.50 (10.43)	240.00 (9.75)	275.70 (11.88)	222.00 (9.86)	-	235.00 (11.11)
8	Marketing cost incurred by retailer	-	117.50 (6.35)	-	-	107.50 (4.48)	125.00 (5.08)	111.30 (4.79)	124.00 (5.51)	-	85.00 (4.01)
9	Price paid by consumer	-	1850.00	-	-	2400.00	2460.00	2320.00	2250.00	-	2115.00

Note: Figures in parentheses indicate percentages of consumer's price.
CA : Commission agent.
Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer.

4.6.5.2 Price spread for different vegetables through Channel-II

The price spread of vegetables marketed through channel-II is presented in Table 4.38. It was found that in AES-I, growers retained the highest share of consumer's rupee in case of cauliflower (70.70 %), followed by cabbage (69.84 %) and tomato (67.88 %). The lowest share of consumer's rupee was received for cucumber (65.94 %). In AES-II, growers retained the highest share of consumer's rupee in case of cauliflower (73.41 %) followed by cabbage (71.65 %), radish (70.92 %), brinjal (70.75 %), bottle gourd (70.13 %), tomato (69.95 %), okra (69.83 %) and bitter gourd (67.60 %). The lowest share of consumer's rupee was received for cucumber (67.16 %). Comparatively, in AES-II, the growers retained more share of consumer's rupee for all the vegetables than AES-I. In both agro-ecological situations, the total cost of marketing paid by the grower accounted for five to eight per cent of the consumer's rupee and commission charges were the major item of grower's marketing cost (Appendix IV). The total cost of marketing paid by commission agent-cum-wholesaler accounted for about two to four per cent (Appendix VII) and a net margin of four to five per cent was earned by this agency. The various costs paid by retailer accounted for about four to eight per cent (Appendix IX). Among the market functionaries involved in this channel, the margin of retailer was quite high and found to be in the range of 8 to 12 per cent except bitter gourd in which the margin of retailer was only 6 per cent.

4.6.5.3 Price spread for different vegetables through Channel-III

The price spread of vegetables marketed through channel-II is presented in Table 4.39. In marketing channel III, the farmer's share in consumer's rupee was turned out to be more than 75 per cent in all the vegetables in AES-I and AES-II except bitter gourd (74.30 %). It was mainly due to the elimination of one of the market functionaries i.e., commission agent-cum-wholesaler. It was found that in AES-I, growers retained the highest share of consumer's rupee in case of cauliflower (80.97 %), followed by cabbage (79.93 %), radish (79.50 %), tomato (79.09 %), potato (78.25 %) and cucumber (75.18 %). In AES-II, growers retained the highest share of consumer's rupee in case of radish (80.58 %) followed by cauliflower (79.41 %), bottle gourd (78.09 %), tomato (77.99 %), okra (77.64 %), brinjal (77.58 %),

cabbage (76.89 %), cucumber (75.94 %) and bitter gourd (74.30 %). Comparatively, in AES-II, the growers retained more share of consumer's rupee for all the vegetables than AES-I except for cauliflower, cabbage and tomato. In both agro-ecological situations, the total cost of marketing paid by the grower accounted for three to five per cent of the consumer's rupee (Appendix V). The various costs paid by retailer accounted for about two to four per cent (Appendix X). The margin of retailer was quite high and found to be in the range of 13 to 17 per cent except for cabbage in which the margin of retailer was about 11 per cent in AES-I.

4.6.6 Marketing efficiency

Marketing efficiency shows the extent to which different marketing agencies are able to move the vegetables from producers to consumers at lowest possible cost, consistent with the provision of maximum services desired by the consumers in the marketing channels. The efficiency varies in accordance with the structure and composition of price-spread and the degree of market integration. It also implies avoiding of wasteful expenditure and exorbitant profit margins of the intermediaries resulting in direct gain to farmers in the form of remunerative farm prices or to consumers through reasonable selling prices or to both farmers and consumer by way of reducing the price spreads. The efficiency of different marketing channels for vegetables has been analysed and are presented in Table 4.41.

In case of tomato, channel-III was found to be more efficient as compared to channel-I and channel-II as marketing efficiency index was higher (3.78) in AES-I and (3.54) in AES-II. In case of cucumber, the market efficiency was high in channel-III (3.03) in AES-I and (3.15) in AES-II. Similarly, in case of bottle gourd, bitter gourd, brinjal, okra and potato the marketing efficiency was higher in channel-III (3.56, 2.89, 3.46, 3.47 and 3.59 respectively). In cabbage, cauliflower and radish, again Channel-III was the best channel with the indices of 3.98 (AES-I) and 3.10 (AES-II) for cabbage, 4.25 (AES-I) and 3.85 (AES-II) for cauliflower and 3.91 (AES-I) and 4.15 (AES-II) for radish. Channel-II was the next best channel in marketing of tomato (2.11 in AES-I and 2.32 in AES-II), bitter gourd (2.08), brinjal (2.41), cabbage (2.31 in AES-I and 2.52 in AES-II), cauliflower (2.41 in AES-I and 2.76 in AES-II) whereas channel-I was the next best channel in marketing of bottle gourd (2.66), okra

Table 4.40 : Price spread for different vegetables through Channel-III

(Rs/q)

Sr. No.	Functionary	Tomato		Cucumber		Bottle gourd		Bitter gourd		Brinjal	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Net price received by the producer	1740.00 (79.09)	1786.00 (77.99)	1391.00 (75.18)	1481.00 (75.94)	-	1640.00 (78.09)	-	1278.00 (74.30)	-	1513.00 (77.58)
2	Marketing cost incurred by producer	87.00 (3.95)	83.00 (3.62)	95.00 (5.13)	89.00 (4.56)	-	80.00 (3.81)	-	82.00 (4.76)	-	84.00 (4.30)
3	Price paid by retailer	1827.00 (83.04)	1869.00 (81.61)	1486.00 (80.32)	1570.00 (80.51)	-	1720.00 (81.90)	-	1360.00 (79.06)	-	1597.00 (81.89)
4	Margin of retailer	290.00 (13.18)	335.00 (14.62)	288.00 (15.57)	300.00 (15.38)	-	305.00 (14.52)	-	288.00 (16.74)	-	280.00 (14.35)
5	Marketing cost incurred by retailer	83.00 (3.77)	86.00 (3.75)	76.00 (4.10)	80.00 (4.10)	-	75.00 (3.57)	-	72.00 (4.19)	-	73.00 (3.74)
6	Price paid by consumer	2200.00	2290.00	1850.00	1950.00	-	2100.00	-	1720.00	-	1950.00

Note: Figures in parentheses indicate percentages of consumer's price.
Channel-III : Producer-retailer-consumer.

Table 4.40 (cont.) : Price spread for different vegetables through Channel-III

(Rs./q)

Sr. No.	Functionary	Okra		Potato		Cauliflower		Cabbage		Radish	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Net price received by the producer	-	1452.00 (77.64)	1408.50 (78.25)	-	1914.95 (80.97)	1906.00 (79.41)	1718.50 (79.93)	1561.00 (76.89)	1653.75 (79.50)	1652.00 (80.58)
2	Marketing cost incurred by producer	-	70.00 (3.74)	66.50 (3.69)	-	75.05 (3.17)	73.00 (3.04)	79.50 (3.69)	74.00 (3.64)	78.25 (3.76)	75.00 (3.65)
3	Price paid by retailer	-	1522.00 (81.39)	1475.00 (81.94)	-	1990.00 (84.14)	1979.00 (82.45)	1798.00 (85.95)	1635.00 (80.54)	1732.00 (83.26)	1727.00 (84.24)
4	Margin of retailer	-	270.00 (14.43)	255.25 (14.18)	-	310.50 (13.12)	355.00 (14.79)	280.00 (10.69)	320.00 (15.76)	298.00 (14.32)	275.00 (13.41)
5	Marketing cost incurred by retailer	-	78.00 (4.17)	69.75 (3.88)	-	64.50 (2.73)	66.00 (2.75)	72.00 (3.34)	75.00 (3.69)	50.00 (2.40)	48.00 (2.34)
6	Price paid by consumer	-	1870.00	1800.00	-	2365.00	2400.00	2150.00	2030.00	2080.00	2050.00

Note: Figures in parentheses indicate percentages of consumer's price.
Channel-III : Producer-retailer-consumer.

