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# IMPACT OF HAIL PROTECTION MECHANISM ON APPLE CROP IN HIMACHAL PRADESH- A CASE STUDY OF SHIMLA DISTRICT

**Study sponsored by Ministry of Agriculture and Farmers Welfare
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## PREFACE

The present study "Impact of Hail Protection Mechanism on Apple Crop in Himachal Pradesh- A Case Study of Shimla District" is a state-specific study conducted by this centre. It was undertaken at the instance of Directorate of Economics and Statistics, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi.

Apple is a major fruit of the state of Himachal Pradesh and varied topography of the State provides a great scope for apple production. The Government has initiated various schemes for the development of apple farming by providing various facilities and incentives. Consistent efforts are also being made to strengthen the economy of apple orchardists. For past few years, problem of hailstorm has become grave and it is wreaking havoc on the production of apple crop in the state, and so, for protection against this, hail protection mechanism like anti-hail Nets and Cannons are becoming very useful. Shimla district has the highest producing apple belt of the state. And hail protection mechanism is mostly installed and used in district Shimla by the orchardists to protect their apple crop from hailstorm.

Keeping in view that Himachal Pradesh was the first state in the country where anti-hail Cannons were installed and used to protect apple crop from hails, this study bears much importance as this is the first formal study undertaken about this mechanism. This study is an attempt to evaluate the impact of the mechanism in terms of issues and challenges related to the functioning of anti-hail Cannons and Nets, to study the various installation and operational costs incurred on the mechanism in study area and to analyse its effectiveness through stakeholders perspectives with benefits and drawbacks of the mechanism, and to make some policy recommendations for the improvement in the hail protection mechanism services, so that the mechanism can function better in the future.

The Agro Economic Research Centre at this university undertook the present study to evaluate the impact of hail protection mechanism on apple crop in the state of Himachal Pradesh. The findings of this study will pave the way for removing the bottlenecks and making this mechanism more lucrative and efficient. The authors and other staff members of the Centre engaged in the study deserve appreciation for their hard work in bringing out this volume for wider circulation.

**(Sikander Kumar)**

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The present study of "Impact of Hail Protection Mechanism on Apple Crop in Himachal Pradesh- A Case Study of Shimla District" was sponsored by the Directorate of Economics & Statistics, Department of Agriculture Cooperation & Farmers Welfare, Ministry of Agriculture, Govt. of India, New Delhi. This study was a state-specific and carried out in the state of Himachal Pradesh.

We express our deep gratitude to Shri P. C. Bodh, Adviser (AER Division) Ministry of Agriculture & Farmers' welfare, Govt. of India, New Delhi, for his valuable advice, productive suggestions and collaboration during the execution and completion of the study.

On behalf of the centre, we place on record the generosity of Prof. Sikander Kumar, Hon'ble Vice Chancellor, Himachal Pradesh University, Shimla, for providing valuable guidance and facilities during various stages of the completion of the study. His constant encouragement and valuable guidance provided, to be, an important input in completing the study and making it richer.

We extend heartfelt thanks to the Director, Joint Director, Horticulture Development Officers and other officials of the Directorate of Horticulture, Nav Bahar, Shimla for providing needed data and cooperation during initial stage of the execution of the study.

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We are extremely thankful to Prof. C.S. Vaidya, former Officer Incharge, AERC for his valuable support throughout the execution of the study. We are also grateful to Mr. Chaman Lal, Superintendent, for made the necessary arrangement and provided the secretariat services for completion the study work. Also, we express our sincere thanks to Dr. Anil Kumar, Dr. Sujan Singh and Mr. Inder Verma for giving their help & support from time to time during the study and Mrs. Meera Verma for providing Library material and support for typing work.

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# Abbreviations

| | |
|---|---|
| AERC | Agro Economic Research Centre |
| DRDO | Defence Research and Development Organisation |
| GCA | Gross Cropped Area |
| Govt. | Government |
| Ha. | Hectare |
| HDO | Horticulture Development Officer |
| HH. | Households |
| HP | Himachal Pradesh |
| HPU | Himachal Pradesh University |
| IIT | Indian Institute of Technology |
| IMD | Indian Meteorological Department |
| Kgs. | Kilograms |
| Kms. | Kilometers |
| LPG | Liquefied Petroleum Gas |
| Ltd. | Limited |
| MIDH | Mission for Integrated Development of Horticulture |
| MT | Million Tonnes |
| NGO | Non-Governmental Organisation |
| No. | Number |
| NSG | Non-School Going |
| Rs. | Rupees |
| Rs./HH. | Rupees per Household |
| SC | Scheduled caste |
| Sq. Mtr. | Square Meter |
| SMS | Subject Matter Specialist |
| ST | Scheduled Tribe |
| WMO | World Meteorological Organisation |

# Executive Summary

Horticulture plays an important role in the economic development of Himachal Pradesh. Varied topography of the State provides great scope for apple production which is a major fruit crop of the state. District Shimla is the highest apple producing belt in the state where the hail protection mechanism is functioning and protecting apple crops from hailstorms. For the past few years apple orchardists have suffered heavy production losses due to hailstorm in areas where anti-hail Cannons and Nets are now being used to protect apple from hailstorm destruction. Anti-hail Net is an old protection system against hailstorm disaster in apple areas, which cover the plants like umbrellas. This mechanism is not provided by state horticulture department, rather, farmers purchase anti-hail Nets from private retailers and government provides 80 per cent subsidy on them, out of which 30 per cent is being borne by the state government and 50 per cent by Centre government. On the other hand anti-hail Cannon is a modern device which shoots a fire shot in the air to disperse off the hail causing clouds. Area covered by each anti-hail Cannon is approximately 80-90 hectares i.e. within a radius of about 500 meters. For the first time in the country, in 2010-11 the State Horticulture Department installed three anti-hail Cannons on pilot basis in the state under a central government-funded project worth Rs.3.29 crores. Due to lack of support in the form of financial assistance from the government for installation of more Cannons, orchardists in Shimla took to adopting this technology on their own. The present study has been confined to examine the impact of hail protection mechanism on apple crop in the Shimla district of Himachal Pradesh. For this purpose the physical and financial aspects, technological effectiveness and institutional functioning of hail protection mechanism of the selected district has been studied. With this background the present study was conducted with following specific objectives.

**Objectives of the Study**

**1.** To study the institutional functioning, technological effectiveness and the economics of anti-hail Cannons and Nets.

**2.** To study impact of hail protection mechanism on apple production and income of apple orchardists.

**3.** To study benefits and drawbacks of hail protection mechanism from stakeholders perspectives.

**4.** To suggest policy recommendations for improved and better implementation of hail protection mechanism in the state.

**Methodology of the Study**

A multistage purposive cum random sampling technique was used in the selection criteria. Shimla district was purposively selected because ant-hail Cannons were installed only in this district and also because it

has the highest area coverage under anti-hail Nets. Two blocks were selected on the basis of highest numbers of Cannons installed and highest area covered under Nets. Jubbal & Kotkhai block was selected for anti-hail Cannons and Thanedhar block was selected for anti-hail Nets. Five revenue villages were selected for anti-hail Cannons on the basis of Cannon installation and three villages were randomly selected for anti-hail Nets. The study was based on a total sample of 120 orchardists out of which 90 mechanism users (45 users each for Cannon and Net) and 30 non-users (15 non-users each for Cannon and Net).

**Major Findings of the Study**

Apple is the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. Shimla district alone accounts for about 55-60 per cent of total production in the state. Block-wise area and production of apple in district Shimla: Jubbal & Kotkhai block accounted for highest area and production among all 10 blocks of the district during all years (2009-10 to 2017-18).

The analyses reveal that there were two types of mechanism, anti-hail Cannons and Nets used to protect apple crops from hailstorm in the state. Hail protection mechanism was mostly installed and used in district Shimla. Department of horticulture was the main implementing agency, which monitors the functioning of anti-hail Cannons and Nets used for protecting apple crop. In Jubbal & Kotkhai block, farmers Committees were formed by the orchardists, to monitor the functioning of privately installed Cannons in their areas during 2016. To protect apple crop from hailstorms the state government enhanced subsidy on anti-hail Nets from 50 per cent to 80 per cent during the year 2015-16. But there was no provision of assistance on anti-hail Cannon before the year 2018. Ever since, the State government introduced 60 per cent subsidy on Cannons.

One time installation cost of government installed Cannon at Braionghat was Rs. 47,54,000 during 2016-17. Whereas material cost of operations like, Cannon shots, cost of cylinder, freight charges, Cannon operator and labour were also incurred by the government during the year, 2013-14 to 2018-19. In case of privately installed Cannons for 2018-19 at Kalbog, Ratnari, Baghi and Mahasu villages of Jubbal & Kotkhai block, one time total installation cost was Rs. 2,87,99,525, which was Rs. 76,99,525, Rs. 68,00,000, Rs. 55,00,000 and Rs. 85,00,000 for the said villages, respectively. Installation cost was highest for Mahasu village. Cost of cylinder refills and freight charges were highest for village Baghi. Cannon operator charges were highest for Kalbog village.

The analyses of physical and financial achievements of anti-hail Nets reveal that district Shimla had highest area covered under Nets with subsidy and also highest subsidy provided on Nets. Block-wise

analyses show that Thanedhar block had highest coverage area under Nets with subsidy and also attained highest share of subsidy on Nets among all blocks of district Shimla.

The analyses reveal that majority of the sample of anti-hail Cannon and Net users and non-users belonged to general category. In both the blocks, total males were more than total females. Majority of sampled orchardists were in the age group of 18-60 years. Educational status of sampled orchardists revealed that majority of anti-hail Cannon users and non-users were graduates. Majority of anti-hail Net users were secondary level educated and non-users were graduates. Agriculture (horticulture) was the main and subsidiary occupation for majority of sampled orchardists. In both the blocks, anti-hail Cannon and Net users and non-users generated highest income from their apple orchard produce sale. Per household annual income was higher among users than non-users in both the block.

Per farm own land area and gross cropped area (GCA) of users was more than that of non-users in both the blocks. Maximum area of their land was under apple crop, which was about 95 per cent for anti-hail Cannon users and non-users and about 92 per cent for anti-hail Net users and non-users. Per farm production of apples was higher among users than non-users under both mechanisms. Further, per farm quantity sold, total price and average price per box of apples and other fruits was higher among anti-hail Cannon and Net users than non-users.

Number and value of equipment and machinery was higher among users in both the blocks. For anti-hail Cannon users and non-users, highest value was attributed to grading and packing machine of apple, and for anti-hail Net users and non-users this was attributed to petrol/diesel spray machine. Per household total value of equipment and machinery was higher among users as compared to non-users of anti-hail Cannon and Net.

Per household value of buildings; dwelling house, cattle shed and storage/shop was higher among users as compared to non-users in both the blocks. Per household number and value of other assets was also higher among users, where, four-wheeler had highest value in other assets owned by sampled orchardists. But, per household number and value of livestock was higher for non-users than users. Cattle were the major livestock rearing by sampled orchardists in both the blocks. Anti-hail Cannon and Net users attained better socio-economic profile and farm level characteristics than non-users. They also attained better living standards as compared to non-users, this was due to increased production and orchards sale and income from orchard produce because of protecting their orchards with anti-hail Cannons and Nets.

The analyses reveal that anti-hail Cannon users and non-users mentioned hailstorm as the biggest cause of loss to apple crop. Maximum loss due to hailstorms occurred during fruit setting season for

Cannon users and flowering season for Cannon non-users. For anti-hail Net users and non-users also, maximum loss of apple crop was due to hailstorm during all seasons. Maximum loss due to hailstorm occurred during flowering season for both, users and non-users of anti-hail Net mechanism. Thus, before the installation of hail protection mechanism in the study area, hailstorm was a major event of loss for apple crop of sampled orchardists of district Shimla and this mostly happened during flowering and fruit setting seasons. In both the blocks occurrence of hailstorms was more for non-users than users during study reference period. Higher frequency, duration and intensity of hailstorm accounted for non-users of anti hail Cannon. The frequency of hailstorm was highest (>3 times) for both users and non-users of anti-hail Net. The duration and intensity of hailstorm was higher for non-users of anti-hail Net.

Non-users of both mechanisms in the district reported higher expected loss of apple (in terms of affected area, quantitative and qualitative loss) due to hailstorms as compared to mechanism users. Thus, the hail protection mechanism had positive impact on its users of study area. Further, the analyses reveal that majority of users and non-users of both blocks (both mechanisms) were not satisfied about the role of horticulture department in terms of visits undertaken and mechanism advised post loss of apple crop due to hailstorm in their areas.

Hail protection mechanism has a two way impact on apple produce. Firstly, it increase the quantity of apple production by protecting the crop from hail damage during flowering and fruit setting period and secondly, the mechanism improve the quality of the produce by substantially reducing the hazards of marks and dents on the fully ripe fruit, hence, giving the mechanism users a better price for their produce. Whereas, for non-users, quantity of apple is reduced by early damage to the crop from hail and also the quality of produce is compromised by marks and dents in the fully ripe fruit. Thus giving the non-users comparatively lesser price for their apple produce in the market. Therefore, hail protection mechanism has a positive impact on the income and the production apple crop for the users compared to non-users.

All the users and non-users of anti-hail Cannon and Net Mechanism were aware about hail protection mechanism in the district. Horticulture department was the main source of information about this mechanism for majority of users and non-users of both blocks in study area.

The analyses reveal that 100 per cent anti-hail Cannon and Net users were aware that the horticulture department provided subsidy on anti-hail Nets in the state. 100 per cent anti-hail Net users had applied for assistance on their purchase of Nets, but 100 per cent Cannon users did not apply for subsidy because they did not purchase any anti-hail Net due to anti-hail Cannons being installed in their areas. About 84 per cent anti-hail Net users received subsidy on their purchase of Nets. Majority of Net users got 80 per cent subsidy on their purchase of Nets. Total per household subsidy was Rs. 87,339.58. Total subsidy given to all the Net users was Rs. 33,18,904.

Further, the analyses reveal that majority of anti-hail Net users responded that the horticulture department took a period of more than 3 months between processing and sanctioning of their subsidy applications. Total per farm area for Net users was 0.93 hectare, out of which 60 percent was covered with subsidy and remaining 40 per cent was covered without subsidy. Majority of Net users (about 91%) responded that the financial assistance on Nets to be inadequate and it is insufficient to meet their requirements. Total per farm buying cost, installation cost and un-installation cost of anti-hail Nets was Rs. 5,73,611.11, Rs. 31,300.00 and Rs. 13284.44, respectively. The bigger land holding size group paid higher costs for using anti-hail Nets in their farms.

The analyses reveal that the government officials recommended the installation of weather radars for better weather assessment. According to them, Cannons are more effective than Nets in protecting the apple crop from hailstorms. Farmers in their area preferred Cannons over Nets. The only drawback of the Cannons, according to the officials, was that it is not working effectively. Biggest benefit of Cannons, according to them, is the protection it provides to the crops against hailstorm. As no financial or otherwise assistance was given by the government, the orchardists had to bear heavy costs for private installation of Cannons. The orchardists suggested installation of radars for accurate weather forecast, and that at least 3-4 Cannons installation in every *Panchayat*, on the peak of the mountain for maximum impact.

Majority of users for both mechanisms responded that the horticulture department did not convene any meetings and give advice about hail protection mechanism in study area and the meetings held and information given about hail protection mechanism was ineffective. In total, 80 per cent of the users perceived the mechanism to be good for apple protection and the remaining 20 per cent perceived it to be average. In total, 68.89 per cent users responded 75-100% quantitative protection to apple crop and 72.23 per cent users responded same percentage of qualitative protection for both mechanisms. In total, 54.44 per cent users preferred Cannon over Net. Out of total mechanism users, Majority of them preferred Cannon as a better hail protection mechanism for protecting their apple crop from hailstorms. Majority users preference for their mechanism (whether Cannon or Net) was mostly due to maximum protection of apple crop.

The analyses concluded that majority of users suffered the problem of high installation cost of the mechanism. Majority of mechanism users recommended that maintenance/servicing of mechanism. Radar installation, government takeover of Cannons, and more Cannons installation were the top three recommendations given by the majority of anti-hail Cannon users. Net structure provision, subsidy area increased, and maintenance/servicing were the top three recommendations given by the majority of anti-hail Net users.

The two primary reasons given by non-users for not opting out this mechanism were: expensive and more labour effort. 100 percent of the non-users were willing to use this mechanism, out of which, 63.33 per cent preferred Cannon and 36.67 per cent preferred Net. Majority of non-users suggested government control/takeover of the mechanism.

**Policy Recommendation**

Following are the major policy recommendation suggested by stakeholders for the improvement in the services of hail protection mechanism in district Shimla of the State.

As can be concluded form the study that agriculture (horticulture), especially cultivation of apple crop is the main source of income for majority of sampled orchardists and as hailstorms were reported to be the biggest cause of loss to apple crop, special emphasis should be paid on protecting the apple crop from any kind of losses (particularly hailstorms) and to increase its production and sale. As department of horticulture is the main implementing agency for monitoring the government installed anti-hail Cannons, it does not help with installation or operation of the privately installed Cannons. Thus, the government should help through the horticulture department, the orchardists by undertaking the financial and physical aspects of the functioning of the privately installed Cannons. The government can keep the management in the private hands by letting the orchardists operate the Cannons, but provide financial help by fully funding the installation and annual operation costs like the costs of cylinder refills, labour costs etc. The horticulture department also provides financial assistance on anti-hail Nets, which is presently 80 per cent in the state. Orchardists face a lot of troubles in installing and un-installing these Nets every year in their orchards. Hence, the horticulture department can help provide suitable Net structures, and also organized well trained/professional labour force every year, so as to make the use of anti-hail Nets more efficient.

Presently, five functioning anti-hail Cannons (1 government, 4 private) are installed in the sample block (Jubbal & Kotkhai). More number of Cannons should be installed in the hailstorm prone areas. The placement of these Cannons should be of the peak of the hill for maximum impact. Anti-hail Nets can be used for a time span of 4-5 years after that these needs to be discarded. As these Nets are made of plastic, proper provision should be made to discard these Nets after they have served their utility.

Hail protection mechanism users attained better social economic profile and farm level characteristics than non-users, hence, the use of this mechanism (anti-hail Cannons and Nets) should be propagated in the apple producing belt of the state.

As seen from the study, non-users of hail protection mechanism reported higher expected loss of apple crop due to hailstorm as compared the users, which proves that the mechanism was effective in

preventing the losses from hailstorm, thus, use of this mechanism should be advertised and also incentivised.

As seen from the study, horticulture department is the main source of information about this mechanism for majority of users and non-users of hail protection mechanism, hence, the horticulture department should organize information dissemination, and training and skill development camps, where better and more effective and efficient use of this mechanism can be taught to the orchardists for helping them protect their crop from hailstorms. Anti-hail Net users, who had applied for subsidy, received subsidy after a time lag of more than 3 moths, this problem should be rectified. Also, despite 80 per cent subsidy on Nets, orchardists still find this aid to be insufficient. Hence, the government should work upon providing more financial aid to the orchardists. Further, subsidy is given on 5,000 square meters area only, thus, government should provide subsidy for the entire orchard land.

Weather radars should be installed for every existing anti-hail Cannon and also for the future ones, so that Cannons can be operated effectively if and when the need will be.

More per cent of mechanism users and non-users preferred Cannons over Nets as it saves them the annual effort of installing and un-installing Nets on trees, thus, emphasis should be paid on long term use of Cannons and its implications on the productivity of apple crop. Also, the government should conduct scientific research on the effects of this mechanism on the environment, i. e., the impact of anti-hail Cannon on the clouds and the weather and the impact of anti-hail Nets on the health of the trees and fruit and also the soil, keeping in terms with the sustainable development aspect of agriculture economics.

# Chapter-I

## INTRODUCTION

### 1.1 Background

Horticulture, especially apple production plays an important role in the economic development of Himachal Pradesh. Varied topography of the State provides a great scope for apple production. To ensure sustainable growth in future apple production, adequate thrust is being given on the apple productivity enhancement. The Government has initiated various schemes for the development of apple farming by providing various facilities and incentives and consistent efforts are being made to strengthen the economy of apple orchardists. For past few years, problem of hailstorm has become grave and it is wreaking havoc on the production of fruits, and so for protection against this, hail protection mechanism like anti-hail Nets and Cannons are becoming very useful. Anti-hail Nets cover the plants like umbrellas. During financial year 2018-19, 18.96 hectares was covered under anti hail nets in district Shimla, the highest apple producing district in the state. The subsidy on anti-hail nets has been enhanced to 80 per cent out of which 30 per cent is being borne by the State government and 50 per cent by Centre government. On the other hand, anti-hail Cannon shoot a fire shot in the air to disperse off the hail causing clouds. Area covered by each anti-hail cannon is approximately 80-90 hectares i.e. within a radius of about 500 meters.

For the first time in the country, in 2010-11 the State Horticulture Department installed the anti-hail Cannons on pilot basis in the state under a central government-funded project worth Rs.3.29 crores, to protect apple crop from hailstorms during the flowering and fruit setting season. The state government imported these Cannons from California and installed these at Kathasu village of tehsil Jubbal, Braionghat village of tehsil Kotkhai and Deorighat village of tehsil Rohru. These Cannons were connected with the weather radar set up at the place of Tumdoo, located at an altitude of 10,000 feet near Kharapathar village of Tehsil Jubbal. The acetylene-firing anti-hail Cannon covers an aerial distance of around 80 to 90 hectares and the coverage area of the weather radar is 25 Kms. The Cannons send shock waves into the pressure areas where hail clouds are formed and punctures them, resulting in rain or soft hail instead of the damaging hail stones. Due to lack of support in the form of financial assistance from the government for installation of more Cannons, orchardists in Shimla took to adopting this

technology on their own. So far, five private anti-hail Cannons have been imported in 2016 from New Zealand and installed at Baghi, Ratnari, Kalbog and Mahasu villages of tehsil Kotkhai and Madaog village of tehsil Chopal.

### 1.2 Need and Importance of the Study

Apple is a major fruit of the state of Himachal Pradesh which accounted for about 49 per cent of area under fruit crops and about 85 per cent of total fruit production for the year 2017-18. Area under apple has increased from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and 1,11,896 hectares in 2016-17. There has been a phenomenal increase in the area and production of apple, but the productivity of apple has been low compared to the major apple producing countries of the world. Many interrelated factors like socio-economic, agro climatic, infrastructure, market, policy issues etc. are responsible for the low productivity of apple.

In the last decade the incidences of hailstorm in the apple areas of Himachal Pradesh have increased alarmingly. Every year apple crop worth crores of rupees is destroyed by hailstorm in the state. To protect this, especially destruction in highest apple production belt of district Shimla, orchardists are using hail protection mechanism like; anti-hail Nets and Cannons. Thus, in order to determine the effectiveness of hail protection mechanism, it is important to examine the working and achievement components of anti-hail Cannons and Nets in the study areas. Further, there is a need to study the impact of this mechanism on production and income pattern of apple orchardists, its benefits for apple orchardists as well as major problems encountered by them.

So far, no comprehensive study has been undertaken to study the impact of this mechanism in the apple belt of the state. Only few articles have been found which were based on traditional tools and techniques used in apple production along with articles written by progressive farmers and others based on this modern hail-protection mechanism. In this context, the present study is expected to have important implications for continuation and enhancement of this mechanism. It will also provide effective and empirical evidence as to how anti-hail Cannons and Nets have actually been working in the state. This will help the planners and administrators of horticulture department in streamlining the process of installation of this mechanism in the state in an effective manner. Further, the study will have an added significance

from the academic and administrative point of view, as not much prior research has taken place in this regard.

### 1.3 Objectives of the Study

With above background the present study was conducted with following specific objectives.

**1.3.1** To study the institutional functioning, technological effectiveness and the economics of anti-hail Cannons and Nets.

**1.3.2** To study impact of hail protection mechanism on apple production and income of apple orchardists.

**1.3.3** To study benefits and drawbacks of hail protection mechanism from stakeholders perspectives.

**1.3.4** To suggest policy recommendations for improved and better implementation of hail protection mechanism in the state.

### 1.4 Review of Literature

A critical review of literature in any scientific inquiry is essential to determine the nature, extent and direction of research conducted on different aspects of the problems under investigation. The integrated information thus acts as a search light to guide the course of prospective research activities. There are few articles on the modern aspects of anti-hail Cannons in the state and some other articles related to the impact of anti-hail Nets along with hail risk management in fruit procuction based on other countries experiences.

**Kuldeep Chauhan (2015),** has written in his article "Anti-hail guns savior for apple farmers", that apple farmers in the Braionghat and Deorighat apple belt of District Shimla have heaved a sigh of relief from devastating hailstorms which have spelt disaster in other areas as anti-hail cannons have successfully kept the hailstorms in their orchards at bay since 2011 when the two cannons were installed here. He has already mentioned the views of Mr. Roshan Lal Chauhan, orchardist and chairman of the Shimla, Himachal Gyan-Vigyan Samiti, who stated that the fire shots from the anti-hail Cannon targeted at the black hailstone clouds successfully quells these, bringing much sought-after relief to orchardists here since 2011. He also added the views

of many orchardists from Cannon benefitted areas who mentioned that, “anti-hail Cannon is a savior as we did not witness hailstone here for the last four years”. He has also mentioned the perspective of Pramod Chauhan from Dakahal-Kiari, the oldest apple-producing area of Kotkhai, who told about the hailstones that smashed orchards in the Ganasidhar- Baghi belt in Kotkhai, the Sangroli-Dhurla belt of Maroag and the Duindar belt of Hambal in Chopal which was not happening in the Braionghat and Deorighat belt.

**Markus Gandorfer (2016),** has studied about hail risk management in fruit production and observed that the hail damage belongs to the most important reasons of production risk in fruit farming. Associated yield and quality losses have severe negative economic consequences at the farm level. Consequently, proper hail risk management adapted according to local conditions is essential for successful farm management. To manage hail risk, fruit farmers can select from various options. Both anti-hail Cannons and cloud seeding planes are only economically viable if shared among a group of farmers due to the high investment needed. A popular farm-specific hail management instrument is spatial diversification of orchards. The most commonly used instruments are anti-hail Nets and hail insurance. A major difference between anti-hail Nets and hail insurance is that establishing an anti-hail Net requires a long term investment while the decision for hail insurance can be made annually. Furthermore, the two instruments hedge hail risk in different ways. While hail insurance covers (ex post) the monetary yield and quality loss the anti-hail Net prevents yield and quality damage. Based on a time series of 10 years of insurance data of three apple orchards in Germany, a risk analysis (historical simulation) of hail insurance and anti-hail Nets is presented. The risk analysis accounts for orchard-specific hail risk and farmers' risk aversion applying an expected utility model. Analysis shows that hail insurance is particularly interesting for highly risk averse farmers with high debt-to-asset ratios associated with low initial wealth at locations with medium hail risk. At locations with high hail risk, anti-hail Nets are the preferable risk management instrument in terms of certainty equivalent outcomes.

**Saurabh Chauhan (2016)**, has written in his article, “Himachal farmers install anti-hail Cannon worth Rs. 1.20 Crore on their own” that after facing losses year after year due to hailstorm, farmers of Shimla district finally installed two anti-hail Cannons at Ratnari and Baghi villages of Jubbal & Kotkhai block which is 85 Kms. far from Shimla. Since there was no

provision of a government subsidy, farmers paid for this project out of their own pockets. He said that, these Cannons were imported from New Zealand and are expected to protect over a dozen villages from hailstorm. The idea of installing them was conceived in March, 2016 and a society was formed. Subsequently, all the formalities for importing these Cannons were completed and in the month of August, 2016 farmers received anti-hail Cannons and installed them at Baghi and Ratnari villages. He has also written about the views of Baghi *Gram Panchayat* head Mr. Raj Kumar Bhinta, who stated the simple science behind anti-hail Cannon and its effectiveness. "An anti-hail Cannon is hassle-free in its use as compared to putting up anti-hail Nets", he said. Further, Saurabh Chauhan has mentioned about some perspectives of Ankush Chauhan, an apple grower from Kotkhai, who stated that anti-hail Net is an old remedy that ends up damaging trees of apple, he added, "anti-hail Nets checks the tree growth besides depriving the plant of sunlight" and also stating that anti-hail Nets were traditionally used to save apple trees form hailstorm but it required professional team for installation and un-installation which was an expensive aspect.

**Mirella Aoun (2018),** has written in his article named "The use of Nets for tree fruit crops and their impact on the production: A Review", that the Protected tree fruit cultivation using sustainable, environment-friendly practices was considered a promising alternative to meet the challenge of various biotic and abiotic stresses threatening fruit production under climate changes. Nowadays, Nets are being globally used to protect the trees against harsh environmental conditions including hail, wind, excess sunlight and pests, while improving tree health and enhancing fruit quality. Different types of Nets including anti-hail, exclusion and photo selective Nets have a different impact on the fruit tree response and production depending on their type, shading factor, mesh size, timing of display in the orchard and the netting system erected in the orchard. This review analyses the effect of various types of Nets on the microclimate, tree growth and management, fruit quality, diseases, disorders, and economical insect pests and beneficial insects.

**Porsch, Gandorfer and Bitsch (2018),** have studied that the hail risk management is essential for successful farm management in German fruit production, particularly because hail events and associated losses have increased in recent years. The purpose of this paper was to conduct a detailed risk analysis comparing different strategies to manage hail risk, taking into

account farmers' risk aversion and farm-specific conditions. Design/methodology/ approach within an expected utility framework, two different strategies for managing hail risk were compared: one belonging to the group of financial instruments (hail insurance) and the other to the group of technical instruments (anti-hail Net). A unique data set comprising of a ten-year time series of orchard-specific hail damage and hail insurance data was used. These were the major findings of the paper: for orchards with low local hail risk and low yield potential, not using hail risk mitigation was most efficient. For orchards with high local hail risk and high yield potential, anti-hail Nets provide the highest certainty equivalents. For orchards with high local risk, but low yield potential, hail insurance was most efficient. For orchards, with low local risk, but high yield potential, the certainty equivalents were higher for anti-hail Net, when the farmer was risk neutral or slightly risk-averse. With increasing risk aversion, hail insurance was most efficient, which could be explained by the greater degree of the instrument's flexibility. The novelty of the study lies in the direct comparison of the risk effects of anti-hail Nets and hail insurance in fruit production.

**University of Horticulture and Forestry (2018)** had organized workshop on "Management of Hailstorm for Sustainable Crop Production in Himachal Pradesh", to discuss the status of hailstorm occurrence and its impacts on mountain ecosystem. Eminent scientists' from across the country, experts from IIT, Bombay and Hyderabad, Indian Meteorological Department, Principle Secretary of Horticulture of the State of HP, A.V. Suman from California based Newton Systems International; the company that installed three anti-hail Cannons from the side of government in district Shimla, and DRDO along with 85 progressive apple orchardists from the state and representatives of private companies participated in the event. The workshop concluded that the hailstorms are nightmares for fruit and vegetable growers of the state. Hail causes huge financial losses to farmers every year. Farmers in some areas use anti-hail Cannons but it was very expensive for an individual farmer. During the interaction session between the farmers and scientists, six progressive farmers from the areas where anti-hail Cannons were operational shared their experiences about the frequency and impacts of hailstorms in their respective areas and the advantages and disadvantages of the technology. A farmer working with an NGO in the Khaneti area of Kotkhai tehsil shared that the lack of technical guidance regarding the usage of the anti-hail Cannon in their area was a concern. Lack of maintenance of anti-hail Cannons and high costs of anti-hail Nets were other issues raised by the farmers.

Moreover, there was no concrete data available regarding the efficiency of these Cannons. Surprisingly, the government has been missing another crucial aspect like feedback from farmers that could help in the assessment of the particular mechanism. It is not sufficient to install an anti-hail Cannon on subsidized rates, farmers should also be aware of technical aspects so that they know how to use them efficiently. Though the World Meteorological Organization has documented that there is no physical evidence of anti-hail Cannons efficiency, the Cannons did find more utility when used in concordance with the Weather Radar System. These aforesaid issues were attended in the workshop along with interaction session of scientists with the farmers using anti-hail Cannons in their areas.

This workshop also focused on various aspects of suitable hailstorm management technologies and livelihood of farmers and strengthening the 'Make in India' initiative. This was also suggested by workshop experts that the indigenous technologies under the ambit of 'Make in India' should be explored for developing cheaper anti-hail Cannons in the country itself and stressed on long-term research assessments of this technology. Dr. Neeraj Kumbhakarna from IIT Mumbai proposed various detonation alternatives to recent technologies. He said that the cost of the cannons could be brought down to Rs. 6-10 lakhs if these machines were produced in the country itself. He suggested that LPG or kerosene could replace acetylene gas in these machines in order to bring down the operational cost. Meteorological department of the state has suggested developing micro scale models for a particular area and setting up of radars to assess cloud movements and also recommended mitigation strategies like weather modification through the use of silver iodide and anti-hail Cannon.

**Kuldeep Chauhan (2019)** has written about some aspects of hail protection mechanism in his article, "Apple farmers seek government help for anti-hail Cannon". He stated that apple farmers of Jubbal & Kotkhai block have urged Chief Minister of the state to provide assistance for operating anti-hail Cannons because the farmers were facing problems in operating these Cannons due to lack of trained operators and funds. Author said "We have spent more than Rs. 70 lakhs on each anti-hail Cannon which was set up at Baghi, Ratnari, Kalbog, Mahasu and Maraog three years ago. But we don't have technical operators, spare parts to maintain the system and gas cylinder to operate these". The government has assured help but due to the code of conduct, famers have to wait, author added. Chauhan also mentioned the recent hailstorm

(during the year 2019) that wreaked havoc on fruit crops in Narkanda, causing losses of over Rs. 5 crores. Though the previous government opposed the concept of Cannon on the grounds that the system was not a proven success and that the government given 80 per cent subsidy on another hail protection mechanism of anti-hail Net to the farmers. However, everyone knows that Nets are very expensive and hampers the growth of apple trees and debars sunlight on trees which causes damage to the trees in the long run.

# Chapter-II

## STUDY DESIGN AND METHODOLOGY

For the past few years apple orchardists have suffered heavy production losses due to hailstorm in areas where anti-hail Cannons and Nets are being used to protect apple from hailstorm destruction. The present study has been confined to examine the impact of hail protection mechanism on apple crop in the Shimla district of Himachal Pradesh. For this purpose the physical and financial aspects, technological effectiveness and institutional functioning of hail protection mechanism of the selected district has been studied.

### 2.1 Sampling Technique and Sample Size

A multistage purposive cum random sampling technique was used in the selection of district, blocks, revenue villages and orchardists. At first, Shimla district was purposively selected because ant-hail Cannons were installed only in this district and also because it has the highest area coverage under anti-hail Nets.

In the second stage, all blocks were arranged on the basis of number of anti-hail Cannons and the coverage of anti-hail Nets. Two blocks were selected on the basis of highest numbers of Cannons installed and highest area covered under Nets. Perusal of data indicated that, Jubbal & Kotkhai block had highest number of anti-hail Cannons and hence was selected for the study. Similarly, on the basis of highest area under Nets, Thanedhar block was selected for study of impact of anti-hail Nets. The details are provided in Table-2.1. There were total 8 anti-hail Cannons installed at different villages of three blocks of district Shimla, where most of the Cannons were installed in Jubbal & Kotkhai block. Table-2.2 shows that Thanedhar block had highest coverage of anti-hail Nets (with subsidy provided on Nets by the Government).

In third stage, all the revenue villages in each selected block were arranged on the basis of apple area and subsidies covered under anti-hail Nets. Five revenue villages were selected for anti-hail Cannons on the basis of Cannon installation and three villages were randomly selected for anti-hail Nets.

In fourth stage, all mechanism users in each selected village were arranged on the basis of their holdings and a total sample of 90 orchardists was selected randomly. Out of this, 45

orchardists were selected for anti-hail Cannons and 45 orchardists for anti-hail Nets. Further, to work out the total impact, 30 orchardists who were non-users of this mechanism have also been interviewed. Out of which 15 orchardists were selected for anti-hail Cannons and 15 for anti-hail Net. Thus, the study was based on a total sample of 120 orchardists (Table-2.3).

**Table-2.1: Block-wise Installation details of anti-hail Cannons in District Shimla**

| Name of Blocks | Name of Villages | Cannons Installed by Government | Cannons Installed by Farmers Privately | Total No. of Cannons Installed | Whether Cannon was Functioning |
|---|---|---|---|---|---|
| **Chopal** | Madaog | 0 | 1 | 1 | Yes |
| **Jubbal & Kotkhai** | Braionghat | 1 | 0 | 1 | Yes |
| | Baghi | 0 | 1 | 1 | Yes |
| | Kalbog | 0 | 1 | 1 | Yes |
| | Kathasu | 1 | 0 | 1 | No |
| | Mahasu | 0 | 1 | 1 | Yes |
| | Ratnari, | 0 | 1 | 1 | Yes |
| **Rohru** | Deorighat | 1 | 0 | 1 | Yes |
| | **Total** | **3** | **5** | **8** | |

**Table-2.2: Block-wise Installation details of anti-hail Nets in District Shimla**

| Name of Blocks | Year 2014 to 2019 | |
|---|---|---|
| | Subsidy/Assistance provided (in Lakhs) | Total Area Covered (in Hectares) |
| Basantpur | 6.84 | 3.36 |
| Chopal | 35.57 | 17.97 |
| Jubbal & Kotkhai | 62.59 | 30.62 |
| Mashobra | 7.01 | 3.13 |
| Narkanda | 71.00 | 36.52 |
| Rohru | 91.65 | 48.27 |
| Thanedhar | 104.17 | 57.45 |
| Theog | 98.69 | 52.55 |
| **Total** | **477.52** | **249.87** |

**Source:** Department of Horticulture, Navbahar, Shimla, Himachal Pradesh

A sample of 45 users of anti-hail Cannons, i.e. 9 orchardists from each revenue village nearest to cannon installed area was taken on the basis of random sampling. In addition, a sample of 15 orchardists who were not benefitted by this facility, i.e. 3 apple orchardists from each

revenue village were also randomly selected for detailed study. Thus, a total sample of 60 apple orchardists was selected for the purpose of field survey in areas where anti-hail Cannons were installed.

A sample of 45 users of anti-hail Nets, i.e. 15 orchardists was taken randomly from each of the three revenue villages and a sample of 15 mechanism non-users, i.e. 5 orchardists, was taken randomly from each revenue village for field survey. Thus, a total sample of 60 apple orchardists was selected for the purpose of field survey in areas where anti-hail Nets were installed.

**Table No-2.3: Classification of Sample size**

| Type of Mechanism | Name of Block | Name of Revenue Villages | With Mechanism | Without Mechanism | Total |
|---|---|---|---|---|---|
| anti-hail Cannons | Jubbal & Kotkhai | Braionghat | 9 | 3 | 12 |
| | | Baghi | 9 | 3 | 12 |
| | | Kalbog | 9 | 3 | 12 |
| | | Mahasu | 9 | 3 | 12 |
| | | Ratnari | 9 | 3 | 12 |
| | | **Total** | **45** | **15** | **60** |
| anti-hail Nets | Thanedhar | Thanedhar | 15 | 5 | 20 |
| | | Kotgarh | 15 | 5 | 20 |
| | | Jarol | 15 | 5 | 20 |
| | | **Total** | **45** | **15** | **60** |
| **Total** | | **Sub Total** | **90** | **30** | **120** |

## 2.2 Holding Size Classification

The classification of the sampled orchardists on the basis of their land holdings is presented in Table-2.4. The surveyed orchardists were divided into four size groups viz;

**2.2.1 Marginal Farm Orchardists:** orchardists having 0.5 hectares to <1.0 hectares land.

**2.2.2 Small Farm Orchardists:** orchardists having 1.0 hectares to < 2.0 hectares land.

**2.2.3 Semi-medium Farm Orchardists:** orchardists having 2.0 hectares to < 4.0 hectares land.

**2.2.4 Medium Farm Orchardists:** orchardists having 4.0 hectares to < 10.0 hectares land.

**Table-2.4: Land Holding Size Classification of Sampled Orchardists**

| Block/ Mechanism | Type of Orchardists | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | 7 (15.55) | 12 (26.67) | 18 (40.00) | 8 (17.78) | 45 (100.00) |
| | Non-users | 2 (13.33) | 5 (33.34) | 8 (53.35) | 0 (0.00) | 15 (100.00) |
| | Total | 9 (20.00) | 17 (28.33) | 26 (43.33) | 8 (13.34) | 60 (100.00) |
| Thanedhar (anti-hail Net) | Users | 15 (33.33) | 30 (66.67) | 0 (0.00) | 0 (0.00) | 45 (100.00) |
| | Non-users | 10 (66.67) | 5 (33.34) | 0 (0.00) | 0 (0.00) | 15 (100.00) |
| | Total | 25 (41.67) | 35 (58.33) | 0 (0.00) | 0 (0.00) | 60 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

Table-2.4 shows that majority of the sampled orchardists belong to semi-medium and small categories. The data indicates that in Jubbal & Kotkhai block, out of 45 anti-hail Cannon users, a majority of 40.00 per cent orchardists belongs to semi-medium category, 26.67 per cent to small, 17.78 per cent to medium and 15.55 per cent belongs to marginal category. Similarly, in case of anti-hail Cannon non-users, out of 15 orchardists, a majority of 53.35 per cent belongs to small and 13.33 per cent belongs to marginal category whereas no orchardist belongs to medium category.

Further, the table indicates that in Thanedhar block, out of 45 anti-hail Net users, a majority of 66.67 per cent belongs to small category and another 33.33 per cent belongs to marginal category. No orchardist was found to belong in semi-medium and medium farm categories. In case of 15 non-users of anti-hail Net, a majority of 66.67 per cent orchardists belongs to marginal category and the rest 33.33 per cent belongs to small category. Similarly, no one was found in semi-medium and medium farm categories. Therefore, it can be concluded that majority of anti-hail Cannon users and non-users were semi-medium farm orchardists and majority of anti-hail Net users were small and non-users were marginal farm orchardists. Also, all the anti-hail Net users and non-users were marginal and small farm orchardists.

### 2.3 Nature and Type of Data

The study has been based on both primary and secondary data;

#### 2.3.1 Primary Data

Primary data was collected with the help of 'with and without' approach from sampled orchardists. The primary data was collected by conducting personal interviews and observations. A well designed and pre-tested schedule was used for the purpose of data collection. Primary data collected was supplemented with relevant secondary information collected from records of concerned departments and other published and unpublished sources.

##### 2.3.1.1 Personal Interview

Mechanism users/non-users and functionaries were contacted personally to know their perspectives about hail protection mechanism in the state. All the information was collected through personal interviews of functionaries, intermediaries of horticulture department and farmer groups/committees engaged with hail protection mechanism as well as users and non-users of this mechanism.

##### 2.3.1.2 Observation

The information which could not be obtained through questionnaires and personal interviews was obtained by means of direct personal observation. Moreover, this method was used to explore the unexplored aspects related to the objectives of the study.

##### 2.3.1.3 Pilot Survey

This was conducted before collecting the information through dummy schedules. The final schedule was edited in the light of the results of the pilot surveys.

##### 2.3.1.4 Schedule/Questionnaire

Questionnaire was developed keeping in view the objectives of the study by conducting pilot survey. There were questionnaires for mechanism functionaries, intermediaries, users and non-users while collecting stakeholder's perspectives about hail protection mechanism in the state. The profile/background of the users and non-users of hail protection mechanism under

study areas, institutional functioning, and economics of mechanism like assistance/subsidy provided, time-lag in processing the application of claims, and disbursement of subsidy under this mechanism etc. have been covered in the final schedule.

### 2.3.2 Secondary Data

Secondary data was collected from various sources viz; State government official records, directorate of horticulture, block-level horticulture departments, revenue departments and other private agencies involved in the hail protection mechanism. This secondary data was used to determine the areas to be studied under this mechanism. This data was further used to study the financial and physical aspects of anti-hail Cannons and Nets for apple protection from the hail protection mechanism in the state.

### 2.4 Study Reference Period

The study covers a period of one year that is 2018-19.

### 2.5 Analytical Framework

Mainly tabular analyses have been used in the study to arrive at the results. Simple percentage and average methods have been used to analyse the collected data.