Table 4.41 : Marketing efficiency of different vegetables

Sr. No.	Vegetable	Marketing channel	AES-I			AES-II		
			V	I	MEI	V	I	MEI
1.	Tomato	I	2090	694.00	2.01	2180	663.00	2.28
		II	2100	674.40	2.11	2150	646.00	2.32
		III	2200	460.00	3.78	2290	504.00	3.54
2.	Cucumber	I	1820	622.00	1.92	1880	592.00	2.17
		II	1860	633.50	1.93	1900	624.00	2.04
		III	1850	459.00	3.03	1950	469.00	3.15
3.	Bottle gourd	I	-	-	-	2200	600.00	2.66
		II	-	-	-	2150	642.00	2.34
		III	-	-	-	2100	460.00	3.56
4.	Bitter gourd	I	-	-	-	1700	575.00	1.95
		II	-	-	-	1750	567.00	2.08
		III	-	-	-	1720	442.00	2.89
5.	Brinjal	I	-	-	-	2150	647.00	2.32
		II	-	-	-	2000	585.00	2.41
		III	-	-	-	1950	437.00	3.46

Note: V = Consumer's price
I = Total marketing cost and marketing margin (Rs/q)
MEI = Marketing efficiency index

Table 4.41 (cont.) : Marketing efficiency of different vegetables

Sr. No.	Vegetable	Marketing channel	AES-I			AES-II		
			V	I	MEI	V	I	MEI
6	Okra	I	-	-	-	2090	618.00	2.38
		II	-	-	-	1850	558.00	2.31
		III	-	-	-	1870	418.00	3.47
7	Potato	I	1850	635.00	1.91	-	-	-
		II	-	-	-	-	-	-
		III	1800	391.50	3.59	-	-	-
8	Cabbage	I	2240	706.00	2.17	2140	644.00	2.32
		II	2320	699.50	2.31	2250	638.00	2.52
		III	2150	431.50	3.98	2030	494.50	3.10
9	Cauliflower	I	2300	677.00	2.39	2200	642.00	2.42
		II	2400	703.00	2.41	2460	654.00	2.76
		III	2365	450.05	4.25	2400	494.00	3.85
10	Radish	I	2130	665.00	2.20	2150	644.00	2.33
		II	-	-	-	2115	615.00	2.43
		III	2080	423.25	3.91	2050	398.00	4.15

Note: V = Consumer's price
I = Total marketing cost and marketing margin (Rs/q)
MEI = Marketing efficiency index

(2.38) and potato (1.91). The analysis clearly reveals that marketing efficiency was in inverse relation with the total marketing costs and margins. With the increased number of market intermediaries, the costs and margins also increased and market efficiency decreased. The method of sale to retailer's shop (channel-III) was the best method of sale. Similar results were reported by Baba et al. (2010). Thus, the analysis of marketing efficiency revealed that the vegetable growers of the study area could not wholly patronized the most efficient channel i.e., channel-III because this channel was the shortest channel and growers could sell a small part of total quantities of their marketed surplus.

4.7 Problems and constraints

In this section, an attempt has been made to know the various problems faced by the vegetable growers and traders in production and marketing of vegetables on the basis of opinion survey. The opinion survey was analysed using Garrett's ranking technique.

4.7.1 Problems faced by the growers

The opinion survey was conducted to know the problems of vegetable growers related to production, post-harvest management and marketing of vegetables. The detailed analysis of the opinion survey has been presented in Table 4.42. It can be seen from the table that among the problems relating to production of vegetables, high incidence of pest and diseases was reported top most problems by the growers with average Garrett's score of 75.46 in AES-I and 77 in AES-II. The study by Hosali and Lokapur (2015) also highlighted the problem of high incidence of pest and diseases in production of cauliflower. In AES-I, the high cost of inputs and poor quality of seed were rated at second and third place, respectively with respective average Garrett's score of 64.26 and 54 in AES-I. The next major problems were labour scarcity and animal menace with respective average Garrett's score of 46 (rank IV) and 37 (rank V). In AES-II, the high cost of inputs and poor quality of seed were rated at second and third place, respectively with respective average Garrett's score of 63 and 54 in AES-I. These were followed by labour scarcity and non-availability of credit with respective average Garrett's score of 46 (rank IV) and 23 (rank V).

In case of problems relating to post-harvest management of vegetables, lack of scientific storage facilities was most prominent problem indicated as rank I with mean Garrett's score of 73.50 in AES-I and 75 in AES-II. It was followed by lack of training facilities like use of zero energy cool chambers for post-harvest management of vegetables with average Garrett's score of 50 (rank II) in AES-II. However, in AES-I, the second rank was given to unfavourable weather conditions during harvest of vegetables with average Garrett's score of 50. The problems of poor transportation facilities and poor packaging material were ranked IV and V, respectively in both the agro-ecological situations.

With respect to the problems relating to marketing of produce, unfavourable price received by producers was the most prominent problem recorded at first place by mean Garrett score of 81 each in both AES-I and AES-II. The next prominent problems were faulty weighing practices by traders and lack of market information indicated as rank II and rank III, respectively in both the scenarios by mean Garrett's scores. The problems of distant market and high transportation charges were also prominent in the study area. The other problems prominent in the area were costly packing material, lack of link roads, road blockage during marketing season on account of rainy season and lack of standard grades.

To sum up it can be concluded that high incidence of pest attack followed by high cost of inputs and poor quality of seed were the major problems relating to production of vegetables. Lack of scientific storage facilities was the major problem relating to post-harvest management of vegetables. Unfavourable price for the produce followed by faulty weighing practices by traders and lack of market information was the major problems faced by growers in marketing of vegetables.

4.7.2 Problems faced by traders

The Garrett ranking analysis for marketing problems faced by vegetable traders of the study area has been presented in the Table 4.43. It can be seen from the table that among the different problems considered for evaluation, lack of scientific storage facilities was the most prominent problem faced by the traders and was rated at number one as indicated by mean Garrett's score of 78. The study by Hosali and Lokapur (2015) also ranked the problem relating to storage as rank I in the marketing

Table 4.42 : Problems faced by growers in different aspects of vegetable cultivation **(Garrett's score)**

Sr. No.	Particulars	AES-I				AES-II			
		Sum of the scores	Mean	Ranks	Severity level	Sum of the score	Mean	Ranks	Severity level
1	**Problems relating to production**								
a)	High incidence of pest and diseases	3773	75.46	I	High	3850	77	I	High
b)	High cost of inputs (seed, fertiliser, pesticides etc)	3213	64.26	II	Medium	3150	63	II	Medium
c)	Poor quality of seeds	2700	54	III		2700	54	III	
d)	Labour scarcity and high wage rate	2300	46	IV		2300	46	IV	
e)	Stray/wild animals and monkey menace	1850	37	V		629	12.58	VI	Low
f)	Non-availability of credit	1150	23	VI	Low	1150	23	V	
2	**Problems relating to post-harvest management**								
a)	Lack of scientific storage facilities	3675	73.50	I	High	3750	75	I	High
b)	Lack of training facilities for post-harvest management of vegetables	2193	43.86	III	Medium	2500	50	II	Medium
c)	Unfavourable weather conditions during harvest	2500	50	II		2064	41.28	III	
d)	Poor transportation facility	2000	40	IV		2000	40	IV	
e)	Poor quality of packing material	1200	24	V	Low	360	7.2	V	Low
3	**Problems relating to marketing**								
a)	Unfavourable price for the produce	4050	81	I	High	4050	81	I	High
b)	Faulty weighing practices and delayed payment by traders	3312	66.24	II	Medium	3450	69	II	
c)	Lack of market information	3100	62	III		3100	62	III	Medium
d)	Market at distance place	2800	56	IV		2800	56	IV	
e)	High cost and non-availability of means of transportation at right time	2500	50	V		2500	50	V	
f)	Costly packing material	2200	44	VI		2200	44	VI	
g)	Lack of link road to farms	1900	38	VII		1900	38	VII	
h)	Road blockage during marketing season	1519	30.38	VIII	Low	1333	26.66	VIII	Low
i)	Lack of standard grades and no separate price for graded produce	950	19	IX		950	19	IX	

of cauliflower. The problem of high loss of produce during transportation was ranked second as indicated by mean Garrett's score of 66. The next problems faced by traders were non-availability of means of transportation at right time and labour scarcity and were ranked third and fourth on the basis of Garrett's scores.

The problem of costly packing material and road blockage during marketing season were the other problems faced by the traders and were ranked fifth and sixth on the basis of mean Garrett's score of 43 and 34, respectively. The problem relating to grading was ranked the last one by the traders which showed its least prominence.

To sum up it can be concluded that lack of scientific storage facilities followed by high loss of produce during transportation, non-availability of transportation means and labour scarcity were the major problems faced by the traders.

Table 4.43 : Marketing problems faced by vegetable traders (Garrett's score)

Sr. No.	Particulars	Sum of the scores	Mean	Ranks	Severity level
1.	Lack of scientific storage facilities	390	78	I	High
2.	High loss of produce during transportation	330	66	II	
3.	Non availability of means of transport at right time	285	57	III	
4.	Labour scarcity and high wage rate	250	50	IV	Medium
5.	Costly packing material	215	43	V	
6.	Road blockage during market season	170	34	VI	
7.	Lack of grading standards and no separate price for graded produce	110	22	VII	Low

5. SUMMARY AND CONCLUSIONS

5.1 Introduction

Vegetables are significant food and revenue sources. These can significantly contribute to both the reduction of poverty and the security of food and nutrition. These play a critical role in helping to solve the food and nutritional issues of the nation. With a share of 12 per cent of the global vegetable production, India is the second-largest producer of vegetables in the world. However, it continues to fall short of meeting the country's fundamental needs due to low productivity and significant post-harvest losses from the farmer's field to the market and, ultimately, to consumers. The considerable gap between the gross production and net availability of vegetables has been felt due to heavy post-harvest losses.

Agricultural commodities produced on the farms have to undergo a series of operations such as threshing, transportation, processing, storage and distribution before these reach the consumer, and there are appreciable losses of output during these stages of their handling. The sum quantity of outputs lost in these operations at all of these stages is referred to as "post-harvest losses". The production of most of the cash crops is seasonal and highly localized on account of location specific agro-climatic conditions in the country. The extremely perishable nature of cash crops mainly vegetables and fruits results in inability on the part of producers to manage supply till assembling markets. Further, the large distances that separate the production area and the sub-optimal post- harvest technology management, a large proportion of cash crops is spoilt at various stages of post- harvest handling. Many studies suggest that the overall losses in these crops can be up to 25-30 per cent of total production. Both quantitative and qualitative food losses of extremely variable magnitude occur at all stages in the post-harvest system from harvesting, through handling, storage, processing and marketing to final delivery to the consumer. These losses result not only in the loss of the actual crop, but also have an impact on the environment, resources, labour needed to produce the crop and livelihood of individuals involved in the production process. There is a wide range of post-harvest

technologies that can be adopted to reduce losses throughout the process from field to fork. The implementation of appropriate storage, quick transportation and post-harvest techniques add value to the produce and increase the farmer's income.

Himachal Pradesh offers enormous opportunities to practice cash crops cultivation mainly off-season as these have several unique and inherent advantages in terms of agro-climatic conditions and rich biodiversity. The state has established a solid reputation by producing a variety of seasonal and off-season vegetables. The production of vegetables which was 16.08 lakh MT in 2015-16 has gone up to18.61 lakh MT in 2019-20. These crops offer greater hope for raising farmers out of the poverty as the gestation period of vegetables varies from three to six months, higher marketable surplus and better prices at markets compared to other crops. However, these cash crops are grown in every district of the state without any organized backup of post- harvest management techniques. The state also suffers in respect of infrastructure, irrigation facilities, tiny and fragmented holdings, low to moderate accessibility to technology and low investment capacity of farmers. All these lead to low productivity and high spoilage of these crops.

Therefore, keeping these problems in view, the present study was done in Kangra district of Himachal Pradesh to study the marketing system and post- harvest loss assessment of important cash crops since the district has vast potential for production, marketing and export of cash crops. In terms of cultivated area, irrigated area and the number of cultivators, Kangra is the most agriculturally important district in Himachal Pradesh. It has vast potential for commercialization of agriculture through vegetable farming that is highly remunerative and best suited to hills and to the labour abundant small sized land holdings in this district.

Objectives

1 To study the marketable surplus and extent of post-harvest losses in major cash crops of the study area,
2 to study the marketing system, price spread and role of marketing practices in enhancing marketing efficiency.

5.2 Methodology

The study was conducted in Kangra district of Himachal Pradesh. This area was purposively selected because the district has the highest number of cultivators and total cropped area among all the districts of the state. Three stage random sampling technique was adopted for selecting representative/sample farm households. In the first stage of sampling, a list of blocks where vegetables are being grown commercially was prepared. From this list, the blocks were segregated into two categories based on the similarities of agro-climatic and ecological conditions. Thereafter from each category, one block was randomly selected for the comparative study. The blocks so selected were Baijnath (AES-I) and Kangra (AES-II). In the second stage of sampling, the prominent vegetable growing villages were identified in the selected blocks in consultation with the officials of State Agriculture Department. A sampling frame of villages was prepared separately for the selected blocks, then an equal sample of 5 villages from each sampling frame was drawn, thus making total sample of 10 villages. In third stage of sampling, a list of vegetables growing farmers was prepared separately for each selected village under AES-I and AES-II with the consultation of village extension officer (agriculture). An equal sample of 10 farmers from the list of farmers of each sample village was drawn randomly, thus, making a total sample of 100 farmers.

In addition to this, a manageable sample of 30 market functionaries was also drawn from Baijnath and Kangra markets to study the post-harvest losses and marketing of vegetables.

The present study was primarily based on primary data which were collected through survey method. To achieve the stated objectives of the study the simple tabular analysis involving averages, ratios and percentages has been used extensively. Regression analysis was used to investigate the factors that influenced the post-harvest losses in vegetables.

5.3 Major findings

The main findings of the present study are as follows:

- Profile of head of the family of sample farm households revealed that 36

percent respondents in AES-I and 50 per cent respondents in AES-II were between the age of 41 and 60 years, in terms of education 30 per cent in AES-I studied up to secondary level and 34 per cent in AES-II were matriculates. Agriculture was the main occupation of 72 per cent and 70 per cent respondents in AES-I and AES-II, respectively.

- The socio-economic profile of sample farm households showed that in AES-I and AES-II, the average family size in the sample farm household was five and four people, respectively. In case of family structure information 76 per cent had a joint family structure in AES-I, compared to 60 percent farm households with a nuclear family in AES-II. More than 50 per cent of population was between 31-60 years of age in both AES-I and AES-II. The sex ratio turned out to be 1191 in AES-I and 1267 in AES-II. Dependency ratio with respect to total workers was 0.59 in AES-I and 0.36 in AES-II. About 17 per cent of members had education up to middle level in AES-I whereas about 21 per cent of family members had education up to secondary level. In comparison to no illiterates in AES-II,3.05 per cent of females were illiterate in AES-I accounting for the total illiteracy. The overall literacy rate was recorded to be 98.29 percent in AES-I and 100.00 per cent in AES-II.
- Agriculture was reported to be the primary source of income for 42.68 per cent and 56.78 per cent people followed by government service/pension (24.20 %) and private job (14.84 %) in AES-I and AES-II, respectively. Occupational pattern of sample farm households showed that 43.06 per cent males and 42.35 per cent females were engaged in agriculture in AES-I as compared to 61.33 per cent males and 52.50 per cent females in AES-II. This showed that in AES-II proportionately more males and females were engaged in agricultural activities.
- Investment on farm buildings and structures revealed that the residential building and cattle shed accounted for more than 95 per cent and 94 per cent of the total farm investments made by sample farm households in AES-I and AES-II, respectively. *Kuccha* type of cattle shed were more prominent in AES-I as compared to AES-II where mixed type of cattle

shed were more common.