### 2.6 Concepts and Definitions

The concepts and definitions used in the study are listed below;

**2.6.1 Hail Protection Mechanism:** This mechanism is defined as the traditional as well as modern types of mechanism which stop and control hailstorms and protects orchards from hail. Two particular types of mechanisms studied were anti-hail Cannons and anti-hail Nets.

**2.6.2 Anti-hail Cannon:** Anti-hail Cannon is defined as a modern device which disrupts the growth phase of hailstorm and protects orchards from this calamity. An explosive charge of acetylene gas and oxygen is ignited in the lower chamber of the device/machine. When the gas is fired, the energy in the form of shockwaves passes through the neck of the machine. The shock waves split up the ice bearing layers of the cloud and it either comes down as rain or the thin sleet that does not damage the fruit.

**2.6.3 Anti-hail Net:** Anti-hail Net is defined as an old technology which protects orchards from hailstorm by covering the tree like an umbrella by standing on a strong structure that supports its weight on the plant.

**2.6.4 Radar:** Radar is a detection system that uses radio waves to determine the range, angle and velocity of particular objects. Here it is defined as weather forecasting system which forecasts hail formation clouds and is used to detect hailstorm in apple areas. Radars are used to determine the functioning of anti-hail Cannons.

**2.6.5 Orchards:** An area of land having at least ten apple trees which is owned by a person is defined as an orchard irrespective of the fact whether this area is in geographical contiguity or scattered.

**2.6.6 Orchardist:** Any person owning an orchard is defined as an orchardist.

**2.6.7 Bearing tree:** A tree of bearing age is defined as a tree which has attained a specific age irrespective of whether it bears fruit or not, during a particular year. This age is taken to be 5 years for low heights of apple belt, 8 years for medium heights and 10-12 years for high heights of apple belt.

**2.6.8 Non-Bearing tree:** A non-bearing tree is defined as a tree which has not reached the bearing age.

**2.6.9 Main Occupation:** The main occupation of a person is defined as the one from which he earns the maximum income.

**2.6.10 Subsidiary Occupation:** This is defined as the occupation from which a person earns his second largest income.

**2.6.11 A Box of Orchard:** A box of orchard means the one containing about 23 Kgs. of apple. One tone (1,000 Kgs.) is equivalent to 43 boxes of apples.

**2.6.12 Buying Cost:** Buying cost refers to the actual price paid for the purchase of hail protection mechanism equipment and material.

**2.6.13 Installation cost:** Installation cost refers to the cost incurred on labour used for installing the mechanism.

**2.6.14 Un-installation Cost:** This type of cost is subsequently incurred on labour for un-installing the mechanism.

**2.6.15 Maintenance Cost of Mechanism:** Maintenance cost of mechanism is subsequently incurred on its maintenance after installation and un-installation.

# Chapter-III

## APPLE CROP AND FUNCTIONING OF HAIL PROTECTION MECHANISM IN THE STATE

Horticulture as an occupation in the State has developed as a lucrative business proposition since a long time and has witnessed continuous rise in area and production of fruits. There has been a phenomenal increase in the area and production of apple, but the productivity of apple has been low as compared to other apple producing countries in the world. Many factors are responsible for that. In the last decade, the incidence of hailstorm has increased alarmingly, which has destroyed apple crop worth crores of rupees in the state. To protect apple crop from hailstorms, orchardists of the state are using hail protection mechanism like anti-hail Nets and anti-hail Cannons. In this chapter, while discussing about the functioning of hail protection mechanism in the district under study, a brief review of area and production of apple in other districts of the state and blocks of district Shimla is also given in subsequent tables.

### 3.1 Area under Apple Crop in the State

Apple is so far the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. Area under apple has increased from 400 hectares in 1950-51 to 3,025 hectares in 1960-61, 1,11,896 hectares in 2016-17 and 1,12,500 hectares in 2017-18.

### 3.2 District-wise Production of Apple in the State

Table-3.1 shows the district wise production (in million ton) of apple crop in the state from the year 2009-10 till 2017-18. In all these years highest production of apple occurred in district Shimla, both in absolute and relative values. Second highest area was under district Kullu followed by district Kinnaur. District Una had zero production of apple in the state. Highest production district (Shimla) has seen an increasing trend in production of apple, as it was 1,71,945 MT in 2009-10, which increased to 2,51,897 MT in 2017-18. Same is true for the total production of apple in the entire state which increased from 2,80,105 MT in 2009-10 to 4,46,574 MT in 2017-18.

**Table-3.1: District-wise Production of Apple in Himachal Pradesh during different years**

**(In MT.)**

| Particulars | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---|---|---|---|---|---|---|---|---|---|
| Bilaspur | 1 (0.00) | 1 (0.00) | 0 (0.00) | 2 (0.00) | 1 (0.00) | 1 (0.00) | 4 (0.00) | 4 (0.00) | 6 (0.00) |
| Chamba | 3962 (1.41) | 10789 (1.21) | 3074 (1.12) | 2739 (0.66) | 7189 (0.97) | 26054 (4.17) | 24018 (3.09) | 11734 (2.51) | 18959 (4.25) |
| Hamirpur | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 1 (0.00) | 1 (0.00) |
| Kangra | 401 (0.14) | 425 (0.05) | 400 (0.15) | 259 (0.06) | 322 (0.04) | 309 (0.05) | 324 (0.04) | 277 (0.06) | 285 (0.06) |
| Kinnaur | 40289 (14.38) | 63781 (7.15 | 53290 (19.38) | 52020 (12.61) | 54044 (7.32) | 59196 (9.47) | 75202 (9.68) | 60210 (12.86) | 52189 (11.69) |
| Kullu | 54385 (19.42) | 191212 (21.43) | 44619 (16.22) | 87906 (21.32) | 152654 (20.66) | 104589 (16.73) | 143475 (18.46) | 89570 (19.13) | 78948 (17.68) |
| Lahaul & Spiti | 193 (0.07) | 194 (0.02) | 126 (0.05) | 169 (0.04) | 200 (0.03) | 277 (0.04) | 272 (0.04) | 305 (0.07) | 300 (0.07) |
| Mandi | 8659 (3.09) | 22315 (2.50) | 4417 (1.61) | 9015 (2.19) | 24229 (3.28) | 24709 (3.95) | 48608 (6.25) | 38344 (8.19) | 42078 (9.42) |
| Shimla | 171945 (61.39) | 602684 (67.56) | 168634 (61.31) | 259779 (62.99) | 499422 (67.61) | 407751 (65.22) | 482388 (62.08) | 265987 (56.82) | 251897 (56.41) |
| Sirmour | 242 (0.09) | 673 (0.08) | 457 (0.15) | 481 (0.12) | 644 (0.09) | 2290 (0.37) | 2821 (0.36) | 1688 (0.36) | 1896 (0.42) |
| Solan | 28 (0.01) | 38 (0.00) | 19 (0.01) | 25 (0.01) | 18 (0.00) | 23 (0.00) | 14 (0.00) | 14 (0.00) | 15 (0.00) |
| Una | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 280105 (100.00) | 892112 (100.00) | 275036 (100.00) | 412395 (100.00) | 738723 (100.00) | 625199 (100.00) | 777126 (100.00) | 468134 (100.00) | 446574 (100.00) |

**Source:** Directorate of Horticulture, Navbahar, Shimla, Government of Himachal Pradesh.
**Note:** Figures in Parenthesis indicate percentage.

### 3.3 Block-wise Area under Apple in District Shimla

Table-3.2 shows the block-wise area (in hectares) under apple crop in district Shimla. This data is for 10 blocks in district Shimla. The data is from the year 2009-10 till year 2017-18. In all these years, highest area under apple was in block Jubbal & Kotkhai, both in absolute and relative values. Second highest area was under block Rohru, followed by block Narkanda. Block Basantpur had the least area under apple for all these years. Area under apple in every block in Shimla has seen an increasing trend over the years. Block with highest area coverage (Jubbal-Kotkhai) had 6,110.84 hectares under apple in 2009-10, which increased to 7,158.12 hectares in 2017-18. Similarly, block with lowest area coverage (Basantpur) had 665.87 hectares under

apple in 2009-10, which increased to 743.73 hectares in 2017-18. Total area under apple in district Shimla increased from 31,228.13 hectares in 2009-10 to 36,500.12 hectares in 2017-18.

**Table-3.2: Block-wise Area under Apple Crop in District Shimla during different years**

**(In Hectare)**

| Particulars | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---|---|---|---|---|---|---|---|---|---|
| **Basantpur** | 665.87 (2.14) | 666.78 (2.08) | 682.96 (2.07) | 679.22 (1.99) | 680.80 (1.99) | 718.60 (2.03) | 736.00 (2.04) | 743.00 (2.04) | 743.73 (2.04) |
| **Chirgaon** | 3427.28 (10.97) | 3475.17 (10.83) | 3545.82 (10.77) | 3612.01 (10.59) | 3655.30 (10.68) | 3733.91 (10.60) | 3805.00 (10.56) | 3839.00 (10.55) | 3852.31 (10.55) |
| **Chopal** | 2950.75 (9.46) | 2993.86 (9.33) | 3108.30 (9.44) | 3229.05 (9.46) | 3226.13 (9.43) | 3367.43 (9.56) | 3454.00 (9.59) | 3485.00 (9.58) | 3493.86 (9.57) |
| **Jubbal-Kotkhai** | 6110.84 (19.57) | 6271.72 (19.56) | 6466.44 (19.64) | 6767.53 (19.83) | 6749.53 (19.72) | 6902.66 (19.59) | 7097.00 (19.70) | 7158.00 (19.67) | 7158.12 (19.61) |
| **Mashobra** | 1236.02 (3.96) | 1267.21 (3.95) | 1321.65 (4.01) | 1381.04 (4.05) | 1385.04 (4.05) | 1456.96 (4.14) | 1475.00 (4.09) | 1482.00 (4.07) | 1485.54 (4.07) |
| **Nankhari** | 1533.96 (4.91) | 1732.22 (5.40) | 1750.01 (5.31) | 1841.45 (5.40) | 1858.75 (5.43) | 1915.26 (5.44) | 1946.00 (5.40) | 1974.00 (5.42) | 1986.96 (5.45) |
| **Narkanda** | 4541.77 (14.54) | 4579.89 (14.28) | 4615.62 (14.02) | 4680.25 (13.72) | 4670.85 (13.65) | 4803.98 (13.63) | 4876.00 (13.53) | 4905.00 (13.48) | 4904.41 (13.44) |
| **Rampur** | 2303.22 (7.37) | 2601.47 (8.11) | 2779.12 (8.44) | 2980.03 (8.73) | 3020.20 (8.82) | 3085.00 (8.76) | 3155.00 (8.76) | 3223.00 (8.85) | 3282.72 (8.99) |
| **Rohru** | 4912.96 (15.73) | 4915.08 (15.33) | 5029.02 (15.27) | 5171.95 (15.16) | 5200.08 (15.19) | 5338.89 (15.15) | 5487.00 (15.23) | 5538.00 (15.22) | 5541.61 (15.18) |
| **Theog** | 3545.46 (11.35) | 3568.67 (11.13) | 3632.13 (11.03) | 3776.66 (11.07) | 3777.27 (11.04) | 3911.25 (11.10) | 4000.00 (11.10) | 4048.00 (11.12) | 4050.86 (11.10) |
| **Total in Shimla District** | 31228.13 (100.00) | 32072.07 (100.00) | 32931.07 (100.00) | 34119.19 (100.00) | 34223.95 (100.00) | 35233.94 (100.00) | 36029.00 (100.00) | 36395.00 (100.00) | 36500.12 (100.00) |

**Source:** Directorate of Horticulture, Navbahar, Shimla, Government of Himachal Pradesh.
**Note:** Figures in Parenthesis indicate percentage.

### 3.4 Block-wise Production of Apple in District Shimla

The block-wise production of apple crop in district Shimla from the year 2009-10 till 2017-18 is presented in Table-3.3, which indicates that in all these years, highest production of apple occurred in block Jubbal & Kotkhai, both in absolute and relative values. Followed by block Narkanda in 2009-10 and then by block Rohru for rest of the years. Block Basantpur had the least production of apple throughout the years. Highest production block (Jubbal & Kotkhai) has seen an increasing trend in production of apple, as it was 70,536 MT in 2009-10, which

increased to 78,450 MT in 2017-18. Same is true for the total production of apple in the entire district which increased from 1,71,945 MT in 2009-10 to 2,51,897 MT in 2017-18.

**Table-3.3: Block-wise Production of Apple Crop in District Shimla during different Years (In MT)**

| Particulars | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---|---|---|---|---|---|---|---|---|---|
| **Basantpur** | 650.00 (0.38) | 3250.00 (0.54) | 910.62 (0.54) | 1400.18 (0.54) | 2247.40 (0.45) | 2244.00 (0.55) | 2482.00 (0.51) | 1303.00 (0.49) | 1230.00 (0.49) |
| **Chirgaon** | 10318.00 (6.00) | 43800.00 (7.27) | 12259.61 (7.27) | 18883.04 (7.27) | 38954.92 (7.80) | 29929.00 (7.34) | 61559.48 (12.76) | 32502.00 (12.22) | 30200.00 (11.99) |
| **Chopal** | 14099.00 (8.20) | 53800.00 (8.93) | 15058.90 (8.93) | 23195.30 (8.93) | 45996.77 (9.21) | 27319.00 (6.70) | 36000.00 (7.46) | 18175.00 (6.83) | 16280.00 (6.46) |
| **Jubbal & Kotkhai** | 70536.00 (41.02) | 198800.00 (32.99) | 55616.19 (32.98) | 85719.79 (33.00) | 143334.10 (28.70) | 114904.00 (28.18) | 143400.00 (29.73) | 90564.00 (34.05) | 78450.00 (31.14) |
| **Mashobra** | 687.00 (0.40) | 5634.00 (0.93) | 1568.28 (0.93) | 2413.30 (0.93) | 3995.35 (0.80) | 3384.00 (0.83) | 4394.52 (0.91) | 1756.00 (0.66) | 1550.00 (0.62) |
| **Nankhari** | 8596.00 (5.00) | 33500.00 (5.56) | 9392.86 (5.57) | 14466.86 (5.57) | 28267.28 (5.66) | 34944.00 (8.57) | 19500.00 (4.04) | 14734.00 (5.54) | 13000.00 (5.15) |
| **Narkanda** | 25792.00 (15.00) | 74800.00 (12.41) | 20927.35 (12.41) | 32235.47 (12.41) | 53937.58 (10.80) | 40204.00 (9.86) | 50116.00 (10.39) | 20960.00 (7.88) | 15456.00 (6.14) |
| **Rampur** | 8598.00 (5.00) | 39800.00 (6.60) | 11129.78 (6.60) | 17145.15 (6.60) | 67821.50 (13.58) | 32375.00 (7.94) | 36470.00 (7.56) | 19736.00 (7.42) | 18006.00 (7.15) |
| **Rohru** | 20633.00 (12.00) | 92500.00 (15.35) | 25885.16 (15.35) | 39849.48 (15.33) | 73914.50 (14.80) | 75271.00 (18.46) | 93466.00 (19.38) | 46255.00 (17.39) | 60325.00 (23.95) |
| **Theog** | 12036.00 (7.00) | 56800.00 (9.42) | 15885.25 (9.42) | 24470.80 (9.42) | 40952.60 (8.20) | 47177.00 (11.57) | 35000.00 (7.26) | 20002.00 (7.52) | 17400.00 (6.91) |
| **Total** | 171945.00 (100.00) | 602684.00 (100.00) | 168634.00 (100.00) | 259779.37 (100.00) | 499422.00 (100.00) | 407751.00 (100.00) | 482388.00 (100.00) | 265987.00 (100.00) | 251897.00 (100.00) |

**Source:** Directorate of Horticulture, Navbahar, Shimla, Government of Himachal Pradesh.
**Note:** Figures in Parenthesis indicate percentage.

### 3.5 Functioning of Hail Protection Mechanism in the State

There are two types of mechanism, anti-hail Cannons and Nets used to protect apple crops from hailstorm in the state. Hail protection mechanism is mostly installed and used in district Shimla of the state.

#### 3.5.1 Implementing Agency of Hail Protection Mechanism

Department of Horticulture, Himachal Pradesh is the implementing agency of this mechanism. It monitors the functioning of anti-hail Cannons and Nets to protect apple crop in the state and also in study area. However, farmers committees were also formed to monitor the functioning of privately installed anti-hail Cannons in the study areas, as the government of Himachal Pradesh

did not provide assistance in this regard and, therefore, farmers of district Shimla (Jubbal & Kotkhai block) privately imported and installed five anti-hail Cannons on their hailstorms affected production areas, after suffering huge losses due to hailstorms that ruined apple crop in the year 2015.

### 3.5.2 Basic Features of the Mechanism

#### 3.5.2.1 Anti-hail Cannon

Anti-hail Cannon is known as the modern device to control hailstorms in apple areas. This device generates energy through shockwaves from its neck caused by the fire shots that disperse hail causing clouds and melts hailstones into rain or thin sleet. This modern device was firstly introduced by the state government on behalf of department of horticulture in the state, imported from another country. The department of horticulture installed three anti-hail Cannons on pilot basis under central funded project worth Rs. 3.29 crores in the state during 2010-11. These Cannons were installed at three different places; Kathasu in Jubbal tehsil, Braionghat in Kotkhai tehsil and Deorighat in Rohru tehsil of district Shimla. Total installation price of these three anti-hail Cannons was Rs. 1,42,62,000 which was Rs. 47,54,000 per Cannon.

#### 3.5.2.1 (A) Historical Aspects about the Efficiency of anti-hail Cannons

The principle behind the anti-hail Cannon is to prevent the damage caused by hailstones by dispersing the clouds responsible for formation and growth of hailstones. In early 1900s', anti-hail Cannon's shockwaves were generated by gun powder, which was both dangerous and took a longer time to reload and large number of such cannons were needed to be deployed. Now a day, acetylene or butane gas is used to generate hail disruptive shockwaves. This allows the emission of more powerful shockwaves with higher frequency. Shockwaves generally are not affective against already formed hailstones, and so it is very important to curb hail in formative stage. An anti-hail Cannon operation must be initiated 20 minutes before hail storm formation. The efficiency of the Cannon decreases in proportion to the delay in initial operation. Once the super-cooled water situated on the external layer of hailstone is transformed from liquid state to solid state, the hail nuclei are not able to melt. If anti-hail Cannon is activated the time the storm is directly above the device, its efficiency is very low. Therefore, it is strongly recommended to use

storm tracking device like Doppler radar to assess hail forming clouds on time. Though these devices are quite effective, but still improvement in their efficiency are wanted.

### 3.5.2.1 (B) Financial Assistance provided on anti-hail Cannons in the State

There was no subsidy available on the anti-hail Cannon in the state because the Cannons are not for an individual but these devices cover entire hailstorm affected area. After installing three anti-hail Cannons in the state the government did not install any more Cannons due to some political issues. Thus, farmers of the state privately purchased their own anti-hail Cannons in 2016, after making a 'Farmer Committee' and collecting funds from apple growers at *panchayat* level. They did not receive any financial assistance on Cannons as there was no provision for subsidy or other financial assistance from the implementing agency of the state. These farmers also pay for the operation and maintenance of the Cannons themselves.

At present, the implementing agency of the state introduced 60 per cent subsidy on the project of anti-hail Cannons in 2018. The centre government has approved the project of anti-hail Cannons for Himachal Pradesh which would install Cannons in four districts of the state; Shimla, Kullu, Mandi and Chamba. The centre government sanctioned Rs. 23 crores for this project. First installment of Rs. 1.25 crores has already been released by centre government for the state. The state government also kept Rs. 10 crores for this project in their budget. In this way, the state government is providing 60 per cent subsidy on each Cannon.

### 3.5.2.1 (C) Various Costs incurred on anti-hail Cannons in Study Area of the State

There are various costs viz; installation and material costs incurred on government installed Cannons by the government and privately installed Cannons by the farmers of study area. These costs incurred are presented in Tables-3.4 and 3.5.

Various costs incurred on the government installed anti-hail Cannon are given in Table-3.4. This Cannon is installed in village Braionghat in Jubbal & Kotkhai block. One time installation cost for this Cannon was incurred in the year 2010 which was Rs. 47, 54,000. Year-wise material costs for cylinder refills, freight charges, Cannon operator and labour are given from 2013-14 till 2018-19. Highest number of cannon shots were fired in the year 2016-17 (39,641), which was 28.24 per cent of the total shots fired so far (i.e. 1,40,487). Highest number

of cylinder refills were done in the year 2013-14 (259), which was 30.26 per cent of the total 856 refills done till date. Whereas, cost of cylinder refills was highest in the year 2016-17 (Rs. 4,62,308), which was 28.03 per cent of total (Rs. 16,49,325). This was due to maximum operations of the anti-hail Cannon taking place against adverse weather conditions during this particular year. Freight charges were highest in 2013-14 (Rs. 77,000), which was 26.42 per cent of total freight charges incurred (Rs. 2,91,500). Cannon operator was paid the highest remuneration in the year 2014-15 (Rs. 1,08,000), which was 25.54 per cent of the total (Rs. 3,78,400). Labour cost was highest for the year 2016-17 (Rs. 7,500), which was 30.83 per cent of the total.

**Table-3.4: Details of Government Installed anti-hail Cannon Costs for different Years**

**(Value in Rs.)**

| **Year/Particulars** | **2013-14** | **2014-15** | **2015-16** | **2016-17** | **2017-18** | **2018-19** | **Total** |
|---|---|---|---|---|---|---|---|
| **Installation Cost (Incurred in 2010)** | 4754000 | | | | | | |
| **Material Cost** | | | | | | | |
| No. of Cannon Shots | - | 23985 (17.07) | 26875 (19.13) | 39641 (28.24) | 38331 (27.27) | 11655 (8.29) | 140487 (100.00) |
| No. of Cylinder Refills | 259 (30.26) | 115 (13.43) | 129 (15.07) | 168 (19.63) | 124 (14.48) | 61 (7.13) | 856 (100.00) |
| Cost of cylinder Refills | 67461 (4.09) | 199919 (12.13) | 396258 (24.02) | 462308 (28.03) | 368197 (22.32) | 155182 (9.41) | 1649325 (100.00) |
| Freight charges | 77000 (26.42) | 45000 (15.44) | 31000 (10.63) | 51800 (17.77) | 49200 (16.88) | 37500 (12.86) | 291500 (100.00) |
| Cannon Operator | 78900 (20.85) | 108000 (28.54) | 73500 (19.42) | 36000 (9.51) | 60000 (15.86) | 22000 (5.82) | 378400 (100.00) |
| Labour cost | 3402 (13.87) | 3340 (13.62) | 5360 (21.86) | 7560 (30.83) | 4860 (19.82) | - | 24522 (100.00) |

**Source:** Department of Horticulture, SMS, Kotkhai.
**Note:** All figures in parenthesis indicate percentage, and the percentage of different years has been calculated from total cost.