- The per farm investment in all types of implements, tools, and machinery was Rs16503 in AES-I and Rs 30127 in AES-II. In the total farm investments, farm machinery and implements accounted for 1.62 per cent in AES-I and 2.79 per cent in AES-II.
- Livestock inventory showed that the average number of livestock per farm was1.42 in AES-I and 1.91 in AES-II, with cow being the most popular among the farm households and majority was of improved breeds. The number of improved cows was 0.80 in AES-I and 0.98 in AES-II. The total investment on livestock unit was more in AES-II (Rs. 29875/farm) than AES-I (Rs.23209/farm).
- The average land holding on the sample farm households was 0.37 hectares in AES-I and 0.53 hectares in AES-II. The available land was being put under cultivation, forest, pasture& grasslands, orchards, etc. Among the different land uses highest area was allocated for cultivation of crops accounting for about 85 per cent and 90 per cent of total land holding in AES-I and AES-II, respectively.
- Cropping pattern of the sample farm households was dominated by vegetables as these accounted for 69.69 per cent and 66.04 per cent of the total cropped area in AES-I and AES-II, respectively. The cropping intensity on sample farm households was about 202 per cent in AES-I and 209 in AES-II which indicated that cultivated land is used more than once in a year.
- As far as the production and productivity of vegetables was concerned, it was estimated that total production of vegetables was more in AES-II (74.21 q) than AES-I (43.54 q). Among various vegetables, per farm production of tomato was highest (9.69 q) in AES-I while the per farm production of bottle gourd was highest (15.50 q) in AES-II. The productivity of all vegetables was comparatively more in AES-II than AES-I and ranged between 89.70q/ha (brinjal) to 244.70 q/ha (tomato) in AES-I and 91.66 q/ha (potato) to 250.60 q/ha (bottle gourd) in AES-II.
- The marketable surplus of all the vegetable crops except potato was found

to be more than 90 per cent of total production in AES-I while in AES-II, all the vegetables had more than 95 per cent of the marketable surplus. The marketed surplus of all the vegetable crops in AES-I varied from 81.80 per cent in potato to 94.73 per cent in radish while in AES-II, the marketed surplus varied from 89.30 per cent in tomato to 96.24 per cent in okra. The per cent share of utilization to total production ranged from 0.83 per cent (radish) to 13.21 per cent (potato) in AES-I and 0.65 per cent (bottle gourd) to 2,12 per cent (brinjal) in AES-II.

- The total marketed surplus of all the vegetables was higher in AES-II (3076.45 q) as compared to AES-I (1388.19 q). Among all vegetables, total marketed surplus per farm was highest for cauliflower (341.50 q) in AES-I while it was highest for bottle gourd (579.33 q) in AES-II.
- There was post-harvest loss of 2.40 quintal per farm in all the vegetables grown in AES-I. Comparatively, the post-harvest loss in AES-II was 5.20 quintal per farm in all the vegetables. Tomato accounted for the maximum post-harvest loss which alone shared 35.83 per cent and 20.76 per cent of the total loss per farm in AES-I and AES-II, respectively.
- The total post-harvest losses in tomato were 10.08 kg/quintal in AES-I and12.33 kg/quintal in AES-II. Total post-harvest losses in cucumber were 9.64 kg/quintal in AES-I and 11.88 kg/quintal in AES-II. Similarly, the total post-harvest losses in bottle gourd, bitter gourd, brinjal and okra were 10.73 kg/quintal, 6.39 kg/quintal, 5.27 kg/quintal and 6.13 kg/quintal, respectively. The total post-harvest losses in potato were 9.11 kg/quintal. In case of cauliflower, total post-harvest losses were 9.39 kg/quintal in AES-I and 12.91 kg/quintal in AES-II. The total post-harvest losses in cabbage were 11.45 kg/quintal in AES-I and 12.51 kg/quintal in AES-II. Similarly, the total post-harvest losses in radish varied from 6.84 kg/quintal in AES-I to 3.38 kg/quintal in AES-II.
- Whole orientation of the vegetable growers in the study area was concentrated towards the production. Their negligent attitude towards the post-harvest losses, improper harvesting techniques, unfavorable weather conditions during harvest, faulty methods of packing, and improper

handling during different operations were the main reasons for post-harvest losses in vegetables in both AES-I and AES-II at farm level. At trader's level, lack of better transportation facilities along with improper methods of sorting/grading and loading/ unloading, physical injuries accompanied by warm conditions and moisture became vulnerable for pest-infestation were the main reasons for rotting and losses in vegetables.

- The variation in the independent variables included in the regression model explained maximum variation of 93.81 per cent in the post-harvest losses of cucumber (AES-I) and minimum variation of 70.01 in the post-harvest losses of okra (AES-II).
- The assembling of vegetables was done at their farms by 58 per cent and 70 per cent and at their residential houses/store houses by 42 per cent and 30 per cent of the growers in AES-I and AES-II, respectively.
- The proportion of growers practicing sorting was comparatively higher in AES-I (89 %) than AES-II (57 %). The plastic net bags, gunny bags and polythene bags were the most used packaging material for most of the vegetables. Most of the growers (53 % in AES-I and 74 % in AES-II) carried their produce through autorickshaw from farm to the markets. Tempo and scooter were the other means of transportation for transporting the produce from study area to the markets. Open auction and mutual agreement were the different methods of sale of the vegetables.
- Channel I (Producer →Local trader → Retailer→ Consumer) was the most important channel for disposal of vegetables in AES-I by more than 70 per cent of the growers while Channel II (Producer→ Commissionagent-cum-wholesaler →Retailer →Consumer) was the most used channel for disposal of vegetables in AES-II by more than 68 per cent of the growers except okra.
- The analysis of price spread revealed that in marketing channel-I, growers retained highest share of consumer's rupee in cauliflower (70.56 %), followed by radish (68.51 %) in AES-I whereas in AES-II, growers got the highest share of consumer's rupee in bottle gourd (72.72 %) followed by cauliflower (72.09 %). Among the market functionaries, the margin of local

traders ranged between 7 to 11 per cent while the retailers could earn the maximum margin of 9 to 13 per cent.

- The growers got more than 65 per cent of consumer's rupee for most of the vegetables in channel-II and it was found to be highest for cauliflower i.e., 70.70 per cent in AES-I and 73.41 per cent in AES-II. The margin of commission-agent-cum-wholesaler in this channel ranged between four to five per cent while margin of retailer varied from 8 to 12 per cent.
- The grower's share in consumer's rupee in channel-III was turned out to be more than 75 per cent in all the vegetables in AES-I and AES-II except bitter gourd. The retailer's margin was also quite high ranging from 13 to 17 per cent except cabbage in AES-I.
- The marketing efficiency was found to be maximum in channel-III as compared to channel-I and channel-II in both AES-I and AES-II.
- According to Garrett's ranking analysis, high incidence of pest and diseases was reported top most problems relating to production aspects of vegetables by the growers in both AES-I and AES-II. With respect to the problems relating to post-harvest management of vegetables, lack of scientific storage facilities was most prominent problem in both AES-I and AES-II. In case of problems relating to marketing of produce, unfavourable price received by growers was the most prominent problem in both AES-I and AES-II.
- According to Garrett's ranking analysis, lack of scientific storage facilities followed by high loss of produce during transportation, non-availability of transportation means and labour scarcity were the major problems faced by the traders.

5.4 Suggestions and policy implications

On the basis of the findings, observations and discussions with the vegetable growers during the field survey, the following suggestions and policy prescriptions are made:

- Small scale post-harvest processing infrastructure should be created in the study area as growers are sustaining huge post-harvest losses affecting returns

accruing to them.

- The efforts should be made to reduce the pre-harvest disease/pest occurrence at growers' level by educating them.
- Training initiatives on post-harvest handling of the perishable products like vegetables should be encouraged and follow ups, feedback and adoption measurement should be carried out periodically for sustainability.
- Private marketing organizations should be involved to handle post-harvest operations by directly contracting with farmers to market their produce.
- Use of enhanced grading, packaging, storage and transportation methods, as well as the integration of agricultural and marketing extension systems to popularise post-harvest technologies among vegetable growers to reduce post-harvest losses.

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APPENDICES

Appendix-I
FARMER'S SURVEY SCHEDULE

Department of Agricultural Economics, Extension Education & Rural Sociology

CSK HP Krishi Vishvavidyalaya, Palampur (H.P.) – 176062

Research Problem: Economic analysis of marketing and post-harvest losses of cash crops: a comparative analysis

Objectives:

1) To study the marketable surplus and extent of post-harvest losses in major cash crops of the study area, and

2) To study the marketing system, price spread and role of marketing practices in enhancing marketing efficiency.