Various costs incurred on privately installed Cannons in the year 2018-19 are given in Table-3.5. These Cannons are installed in Kalbog, Ratnari, Baghi and Mahasu areas of Jubbal & Kotkhai block. Installation cost was highest for village Mahasu (Rs. 85,00,000), which was 29.51 per cent of the total cost of all the privately installed Cannons (Rs. 2,87,99,525). Highest number of Cannon cylinder refill was done in village Baghi (224) which was 29.05 per cent of the total cylinder refills (771). Evidently, highest cost of cylinder refills was also incurred by

village Baghi (Rs. 7,16,800), which was 33.14 per cent of the total costs (Rs. 21,62,800). Village Kalbog paid the highest remuneration to its Cannon operator (Rs. 2,40,000) in the year 2018-19, which was 43.09 per cent of the total remuneration in four villages. Highest freight charges were incurred by village Baghi (Rs. 62,222), which was 31.17 per cent of the total freight charges (Rs. 1,99,594).

**Table-3.5: Details of Privately Installed Cannon Costs for 2018-19**

**(Value in Rs.)**

| Particulars | Kalbog | Ratnari | Baghi | Mahasu | Total |
|---|---|---|---|---|---|
| Installation Cost | 7699525 (27.78) | 6800000 (23.61) | 5500000 (19.10) | 8500000 (29.51) | 28799525 (100.00) |
| No. of Cannon Cylinder Refill | 180 (23.35) | 167 (21.66) | 224 (29.05) | 200 (25.94) | 771 (100.00) |
| Cost of Cannon Cylinder Refill | 486000 (22.47) | 500000 (23.12) | 716800 (33.14) | 460000 (21.27) | 2162800 (100.00) |
| Cannon Operator | 240000 (43.09) | 72000 (12.93) | 120000 (21.54) | 125000 (22.44) | 557000 (100.00) |
| Freight Charges | 54900 (27.51) | 32472 (16.27) | 62222 (31.17) | 50000 (25.05) | 199594 (100.00) |

**Source:** Farmer committees and Incharge of anti-hail Cannons at Jubble & Kotkhai block.
**Note:** All figures in parenthesis indicate percentage to total.

### 3.5.2.2 Anti-hail Net

Anti-hail Net is an old protection system against hailstorm disaster in apple areas. This type of mechanism is not provided by state horticulture department but farmers purchase anti-hail Nets from private retailers and government provides some financial assistance/subsidy on this mechanism.

### 3.5.2.2 (A) Financial Assistance provided on anti-hail Net

To protect fruit crops, especially apple, from hailstorms the state government enhanced subsidy on anti-hail Nets from 50 per cent to 80 per cent during the year 2015-16. Further, the government announced Rs. 10 crores for providing 80 per cent subsidy to the farmers for the purchase of anti-hail Nets with the target of bringing about 30 lakhs square meters under protection of anti-hail Nets in the state during the year 2018-19.

### 3.5.2.2 (B) Modality for Implementation of the anti-hail Net Subsidy Scheme

Under this scheme, assistance is provided to all categories of farmers. Only bonafide farmer of the state of Himachal Pradesh are eligible for availing subsidy on this particular hail protection mechanism. The maximum limit for availing assistance is restricted to 5,000 square meters per beneficiary/family.

The guidelines and cost norms which were already being followed under the mission for Integrated Development of Horticulture (MIDH) is adhered to so as to maintain uniformity in the implementation of the subsidy scheme (Table-3.6). The assistance provided to the farmers as per the norms and guidelines of the MIDH are given as follows:

**Table- 3.6: Details of Subsidy Scheme under anti-hail Net in the State**

| Component | Cost Norms (as per MIDH) | Rate of Assistance | Maximum Amount | Remarks |
|---|---|---|---|---|
| anti-hail Net | Rs. 35/- per square meter | 80 % | Rs. 28/- per square meter | Maximum area upto 5000 sq. mtr. Per beneficiary |

### 3.5.2.2 (C) Documents required for Subsidy on anti-hail Net

The documents as listed below:

- Application form for availing assistance filled by beneficiary.
- Photograph of beneficiary at the time of purchasing anti-hail Net.
- A copy of Bank Passbook of the beneficiary.
- A copy of Aadhaar Card of the beneficiary.
- A copy of receipt of anti-hail Net purchased by the beneficiary.

### 3.5.2.2 (D) Procedure for Availing Assistance provided on anti-hail Net

The process of assistance is also done as per the norms and guidelines of MIDH (Mission for Integrated Development of Horticulture). At first, submission of complete application form filled in by the prospective beneficiary is required, along with above mentioned documents to the Subject Matter Specialist (SMS) and Horticulture Development Officer (HDO) of the concerned Block. Secondly, the HDO, after being satisfied by the application, sends the application for the

approval of the Block Level Committee, District Level Committee and Project Approval Committee, who consider the cost of assistance sought by the potential beneficiary. The Deputy Director of Horticulture of the concerned District, on recommendation of the application by above mentioned committees, sanctions the subsidy to the beneficiary through the concerned HDO. Further, on successful execution of the physical work duly verified by the concerned HDO, the Deputy Director of Horticulture of the concerned District releases a part or full amount of due assistance, through a Cheque or Demand Draft favoring the beneficiary.

### 3.5.2.2 (E) Achievements of anti-hail Net in the State

The following two types of achievements are related to anti-hail Net viz; physical achievements, which means area covered under subsidy (in square meters) and financial achievements, which means subsidy provided (in Rs. lakh) on the purchase of Nets. Achievements of anti-hail Net in the state is presented in Tables-3.7 and 3.8.

**Table-3.7: District-wise Physical Achievements of anti-hail Net during different years**

| Particulars | Area covered under subsidy (in Sq. Meter) | | | | | |
|---|---|---|---|---|---|---|
| | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
| Bilaspur | 2250 (0.62) | 25484 (1.44) | 3220 (0.45) | 16117 (4.82) | 0 (0.00) | 0 (0.00) |
| Chamba | 0 (0.00) | 10000 (0.56) | 13000 (1.83) | 0 (0.00) | 0 (0.00) | 3000 (0.58) |
| Hamirpur | 0 (0.00) | 400 (0.02) | 7136 (1.00) | 1000 (0.30) | 0 (0.00) | 5000 (0.96) |
| Kangra | 3236 (0.90) | 4000 (0.23) | 500 (0.07) | 10000 (2.99) | 0 (0.00) | 0 (0.00) |
| Kinnaur | 2000 (0.57) | 20000 (1.13) | 1997 (0.28) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Kullu | 185000 (51.72) | 490000 (27.63) | 115000 (16.16) | 26770 (8.01) | 1910000 (42.25) | 63000 (12.08) |
| Lahaul & Spiti | 0 (0.00 | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Mandi | 49670 (13.89) | 20000 (1.13) | 77500 (10.89) | 57000 (17.06) | 2333000 (51.60) | 130205 (24.97) |
| Shimla | 114548 (32.02) | 1180277 (66.56) | 492268 (69.18) | 202824 (60.71) | 253413 (5.61) | 275197 (52.78) |
| Sirmour | 1000 (0.28) | 20000 (1.13) | 1000 (0.14) | 2000 (0.60) | 24500 (0.54) | 30000 (5.75) |
| Solan | 0 (0.00) | 0 (0.00) | 0 (0.00) | 18375 (5.51) | 0 (0.00) | 14975 (2.88) |
| Una | 0 (0.00) | 3000 (0.17) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 357704 (100.00) | 1773161 (100.00) | 711621 (100.00) | 334086 (100.00) | 4520913 (100.00) | 521377 (100.00) |

**Source:** Department of Horticulture, Navbahar, Shimla, Himachal Pradesh.
**Note:** Figures in Parenthesis indicate percentage.

District-wise physical achievements of anti-hail Net during 2012-13 to 2017-18 are presented by Table-3.7, which indicates that the area covered under subsidy scheme on Nets, was highest for district Shimla during all years except during the years 2012-13 and 2016-17. Out of the total area covered under this scheme in the state, about 69 per cent area was covered in district Shimla during the year 2014-15, which was highest among the area coverage during all years. Second highest area covered under this scheme was in district Kullu followed by district Mandi, respectively. Districts Kinnaur and Sirmour covered lowest area under this particular scheme, and the percentage accounted between 1 to 6 per cent of total during all years. Further, it was found that district Lahaul & Spiti covered no area under subsidy scheme on anti-hail Nets. Thus, it can be concluded that district Shimla had highest coverage under physical achievements of anti-hail Net because the district had largest area and production under apple and also covered highest area of apple crop under anti-hail Net in the state.

**Table-3.8: District-wise Financial Achievements of Anti-hail Net during different years**

| **Particulars** | **Subsidy provided (Rs. in Lakh)** | | | | | |
|---|---|---|---|---|---|---|
| | **2012-13** | **2013-14** | **2014-15** | **2015-16** | **2016-17** | **2017-18** |
| Bilaspur | 0.23 (0.35) | 2.58 (1.32) | 0.44 (0.47) | 2.63 (1.11) | 0 (0.00) | 0 (0.00) |
| Chamba | 0 (0.00) | 1.00 (0.51) | 2.28 (2.46) | 0 (0.00) | 0 (0.00) | 0.53 (0.47) |
| Hamirpur | 0 (0.00) | 0.04 (0.02) | 1.23 (1.33) | 0.18 (0.08) | 0 (0.00) | 0.88 (0.78) |
| Kangra | 0.32 (0.48) | 0.40 (0.20) | 0.09 (0.10) | 1.75 (0.74) | 0 (0.00) | 0 (0.00) |
| Kinnaur | 0.20 (0.30) | 2.00 (1.02) | 0.35 (0.38) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Kullu | 18.50 (27.79) | 49.00 (25.08) | 20.13 (21.70) | 4.55 (1.92) | 33.43 (28.79) | 31.50 (27.81) |
| Lahaul & Spiti | 0 (0.00 | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Mandi | 4.97 (7.46) | 20.00 (10.24) | 13.56 (14.62) | 9.98 (4.21) | 40.78 (35.12) | 22.69 (20.03) |
| Shimla | 42.26 (63.47) | 118.03 (60.42) | 54.49 (58.75) | 214.99 (90.59) | 37.63 (32.40) | 49.81 (43.97) |
| Sirmour | 0.10 (0.15) | 2.00 (1.03) | 0.18 (0.19) | 0.35 (0.15) | 4.29 (3.69) | 5.25 (4.63) |
| Solan | 0 (0.00) | 0 (0.00) | 0 (0.00) | 2.89 (1.20) | 0 (0.00) | 2.62 (2.31) |
| Una | 0 (0.00) | 0.30 (0.16) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 66.58 (100.00) | 195.35 (100.00) | 92.75 (100.00) | 237.32 (100.00) | 116.13 (100.00) | 113.28 (100.00) |

**Source:** Department of Horticulture, Navbahar, Shimla, Himachal Pradesh.
**Note:** Figures in Parenthesis indicate percentage.

Table-3.8 shows the district-wise financial achievements of anti-hail Net during 2012-13 to 2017-18 in the state. This table indicates that in all these years, highest amount of subsidy on anti-hail Net was provided to district Shimla, except during the year 2016-17. It was followed by districts Kullu and Mandi, respectively. District Shimla had highest subsidy amount during the year 2015-16, which was Rs. 214.99 Lakhs which calculated as 90.59 per cent of total subsidy provided in the state. Further, it was observed that the lowest amount of subsidy was provided to district Kinnaur and Sirmour, which was calculated between 1 to 5 per cent of total share of subsidy on Nets in all years. No subsidy amount was provided to district Lahaul & Spiti due to its nil coverage of area under Nets. Therefore, it can be concluded that district Shimla had highest percentage of subsidy on anti-hail Net during all years except during the year 2016-17. After that district Kullu had second highest percentage and district Mandi had third highest percentage of subsidy on anti-hail Net during all years.

### 3.6 Summing Up

Apple is the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. The analyses reveal that the area under apple in the state has increased significantly from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and to 1,12,500 hectares in 2017-18, respectively. Shimla district alone accounts for about 55-60 per cent of total production in the state during all years (2009-10 to 2017-18). This district has accounted highest production of apple among all districts of the state and showed increasing trend in production of apple, as it was 1,71,945 MT in 2009-10, which was increased to 2,51,897 MT in 2017-18.

Block-wise area and production of apple in district Shimla: Jubbal & Kotkhai block had accounted highest area and production among all 10 blocks of the district during all years (2009-10 to 2017-18 followed by Rohru and Narkanda blocks, respectively.

The analyses reveal that there were two types of mechanism, anti-hail Cannons and Nets used to protect apple crops from hailstorm in the state. Hail protection mechanism was mostly installed and used in district Shimla. Department of horticulture was the main implementing agency for these mechanism, which monitors the functioning of anti-hail Cannons and Nets used for protecting apple crop in study areas. In Jubbal & Kotkhai block of district Shimla, farmers

Committees were formed by the orchardists themselves, to monitor the functioning of privately installed Cannons in their areas during 2016. To protect fruit crops, especially apple, from hailstorms the state government enhanced subsidy on anti-hail Nets from 50 per cent to 80 per cent during the year 2015-16. The horticulture department provided 80 per cent subsidy to farmers for their purchase of anti-hail Nets and maximum limit for availing assistance was restricted to 5,000 square meters per beneficiary/family. But there was no provision for availing assistance on anti-hail Cannon before the year, 2018. Ever since, the State government introduced 60 per cent subsidy on the Cannons.

The analyses reveals that Jubbal & Kotkhai block had highest coverage under the installation of anti-hail Cannons among all blocks of district Shimla, whereas, some Cannons were installed by government and some privately by the apple orchardists, incurring various installation and operation costs of anti-hail Cannons themselves. One time installation cost of government installed Cannon at Braionghat was Rs. 47,54,000 during 2016-17. Whereas material cost of its every operations like, Cannon shots, cost of cylinder, freight charges, Cannon operator and labour were also incurred by the government during the year, 2013-14 to 2018-19. Highest Cannon shots were used against adverse weather condition during the year 2016-17 and cost of cylinder refills and labour cost was also highest for this year. In case of privately installed Cannons at Kalbog, Ratnari, Baghi and Mahasu villages of Jubbal & Kotkhai block, one time total installation cost was Rs. 2,87,99,525, which was Rs. 76,99,525, Rs. 68,00,000, Rs. 55,00,000 and Rs. 85,00,000 for Kalbog, Ratnari, Baghi and Mahasu villages, respectively. Installation cost was highest for Mahasu village. Cost of cylinder refills and freight charges were highest for village Baghi. Cannon operator charges were highest for Kalbog village.

The analyses of physical and financial achievements of anti-hail Nets reveal that district Shimla had highest coverage under physical achievements of area covered under subsidy on Nets and financial achievements of subsidy provided on Nets. Block-wise analyses show that Thanedhar block had highest coverage area under Nets with subsidy and also attained highest share of subsidy on Nets among all blocks of district Shimla.

# Chapter-IV

## SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLED ORCHARDISTS

Profile of the hail protection mechanism users and non-users is studied in this chapter, which is based on their social features viz; caste composition, family size composition, age composition and education level. Further, the farm level characterstics of sampled orchardists based on their economic features viz; land holdings, croping pattern and occupation pattern are also studied in this chapter. Thus, the present chapter is devoted to understand the socio-economic background of the sampled orchardists. This is necessary to evaluate the background under which these orchardists inhabit, so that the inference could be viewed accordingly. This chapter also highlights the difference in socio-economic characteristics of users and non-users of the mechanism.

### 4.1 Caste Composition

Caste composition of sampled orchardists is depicted in percentage form in Table-4.1. Various caste categories are General, SC, ST and Other. In both the blocks users and non-users, majority of the orchardists were in General category and the remaining in SC category. There was no orchardist found belonging to ST and other categories. For anti-hail Cannon users 88.89 per cent of orchardists comprised of general category and 11.11 per cent of SC category. For Cannon non-users these values were 73.33 and 26.67 per cent. For anti-hail Net users 66.67 per cent of total orchardists comprised of general category and 33.33 per cent of SC category. For Net non-users these values were 73.33 and 26.67 per cent.

In terms of classifications for Cannon users 100 per cent orchardists were in general category for medium farmers. For Cannon non-user, general category was highest for semi-medium farmers (87.50%). Further, for Cannon users and non-users, marginal farmers had highest SC category (42.86 and 100%). For Net users, orchardists in general and SC category were equal for marginal and small farmers whereas for Net non-users small farmers had higher general category (100%) and marginal farmers had higher SC category (40%). ST and other caste categories had no orchardists in them.

**Table-4.1: Caste Composition of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | General | 57.14 | 91.67 | 94.44 | 100.00 | 88.89 |
| | | SC | 42.86 | 8.33 | 5.56 | 0.00 | 11.11 |
| | | ST | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | General | 0.00 | 80.00 | 87.50 | 0.00 | 73.33 |
| | | SC | 100.00 | 20.00 | 12.50 | 0.00 | 26.67 |
| | | ST | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | General | 66.67 | 66.67 | 0.00 | 0.00 | 66.67 |
| | | SC | 33.33 | 33.33 | 0.00 | 0.00 | 33.33 |
| | | ST | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | General | 60.00 | 100.00 | 0.00 | 0.00 | 73.33 |
| | | SC | 40.00 | 0.00 | 0.00 | 0.00 | 26.67 |
| | | ST | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey.

## 4.2 Family Composition

Family composition of sampled orchardists is depicted in numbers and in percentage in Table-4.2. In both the blocks, users and non-users, total males were more than total females. For anti-hail Cannon users, total males were 53.67 per cent and females were 46.33 per cent, and for non-users the total males were 51.43 per cent and females were 48.57 per cent. Also, for Cannon users, small farmers had highest percentage of males (56.60%) and medium farmers had highest percentage of females (48.94%).

For anti-hail Net users, total males were 52.40 per cent and females were 47.60 per cent, and for non-users the total males were 50.67 per cent and females were 49.33 per cent. For Net users, small farmers had higher percentage of Males (55.47%) and marginal farmers had higher percentage of females (53.52) whereas for Net non-users, percentage of Males was higher for marginal farmers (51.16%) and that of females was higher for small farmers (50%).

**Table-4.2: Family Composition of Sampled Orchardists**

**(In No.)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail Cannon)** | Users | Male | 16 (53.33) | 30 (56.60) | 47 (53.41) | 24 (51.06) | 117 (53.67) |
| | | Female | 14 (46.67) | 23 (43.40) | 41 (46.59) | 23 (48.94) | 101 (46.33) |
| | | Total | 30 (100.00) | 53 (100.00) | 88 (100.00) | 47 (100.00) | 218 (100.00) |
| | Non-users | Male | 5 (50.00) | 12 (50.00) | 19 (52.78) | 0 (0.00) | 36 (51.43 |
| | | Female | 5 (50.00) | 12 (50.00) | 17 (47.22) | 0 (0.00) | 34 (48.57) |
| | | Total | 10 (100.00) | 24 (100.00) | 36 (100.00 | 0 (0.00) | 70 (100.00) |
| **Thanedhar (anti-hail Net)** | Users | Male | 33 (46.48) | 76 (55.47) | 0 (0.00) | 0 (0.00) | 109 (52.40) |
| | | Female | 38 (53.52) | 61 (44.53) | 0 (0.00) | 0 (0.00) | 99 (47.60) |
| | | Total | 71 (100.00) | 137 (100.00) | 0 (0.00) | 0 (0.00) | 208 (100.00) |
| | Non-users | Male | 22 (51.16) | 16 (50.00) | 0 (0.00) | 0 (0.00) | 38 (50.67) |
| | | Female | 21 (48.84) | 16 (50.00) | 0 (0.00) | 0 (0.00) | 37 (49.33) |
| | | Total | 43 (100.00) | 32 (100.00) | 0 (0.00) | 0 (0.00) | 75 (100.00) |

**Source:** Data from Field Survey
**Note:** Figures in parenthesis indicate percentages to total.

## 4.3 Age Composition

Age composition of sampled orchardists is depicted in percentage form in Table-4.3. The age categories are 0-5 years, 5-14 years, 14-18 years, 18-60 years and 60& above. In both the blocks users and non-users, maximum percentage of family members was in the 18-60 years age group. For anti-hail Cannon users it was 70.64 per cent and for non-users it was 70.00 per cent. Similarly for anti-hail Net users it was 68.75 per cent and for non-users it was 65.34 per cent. In anti-hail Cannon block, least family members were in 0-5 years age group for both users (3.21%) and non-users (4.28%). Whereas, in anti-hail Net block, least family members were in 14-18 years age group for users (3.36%) and non-users (0.00). In terms of classifications, for Cannon users, highest percentage of orchardists in 18-60 years age group were for semi-medium farmers (72.73%) and for Cannon non-users, this was highest for marginal farmers (80%). For Net users,

marginal farmers had higher percentage of orchardists (70.42%) in 18-60 years age group, whereas, for Net non-users this was higher for small farmers (68.75%).