1. Basic information of the respondent

1) Name of the respondent:……S/o,W/o:…….
2) Age:…….
3) Villlage:……..Panchayat……Block……..Teh sil……District…….
4) Main occupation……...
5) Subsidiary occupation…….……
6) Contact No……
7) Economic status: APL/BPL
8) Type of family: Nuclear/Joint
9) No. of family members : Male……. Female…….Children……

2. Educational and occupational pattern of family members

Sr. No.	Relation with respondent	Age (years)	Sex (M/F)	Education (I/P/M/H/S/D/G/PG/SG/NS)	Occupation			
					Main		Subsidiary	
					Particulars	Annual income (Rs)	Particulars	Annual income (Rs)
1								
2								
3								
4								
5								
6								
7								
8								

Note: I- Illiterate, P-Primary, M- Middle, H- high, S- Senior Secondary, D- Diploma, G-Graduation and PG- Post Graduation, SG-School Going and NS- Non School Going

3. Land inventory

Sr. No.	Particulars	Area (Kanal/Bigha)			Source of irrigation	Remarks
		IR	UIR	Total		
1	Owned land					
2	Leased-in land					
3	Leased-out land					
4	Total holding (1+2-3)					

Note: IR= Irrigated, UR=Unirrigated

4. Land utilization (Kanal/Bigha)

Sr. No.	Particulars	Irrigated	Rainfed	Total	Remarks
1	Cultivated land				
2	Forest area				
3	Pasture/grassland				
4	Orchard/No. of plants				
5	Wasteland (Fallow)				
6	Area under buildings				
7	Other land				
8	Approx. value of land (Rs)				
9	Land revenue paid (Rs/year)				

5. Inventory of residential and farm buildings

Sr. No.	Particulars	Number	Year of construction	Present value (Rs)	Annual repairs (Rs)	Source of funds (P/L/R)	Remarks
1	Residential						

i.	*Kuccha*						
ii.	*Pucca*						
iii.	Mixed						
2	Cattle shed						
i.	*Kuccha*						
ii.	*Pucca*						
iii.	Mixed						
3	Store house						
4	Poultry shed						
5	Compost shed						
6	Any other						

Note: P-Personal savings L-Loan from bank, R- Loan from relatives

6. Infrastructure and basic facilities

Sr. No.	**Particulars**	**Distance from home (Km)**	**Sr. No.**	**Particulars**	**Distance from home (Km)**
1	Access to clear drinking water		8	Transportation/vehicle facilities	
2	Sanitation (toilet)		9	Office of HDO/ADO	
3	Road connectivity		10	Health centre	
4	Electricity		11	Veterinary hospital	
5	School		12	Bank	
6	College		13	Office of SMS	
7	Market yard		14	Input outlay centre	

7. Livestock inventory and livestock products:

Sr. No.	**Particulars**	**No.**	**Animal product Realized/day/shearing**		**Present value (Rs)**
			Name & Qty	Value (Rs)	
1	Cow (local)				
	a. In milk				
	b. Dry				
2	Cow (improved)				
	a. In milk				
	b. Dry				
3	Buffalo				
	a. In milk				
	b. Dry				
4	Horses/ponies				
5	Bullocks				
6	Heifer				
	a. Cow				
	b. Buffalo				
7	Calves				
	a. Cow				
	b. Buffalo				
8	Sheep				
9	Goats				
10	Other (specify)				

8. Cropping pattern

Sr. No.	Crop	Area (Kanal/Bigha)	Time of sowing (month)	Variety	Time of harvest (month)	Production (q or kg)
	KHARIF SEASON					
1	**Cereal crops**					
	Maize					
	Small millets(Ragi)					
	Paddy					
2	**Pulses**					
	Mash					
	Rajmash					
3	**Oilseeds**					
	Sesamum					
4	**Fodder**					
	Chari					
	Bajra					
5	**Vegetables**					
	Tomato					
	Capsicum					
	Brinjal					
	Cucumber					
	Cabbage					
	Cauliflower					
	RABI SEASON					
1	**Cereal crops**					
	Wheat					

	Barley					
2	**Pulses**					
	Gram					
3	**Oilseeds**					
	Mustard					
4	**Fodder**					
	Oats					
	Berseem					
5	**Vegetables**					
	Radish					
	Cabbage					
	Cauliflower					

9. Production, marketable and marketed surplus of major vegetable crops

Sr. No.	**Vegetable**	**Production (kg)**	**No. of pickings**	**Self consumption (kg)**	**Kind payment (kg)**	**Gift (kg)**	**Other (kg)**	**Quantity sold in market (kg)**
1	Tomato							
2	Capsicum							
3	Brinjal							
4	Cucumber							
5	Cabbage							
6	Cauliflower							
7	Potato							
8	Peas							
9	Radish							
10	Broccoli							
11	Others (specify)							

10. Marketing of vegetables through different agencies

Sr. No.	Vegetable	Village/ trader (local)			Private trader (outside)			Commission agent/ wholesaler			Retailer			Consumer			Other (specify)		
		Name of the Market	Quantity sold (q)	Price (Rs/q)	Name of the Market	Quantity sold (q)	Price (Rs/q)	Name of the market	Quantity sold (q)	Price (Rs/q)	Name of the market	Quantity sold (q)	Price (Rs/q)	Name of the market	Quantity sold (q)	Price (Rs/q)	Name of the Market	Quantity sold (q)	Price (Rs/q)
1	Tomato																		
2	Capsicum																		
3	Brinjal																		
4	Cucumber																		
5	Cabbage																		
6	Cauliflower																		
7	Potato																		
8	Peas																		
9	Radish																		
10	Broccoli																		
11	Others (specify)																		

11. Marketing practices followed by the vegetable growers

Sr. No.	Vegetable crop	Sorting			Cleaning /Washing					Grading				
		Yes/ No	Mode		Yes / No	Mode		Time (hrs)	Cost/ unit (Rs)	Yes/ No	Mode		Character considered (size/ colour/ Other)	Cost/ unit (Rs)
			Manual	Machine		Manual	Machine				Manual	Machine		
1	Tomato													
2	Capsicum													
3	Brinjal													
4	Cucumber													
5	Cabbage													
6	Cauliflower													
7	Potato													
8	Peas													
9	Radish													
10	Broccoli													
11	Others (specify)													

12. Marketing practices followed by the vegetable growers Contd…

Sr. No.	**Vegetable crop**	**Packing**							
		Mode (Hand/ Machine)	Packing material				Capacity (kg)	Cost/ unit	Source of packing material (market /govt /self made /other)
			Wooden	Gunny bags	Carton	Polythene bags			
1	Tomato								
2	Capsicum								
3	Brinjal								
4	Cucumber								
5	Cabbage								
6	Cauliflower								
7	Potato								
8	Peas								
9	Radish								
10	Broccoli								
11	Others (specify)								

13. Marketing practices followed by the vegetable growers Contd…

Sr. No.	**Vegetable crop**	**Storage (Yes/No) If Yes, then**			**Transportation**						
		Type of storage	Duration of storage after harvest (Days/ hrs)	Cost/ unit	To farm house		To road head		To market		Cost/ Unit
					Mode	Distance (kms)	Mode	Distance (kms)	Mode	Distance (kms)	
1	Tomato										
2	Capsicum										
3	Brinjal										
4	Cucumber										
5	Cabbage										
6	Cauliflower										
7	Potato										
8	Peas										
9	Radish										
10	Broccoli										
11	Others (specify)										

14. Estimation of crop losses at farmer's level

Sr. No.	**Vegetable crop**	**Total production (q)**	**Crop losses (kg)**					
			At harvest	Assembling/ collection	Sorting/ grading/ cleaning	Packaging	Transportation to first sale point	Others
1	Tomato							
2	Capsicum							
3	Brinjal							
4	Cucumber							
5	Cabbage							
6	Cauliflower							
7	Potato							
8	Peas							
9	Radish							
10	Broccoli							
11	Others (specify)							