**Table-4.3: Age Composition of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | 0-5 years | 3.33 | 1.89 | 4.54 | 2.13 | 3.21 |
| | | 5-14 years | 16.67 | 7.55 | 6.82 | 19.15 | 11.01 |
| | | 14-18 years | 10.00 | 3.77 | 3.41 | 0.00 | 3.67 |
| | | 18-60 years | 66.67 | 71.70 | 72.73 | 68.08 | 70.64 |
| | | 60 & above | 3.33 | 15.09 | 12.50 | 10.64 | 11.47 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | 0-5 years | 10.00 | 4.17 | 2.78 | 0.00 | 4.28 |
| | | 5-14 years | 0.00 | 16.67 | 2.78 | 0.00 | 7.14 |
| | | 14-18 years | 0.00 | 8.33 | 5.55 | 0.00 | 5.71 |
| | | 18-60 years | 80.00 | 58.33 | 75.00 | 0.00 | 70.00 |
| | | 60 & above | 10.00 | 12.50 | 13.89 | 0.00 | 12.87 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | 0-5 years | 2.82 | 4.38 | 0.00 | 0.00 | 3.85 |
| | | 5-14 years | 11.27 | 4.38 | 0.00 | 0.00 | 6.73 |
| | | 14-18 years | 1.41 | 4.38 | 0.00 | 0.00 | 3.36 |
| | | 18-60 years | 70.42 | 67.88 | 0.00 | 0.00 | 68.75 |
| | | 60 & above | 14.08 | 18.98 | 0.00 | 0.00 | 17.31 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | 0-5 years | 6.98 | 12.50 | 0.00 | 0.00 | 9.33 |
| | | 5-14 years | 18.60 | 12.50 | 0.00 | 0.00 | 16.00 |
| | | 14-18 years | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | 18-60 years | 62.79 | 68.75 | 0.00 | 0.00 | 65.34 |
| | | 60 & above | 11.63 | 6.25 | 0.00 | 0.00 | 9.33 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey.

### 4.4 Education Levels among Users and Non-users of both Mechanisms

Educational status of sampled orchardists is depicted in percentage form in Table-4.4. Various categories are Illiterate, Primary, Middle, Matric, Secondary, Graduation, Post-graduation, Technical and N.S.G (Non-school going). For anti-hail Cannon block, maximum family members were graduates, 25.23 per cent for users and 27.14 per cent for non-users. In terms of classification, for Cannon users and non-users both, semi-medium farmers had highest share of graduates (34.09 and 33.33%). For anti-hail Net block, maximum users were secondary level educated, 25.48 per cent, whereas most of the non-users were graduates (18.66%). In terms of classifications for Net users, small farmers had higher share of secondary education (26.28%).

For Net non-users, small farmers had higher share of graduates (25%).

**Table-4.4: Educational Status of Sampled Orchardists**

**( All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Illiterate | 3.33 | 5.66 | 7.95 | 4.26 | 5.97 |
| | | Primary | 16.67 | 13.21 | 7.95 | 8.51 | 10.55 |
| | | Middle | 10.00 | 5.66 | 10.24 | 12.76 | 9.63 |
| | | Matric | 30.00 | 15.09 | 12.50 | 29.79 | 19.27 |
| | | Secondary | 23.33 | 18.87 | 12.50 | 14.89 | 16.06 |
| | | Graduation | 13.34 | 24.53 | 34.09 | 17.02 | 25.23 |
| | | Post-Graduate | 3.33 | 13.21 | 7.95 | 10.64 | 9.17 |
| | | Technical | 0.00 | 3.77 | 3.41 | 0.00 | 2.29 |
| | | N.S.G* | 0.00 | 0.00 | 3.41 | 2.13 | 1.83 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | Illiterate | 10.00 | 12.50 | 5.55 | 0.00 | 8.57 |
| | | Primary | 0.00 | 12.50 | 2.78 | 0.00 | 5.71 |
| | | Middle | 10.00 | 16.67 | 5.55 | 0.00 | 10.00 |
| | | Matric | 20.00 | 4.17 | 16.67 | 0.00 | 12.86 |
| | | Secondary | 30.00 | 20.83 | 13.89 | 0.00 | 18.57 |
| | | Graduation | 0.00 | 29.16 | 33.33 | 0.00 | 27.14 |
| | | Post-Graduate | 0.00 | 4.17 | 19.45 | 0.00 | 11.43 |
| | | Technical | 20.00 | 0.00 | 0.00 | 0.00 | 2.86 |
| | | N.S.G* | 10.00 | 0.00 | 2.78 | 0.00 | 2.86 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | Illiterate | 9.86 | 12.41 | 0.00 | 0.00 | 11.54 |
| | | Primary | 8.45 | 6.57 | 0.00 | 0.00 | 7.21 |
| | | Middle | 14.08 | 4.38 | 0.00 | 0.00 | 7.69 |
| | | Matric | 11.27 | 15.33 | 0.00 | 0.00 | 13.94 |
| | | Secondary | 23.94 | 26.28 | 0.00 | 0.00 | 25.48 |
| | | Graduation | 21.13 | 20.44 | 0.00 | 0.00 | 20.67 |
| | | Post-Graduate | 5.63 | 8.03 | 0.00 | 0.00 | 7.21 |
| | | Technical | 2.82 | 2.19 | 0.00 | 0.00 | 2.40 |
| | | N.S.G* | 2.82 | 4.37 | 0.00 | 0.00 | 3.86 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | Illiterate | 11.63 | 3.12 | 0.00 | 0.00 | 8.00 |
| | | Primary | 16.28 | 12.50 | 0.00 | 0.00 | 14.67 |
| | | Middle | 9.30 | 15.63 | 0.00 | 0.00 | 12.00 |
| | | Matric | 9.30 | 3.12 | 0.00 | 0.00 | 6.67 |
| | | Secondary | 18.60 | 15.63 | 0.00 | 0.00 | 17.33 |
| | | Graduation | 13.95 | 25.00 | 0.00 | 0.00 | 18.66 |
| | | Post-Graduate | 16.28 | 12.50 | 0.00 | 0.00 | 14.67 |
| | | Technical | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | N.S.G* | 4.66 | 12.50 | 0.00 | 0.00 | 8.00 |
| | | Total | 100.00 | 0.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey.

*: Non-School Going.

### 4.5 Occupational Status

The occupational status of sampled orchardists is analysed on the basis of main occupation and subsidiary occupation of the household which is determined by the conditions of the study area and availability of the resources. The Tables-4.5 &4.6 present the results.

**Table-4.5: Main Occupation of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Agriculture | 66.67 | 66.04 | 61.36 | 63.83 | 63.76 |
| | | Service | 0.00 | 7.55 | 5.68 | 2.13 | 4.59 |
| | | Business | 3.33 | 3.77 | 1.14 | 2.13 | 2.29 |
| | | Student | 30.00 | 22.64 | 26.14 | 29.78 | 26.60 |
| | | Other | 0.00 | 0.00 | 5.68 | 2.13 | 2.76 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | Agriculture | 60.00 | 58.33 | 44.44 | 0.00 | 51.43 |
| | | Service | 10.00 | 8.33 | 19.44 | 0.00 | 14.29 |
| | | Business | 10.00 | 0.00 | 5.56 | 0.00 | 4.28 |
| | | Student | 20.00 | 33.34 | 30.56 | 0.00 | 30.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | Agriculture | 64.79 | 63.50 | 0.00 | 0.00 | 63.94 |
| | | Service | 9.86 | 5.84 | 0.00 | 0.00 | 7.21 |
| | | Business | 8.45 | 8.03 | 0.00 | 0.00 | 8.17 |
| | | Student | 16.90 | 20.44 | 0.00 | 0.00 | 19.23 |
| | | Other | 0.00 | 2.19 | 0.00 | 0.00 | 1.45 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | Agriculture | 58.15 | 59.37 | 0.00 | 0.00 | 58.67 |
| | | Service | 11.63 | 15.63 | 0.00 | 0.00 | 13.33 |
| | | Business | 2.32 | 0.00 | 0.00 | 0.00 | 1.33 |
| | | Student | 25.58 | 18.75 | 0.00 | 0.00 | 22.67 |
| | | Other | 2.32 | 6.25 | 0.00 | 0.00 | 4.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey.

Main occupation of sampled orchardists is depicted in Table-4.5. Various types of occupation in this table are Agriculture, Service, Business, Student and Other. In both the blocks, users and non-users, majority of total farmers were involved in agriculture, which was 63.76 and 51.43 per cent for anti-hail Cannon users and non-users respectively, and 63.94 and 58.67 per cent for anti-hail Net users and non-users respectively. This was followed by student, which was 26.60 and 30.00 per cent for anti-hail Cannon users and non-users respectively, and 19.23 and 22.67 per cent for anti-hail Net users and non-users respectively. In terms of classifications, for Cannon users and non-users marginal farmers had highest share of agriculture as occupation

(66.67 and 60%). For student, this share was highest for marginal farmers for Cannon users (30%) and small farmers for Cannon non-users (33.34%). For Net users, marginal farmers had higher share of agriculture (64.79%) and small farmers of student (20.44%), whereas, for Net non-users small farmers had higher share of agriculture (59.37%) and marginal farmers had higher share of student (25.58%).

**Table-4.6: Subsidiary Occupation of Sampled Orchardist**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Agriculture | 26.67 | 54.55 | 65.52 | 50.00 | 52.56 |
| | | Service | 6.67 | 0.00 | 6.90 | 0.00 | 5.08 |
| | | Business | 13.33 | 9.09 | 10.34 | 25.00 | 11.86 |
| | | Student | 53.33 | 27.27 | 10.34 | 25.00 | 25.42 |
| | | Other | 0.00 | 9.09 | 6.90 | 0.00 | 5.08 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | Agriculture | 50.00 | 25.00 | 92.31 | 0.00 | 64.00 |
| | | Service | 0.00 | 12.50 | 0.00 | 0.00 | 4.00 |
| | | Business | 0.00 | 12.50 | 7.69 | 0.00 | 8.00 |
| | | Student | 50.00 | 37.50 | 0.00 | 0.00 | 20.00 |
| | | Other | 0.00 | 12.50 | 0.00 | 0.00 | 4.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | Agriculture | 80.95 | 88.24 | 0.00 | 0.00 | 85.45 |
| | | Service | 4.76 | 0.00 | 0.00 | 0.00 | 1.82 |
| | | Business | 9.53 | 0.00 | 0.00 | 0.00 | 3.64 |
| | | Student | 0.00 | 11.76 | 0.00 | 0.00 | 7.27 |
| | | Other | 4.76 | 0.00 | 0.00 | 0.00 | 1.82 |
| | | Total | 100.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | Agriculture | 70.59 | 88.89 | 0.00 | 0.00 | 76.92 |
| | | Service | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Business | 11.76 | 0.00 | 0.00 | 0.00 | 7.69 |
| | | Student | 17.65 | 11.11 | 0.00 | 0.00 | 15.39 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey.

Subsidiary occupation of sampled orchardists is depicted in Table-4.6. Just like main occupation here as well, in both the blocks, users and non-users, majority of total farmers were involved in agriculture, which was 52.56 and 64 per cent for anti-hail Cannon users and non-users respectively, and 85.45 and 76.92 per cent for anti-hail Net users and non-users respectively. Followed by student, which was 25.42 and 20 per cent for anti-hail Cannon users and non-users respectively, and 7.27 and 15.39 per cent for anti-hail Net users and non-users respectively. In terms of classifications, for Cannon users and non-users, semi-medium farmers

had highest share of agriculture (65.52% and 92.31%) and marginal farmers of student (53.33% and 50%). For Net users, small farmers had higher share of agriculture and student as occupation (88.24 and 11.76%), and for Net non-users, small farmers had higher share of agriculture (88.89%) and marginal farmers as student (17.65%).

### 4.6 Average annual Income from Different Sources of Sampled Orchardists

Average annual income of sampled orchardists during the study period (2018-19) is shown in Table-4.7. Two major sources of income are depicted in this table. First is the agriculture source which is through the Orchard product sale. Second are the non-agriculture sources which include Service, Business, Pension, Rent and Other. In addition to this, annual income per household in every classification is also shown here.

In both the blocks, users and non-users, highest annual income of orchardists was generated from orchard produce sale, which was mainly apple produce. This was 93.91 per cent for anti-hail Cannon users and 70.02 per cent for non-users. For anti-hail Net users this figure was 84.40 per cent, and 57.59 per cent for non-users. In terms of classifications, for Cannon users, medium farmers had highest share of income from orchard sale (98.87%), whereas, for Cannon non-users this share was highest for small farmers (78.18%). For Net users and non-users, small farmers had higher share of income from orchard sale (88.03 and 66.27%). Per household total annual income for users in both blocks was higher than for non-users. It was Rs. 23,03,466.67 for anti-hail Cannon users as compared to Rs. 15,67,533.33 for non-users, and Rs. 12,63,763.33 for anti-hail Net users as compared to Rs. 10,14,000 for non-users. In terms of classifications, for Cannon users, medium farmers had highest per household annual income (Rs. 39,97,625) and for non-users this was highest for semi-medium farmers (Rs. 19,68,750). For Net users and non-users, small farmers had higher per household annual income (Rs. 13,85,031.67 and Rs. 11,13,600).

**Table-4.7: Average Annual Income of Sampled Orchardists from different Sources**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail** | Users | **Agriculture source** | | | | | |
| | | Orchard sale | 87.07 | 92.19 | 91.81 | 98.87 | 93.91 |
| | | **Non-Agri. source** | | | | | |
| | | Service | 0.38 | 4.72 | 4.27 | 0.75 | 3.15 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Business | 11.99 | 1.97 | 2.21 | 0.38 | 1.90 |
| | | Pension | 0.00 | 1.12 | 1.71 | 0.00 | 1.02 |
| | | Rent | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.56 | 0.00 | 0.00 | 0.00 | 0.02 |
| | | Total | 12.93 | 7.81 | 8.19 | 1.13 | 6.09 |
| | | Sub-total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Annual Income/HH. | 452857.14 | 1522166.67 | 2791055.56 | 3997625.00 | 2303466.67 |
| | Non-users | **Agriculture source** | | | | | |
| | | Orchard sale | 62.19 | 75.18 | 69.14 | 0.00 | 70.02 |
| | | **Non-Agri. source** | | | | | |
| | | Service | 32.83 | 19.29 | 27.81 | 0.00 | 26.15 |
| | | Business | 4.98 | 5.21 | 3.05 | 0.00 | 3.75 |
| | | Pension | 0.00 | 0.32 | 0.00 | 0.00 | 0.08 |
| | | Rent | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 37.81 | 24.82 | 30.86 | 0.00 | 29.98 |
| | | Sub-total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Annual Income/HH. | 1005000.00 | 1150600.00 | 1968750.00 | 0.00 | 1567533.33 |
| **Thanedhar (anti-hail Net)** | Users | **Agriculture source** | | | | | |
| | | Orchard sale | 74.55 | 88.03 | 0.00 | 0.00 | 84.40 |
| | | **Non-Agri. source** | | | | | |
| | | Service | 10.04 | 4.56 | 0.00 | 0.00 | 6.04 |
| | | Business | 13.06 | 5.44 | 0.00 | 0.00 | 7.49 |
| | | Pension | 2.35 | 1.91 | 0.00 | 0.00 | 2.03 |
| | | Rent | 0.00 | 0.06 | 0.00 | 0.00 | 0.04 |
| | | Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 25.45 | 11.97 | 0.00 | 0.00 | 15.60 |
| | | Sub-total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Annual Income/HH. | 1021226.67 | 1385031.67 | 0.00 | 0.00 | 1263763.33 |
| | Non-users | **Agriculture source** | | | | | |
| | | Orchard sale | 52.58 | 66.27 | 0.00 | 0.00 | 57.59 |
| | | **Non-Agri. source** | | | | | |
| | | Service | 35.22 | 29.42 | 0.00 | 0.00 | 33.10 |
| | | Business | 7.22 | 0.00 | 0.00 | 0.00 | 4.57 |
| | | Pension | 4.36 | 4.31 | 0.00 | 0.00 | 4.35 |
| | | Rent | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other | 0.62 | 0.00 | 0.00 | 0.00 | 0.39 |
| | | Total | 47.42 | 33.73 | 0.00 | 0.00 | 42.41 |
| | | Sub-total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Annual Income/HH. | 964200.00 | 1113600.00 | 0.00 | 0.00 | 1014000.00 |

**Source:** Data from Field Survey.

## 4.7 Per Farm Land Utilisation Pattern

Per farm land utilisation pattern of sampled orchardists is given in Table-4.8. The area is given in hectares. In both the blocks, the total own land of users was more than of non-users. For anti-hail Cannon users, total land was 2.52 hectares as compared to 1.97 hectares for non-users. For anti-hail Net users, total land was 1.21 hectares as compared to 0.95 hectares for non-users.

**Table-4.8: Per Farm Land Utilization Pattern of Sampled Orchardists**

**(Area in Ha.)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Own land | 0.66 | 1.40 | 2.70 | 5.43 | 2.52 |
| | | Orchard area | 0.60 | 1.16 | 2.53 | 3.74 | 2.08 |
| | | Area under other crops | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| | | Current fallow | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Ghasni | 0.04 | 0.24 | 0.16 | 1.69 | 0.44 |
| | | Forest | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | GCA* | 0.60 | 1.16 | 2.54 | 3.74 | 2.08 |
| | Non-users | Own land | 0.80 | 1.36 | 2.64 | 0.00 | 1.97 |
| | | Orchard area | 0.80 | 1.28 | 2.19 | 0.00 | 1.70 |
| | | Area under other crops | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| | | Current fallow | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Ghasni | 0.00 | 0.07 | 0.45 | 0.00 | 0.27 |
| | | Forest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | GCA* | 0.80 | 1.29 | 2.19 | 0.00 | 1.70 |
| Thanedhar (anti-hail Net) | Users | Own land | 0.87 | 1.38 | 0.00 | 0.00 | 1.21 |
| | | Orchard area | 0.87 | 1.22 | 0.00 | 0.00 | 1.11 |
| | | Area under other crops | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Current fallow | 0.00 | 0.04 | 0.00 | 0.00 | 0.02 |
| | | Ghasni | 0.00 | 0.12 | 0.00 | 0.00 | 0.08 |
| | | Forest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | GCA* | 0.87 | 1.22 | 0.00 | 0.00 | 1.11 |
| | Non-users | Own land | 0.79 | 1.28 | 0.00 | 0.00 | 0.95 |
| | | Orchard area | 0.78 | 1.22 | 0.00 | 0.00 | 0.92 |
| | | Area under other crops | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| | | Current fallow | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Ghasni | 0.01 | 0.05 | 0.00 | 0.00 | 0.03 |
| | | Forest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | GCA* | 0.78 | 1.23 | 0.00 | 0.00 | 0.92 |

**Source:** Data from Field Survey.
***:** Gross Cropped Area.

In terms of classifications, medium farmers had higher own land for Cannon users (5.43 ha.) and semi-medium for Cannon non-users (2.64 ha.). For Net users and non-users, small farmers had higher own land (1.38 and 1.28 ha.). Same was true for total orchard area and GCA, both were higher for the users compared to non-users in both the blocks. These values were 2.08 and 1.11 hectares each for users and 1.70 and 0.92 hectares each for non-users. In terms of classification, for Cannon users, medium farmers had highest orchard area and GCA (3.74 ha. each). This value was highest for semi-medium farmers for Cannon non-users (2.19 ha. each).

For Net users and non-users, small farmers had higher orchard area (1.22 ha. each) and GCA (1.22 and 1.23 ha.).

### 4.8 Cropping Pattern

Cropping pattern of sampled orchardists is shown in Table-4.9. All figures are given in percentage. For both the blocks, users and non-users, maximum total area was under apple crop. This was 94.76 and 96.35 percent for anti-hail Cannon users and non users, and 91.55 and 91.83 per cent for anti-hail Net users and non-users. Followed by other fruits which included apricot, cherry, pear and plum, which was 5.17 and 3.39 per cent for anti-hail Cannon users and non-users and 8.45 and 7.69 per cent for anti-hail Net users and non-users respectively.

The least area was under other crops, including cereals, pulses and vegetables, for both the blocks, which was 0.07, 0.26, 0.00 and 0.48 per cent for anti-hail Cannon and Net users and non-users, respectively. In terms of classifications, for Cannon users and non-users, marginal farmers had highest share of apple in their cropping pattern (97.64 and 100%). For Net users and non users as well this figure was higher for marginal farmers (95.92 and 96.55%).

**Table-4.9: Cropping Pattern of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail Cannon)** | Users | **Apple** | 97.64 (100.00) | 97.11 (100.00) | 93.25 (100.00) | 95.54 (100.00) | 94.76 (100.00) |
| | | - Bearing | 77.42 | 90.10 | 88.99 | 92.99 | 89.90 |
| | | -Non-bearing | 22.58 | 9.90 | 11.01 | 7.01 | 10.10 |
| | | **Other fruits*** | 2.36 (100.00) | 2.89 (100.00) | 6.60 (100.00) | 4.46 (100.00) | 5.17 (100.00) |
| | | -Bearing | 100.00 | 100.00 | 91.11 | 70.00 | 86.21 |
| | | -Non-bearing | 0.00 | 0.00 | 8.89 | 30.00 | 13.79 |
| | | Other crops** | 0.00 | 0.00 | 0.15 | 0.00 | 0.07 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | **Apple** | 100.00 (100.00) | 97.94 (100.00) | 95.42 (100.00) | 0.00 (0.00) | 96.35 (100.00) |
| | | - Bearing | 83.33 | 87.37 | 94.40 | 0.00 | 91.87 |
| | | -Non-bearing | 16.67 | 12.63 | 5.60 | 0.00 | 8.13 |
| | | Other fruits* | 0.00 (0.00) | 1.03 (100.00) | 4.58 (100.00) | 0.00 (0.00) | 3.39 (100.00) |
| | | -Bearing | 0.00 | 0.00 | 33.33 | 0.00 | 30.77 |
| | | -Non-bearing | 0.00 | 100.00 | 66.67 | 0.00 | 69.23 |
| | | Other crops** | 0.00 | 1.03 | 0.00 | 0.00 | 0.26 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Thanedhar (anti-hail Net)** | Users | **Apple** | 95.92 (100.00) | 90.00 (100.00) | 0.00 (0.00) | 0.00 (0.00) | 91.55 (100.00) |
| | | - Bearing | 97.87 | 98.18 | 0.00 | 0.00 | 98.10 |
| | | -Non-bearing | 2.13 | 1.82 | 0.00 | 0.00 | 1.90 |
| | | Other fruits* | 4.08 (100.00) | 10.00 (100.00) | 0.00 (0.00) | 0.00 (0.00) | 8.45 (100.00) |
| | | -Bearing | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | -Non-bearing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other crops** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | Non-users | **Apple** | 96.55 (100.00) | 85.87 (100.00) | 0.00 (0.00) | 0.00 (0.00) | 91.83 (100.00) |
| | | - Bearing | 96.43 | 87.34 | 0.00 | 0.00 | 92.67 |
| | | -Non-bearing | 3.57 | 12.66 | 0.00 | 0.00 | 7.33 |
| | | Other fruits* | 3.45 (100.00) | 13.04 (100.00) | 0.00 (0.00) | 0.00 (0.00) | 7.69 (100.00) |
| | | -Bearing | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | -Non-bearing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Other crops** | 0.00 | 1.09 | 0.00 | 0.00 | 0.48 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |

**Source:** Data from Field Survey
**Note:** All figures in percentage and the percentage have been calculated from the area.
***:** Apricot, Cherry, Pear and Plum ****:** Cereals, Pulses and Vegetables.

### 4.9 Per Farm Production of Apple and Other Fruits

Per farm production of orchards of sampled orchardists during the study reference year is given in Table-4.10, in number of boxes per farm for apples and other fruits. Numbers of orchardists in every category are also mentioned for both the blocks.

**Table-4.10: Per Farm Production of Orchard Fruits of Sampled Orchardists during Study Period**
**(Boxes/Farm)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail Cannon)** | Users | No. of orchardist | 7 | 12 | 18 | 8 | 45 |
| | | Apple | 335 | 1238 | 2369 | 3625 | 1973 |
| | | Other fruits | 14 | 162 | 256 | 544 | 218 |
| | Non-users | No. of orchardist | 2 | 5 | 8 | 0 | 15 |
| | | Apple | 625 | 885 | 1450 | 0 | 1152 |
| | | Other fruits | 0 | 0 | 50 | 0 | 27 |
| **Thanedhar (anti-hail Net)** | Users | No. of orchardist | 15 | 30 | 0 | 0 | 45 |
| | | Apple | 783 | 1193 | 0 | 0 | 1056 |
| | | Other fruits | 58 | 234 | 0 | 0 | 175 |
| | Non-users | No. of orchardist | 10 | 5 | 0 | 0 | 15 |
| | | Apple | 527 | 730 | 0 | 0 | 595 |
| | | Other fruits | 37 | 227 | 0 | 0 | 100 |

**Source:** Data from Field Survey.

The table indicates that farm production for apples was higher for users as compared to non-users in both the blocks, which was 1,973 and 1,056 boxes for anti-hail Cannon and Net users as compared to 1,152 and 595 boxes for non-users in both the blocks. Same was true for other fruits as well. Anti-hail Cannon and Net users produced 218 and 175 boxes as compared to 27 and 100 boxes for non-users. In terms of classifications, for Cannon users, medium farmers had highest production of apple (3,625 boxes). This was highest for semi-medium farmers for cannon non-users (1,450 boxes). For Net users and non-users, small farmers had higher production of apple (1,193 and 730 boxes).

### 4.10 Per Farm Quantity Sold and Market Value of Orchard Produce

Per farm quantity sold and market value of produce of orchards of sampled orchardists is depicted in Table 4.11. Here quantity sold, total price and average price per box for apple and other fruits is given for both the blocks users and non-users. In both the blocks, for apple and other fruits, highest per farm boxes of orchards sold by users as compared to non-users and mechanism users also get higher price/farm and average price/box for their produce of orchards rather than non-users.

In terms of classifications, for anti-hail Cannon user, highest quantity of apple (3,625 boxes/farm) and other fruits (544 boxes/farm) sold by medium farm orchardists among all sampled farm orchardists and higher total prices for apple (Rs. 38,30,750/farm) and other fruits (Rs. 1,21,875/farm) also obtained by medium farmers. For anti-hail Cannon, non-users, highest quantity of apple (1,450 boxes/farm) sold by semi-medium farmers and they also get higher total prices for apples (Rs. 13,43,750/farm) among all farm orchardists. Only semi-medium farmers had production of other fruits. But, average price per box was highest among marginal farmers for apples and other fruits in case of users and non-users. In case of anti-hail Net users, highest quantity of apple 1193 boxes/farm and other fruits 234 boxes/farm sold by small farm orchardists among all farm orchardists and they also get higher total prices for apples and other fruits, which was calculated Rs. 11,57,000 and Rs. 72,258 per farm, respectively. Whereas, average price per box was higher for small farmers for apples (Rs. 970) and it was higher for marginal farmers for other fruits (Rs. 379). For anti-hail Net non-users too, the quantity sold and total prices of apples (730 boxes and Rs. 6,69,000 per farm) and other fruits (227 boxes and Rs.

69,000 per farm) were highest among small farmers, but the average price per box was higher for marginal farmers.

**Table-4.11: Per Farm Quantity Sold and Market Value of Orchard Produce of Sampled Orchardists**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | **Apple** | | | | | |
| | | -Quantity sold (in boxes) | 335 | 1233 | 2369 | 3625 | 1973 |
| | | -Total prices (in Rs.) | 386429 | 1383333 | 2453888 | 3830750 | 2091577 |
| | | -Average price per box* | 1154 | 1122 | 1036 | 1057 | 1060 |
| | | **Other fruits** | | | | | |
| | | -Quantity sold (in boxes) | 14 | 62 | 256 | 544 | 218 |
| | | -Total prices (in Rs.) | 7857 | 20000 | 108500 | 121875 | 71622 |
| | | -Average price per box* | 561 | 323 | 424 | 224 | 329 |
| | Non-users | **Apple** | | | | | |
| | | -Quantity sold (in boxes) | 625 | 885 | 1450 | 0 | 1152 |
| | | -Total prices (in Rs.) | 625000 | 865000 | 1343750 | 0 | 1088333 |
| | | -Average price per box* | 1000 | 977 | 927 | 0 | 945 |
| | | **Other fruits** | | | | | |
| | | -Quantity sold (in boxes) | 0 | 0 | 50 | 0 | 27 |
| | | -Total prices (in Rs.) | 0 | 0 | 17500 | 0 | 9333 |
| | | -Average price per box* | 0 | 0 | 350 | 0 | 346 |
| Thanedhar (anti-hail Net) | Users | **Apple** | | | | | |
| | | -Quantity sold (in boxes) | 783 | 1193 | 0 | 0 | 1056 |
| | | -Total prices (in Rs.) | 739333 | 1157000 | 0 | 0 | 1017777 |
| | | -Average price per box* | 944 | 970 | 0 | 0 | 964 |
| | | **Other fruits** | | | | | |
| | | -Quantity sold (in boxes) | 58 | 234 | 0 | 0 | 175 |
| | | -Total prices (in Rs.) | 22000 | 72258 | 0 | 0 | 55505 |
| | | -Average price per box* | 379 | 309 | 0 | 0 | 317 |
| | Non-users | **Apple** | | | | | |
| | | -Quantity sold (in boxes) | 527 | 730 | 0 | 0 | 595 |
| | | -Total prices (in Rs.) | 490000 | 669000 | 0 | 0 | 549667 |
| | | -Average price per box* | 930 | 916 | 0 | 0 | 924 |
| | | **Other fruits** | | | | | |
| | | -Quantity sold (in boxes) | 37 | 227 | 0 | 0 | 100 |
| | | -Total prices (in Rs.) | 17000 | 69000 | 0 | 0 | 34333 |
| | | -Average price per box* | 459 | 304 | 0 | 0 | 343 |

**Source:** Data from field Survey

*: Average Price per Box = Total Price/Farm / Total Quantity Sold/Farm

## 4.11 Number and Value of Farm Equipments and Machinery owned by Sampled Orchardists

The analyses regarding number and value of farm equipments and machinery owned by sampled orchardists is presented in Tables-4.12 and 4.13. Various equipments are hand operated

implements, pruning scissors, spray machine operated from petrol/diesel and electricity, grading and packing machine, power tiller and grass cutter. All figures are in percentage. Per household number and value of equipments is also given in these tables.

**Table-4.12: Number of Farm Equipments and Machinery Owned by Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Hand operated implements | 75.89 | 86.05 | 83.08 | 80.04 | 82.66 |
| | | Pruning scissors | 12.50 | 7.18 | 10.01 | 11.62 | 9.84 |
| | | Spray machine (P/D)* | 3.57 | 2.54 | 1.78 | 3.29 | 2.45 |
| | | Spray machine (E)** | 4.46 | 1.27 | 1.67 | 1.75 | 1.76 |
| | | Grading & packing machine | 1.79 | 0.85 | 0.83 | 1.10 | 0.96 |
| | | Power tiller | 0.00 | 0.21 | 0.72 | 0.22 | 0.42 |
| | | Grass cutter | 1.79 | 1.90 | 1.91 | 1.97 | 1.91 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | No./H.H*** | 16.00 | 39.42 | 46.61 | 57.00 | 41.78 |
| | Non-users | Hand operated implements | 84.62 | 80.56 | 81.82 | 0.00 | 81.93 |
| | | Pruning scissors | 10.76 | 11.11 | 8.70 | 0.00 | 9.62 |
| | | Spray machine (P/D)* | 1.54 | 4.63 | 3.15 | 0.00 | 3.29 |
| | | Spray machine (E)** | 1.54 | 0.00 | 0.79 | 0.00 | 0.70 |
| | | Grading & packing machine | 0.00 | 0.00 | 0.79 | 0.00 | 0.47 |
| | | Power tiller | 0.00 | 0.00 | 1.19 | 0.00 | 0.70 |
| | | Grass cutter | 1.54 | 3.70 | 3.56 | 0.00 | 3.29 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | No./H.H*** | 32.50 | 21.60 | 31.62 | 0.00 | 28.40 |
| Thanedhar (anti-hail Net) | Users | Hand operated implements | 86.49 | 85.34 | 0.00 | 0.00 | 85.65 |
| | | Pruning scissors | 8.11 | 9.04 | 0.00 | 0.00 | 8.80 |
| | | Spray machine (P/D)* | 2.70 | 2.19 | 0.00 | 0.00 | 2.33 |
| | | Spray machine (E)** | 1.23 | 1.32 | 0.00 | 0.00 | 1.29 |
| | | Grading & packing machine | 0.00 | 0.26 | 0.00 | 0.00 | 0.19 |
| | | Power tiller | 0.00 | 0.26 | 0.00 | 0.00 | 0.19 |
| | | Grass cutter | 1.47 | 1.59 | 0.00 | 0.00 | 1.55 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./H.H*** | 27.13 | 37.97 | 0.00 | 0.00 | 34.35 |
| | Non-users | Hand operated implements | 83.62 | 82.24 | 0.00 | 0.00 | 83.08 |
| | | Pruning scissors | 8.82 | 10.53 | 0.00 | 0.00 | 9.49 |
| | | Spray machine (P/D)* | 2.52 | 3.28 | 0.00 | 0.00 | 2.42 |
| | | Spray machine (E)** | 2.10 | 0.66 | 0.00 | 0.00 | 1.54 |
| | | Grading & packing machine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Power tiller | 0.42 | 1.32 | 0.00 | 0.00 | 0.76 |
| | | Grass cutter | 2.52 | 1.97 | 0.00 | 0.00 | 2.31 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./H.H*** | 23.80 | 30.40 | 0.00 | 0.00 | 26.00 |

**Source:** Data from Field Survey.

***:** Petrol and Diesel**, ****:** Electric, *****:** Number per household

Number of farm equipments and machinery owned by sampled orchardists is given in Table 4.12. In both the blocks, users and non-users, in total the maximum number was attributed to hand operated implements followed by pruning scissor. The difference in these numbers for users and non-users was very small.

In terms of classifications, for anti-hail Cannon users, small farmers had the highest number of hand operated implements (86.05%) and marginal farmers had the highest number of pruning scissors (12.50%). Similarly, for anti-hail Cannon non-users, marginal farmers had highest number of hand operated implements (84.62%) and small farmers had highest number of pruning scissors (11.11%). In case of anti-hail Net users and non-users marginal farmers had higher number of hand operated implements (86.49% and 83.62% respectively) and small farmers had higher number of pruning scissors (9.04% and 10.53% respectively).

Number of equipments per household was higher for users in both the blocks than the non-users. Per household number of equipments was 41.78 and 34.35 for anti-hail Cannon and Net users, as compared to 28.40 and 26 for non-users.

In terms of classifications, for anti-hail Cannon users, medium farmers had highest number of equipments per household (57) and for non users, it was for marginal farmers (32.50). For anti-hail Net users and non-users small farmers had higher number of equipment per household, 37.97 and 30.40 respectively.

Value of farm equipments and machinery owned by sampled orchardists is given in Table-4.13. In the anti-hail Cannon block, for users and non-users, highest value was attributed to grading and packing machine (49.54 and 40.71%) followed by petrol/diesel spray machine (14.78 and 20.92%). For Cannon users, value of grading and packing machine was highest among marginal farm orchardist (62.73%). For Cannon non-users, grading and packing machine was only with semi-medium farmers (50.17%).

In the anti-hail Net block, for, users and non-users, highest value was attributed to petrol/diesel spray machine (27.34% and 31.14%). This value was highest among marginal farmers in users category (43.34%) and small farmers (33.93%) in non-users category. Second highest value for Net users was attributed to grading and packing machine (23.16%) which was

only with the small farmers, whereas, of Net non-users second highest value was of power tiller (17.08%) which was higher with small farmers (26.79%).

**Table-4.13: Value of Farm Equipments and Machinery Owned by Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Hand operated implements | 5.32 | 6.66 | 7.00 | 2.84 | 5.57 |
| | | Pruning scissors | 3.94 | 3.84 | 4.52 | 4.14 | 4.22 |
| | | Spray machine (P/D)* | 12.55 | 19.07 | 11.66 | 16.95 | 14.78 |
| | | Spray machine (E)** | 11.67 | 9.48 | 14.22 | 10.58 | 11.97 |
| | | Grading & packing machine | 62.73 | 49.98 | 42.02 | 55.87 | 49.54 |
| | | Power tiller | 0.00 | 3.07 | 11.73 | 2.06 | 6.10 |
| | | Grass cutter | 3.79 | 7.90 | 8.85 | 7.56 | 7.82 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value/H.H*** | 97928.57 | 127583.33 | 173850.00 | 272937.50 | 167317.78 |
| | Non-users | Hand operated implements | 18.89 | 13.87 | 5.02 | 0.00 | 6.95 |
| | | Pruning scissors | 10.27 | 12.16 | 4.21 | 0.00 | 5.61 |
| | | Spray machine (P/D)* | 24.79 | 52.70 | 15.36 | 0.00 | 20.92 |
| | | Spray machine (E)** | 33.06 | 0.00 | 4.63 | 0.00 | 5.51 |
| | | Grading & packing machine | 0.00 | 0.00 | 50.17 | 0.00 | 40.71 |
| | | Power tiller | 0.00 | 0.00 | 11.96 | 0.00 | 9.71 |
| | | Grass cutter | 12.99 | 21.27 | 8.65 | 0.00 | 10.59 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value/H.H*** | 42350.00 | 43260.00 | 161937.00 | 0.00 | 106433.33 |
| Thanedhar (anti-hail Net) | Users | Hand operated implements | 14.94 | 10.42 | 0.00 | 0.00 | 11.33 |
| | | Pruning scissors | 10.04 | 7.51 | 0.00 | 0.00 | 8.02 |
| | | Spray machine (P/D)* | 43.34 | 23.32 | 0.00 | 0.00 | 27.34 |
| | | Spray machine (E)** | 20.35 | 14.49 | 0.00 | 0.00 | 15.67 |
| | | Grading & packing machine | 0.00 | 28.98 | 0.00 | 0.00 | 23.16 |
| | | Power tiller | 0.00 | 6.40 | 0.00 | 0.00 | 5.11 |
| | | Grass cutter | 11.33 | 8.88 | 0.00 | 0.00 | 9.37 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value/H.H*** | 40613.33 | 80750.00 | 0.00 | 0.00 | 67371.11 |
| | Non-users | Hand operated implements | 14.75 | 11.90 | 0.00 | 0.00 | 13.54 |
| | | Pruning scissors | 8.19 | 9.82 | 0.00 | 0.00 | 8.88 |
| | | Spray machine (P/D)* | 29.06 | 33.93 | 0.00 | 0.00 | 31.14 |
| | | Spray machine (E)** | 23.12 | 7.44 | 0.00 | 0.00 | 16.45 |
| | | Grading & packing machine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Power tiller | 9.91 | 26.79 | 0.00 | 0.00 | 17.08 |
| | | Grass cutter | 14.97 | 10.12 | 0.00 | 0.00 | 12.91 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value/H.H*** | 45420.00 | 67200.00 | 0.00 | 0.00 | 52680.00 |

**Source:** Data from Field Survey.

***:** Petrol and Diesel, ****:** Electric, *****:** Value per household

Per household value of equipments was higher for users (Rs. 1,67,317.78 and Rs. 67,371.11) as compared to non-users (Rs. 1,06,433.33 and Rs. 52,680) in both the blocks. For

Cannon users, highest per household value was for medium farmers (Rs. 2,72,937.50) for non-users this value was highest for semi-medium farmers (Rs. 1,61,937.00). Further, for Net users and non users highest per household value was for small farmers (Rs. 80,750 and Rs. 67,200).

### 4.12 Value of Buildings Owned by Sampled Orchardists

Value of buildings owned by sampled orchardists is given separately for anti-hail Cannon block (Jubbal & Kotkhai) and anti-hail Net block (Thanedar) in Table-4.14(a) and 4.14(b). The buildings are divided into dwelling house, cattle shed and storage/shop. This classification is further divided into kucha, semi-pucca and pucca type. All values are given in percentage of total. Per household value of three types of buildings is also given for users and non-users.

In Table 4.14(a) the total value of pucca dwelling house, cattle shed and storage/shop was highest for Cannon users and non-users alike. For Cannon users, value of pucca dwelling house was 92.25 per cent, pucca cattle shed was 83.85 per cent, and pucca storage/shop was 97.56 per cent. For Cannon non-users these values were 98.19, 78.21 and 100 per cent, respectively. Per household value of all three building types was higher for the anti-hail Cannon users than non-users. Per household value of dwelling house for users was Rs. 67,33,333.33 as compared to Rs. 55,06,666.67 for non-users. This value was highest for medium farmers for users (Rs. 1,22,50,000) and for semi-medium farmers for non-users (Rs. 75,00,000). Per household value of cattle shed for users was Rs. 1,22,444.44 as compared to Rs. 59,666.67 for non-users. Again, this value was highest for medium farmers for users (Rs. 2,31,250.00) and for semi-medium farmers for non-users (Rs. 68,750). Per household value of storage/shop was Rs. 1,82,222.22 for users as compared to Rs. 53,333.33 for non-users. This value was highest for medium farmers for users (Rs. 3,50,000) and for marginal farmers for non-users (Rs. 1,50,000).

In Table 4.14(b) the total value of pucca dwelling house, cattle sheds and storage/shop was highest for Net users and non-users alike. For Net users, value of pucca dwelling house was 97.22 per cent, pucca cattle shed was 85.60 per cent, and pucca storage/shop was 100 per cent. For Net non-users these values were 89.94, 73.85 and 100 per cent, respectively. Per household value of all three building types was higher for the users than non-users. Per household value of dwelling house for users were Rs. 2,47,93,333.33 as compared to Rs. 42,40,000 for non users. This value was higher for small farmers for users (Rs. 49,26,666.67) and marginal farmers for

non-users (Rs. 44,90,000). Per household value of cattle shed for users was Rs. 1,30,444.44 as compared to Rs. 1,08,333.33 for non-users. This value was higher for small farmers for both, users and non-users (Rs. 1,44,833.33 and Rs. 1,30,000). Per household value of storage/shop was Rs. 65,000 for users as compared to Rs. 53,333.33 for non-users. Again, this value was higher for small farmers for both, users and non-users (Rs. 91,666.67 and Rs. 70,000).

**Table-4.14 (a): Value of Buildings Owned by Sampled Orchardists of Jubbal & Kotkhai Block in Shimla District** **(% of total)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | **Dwelling House** | | | | | |
| | | -Kucha | 25.00 | 5.45 | 0.00 | 0.00 | 2.14 |
| | | -Semi-pucca | 25.00 | 0.00 | 9.93 | 0.00 | 5.61 |
| | | -Pucca | 50.00 | 94.55 | 90.07 | 100.00 | 92.25 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value in Rs./H.H. | 2000000.00 | 4583333.33 | 7555555.55 | 12250000.00 | 6733333.33 |
| | | **Cattle Shed** | | | | | |
| | | -Kucha | 9.61 | 25.68 | 18.75 | 0.00 | 12.52 |
| | | -Semi-pucca | 28.85 | 0.00 | 2.08 | 0.00 | 3.63 |
| | | -Pucca | 61.54 | 74.32 | 79.17 | 100.00 | 83.85 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value in Rs./H.H. | 74285.71 | 61666.67 | 133333.33 | 231250.00 | 122444.44 |
| | | **Storage/Shop** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 0.00 | 25.00 | 0.00 | 0.00 | 2.44 |
| | | -Pucca | 0.00 | 75.00 | 100.00 | 100.00 | 97.56 |
| | | Total | 0.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value in Rs./H.H. | 0.00 | 66666.67 | 255555.55 | 350000.00 | 182222.22 |
| Thanedhar (anti-hail Net) | Non-users | **Dwelling House** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 40.54 | 0.00 | 0.00 | 0.00 | 1.81 |
| | | -Pucca | 59.46 | 100.00 | 100.00 | 0.00 | 98.19 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 1850000.00 | 3780000.00 | 7500000.00 | 0.00 | 5506666.67 |
| | | **Cattle Shed** | | | | | |
| | | -Kucha | 100.00 | 31.82 | 0.00 | 0.00 | 21.79 |
| | | -Semi-pucca | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Pucca | 0.00 | 68.18 | 100.00 | 0.00 | 78.21 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 62500.00 | 44000.00 | 68750.00 | 0.00 | 59666.67 |
| | | **Storage/Shop** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Pucca | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 150000.00 | 40000.00 | 37500.00 | 0.00 | 53333.33 |

**Source:** Data from Field Survey.
**Note:** Rs./HH.: Rupees per household.

**Table-4.14 (b): Value of Buildings Owned by Sampled Orchardists of Thanedhar Block in Shimla District** **(% of total)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | **Dwelling House** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 2.83 | 2.76 | 0.00 | 0.00 | 2.78 |
| | | -Pucca | 97.17 | 97.24 | 0.00 | 0.00 | 97.22 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 4246666.67 | 4926666.67 | 0.00 | 0.00 | 4793333.33 |
| | | **Cattle Shed** | | | | | |
| | | -Kucha | 8.20 | 2.88 | 0.00 | 0.00 | 4.26 |
| | | -Semi-pucca | 16.39 | 89.18 | 0.00 | 0.00 | 10.14 |
| | | -Pucca | 75.41 | 7.94 | 0.00 | 0.00 | 85.60 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 101666.67 | 144833.33 | 0.00 | 0.00 | 130444.44 |
| | | **Storage/Shop** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Pucca | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 11666.67 | 91666.67 | 0.00 | 0.00 | 65000.00 |
| Thanedhar (anti-hail Net) | **Non-Users** | **Dwelling House** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 2.67 | 27.81 | 0.00 | 0.00 | 10.06 |
| | | -Pucca | 97.33 | 72.19 | 0.00 | 0.00 | 89.94 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 4490000.00 | 3740000.00 | 0.00 | 0.00 | 4240000.00 |
| | | **Cattle Shed** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 17.95 | 38.40 | 0.00 | 0.00 | 26.15 |
| | | -Pucca | 82.05 | 61.54 | 0.00 | 0.00 | 73.85 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 97500.00 | 130000.00 | 0.00 | 0.00 | 108333.33 |
| | | **Storage/Shop** | | | | | |
| | | -Kucha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Semi-pucca | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | -Pucca | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value in Rs./H.H. | 45000.00 | 70000.00 | 0.00 | 0.00 | 53333.33 |

**Source:** Data from Field Survey.
**Note**: Rs./HH.: Rupees per household.

## 4.13 Number and Value of Other Assets owned by Sampled Orchardists

The analyses of number and value of other assets owned by sampled orchardists is presented in Tables-4.15 and 4.16. Assets mentioned are furniture, electronics, two wheeler and four wheeler. All figures are in percentage and per household number and value of these assets is also given.