15. Losses at farm level during storage

Sr. No.	**Vegetable crop**	**Total quantity stored (kg)**	**Losses (kg)**			
			Loss of water	Insect, pests, diseases and rodents	Quantity rotten	Others
1	Tomato					
2	Capsicum					
3	Brinjal					
4	Cucumber					
5	Cabbage					
6	Cauliflower					
7	Potato					
8	Peas					
9	Radish					
10	Broccoli					
11	Others (specify)					

16. Problems faced by farmers in post-harvest practices and marketing of major vegetables

Sr. No.	Particulars	Ranks								
		1	2	3	4	5	6	7	8	9
1	**Production problems**									
i.	High incidence of pest and diseases									
ii.	High cost of inputs (seeds, fertilisers, pesticides etc.)									
iii.	Poor quality of seed									
iv.	Labour scarcity and high wage rate									
v.	Stray/ wild animals and monkey menace									
vi.	Non-availability of credit									
2	**Post-harvest management problems**									
i.	Lack of scientific storage facilities									
ii.	Lack of training facilities for post-harvest management of vegetables									
iii.	Unfavourable weather condition during harvest									
iv.	Poor transportation facility									
v.	Poor quality of packing material									
3	**Marketing problems**									
i.	Unfavourable price for the produce									
ii.	Lack of link road to farms									
iii.	Market at distant place									
iv.	Lack of market information									
v.	Faulty weighing practices and delayed payment by traders									
vi.	High cost and non-availability of means of transportation at right time									
vii.	Road blockage during marketing season									
viii.	Costly packing material									
ix.	Lack of standard grades and no separate price for graded produce									

Appendix II : Trader's survey schedule

1. Introduction

Name of the market	
Name and address of the firm/trader(s)	
Type of the trader (wholesaler/retailer/local trader/itinerant/producer)	
Occupational career (year of entry in the business)	
Commodities dealt (vegetables)	
Hours of work per day	
What is the most difficult point to do your business?	
Why did you start this job?	

2. Procurement of vegetable commodities by vegetable traders

Sr. No.	**Vegetable crop**	**Market/place from where procured**	**Total quantity purchased during the year (q)**	**Auction/ purchase price (Rs/q)**	
				Min.	**Max.**
1	Tomato				
2	Capsicum				
3	Brinjal				
4	Cucumber				
5	Cabbage				
6	Cauliflower				
7	Potato				
8	Peas				
9	Radish				
10	Broccoli				
11	Others (specify)				

3. Marketing practices (cleaning and grading) followed by the vegetable traders

Sr. No.	Vegetable crop	Cleaning (Yes/No) If Yes, then		Grading (Yes/No) If Yes, then		
		Mode	Place	Character considered	Mode (manual/ machine/other)	Who grades the produce (self/skilled grader/other)
1	Tomato					
2	Capsicum					
3	Brinjal					
4	Cucumber					
5	Cabbage					
6	Cauliflower					
7	Potato					
8	Peas					
9	Radish					
10	Broccoli					
11	Others (specify)					

4. Marketing practices (packing) followed by the vegetable traders

Sr. No.	Vegetable crop	Packing			
		Mode (hand/ machine)	Type of packing material (wooden/plastic boxes/plastic/gunny bags/other)	Capacity (kg)	Source of packing material (market/govt./self made/other)
1	Tomato				
2	Capsicum				

3	Brinjal				
4	Cucumber				
5	Cabbage				
6	Cauliflower				
7	Potato				
8	Peas				
9	Radish				
10	Broccoli				
11	Others (specify)				

5. Marketing practices (storage & transportation) followed by the vegetable traders

Sr. No.	**Vegetable crop**	**Storage (Yes/No) If yes, then**		**Transportation**			
		Type of storage	Duration of storage after harvest (hrs)	To own shop		To other market	
				Means	Distance (km)	Means	Distance (km)
1	Tomato						
2	Capsicum						
3	Brinjal						
4	Cucumber						
5	Cabbage						
6	Cauliflower						
7	Potato						
8	Peas						

9	Radish						
10	Broccoli						
11	Others (specify)						

6. Estimation of crop losses at trader's level

Sr. No.	**Vegetable Crop**	**Total Quantity (q)**	**Losses (kg)**				
			Loading/ unloading	Transportation	Grading/ cleaning	Packing	Others (specify)
1	Tomato						
2	Capsicum						
3	Brinjal						
4	Cucumber						
5	Cabbage						
6	Cauliflower						
7	Potato						
8	Peas						
9	Radish						
10	Broccoli						
11	Others (specify)						

7. Estimation of crop losses at trader's level Contd…

Sr. No.	**Vegetable crop**	**Total quantity stored (kg)**	**Storage and related losses(kg)**			
			Loss of water	Insect, pests, diseases and rodents	Quantity rotten	Others
1	Tomato					

2	Capsicum					
3	Brinjal					
4	Cucumber					
5	Cabbage					
6	Cauliflower					
7	Potato					
8	Peas					
9	Radish					
10	Broccoli					
11	Others (specify)					

8. Marketing cost of trader in the marketing of vegetables

Marketing cost (Rs./q)								
Sr. No.	**Vegetable**	**Packaging**		**Loading charges**	**Transportation charges**	**Unloading charges**	**Storage charges**	**Grading/ cleaning**
		Material	Cost					
1	Tomato							
2	Capsicum							
3	Brinjal							
4	Cucumber							
5	Cabbage							
6	Cauliflower							
7	Potato							
8	Peas							
9	Radish							
10	Broccoli							
11	Others (specify)							

9. Marketing cost of traders continued…

Marketing cost (Rs./q)							
Sr. No.	**Vegetable**	**Losses in transit and storage**	**Market commission**	**Hamali/ Other charges**	**Repacking/ grading charges**	**Disposal charges**	**Other costs (commute charges etc)**
1	Tomato						
2	Capsicum						
3	Brinjal						
4	Cucumber						
5	Cabbage						
6	Cauliflower						
7	Potato						
8	Peas						
9	Radish						
10	Broccoli						
11	Others (specify)						

10. Problems faced by traders in marketing of vegetables

Sr. No.	**Problems**	**Ranks**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
1	Lack of scientific storage facilities							
2	High loss of produce during transportation							
3	Non-availability of means of transport at right time							
4	Labour scarcity and high wage rate							
5	Road blockage during market season							
6	Costly packing material							
7	Lack of grading standards and no separate price for graded produce							

Appendix III: Marketing cost incurred by sample vegetable growers in Channel-I

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost			
		Packing charges		Total	
		AES-I	AES-II	AES-I	AES-II
1	Tomato	28 (100.00)	26 (100.00)	28 (100.00)	26 (100.00)
2	Cucumber	35 (100.00)	30 (100.00)	35 (100.00)	30 (100.00)
3	Bottle gourd	-	24 (100.00)	-	24 (100.00)
4	Bitter gourd	-	30 (100.00)	-	30 (100.00)
5	Brinjal	-	30 (100.00)	-	30 (100.00)
6	Okra	-	24 (100.00)	-	24 (100.00)
7	Potato	28 (100.00)	-	28 (100.00)	-
8	Cauliflower	30 (100.00)	28 (100.00)	30 (100.00)	28 (100.00)
9	Cabbage	32 (100.00)	28 (100.00)	32 (100.00)	28 (100.00)
10	Radish	18 (100.00)	17 (100.00)	18 (100.00)	17 (100.00)

Note: Figures in parentheses indicate percentages to the total.
Channel-I : Producer-local trader-retailer-consumer.

Appendix IV: Marketing cost incurred by sample vegetable growers in Channel-II

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost									
		Packing charges		**Transportation**		**Loading/unloading**		**Commission charges**		**Total**	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	23.40 (15.76)	24.00 (16.78)	65.00 (43.80)	60.00 (41.95)	8.00 (5.40)	9.00 (6.30)	52.00 (35.04)	50.00 (34.97)	148.40 (100.00)	143.00 (100.00)
2	Cucumber	34.50 (21.77)	35.00 (22.88)	65.00 (41.00)	60.00 (39.21)	7.00 (4.42)	8.00 (5.23)	52.00 (32.81)	50.00 (32.68)	158.50 (100.00)	153.00 (100.00)
3	Bottle gourd	-	24.00 (16.90)	-	60.00 (42.25)	-	6.00 (4.23)	-	52.00 (36.62)	-	142.00 (100.00)
4	Bitter gourd	-	30.00 (20.40)	-	60.00 (40.82)	-	7.00 (4.76)	-	50.00 (34.02)	-	147.00 (100.00)
5	Brinjal	-	30.00 (20.54)	-	60.00 (41.10)	-	6.00 (4.10)	-	50.00 (34.26)	-	146.00 (100.00)
6	Okra	-	30.00 (24.39)	-	36.00 (29.27)	-	7.00 (5.69)	-	50.00 (40.65)	-	123.00 (100.00)
7	Potato	-	-	-	-	-	-	-	-	-	-
8	Cauliflower	25.00 (19.53)	28.00 (22.40)	45.00 (35.16)	40.00 (32.00)	6.00 (4.68)	7.00 (5.60)	52.00 (40.63)	50.00 (40.00)	128.00 (100.00)	125.00 (100.00)
9	Cabbage	25.50 (19.70)	28.00 (21.87)	45.00 (34.74)	42.00 (32.82)	7.00 (5.40)	8.00 (6.25)	52.00 (40.16)	50.00 (39.06)	129.50 (100.00)	128.00 (100.00)
10	Radish	-	18.00 (14.17)	-	50.00 (39.37)	-	7.00 (5.51)	-	52.00 (40.95)	-	127.00 (100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer.

Appendix V: Marketing cost incurred by sample vegetable growers in Channel-III

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost							
		Packing charges		Transportation		Loading/unloading		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	25.00 (28.74)	24.00 (28.91)	55.00 (63.22)	50.00 (60.24)	7.00 (8.04)	9.00 (10.85)	87.00 (100.00)	83.00 (100.00)
2	Cucumber	32.00 (33.68)	30.00 (33.70)	55.00 (57.89)	50.00 (56.18)	8.00 (8.43)	9.00 (10.12)	95.00 (100.00)	89.00 (100.00)
3	Bottle gourd	-	22.00 (27.50)	-	51.00 (63.75)	-	7.00 (8.75)	-	80.00 (100.00)
4	Bitter gourd	-	25.00 (30.48)	-	50.00 (60.98)	-	7.00 (8.54)	-	82.00 (100.00)
5	Brinjal	-	27.00 (32.14)	-	50.00 (59.52)	-	7.00 (8.34)	-	84.00 (100.00)
6	Okra	-	32.00 (45.72)	-	31.00 (44.28)	-	7.00 (10.00)	-	70.00 (100.00)
7	Potato	32.00 (48.12)	-	29.00 (43.60)	-	5.50 (8.28)	-	66.50 (100.00)	-
8	Cauliflower	27.50 (36.65)	27.00 (36.98)	40.00 (53.29)	38.00 (52.06)	7.55 (10.06)	8.00 (10.96)	75.05 (100.00)	73.00 (100.00)
9	Cabbage	26.50 (33.34)	25.00 (33.78)	45.00 (56.60)	40.00 (54.05)	8.00 (10.06)	9.00 (12.17)	79.50 (100.00)	74.00 (100.00)
10	Radish	19.00 (24.28)	21.00 (28.00)	52.00 (66.46)	48.00 (64.00)	7.25 (9.26)	6.00 (8.00)	78.25 (100.00)	75.00 (100.00)

Note : Figures in parentheses indicate percentages to the total.
Channel-III : Producer-retailer-consumer.

Appendix VI: Marketing cost incurred by local trader in Channel-I

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost									
		Packing charges		Transportation		Loading/unloading		Storage and losses		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	21.00	24.00	38.00	40.00	10.00	12.00	32.50	30.00	101.50	106.00
		(20.69)	(22.64)	(37.44)	(37.74)	(9.85)	(11.32)	(32.02)	(28.30)	(100.00)	(100.00)
2	Cucumber	21.00	23.00	36.00	39.00	8.00	10.00	29.00	30.00	94.00	102.00
		(22.34)	(22.54)	(38.30)	(38.24)	(8.51)	(9.80)	(30.85)	(29.42)	(100.00)	(100.00)
3	Bottle gourd	-	22.00	-	36.00	-	11.00	-	28.00	-	97.00
			(22.68)		(37.11)		(11.34)		(28.87)		(100.00)
4	Bitter gourd	-	21.50	-	36.00	-	10.00	-	27.00	-	94.50
			(22.75)		(38.10)		(10.58)		(28.57)		(100.00)
5	Brinjal	-	22.50	-	35.50	-	12.75	-	24.00	-	94.75
			(23.75)		(37.47)		(13.46)		(25.33)		(100.00)
6	Okra	-	22.00	-	35.00	-	12.00	-	20.00	-	89.00
			(24.72)		(39.33)		(13.48)		(22.47)		(100.00)
7	Potato	22.00	-	38.00	-	10.00	-	22.75	-	92.75	-
		(23.72)		(40.97)		(10.78)		(24.53)		(100.00)	
8	Cauliflower	24.00	26.00	36.00	40.00	9.00	10.00	28.00	26.00	97.00	102.00
		(24.74)	(25.50)	(37.11)	(39.21)	(9.28)	(9.80)	(28.87)	(25.49)	(100.00)	(100.00)
9	Cabbage	24.00	26.00	35.00	38.00	8.00	10.00	29.50	27.00	96.50	101.00
		(24.87)	(25.74)	(36.27)	(37.63)	(8.30)	(9.90)	(30.56)	(26.73)	(100.00)	(100.00)
10	Radish	20.00	22.00	35.00	40.00	8.00	10.00	14.00	12.00	77.00	84.00
		(25.97)	(26.19)	(45.46)	(47.62)	(10.38)	(11.90)	(18.19)	(14.29)	(100.00)	(100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-I : Producer-local trader-retailer-consumer.

Appendix VII : Marketing cost incurred by commission agent-cum-wholesaler in Channel-II

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost									
		Loading/unloading		Market fee		Losses during storage		Other charges		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	20.00 (25.97)	18.00 (24.16)	30.00 (38.96)	32.00 (42.95)	20.00 (25.98)	18.00 (24.16)	7.00 (9.09)	6.50 (8.72)	77.00 (100.00)	74.50 (100.00)
2	Cucumber	15.00 (21.12)	17.00 (22.52)	32.00 (45.08)	34.00 (45.03)	17.00 (23.94)	18.00 (23.85)	7.00 (9.86)	6.50 (8.60)	71.00 (100.00)	75.50 (100.00)
3	Bottle gourd	-	17.00 (25.96)	-	28.00 (42.75)	-	14.00 (21.37)	-	6.50 (9.92)	-	65.50 (100.00)
4	Bitter gourd	-	16.00 (26.67)	-	25.00 (41.67)	-	13.00 (21.67)	-	6.00 (10.00)	-	60.00 (100.00)
5	Brinjal	-	15.00 (23.72)	-	27.00 (42.69)	-	15.00 (23.72)	-	6.25 (9.88)	-	63.25 (100.00)
6	Okra	-	15.00 (24.41)	-	28.00 (45.57)	-	12.00 (19.53)	-	6.45 (10.50)	-	61.45 (100.00)
7	Potato	-	-	-	-	-	-	-	-	-	-
8	Cauliflower	12.50 (20.49)	14.00 (22.40)	28.00 (45.90)	30.00 (48.00)	14.00 (22.95)	12.00 (19.20)	7.50 (10.66)	6.50 (10.40)	62.00 (100.00)	62.50 (100.00)
9	Cabbage	12.50 (22.73)	14.00 (22.43)	25.00 (45.45)	30.00 (46.73)	11.00 (20.00)	10.00 (18.69)	7.50 (11.82)	6.50 (12.15)	55.00 (100.00)	53.50 (100.00)
10	Radish	-	15.00 (25.64)	-	25.00 (42.74)	-	12.00 (20.51)	-	6.50 (11.11)	-	58.50 (100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer.