**Table-4.15: Number of Other Assets of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Furniture | 61.40 | 60.17 | 59.65 | 55.00 | 59.05 |
| | | Electronics | 34.21 | 33.33 | 33.48 | 36.50 | 34.12 |
| | | Two wheeler | 0.88 | 0.00 | 0.00 | 1.00 | 0.30 |
| | | Four wheeler | 3.51 | 6.50 | 6.87 | 7.50 | 6.53 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | No./HH. | 16.00 | 20.00 | 25.00 | 25.00 | 22.00 |
| | Non-users | Furniture | 62.75 | 63.00 | 56.99 | 0.00 | 59.65 |
| | | Electronics | 33.33 | 31.00 | 37.63 | 0.00 | 35.01 |
| | | Two wheeler | 0.00 | 0.00 | 0.54 | 0.00 | 0.30 |
| | | Four wheeler | 3.92 | 6.00 | 4.84 | 0.00 | 5.04 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | No./HH. | 25.00 | 20.00 | 23.00 | 0.00 | 22.00 |
| Thanedhar (anti-hail Net) | Users | Furniture | 58.21 | 58.91 | 0.00 | 0.00 | 58.71 |
| | | Electronics | 37.86 | 36.72 | 0.00 | 0.00 | 37.04 |
| | | Two wheeler | 0.36 | 0.56 | 0.00 | 0.00 | 0.51 |
| | | Four wheeler | 3.57 | 3.81 | 0.00 | 0.00 | 3.74 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./HH. | 17.00 | 24.00 | 0.00 | 0.00 | 22.00 |
| | Non-users | Furniture | 57.58 | 58.41 | 0.00 | 0.00 | 57.88 |
| | | Electronics | 38.38 | 35.40 | 0.00 | 0.00 | 37.30 |
| | | Two wheeler | 0.51 | 0.88 | 0.00 | 0.00 | 0.64 |
| | | Four wheeler | 3.53 | 5.31 | 0.00 | 0.00 | 4.18 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./HH. | 20.00 | 23.00 | 0.00 | 0.00 | 21.00 |

**Source:** Data from Field Survey.
**Note:** No./HH.: Number per household.

Table-4.15 shows the number of other assets owned by sampled orchardists. In both the blocks, the number of furniture was highest, followed by the number of electronics, for both users and non-users alike. For Cannon users, furniture accounted for 59.05 per cent of total number of assets, followed by 34.12 per cent of electronics. For Cannon non-users, these values were 59.65 and 35.01 per cent. In terms of classifications, number of furniture was highest with marginal farmers (61.40% of total) and number of electronics was highest with medium farmers (36.50%) for Cannon users. For Cannon non-users, number of furniture was highest with small farmers (63%) and number of electronics was highest with semi-medium farmers (37.63%). For Net users, furniture accounted for 58.71 per cent of total number of assets, followed by 37.04 per cent of electronics. For Net non-users, these values were 57.88 and 37.30 per cent. In terms of classifications, number of furniture was higher for small farmers for both, users (58.91%) and

non users (58.41%) and number of electronics was higher for marginal farmers for both, users (57.86%) and non-users (38.38%).

Total per household number of other assets was the same for anti-hail Cannon users and non-users, this was 22. For Cannon users, semi-medium and medium farmers had highest number of assets per household (25 each) and for Cannon non-users; marginal farmers had highest number of assets per household (25). For anti-hail Net users, number of assets per household was 22, whereas, for non-users this number was 21. For Net users and non-users, this number was higher for small farmers (24 and 23).

**Table-4.16: Value of Other Assets of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Furniture | 18.38 | 16.64 | 12.16 | 15.03 | 13.95 |
| | | Electronics | 18.38 | 20.21 | 8.88 | 9.38 | 11.39 |
| | | Two-wheeler | 0.49 | 0.00 | 0.00 | 2.68 | 0.70 |
| | | Four-wheeler | 62.75 | 63.15 | 78.96 | 72.91 | 73.96 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value /HH. | 291428.57 | 630833.33 | 1294722.22 | 1397250.00 | 979844.44 |
| | Non-users | Furniture | 14.06 | 13.59 | 18.74 | 0.00 | 16.54 |
| | | Electronics | 31.25 | 11.91 | 16.49 | 0.00 | 15.87 |
| | | Two-wheeler | 0.00 | 0.00 | 1.96 | 0.00 | 1.11 |
| | | Four-wheeler | 54.69 | 74.50 | 62.81 | 0.00 | 66.48 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value /HH. | 320000.00 | 655000.00 | 636875.00 | 0.00 | 600666.67 |
| Thanedhar (anti-hail Net) | Users | Furniture | 22.56 | 17.10 | 0.00 | 0.00 | 18.28 |
| | | Electronics | 26.62 | 19.51 | 0.00 | 0.00 | 21.05 |
| | | Two-wheeler | 0.87 | 1.49 | 0.00 | 0.00 | 1.36 |
| | | Four-wheeler | 49.95 | 61.90 | 0.00 | 0.00 | 59.31 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value /HH. | 344333.33 | 621933.33 | 0.00 | 0.00 | 529400.00 |
| | Non-users | Furniture | 22.56 | 16.01 | 0.00 | 0.00 | 19.90 |
| | | Electronics | 21.34 | 15.30 | 0.00 | 0.00 | 18.89 |
| | | Two-wheeler | 2.44 | 2.85 | 0.00 | 0.00 | 2.60 |
| | | Four-wheeler | 53.66 | 65.84 | 0.00 | 0.00 | 58.61 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value /HH. | 410000.00 | 562000.00 | 0.00 | 0.00 | 460666.67 |

**Source:** Data from Field Survey.
**Note:** No./HH.: Number per household.

Table-4.16 shows the value of other assets owned by sampled orchardists. Assets mentioned are furniture, electronics, two-wheeler and four-wheeler. All figures are in

percentage. Per household value of these assets is also given. In both the blocks, the value of four-wheelers was highest. For Cannon users value of four wheeler was 73.96 per cent of total and semi-medium farmers had the highest share of four-wheeler in total value (78.96%). For Cannon non-users, this value was 66.48 per cent with small farmers having the highest share (74.50%). For Net users, value of four-wheeler was 59.31 per cent, with small farmers having higher share (61.90%), and for Net non-users, this value was 58.61 per cent, with small farmers, again, having the higher share (65.84%).

Total per household value of assets was higher for users in both the blocks than non-users. For Cannon users total per household value of assets was Rs. 9,79,844.44 as compared to Rs. 6,00,666.67 for non users. For Net users this value was Rs. 5,29,400 as compared to Rs. 4,60,666.67 for non-users. In terms of classifications, for Cannon users, medium farmers had highest per household value (Rs. 13,97,250), whereas, for Cannon non-users, small farmers had the highest per household value (Rs. 6,55,000). For Net users and non-users, small farmers had higher per household value of assets (Rs. 6,21,933.33 and Rs. 5,62,000).

### 4.14 Livestock Composition

Number and value of livestock composition of sampled orchardists is given in Tables-4.17 and 4.18. Various livestock mentioned here are cattle, buffaloes and goat/sheep. All figures are given in percentage. Number of livestock per household is also given.

Number of livestock composition of sampled orchardists is given in Tables-4.17. For anti-hail Cannon users, 100 per cent livestock was cattle. No sampled orchardists had buffaloes or goat/sheep with them, whereas, Cannon non-users had 66.67 per cent of cattle, 26.67 per cent of buffaloes and 6.66 per cent of goat/sheep. Anti-hail Net users had 97.30 per cent cattle and 2.70 per cent goat/sheep with no buffaloes. Net non-users had 92.86 per cent cattle and 7.14 per cent goat/sheep with no buffaloes.

Number of livestock per household was higher with non-users in both the blocks than users. For Cannon and Net users this value was 0.87 and 0.82 as compared to 1 and 0.93 for non-users. For Cannon users, medium farmers had highest number of livestock per household (1). For Cannon non-users this value was highest for marginal farmers (2). For Net users and non-users, small farmers had higher number of livestock per household (0.86 and 1.60).

**Table-4.17: Number of Livestock Composition of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Cattle | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | No./HH. | 0.86 | 0.67 | 0.94 | 1.00 | 0.87 |
| | Non-users | Cattle | 75.00 | 75.00 | 57.14 | 0.00 | 66.67 |
| | | Buffaloes | 0.00 | 25.00 | 42.86 | 0.00 | 26.67 |
| | | Goat/Sheep | 25.00 | 0.00 | 0.00 | 0.00 | 6.66 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | No./HH. | 2.00 | 0.80 | 0.87 | 0.00 | 1.00 |
| Thanedhar (anti-hail Net) | Users | Cattle | 100.00 | 96.15 | 0.00 | 0.00 | 97.30 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 3.85 | 0.00 | 0.00 | 2.70 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./HH. | 0.73 | 0.86 | 0.00 | 0.00 | 0.82 |
| | Non-users | Cattle | 100.00 | 87.50 | 0.00 | 0.00 | 92.86 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 12.50 | 0.00 | 0.00 | 7.14 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | No./HH. | 0.60 | 1.60 | 0.00 | 0.00 | 0.93 |

**Source:** Data from Field Survey
**Note:** No./HH.: Number per household.

Value of livestock composition of sampled orchardists is given in Table-4.18. For anti-hail Cannon users 100 per cent value of livestock was of cattle, whereas, for Cannon non-users this value was 72.02 per cent. Value of buffaloes for Cannon non-users was 27.30 per cent and of goat/sheep it was 0.68 per cent. For anti-hail Net users, value of cattle was 99.63 per cent and of goat/sheep it was 0.37 per cent. For Net non-users, value of cattle was 99.03 per cent and of goat/sheep it was 0.97 per cent.

Value of livestock per household was higher for Cannon non-user (Rs. 19,533.33) as compared to user (Rs. 17,044.44). For Cannon user, medium farmers had the highest value per household (Rs. 22,500), and for Cannon non-users this value was highest for marginal farmers (Rs. 36,000). In anti-hail Net block, per household value of livestock was higher for users (Rs. 18,177.78) than non-users (Rs. 17,166.67). For Net users and non-users, per household value was higher for small farmers (Rs. 19,866.67 and Rs. 26,500).

**Table-4.18: Value of Livestock Composition of Sampled Orchardists**

**(All figures in %)**

| Block/ Mechanism | Particulars | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Cattle | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | Value/H.H. | 16428.57 | 12583.33 | 17833.33 | 22500.00 | 17044.44 |
| | Non-users | Cattle | 97.22 | 76.32 | 57.24 | 0.00 | 72.02 |
| | | Buffaloes | 0.00 | 23.68 | 42.76 | 0.00 | 27.30 |
| | | Goat/Sheep | 2.78 | 0.00 | 0.00 | 0.00 | 0.68 |
| | | Total | 100.00 | 100.00 | 100.00 | 0.00 | 100.00 |
| | | Value/H.H. | 36000.00 | 15200.00 | 18125.00 | 0.00 | 19533.33 |
| Thanedhar (anti-hail Net) | Users | Cattle | 100.00 | 99.50 | 0.00 | 0.00 | 99.63 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 0.50 | 0.00 | 0.00 | 0.37 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value /H.H. | 14800.00 | 19866.67 | 0.00 | 0.00 | 18177.78 |
| | Non-users | Cattle | 100.00 | 98.11 | 0.00 | 0.00 | 99.03 |
| | | Buffaloes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Goat/Sheep | 0.00 | 1.89 | 0.00 | 0.00 | 0.97 |
| | | Total | 100.00 | 100.00 | 0.00 | 0.00 | 100.00 |
| | | Value /H.H. | 12500.00 | 26500.00 | 0.00 | 0.00 | 17166.67 |

**Source:** Data from Field Survey.
**Note:** No./HH.: Number per household.

## 4.15 Summing Up

The analyses reveal that majority of the sample of anti-hail Cannon and Net users and non-users belonged to general category. In both the blocks, total males were more than total females. Majority of sampled orchardists were in the age group of 18-60 years. Educational status of sampled orchardists revealed that majority of anti-hail Cannon users and non-users were graduates and semi-medium farm orchardists had highest share of graduates among all farm orchardists. Majority of anti-hail Net users were secondary level educated and non-users were graduates. Agriculture (horticulture) was the main and subsidiary occupation for majority of sampled orchardists. In both the blocks, anti-hail Cannon and Net users and non-users generated highest income from their apple orchard produce sale. Per household annual income was higher among users than non-users in both the block. It was highest among medium farm orchardists for users and semi-medium farm orchardists for non-users categories for Cannon block and small farm orchardists for users and non-users categories for Net block.

Per farm own land area and gross cropped area (GCA) of users was more than of non-users in both the blocks. It was highest among medium and semi-medium farm orchardists for anti-hail Cannon users and non-users, and small farm orchardists for anti-hail Net users and non-users. Maximum area of their land was under apple crop, which was about 95 per cent for anti-hail Cannon users and non-users and about 92 per cent for anti-hail Net users and non-users. Here, marginal farm orchardists had highest share of apple in their cropping pattern. Per farm production of apples was higher among users than non-users under both mechanisms. This was 1,937 and 1,056 boxes per farm in case of Cannon and Net users and 1,152 and 995 boxes per farm in case of non-users. Further, per farm quantity sold, total price and average price per box of apples and other fruits was higher among anti-hail Cannon and Net users than non-users. Here, medium and semi-medium farmers had highest share among all farm orchardist for Cannon users and non-users, and small farmers among all farm orchardists for Net users and non-users.

Number and value of equipment and machinery was higher among users in both the blocks. For anti-hail Cannon users and non-users, highest value was attributed to grading and packing machine of apple, and for anti-hail Net users and non-users, this was attributed to petrol/diesel spray machine. Per household total value of equipment and machinery was higher among users (Rs. 1,67,317.78 and Rs. 67,371.11) as compared to non-users (Rs. 1,06,433.33 and Rs. 52,680) of anti-hail Cannon and Net. This value was highest among medium and semi-medium farm orchardists for Cannon user and non-users, and small farm orchardists for anti-hail Net users and non-users.

Per household value of buildings; dwelling house, cattle shed and storage/shop was higher among users as compared to non-users in both the blocks. Per household number and value of other assets was also higher among users, where, four-wheeler had highest value in other assets owned by sampled orchardists. But, per household number and value of livestock was higher for non-users than users. Cattle were the major livestock rearing by sampled orchardists in both the blocks.

Finally, it can be concluded that anti-hail Cannon and Net users attained better socio-economic profile and farm level characteristics than non-users. They also attained better living standards as compared to non-users, this was due to increased production and orchards sale and income from orchard produce because of protecting their orchards with anti-hail Cannons and Nets.

# Chapter-V

## IMPACT OF HAIL PROTECTION MECHANISM ON APPLE PRODUCTION AND INCOME OF SAMPLED ORCHARDISTS AND MECHANISM AWARENESS

In last decade the incidence of hailstorms in the apple belt of district Shimla has increased alarmingly. Every year apple crop worth crores of rupees is destroyed by hailstorm. During the assembly elections in 2007, State government promised the peoples of most hailstorm affected areas to install anti-hail Cannons in their areas to check the destruction of apple crop. Therefore, in 2010, Horticulture Department of the state installed three anti-hail Cannons at most hailstorm affected areas. Other farmers of the district, where government Cannons were not installed, also purchased this technology privately. The state government also announced 80 per cent subsidy on the purchase of another hail protection mechanism named anti-hail Nets, for protecting apple crops from hails. Now the apple orchardists of district Shimla are using anti-hail Nets and have also installed anti-hail Cannons for protecting their apple crops from hailstones. Thus, the present chapter is devoted to highlight the comparative analyses of sampled orchardists with and without mechanism, about hailstorm occurrence, and apple losses due to hailstorm during study period in their area.

In this chapter, the impact of hail protection mechanism on apple production and income of apple orchardists is also assessed. This is done by analyzing the difference in income and production of users and non-users of the mechanism in terms of average annual income from apple and per farm production of apple in boxes during study period. The comparison of users and non-users draws a clear line as to how the mechanism has benefitted the users in enhancing their income and production as compared to the non-users.

Further, the analyses regarding awareness among user and non-users about hail protection mechanism in study area is also studied in this chapter.

### 5.1 Event of Losses for Apple Crop before Hail Protection Mechanism in Study Area

Event of losses for apple crop in study area is classified into different type of causes/events during different season. Apple crop of sampled orchardists suffered from four different types of events of losses like; dry weather/frosting, pest and diseases, fall, and hailstorm during four seasons i. e., flowering season, fruit setting season, fruit growing, and also fruit picking season.

The classification of event of losses for apple orchardists before mechanism installation is presented in Table-5.1. This analyses indicate that anti-hail Cannon users and non-users mentioned loss of apple crop due to hailstorm as the biggest cause, which was calculated to be 61.11 per cent during flowering season, 64.82 per cent during fruit setting season, 48.57 per cent during fruit growing season, and 57.15 per cent during fruit picking season for users and 75.00 per cent, 45.16 per cent, 51.72 per cent and 61.90 per cent during flowering, fruit setting, fruit growing and fruit picking seasons, for non-users. Second major cause for loss of apple was due to dry weather/frosting followed by fall and pest and diseases, responded by both categories. Maximum loss due to hailstorms occurred during fruit setting season for users and flowering season for non-users.

**Table-5.1: Event of Losses before Mechanism Installation for Apple Orchardists in Study Area** **(All figures in %)**

| Block/ Mechanism | Particulars | | Flowering season | Fruit setting season | Fruit growing season | Fruit picking season | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | Dry weather/Frosting | 31.95 | 20.37 | 21.43 | 4.76 | 21.43 |
| | | Pest & diseases | 6.94 | 11.11 | 11.43 | 2.38 | 8.40 |
| | | Fall | 0.00 | 3.70 | 18.57 | 35.71 | 12.61 |
| | | Hailstorm | 61.11 | 64.82 | 48.57 | 57.15 | 57.56 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | Dry weather/Frosting | 20.00 | 6.45 | 6.90 | 0.00 | 7.92 |
| | | Pest & diseases | 5.00 | 25.81 | 27.59 | 0.00 | 16.83 |
| | | Fall | 0.00 | 22.58 | 13.79 | 38.10 | 18.81 |
| | | Hailstorm | 75.00 | 45.16 | 51.72 | 61.90 | 56.44 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Thanedhar (anti-hail Net) | Users | Dry weather/Frosting | 42.86 | 37.78 | 23.40 | 23.94 | 32.15 |
| | | Pest & diseases | 3.57 | 21.11 | 21.28 | 1.41 | 12.68 |
| | | Fall | 0.00 | 0.00 | 8.51 | 28.17 | 8.26 |
| | | Hailstorm | 53.57 | 41.11 | 46.81 | 46.48 | 46.91 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | Non-users | Dry weather/Frosting | 40.00 | 21.87 | 22.22 | 21.74 | 25.86 |
| | | Pest & diseases | 0.00 | 9.38 | 19.44 | 0.00 | 8.62 |
| | | Fall | 0.00 | 25.00 | 16.67 | 34.78 | 18.96 |
| | | Hailstorm | 60.00 | 43.75 | 41.67 | 43.48 | 46.56 |
| | | Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Data from Field Survey.

Similarly, in case of anti-hail Net users and non-users, maximum loss of apple crop was due to hailstorm during all seasons. For Net users, loss due to hailstorm was calculated to be 53.57 per cent, 41.11 per cent, 46.81 per cent, and 46.48 per cent during flowering, fruit setting, fruit growing, and fruit picking seasons, respectively. For non-users these percentages were

60.00 per cent, 43.75 per cent, 41.67 per cent and 43.48 per cent. Maximum loss of apple due to hailstorm occurred during flowering season for both, users and non-users, of anti-hail Net mechanism. Further, the analyses show that dry weather/frosting was second major cause of apple loss for anti-hail Net users and non-users followed by other events of losses.

Thus, it can be concluded that before the installation of hail protection mechanism in the study area, hailstorm was a major event of loss for apple crop of sampled orchardists of district Shimla and this mostly happened during flowering and fruit setting seasons.

### 5.2 Occurrence of Hailstorm in Study Area during Reference Period (2018-19)

Table-5.2 shows the responses of sampled households on whether hailstorm occurred in their area during the study period or not. For Canon users, 26 out of 45 households (57.78%) said that hailstorm occurred in their area in the study period, while 19 out of 45 households (42.22%) said it did not occur. For Cannon non-users, 15 out of 15 households (100%) said that hailstorm occurred in their area. For Net users, 36 out of 45 households (80%) said that hailstorm occurred in their area in the study period, while 9 out of 45 households (20%) said it did not occur. For Net non-users 15 out of 15 households (100%) said that hailstorm occurred. Therefore, in both the blocks occurrence of hailstorm was more for non-users than users.