Appendix VIII: Marketing cost incurred by retailer in Channel-I

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost									
		Packing charges		Transportation		Loading/unloading		Storage and losses		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	20.00 (24.31)	18.00 (22.23)	24.00 (29.18)	25.00 (30.87)	10.00 (9.73)	8.00 (9.87)	30.25 (36.78)	30.00 (37.03)	84.25 (100.00)	81.00 (100.00)
2	Cucumber	22.00 (27.85)	20.00 (26.67)	20.00 (25.31)	22.00 (29.33)	9.00 (11.39)	8.00 (10.67)	28.00 (35.45)	25.00 (33.33)	79.00 (100.00)	75.00 (100.00)
3	Bottle gourd	-	21.00 (28.38)	-	22.00 (29.73)	-	6.00 (8.11)	-	25.00 (33.78)	-	74.00 (100.00)
4	Bitter gourd	-	20.00 (27.78)	-	19.00 (26.39)	-	8.00 (11.11)	-	25.00 (34.72)	-	72.00 (100.00)
5	Brinjal	-	19.00 (26.29)	-	20.00 (27.68)	-	6.25 (8.65)	-	27.00 (37.38)	-	72.25 (100.00)
6	Okra	-	17.00 (24.29)	-	24.00 (34.29)	-	7.00 (10.00)	-	22.00 (31.42)	-	70.00 (100.00)
7	Potato	16.75 (23.67)	-	24.25 (34.28)	-	7.75 (10.96)	-	22.00 (31.09)	-	70.75 (100.00)	-
8	Cauliflower	20.00 (28.57)	17.00 (25.37)	15.00 (21.43)	18.00 (26.87)	8.00 (11.42)	6.00 (8.96)	27.00 (38.58)	26.00 (38.80)	70.00 (100.000	67.00 (100.00)
9	Cabbage	20.00 (27.78)	16.00 (23.53)	17.00 (23.61)	18.00 (26.47)	8.00 (11.11)	6.00 (8.82)	27.00 (37.50)	28.00 (41.18)	72.00 (100.00)	68.00 (100.00)
10	Radish	18.00 (33.14)	15.00 (29.70)	13.80 (25.42)	15.00 (29.70)	7.50 (13.81)	6.50 (12.87)	15.00 (27.63)	14.00 (27.63)	54.30 (100.00)	50.50 (100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-I : Producer-local trader-retailer-consumer.

Appendix IX: Marketing cost incurred by retailer in Channel-II

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost											
		Packing		Transportation		Loading/unloading		Storage and losses		Commission and market fee		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	21.50	23.00	25.00	29.00	7.50	8.50	30.50	32.00	47.25	50.00	131.75	142.50
		(16.32)	(16.14)	(18.98)	(20.35)	(5.69)	(5.97)	(23.15)	(22.45)	(35.86)	(35.09)	(100.00)	(100.00)
2	Cucumber	21.50	24.00	22.50	25.00	7.50	9.00	24.50	27.00	64.50	67.00	140.50	152.00
		(15.30)	(15.78)	(16.01)	(16.45)	(5.34)	(5.93)	(17.44)	(17.76)	(44.08)	(46.76)	(100.00)	(100.00)
3	Bottle gourd	-	24.00	-	23.00	-	8.00	-	28.00	-	51.00	-	134.00
			(17.91)		(17.16)		(5.97)		(20.90)		(38.06)		(100.00)
4	Bitter gourd	-	18.00	-	18.00	-	6.00	-	24.00	-	44.00	-	110.00
			(16.36)		(16.36)		(5.45)		(21.83)		(40.00)		(100.00)
5	Brinjal	-	20.00	-	18.00	-	6.50	-	25.00	-	46.00	-	115.50
			(17.31)		(15.58)		(5.63)		(21.65)		(39.83)		(100.00)
6	Okra	-	18.00	-	25.00	-	7.50	-	22.00	-	45.00	-	117.50
			(15.32)		(21.28)		(6.38)		(18.72)		(38.30)		(100.00)
7	Potato	-	-	-	-	-	-	-	-	-	-	-	-
8	Cauliflower	18.00	20.00	15.50	20.00	6.50	8.00	25.00	32.00	42.50	45.00	107.50	125.00
		(16.74)	(16.00)	(14.42)	(16.00)	(6.05)	(6.40)	(23.26)	(25.60)	(39.53)	(36.00)	(100.00)	(100.00)
9	Cabbage	16.50	20.00	17.80	22.00	6.50	8.00	28.00	29.00	42.50	45.00	111.30	124.00
		(14.82)	(16.13)	(15.99)	(17.74)	(5.84)	(6.45)	(25.16)	(23.38)	(38.19)	(36.30)	(100.00)	(100.00)
10	Radish	-	15.00	-	12.00	-	6.00	-	12.00	-	40.00	-	85.00
			(17.65)		(14.12)		(7.06)		(14.12)		(47.05)		(100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-II : Producer-commission agent-cum-wholesaler-retailer-consumer.

Appendix X : Marketing cost incurred by retailer in Channel-III

(Rs/q)

Sr. No.	Vegetables	Items of marketing cost									
		Packing charges		Transportation		Loading/unloading		Storage and losses		Total	
		AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II	AES-I	AES-II
1	Tomato	22.00	24.00	24.50	26.00	7.50	8.00	29.00	28.00	83.00	86.00
		(26.50)	(27.90)	(29.52)	(30.24)	(9.04)	(9.30)	(34.94)	(32.56)	(100.00)	(100.00)
2	Cucumber	23.00	24.00	22.00	25.00	7.00	8.00	24.00	23.00	76.00	80.00
		(30.26)	(30.00)	(28.95)	(31.25)	(9.21)	(10.00)	(31.58)	(28.75)	(100.00)	(100.00)
3	Bottle gourd	-	23.00 (30.67)	-	22.00 (29.33)	-	7.00 (9.33)	-	23.00 (30.67)	-	75.00 (100.00)
4	Bitter gourd	-	19.00 (26.39)	-	22.00 (30.56)	-	7.00 (9.72)	-	24.00 (33.33)	-	72.00 (100.00)
5	Brinjal	-	19.00 (26.03)	-	20.00 (27.40)	-	8.00 (10.96)	-	26.00 (35.61)	-	73.00 (100.00)
6	Okra	-	18.00 (23.78)	-	27.00 (34.97)	-	8.00 (10.49)	-	25.00 (30.76)	-	78.00 (100.00)
7	Potato	16.25	-	24.50	-	7.00	-	22.00	-	69.75	-
		(23.30)		(35.12)		(10.04)		(31.54)		(100.00)	
8	Cauliflower	18.50	18.00	14.00	17.00	5.00	6.00	27.00	25.00	64.50	66.00
		(28.68)	(27.27)	(21.71)	(25.76)	(7.75)	(9.09)	(41.86)	(37.88)	(100.00)	(100.00)
9	Cabbage	22.00	20.00	17.50	20.00	5.00	6.00	27.50	29.00	72.00	75.00
		(30.56)	(26.67)	(24.31)	(26.67)	(6.94)	(8.00)	(38.19)	(38.67)	(100.00)	(100.00)
10	Radish	15.00	16.00	12.00	13.00	6.00	7.00	17.00	12.00	50.00	48.00
		(30.00)	(33.34)	(24.00)	(27.03)	(12.00)	(14.58)	(34.00)	(25.00)	(100.00)	(100.00)

Note: Figures in parentheses indicate percentages to the total.

Channel-III : Producer -retailer-consumer.

Brief Bio data of Student

Name	: Shagun Katoch
Father's Name	: Sh. Ajmer Katoch
Mother's Name	: Smt. Reeta Katoch
Date of Birth	: 23rd September, 1997
Permanent Address	: Village Rakrial Post office Jhaniara Tehsil and District Hamirpur, Himachal Pradesh-177001

Academic Qualifications:

Qualification	Year	School/Board/ University	Marks (%)	Division	Major subjects
10th	2013	CBSE New Delhi	95.00	First	English, Science, Mathematics, Hindi, Social Science
12th	2015	CBSE New Delhi	91.08	First	Biology, Physics, Chemistry, English, Physical Education
B.Sc. (Hons.) Agriculture	2020	CSKHPKV, Palampur	80.09	First	All agricultural and allied subjects
M.Sc. (Agricultural Economics)	2022	CSKHPKV, Palampur	86.90	First	Agricultural Economics

Scholarships/Gold Medals/Any other Distinction

2016-2020	College merit scholarship, B.Sc. (Hons) Agriculture
2020-2022	College merit scholarship, M.Sc. Agriculture
Others	Participation certificate for zonal agrivision convention at Jammu (April, 2022)