**Table-5.2: Responses of Sampled Orchardists about Occurrence of Hailstorm in their Area during Study Period** **(No. of HH.)**

| Particulars | Jubbal & Kotkhai (anti-hail Cannon) | | Thanedhar (anti-hail Net) | |
|---|---|---|---|---|
| | Users | Non-users | Users | Non-users |
| Yes | 26 (57.78) | 15 (100.00) | 36 (80.00) | 15 (100.00) |
| No | 19 (42.22) | 0 (0.00) | 9 (20.00) | 0 (0.00) |
| Total | 45 (100.00) | 15 (100.00) | 45 (100.00) | 15 (100.00) |

**Source:** Data from Field Survey.

### 5.3 Details of Hailstorm Occurred in study Area

Details of hailstorm occurred in study area included its frequency (in time), duration (in minutes) and intensity (in size and quality) during study period. Frequency of hailstorm is categorised into three parts like; 1-2 time, 2-3 times and more than 3 times. Duration of hailstorm is divided into

three parts like; 1-3 minutes, 3-5 minutes and more than 5 minutes. Intensity of hailstorm is also categorised into three parts according to its size viz; low, medium and high.

The analyses of hailstorm occurred in study area during 2018-19 is presented by Table-5.3, which indicates that the majority of anti-hail Cannon users (92.30%) responded that the frequency of hailstorm was 1-2 times in their farms, whereas, majority of non-users (46.67%) responded that the frequency of hailstorm was 2-3 times in their farms. Further, the duration of hailstorm was recorded to be 3-5 minutes by majority of users and non-users alike. Majority of users and non-users of anti-hail Cannon responded that the intensity of hailstorm was high which was considered by 53.85 per cent users and 66.67 per cent non-users. In case of anti-hail Net users and non-users, majority of users (55.56%) and non-users (46.67%) responded that the frequency of hailstorm was more than 3 times in their farms and followed by those who have responded that the frequency of hailstorm was 1-2 times and then 2-3 times, respectively. The duration of hailstorm was recorded to be 1-3 minutes by majority of users (63.80%) and it was recorded to be 3-5 minutes by majority of non-users (53.33%). Further, the majority of anti-hail Net users and non-users responded that the intensity of hailstorm occurred in their farm was medium, which was considered by 52.78 per cent users and 53.33 per cent non-users.

**Table-5.3: Details of Hailstorm Occurred in Study Area during Study Period**

**(All figures in %)**

| **Particulars** | **Jubbal & Kotkhai (anti-hail Cannon)** | | **Thanedhar (anti-hail Net)** | |
|---|---|---|---|---|
| | **Users** | **Non-users** | **Users** | **Non-users** |
| **Frequency (in time)** | | | | |
| 1-2 | 92.30 | 13.33 | 36.11 | 40.00 |
| 2-3 | 3.85 | 46.67 | 8.33 | 13.33 |
| >3 | 3.85 | 40.00 | 55.56 | 46.67 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| **Duration (in minutes)** | | | | |
| 1-3 | 42.31 | 6.67 | 63.89 | 46.67 |
| 3-5 | 50.00 | 53.33 | 33.33 | 53.33 |
| >5 | 7.69 | 40.00 | 2.78 | 0 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| **Intensity (in size and quality)** | | | | |
| Low | 26.92 | 0 | 25.00 | 6.67 |
| Medium | 19.23 | 33.33 | 52.78 | 53.33 |
| High | 53.85 | 66.67 | 22.22 | 40.00 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Data from Field Survey.

Therefore, it can be concluded that the highest percentage of frequency, duration and intensity of hailstorm was accounted for non-users of anti hail Cannon, whereas, the frequency of hailstorm was highest (>3 times) for both users and non-users of anti-hail Net but higher percentage was accounted for users category. Further, the duration and intensity of hailstorm was higher for non-users of anti-hail Net. At last, the comparative analyses show that the frequency of hailstorm was higher (>3 times) in Thanedhar block using anti-hail Net as compared to Jubbal & Kotkhai block (1-2 times) using anti-hail Cannon.

### 5.4 Expected Loss of Apple of Sampled Orchardists

Expected loss of apple of sampled orchardists during study period is classified into per farm hailstorm affected and non-affected area (in hectare), quantitative loss and qualitative loss in terms of quantity (in boxes) and value (in Rs.) due to hailstorm. Further, the results about expected loss of apple are presented in Table-5.4.

This analyses shows that in Jubbal & Kotkhai block, per farm hailstorm affected area was 0.75 hectare for anti-hail Cannon users and it was higher (1.51 hectares) for non-users. Per farm hailstorm non-affected area was 1.15 hectare for Cannon users and it was only 0.05 hectares for non-users. In terms of classifications, medium farm orchardists for anti-hail Cannon users accounted for highest per farm hailstorm affected and non-affected areas among all farm orchardists. Whereas, semi-medium farm orchardists for anti-hail Cannon non-users accounted for highest per farm hailstorm affected and non-affected areas among all farm orchardists.

In Thanedhar block, per farm hailstorm affected area was 0.07 hectares for anti-hail Net users and it was higher (0.77 hectares) for non-users. Per farm hailstorm non-affected area was higher for Net users (0.94 hectares) as compared to non-users (0.09 hectares). Small farm orchardists accounted for highest per farm hailstorm affected and non-affected areas for users and non-users.

Further, this analyses show that quantitative and qualitative loss of apple due to hailstorms in both the blocks. In Jubbal & Kotkhai, for anti-hail Cannon users, the expected quantitative loss of apple was 225 boxes of value of Rs. 2,37,311.11 per farm, and it was 577 boxes of value of Rs. 5,66,000.00 per farm for non-users.

**Table-5.4: Per Farm Expected Loss of Apple and Area Affected of sampled Orchardists due to Hailstorm during Study Period**

| Block/ Mechanism | Type of Orchardists | | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|---|
| Jubbal & Kotkhai (anti-hail Cannon) | Users | **Area** | | | | | |
| | | - Affected | 0.12 | 0.35 | 0.74 | 1.45 | 0.75 |
| | | - Non-affected | 0.45 | 0.75 | 1.57 | 1.96 | 1.15 |
| | | **Quantitative loss** | | | | | |
| | | - Quantity | 37.00 | 82.00 | 339.00 | 350.00 | 225.00 |
| | | -Value | 49857.14 | 85833.33 | 338888.84 | 400000.00 | 237311.11 |
| | | **Qualitative loss** | | | | | |
| | | - Quantity | 29.00 | 64.00 | 17.00 | 0.00 | 28.00 |
| | | -Value | 17142.86 | 33333.33 | 8333.33 | 0.00 | 14888.89 |
| | Non-users | **Area** | | | | | |
| | | -Affected | 0.67 | 1.06 | 2.01 | 0.00 | 1.51 |
| | | -Non-affected | 0.07 | 0.00 | 0.08 | 0.00 | 0.05 |
| | | **Quantitative loss** | | | | | |
| | | -Quantity | 325.00 | 540.00 | 663.00 | 0.00 | 577.00 |
| | | -Value | 325000.00 | 540000.00 | 642500.00 | 0.00 | 566000.00 |
| | | **Qualitative loss** | | | | | |
| | | -Quantity | 250.00 | 520.00 | 721.00 | 0.00 | 591.00 |
| | | -Value | 125000.00 | 260000.00 | 358125.00 | 0.00 | 294333.33 |
| Thanedhar (anti-hail Net) | Users | **Area** | | | | | |
| | | -Affected | 0.04 | 0.09 | 0.00 | 0.00 | 0.07 |
| | | -Non-affected | 0.80 | 1.01 | 0.00 | 0.00 | 0.94 |
| | | **Quantitative loss** | | | | | |
| | | -Quantity | 20.00 | 60.00 | 0.00 | 0.00 | 46.00 |
| | | -Value | 20000.00 | 59500.00 | 0.00 | 0.00 | 46333.33 |
| | | **Qualitative loss** | | | | | |
| | | -Quantity | 13.00 | 68.00 | 0.00 | 0.00 | 50.00 |
| | | -Value | 6666.67 | 34066.67 | 0.00 | 0.00 | 24933.33 |
| | Non-users | **Area** | | | | | |
| | | -Affected | 0.72 | 0.86 | 0.00 | 0.00 | 0.77 |
| | | -Non-affected | 0.03 | 0.27 | 0.00 | 0.00 | 0.09 |
| | | **Quantitative loss** | | | | | |
| | | -Quantity | 168.00 | 200.00 | 0.00 | 0.00 | 178.00 |
| | | -Value | 170000.00 | 200000.00 | 0.00 | 0.00 | 180000.00 |
| | | **Qualitative loss** | | | | | |
| | | - Quantity | 270.00 | 308.00 | 0.00 | 0.00 | 283.00 |
| | | -Value | 1350500.00 | 154000.00 | 0.00 | 0.00 | 141333.33 |

**Source:** Data from Field Survey
**Note:** Area in Hectares, Quantity in Boxes, Value in Rupees.

Similarly, qualitative loss of apple was 28 boxes of value of Rs. 14,888.89 per farm for Cannon users and 591 boxes of value in Rs. 2,94,333.33 per farm for non-users. For anti-hail Cannon users, highest quantitative loss of apple was accounted by medium farm orchardists and highest qualitative loss of apple was accounted by small farm orchardists. But, in case of non-

users, highest quantitative and qualitative loss of apple due to hailstorm was reported by semi-medium farm orchardists.

Wherein Thanedhar block, for anti-hail Net users, the quantitative loss of apple due to hailstorm was 46 boxes of value of Rs. 46,333.33 per farm and it was 178 boxes of the value of Rs. 1,80,000.00 per farm for non-users. Expected qualitative loss of apple due to hailstorm was 50 boxes of the value of Rs. 24,933.33 per farm for users and 283 boxes of the value of Rs. 1,41,333.33 per farm for non-users. In terms of classifications, highest quantitative and qualitative loss due to hailstorm was reported by small farm orchardists for anti-hail Net users and non-users alike.

Therefore, the analyses concluded that the non-users of both mechanisms in the district reported higher expected loss of apple (in terms of affected area, quantitative and qualitative loss) due to hailstorm as compared to mechanism users. Thus, the hail protection mechanisms had positive impact on its users of study area.

**5.5 Role of Horticulture Department on Post Loss of Apple Crop due to Hailstorms**

It is necessary to know whether sampled orchardists have any idea and knowledge about visits undertaken and mechanism advised by the officials of horticulture department post loss of apple crop due to hails. There are different types of views regarding role played by the horticulture department about above mentioned issues.

It can be observed from the Table-5.5 that in Jubbal & Kotkhai block, out of total anti-hail Cannon users, majority (71.11%) of them responded that the officials of horticulture department did not undertake any visit in their areas post loss of apple crop due to hails and only 26.67 per cent orchardists responded that the officials undertook visit in their areas post loss of apple crop due to hailstorm. 2.22 per cent orchardists were unaware about this particular aspect. In case of Cannon non-users, majority (86.66 %) of orchardists responded that the officials of horticulture department did not visit the farm post loss of apple crop due to hailstorm. Only 6.67 per cent orchardists responded that the officials of horticulture department visited their farms. 6.67 per cent orchardists were unaware of this aspect. 100 per cent of the orchardists who responded yes to the visits undertaken denied that mechanism was advised by the official who visited their farms.

Similarly, in Thanedhar block, majority of anti-hail Net users (86.67%) and non users (86.66%) responded no to the visits undertaken by officials of horticulture department post loss of apple crop due to hails. Only 11.11 per cent users and 6.67 per cent non-users responded that the officials undertook visits in their areas after hailstorm. 100 per cent orchardists out of them denied any mechanism advised by horticulture department for protecting their crop from hails.

Therefore, the analyses concluded that the majority of users and non-users of both blocks (both mechanism) were not satisfied about the role of horticulture department in terms of visits undertaken and mechanism advised post loss of apple crop due to hailstorms in their areas.

**Table-5.5: Household Responses to Role of Horticulture Department Post Loss of Apple Crop Due to Hail** **(All figures in %)**

| Particulars | Jubbal & Kotkhai (anti-hail Cannon) | | Thanedhar (anti-hail Net) | |
|---|---|---|---|---|
| | Users | Non-users | Users | Non-users |
| **Visits undertaken** | | | | |
| Yes | 12 (26.67) | 1 (6.67) | 5 (11.11) | 1 (6.67) |
| No | 32 (71.11) | 13 (86.66) | 39 (86.67) | 13 (86.66) |
| Unaware | 1 (2.22) | 1 (6.67) | 1 (2.22) | 1 (6.67) |
| Total | 45 (100.00) | 15 (100.00) | 45 (100.00) | 15 (100.00) |
| **Mechanism advised** | | | | |
| Yes | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| No | 12 (100.00) | 1 (100.00) | 5 (100.00) | 1 (100.00) |
| Unaware | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 12 (100.00) | 1 (100.00) | 5 (100.00) | 1 (100.00) |

**Note:** Figures in parenthesis indicate percentage to total.
**Source:** Data from Field Survey.

## 5.6 Impact of Mechanism on Income of Apple Orchardists

Table-5.6 depicts the per farm income of orchardists from apple crop. A comparison is drawn between the income of users and non-users to assess the impact of hail protection mechanism on apple income.

For anti-hail Cannon users, the per farm annual income from apple was Rs. 20,91,577 which was almost twice than that of non-users (Rs. 10,88,333). Per farm annual income was higher for users in every category except for marginal users. Similarly, for anti-hail Net users, the per farm annual income from apple was Rs. 10,17,777, which was again almost twice the annual income of non-users (Rs. 5,49,667). Here, per farm annual income from apple was higher for users in every category.

This massive distinction clearly shows that the users of hail protection mechanism were earning almost double from their apple produce as compared to the non-users.

**Table-5.6: Per Farm Annual Income from Apple of Sampled Orchardists during Study Period**

**(All figures in Rs.)**

| Block/ Mechanism | Type of Orchardists | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail Cannon)** | Users | 386429 | 1383333 | 2453888 | 3830750 | 2091577 |
| | Non-users | 625000 | 865000 | 1343750 | 0 | 1088333 |
| **Thanedhar (anti-hail Net)** | Users | 739333 | 1157000 | 0 | 0 | 1017777 |
| | Non-users | 490000 | 669000 | 0 | 0 | 549667 |

**Source:** Data from Field Survey.

### 5.7 Impact of Mechanism on Apple Production of Sampled Orchardists

Table-5.7 shows the per farm production of apple of sampled orchardists in terms of boxes. A comparison of production of users of the mechanism is drawn with the non-users to see if the mechanism has any impact.

For Cannon users, per farm production of apple was 1973 boxes which was higher than non-users, which were 1152 boxes. Per farm production of apple was higher for users in every category except for marginal users. For Net users, per farm production of apple was 1056 boxes which was almost twice the per farm production for non-users (593 boxes). Production for users was higher in every category.

Therefore, users of both the mechanisms had higher production of apple than the non-users, concluding that the hail protection mechanism had a positive impact on production of apple in study area.

**Table-5.7: Per Farm Production of Apple of Sampled Orchardists during Study Period**

**(Boxes/Farm)**

| Block/ Mechanism | Type of Orchardists | Marginal | Small | Semi-medium | Medium | Total |
|---|---|---|---|---|---|---|
| **Jubbal & Kotkhai (anti-hail Cannon)** | Users | 335 | 1238 | 2369 | 3625 | 1973 |
| | Non-users | 625 | 885 | 1450 | 0 | 1152 |
| **Thanedhar (anti-hail Net)** | Users | 783 | 1193 | 0 | 0 | 1056 |
| | Non-users | 527 | 730 | 0 | 0 | 595 |

**Source:** Data from Field Survey.

Hail protection mechanism has a two way impact on apple produce. Firstly, it increase the quantity of apple production by protecting the crop from hail damage during flowering and fruit setting period and secondly, the mechanism improve the quality of the produce by substantially reducing the hazards of marks and dents on the fully ripe fruit, hence, giving the mechanism users a better price for their produce.

Whereas, for non-users, quantity of apple is reduced by early damage to the crop from hail and also the quality of produce is compromised by marks and dents in the fully ripe fruit. Thus giving the non-users comparatively lesser price for their apple produce in the market.

### 5.8 Awareness about Hail Protection Mechanism

The analyses regarding sampled orchardists views on awareness about hail protection mechanism are presented in Table-5.8, which indicate that all the users and non-users of anti-hail Cannon and anti-hail Net mechanisms were aware about this particular hail protection mechanism in the district.

**Table-5.8: Sampled Orchardists Awareness about the Mechanism**

**(All figures in %)**

| Particulars | Jubbal & Kotkhai (anti-hail Cannon) | | Thanedhar (anti-hail Net) | |
|---|---|---|---|---|
| | Users | Non-users | Users | Non-users |
| Aware | 45 (100.00) | 15 (100.00) | 45 (100.00) | 15 (100.00) |
| Unaware | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 45 (100.00) | 15 (100.00) | 45 (100.00) | 15 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 5.9 Sampled Orchardists Source of Information about the Mechanism

This part of analyses elaborates the information dissemination system of hail protection mechanism for sampled orchardists in district Shimla of the state. Here, orchardists mentioned different types of sources of information about the mechanism (anti-hail Cannon and anti-hail Net) like; Horticulture Department, *Panchayat Pradhan*/members, Media and Other people. The analyses about this are presented in Table-5.9.

It is depicted from table that in Jubbal & Kotkhai block, majority of anti-hail cannon users (62.50%) and non users (52.83%) responded that the horticulture department was the main source of information about this particular mechanism in the district. It was followed by those who responded that other people were the second major source of information about the mechanism.

In Thanedhar block, majority of (42.11%) anti-hail Net users (43.75%) and non-users (43.75%) have responded that the horticulture department was the major source of information about the hail protection mechanism in the district. It was followed by those orchardists who responded that the other people were the main sources of information about this mechanism in the district.

Therefore, it can be concluded the horticulture department was the main source of information about hail protection mechanism for majority of users and non-users of both blocks in study area. Further, it can also be concluded that the other people was the second major source of information.

**Table-5.9: Households Source of Information about the Mechanism**

**(All figures in %)**

| Particulars | Jubbal & Kotkhai (anti-hail Cannon) | | Thanedhar (anti-hail Net) | |
|---|---|---|---|---|
| | Users | Non-users | Users | Non-users |
| Horticulture department | 62.50 | 52.63 | 43.75 | 42.11 |
| *Panchyat Pradhan*/members | 7.14 | 5.26 | 7.81 | 10.52 |
| Media | 1.78 | 0 | 25.00 | 10.52 |
| Other people | 28.58 | 42.11 | 23.44 | 36.85 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Data from Field Survey.

## 5.10 Summing Up

The analyses reveal that anti-hail Cannon users and non-users mentioned hailstorm, as the biggest cause of loss of apple crop. Maximum loss due to hailstorms occurred during fruit setting season for Cannon users and flowering season for Cannon non-users. For anti-hail Net users and non-users also, maximum loss of apple crop was due to hailstorm during all seasons. Maximum loss due to hailstorm occurred during flowering season for both, users and non-users of anti-hail Net mechanism. Thus, before the installation of hail protection mechanism in the study area, hailstorm was a major event of loss for apple crop of sampled orchardists of district Shimla and this mostly happened during flowering and fruit setting seasons. In both the blocks occurrence of hailstorms was more for non-users than users during study reference period. Higher frequency, duration and intensity of hailstorm accounted for non-users of anti hail Cannon in Jubbal & Kotkhai block. The frequency of hailstorm was highest (>3 times) for both users and non-users of anti-hail Net in Thanedhar block. The duration and intensity of hailstorm was higher for non-users of anti-hail Net.

Non-users of both mechanisms in the district reported higher expected loss of apple (in terms of affected area, quantitative and qualitative loss) due to hailstorms as compared to mechanism users. Thus, the hail protection mechanism had positive impact on its users of study area.

The analyses conclude that the hail protection mechanism has a positive impact on the income and the production of apple crop for the users as compared to non-users.

Further, the analyses reveal that majority of users and non-users of both blocks (both mechanism) were not satisfied about the role of horticulture department in terms of visits undertaken and mechanism advised post loss of apple crop due to hailstorm in their areas. All the users and non-users of anti-hail Cannon and Net Mechanism were aware about hail protection mechanism in the district. Horticulture department was the main source of information about this mechanism for majority of users and non-users of both blocks in study area.

# Chapter-VI

## SUBSIDY AND COST UNDER ANTI-HAIL NET

This chapter deals with awareness levels among anti-hail Cannon and anti-hail Net users, about subsidy provision for anti-hail Net and their applications for availing subsidy on Nets. The perspectives of anti-hail Net users about the financial assistance/subsidy received, net coverage area of their farm during study period and actual cost paid by them for the purchase of anti-hail Net are also highlighted in this chapter.

### 6.1 Mechanism Users Awareness about Subsidy Provision and Subsidy Applied

Table-6.1 shows the response of mechanism users on the awareness about subsidy provision and their application for subsidy on anti-hail Net. In case of awareness about subsidy provision, 100 per cent anti-hail Cannon and anti-hail Net users were aware that the Horticulture Department provided subsidy on anti-hail Nets in the state.

**Table-6.1: Mechanism User's Awareness about Subsidy Provision and their Applications for anti-hail Nets from Horticulture Department** **(No. of HH.)**

| Particulars | Jubbal & Kotkhai Cannon Users | Thanedhar Net Users | Total |
|---|---|---|---|
| **Subsidy Provision Awareness** | | | |
| Yes | 45 (100.00) | 45 (100.00) | 90 (100.00) |
| No | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |
| **Subsidy Applied** | | | |
| Yes | 0 (0.00) | 45 (100.00) | 45 (50.00) |
| No | 45 (100.00) | 0 (0.00) | 45 (50.00) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

In case of subsidy applied, 100 per cent anti-hail Net users had applied for assistance on their purchase of anti-hail Nets. But, 100 per cent Cannon users did not apply for subsidy because they did not purchase any anti-hail Net due to anti-hail Cannons installed in their areas.

### 6.2 Financial Assistance Received by Anti-hail Net Users

Responses about financial assistance received on Nets by anti-hail Net users are presented in Table-6.2. It is observed from the table that out of total 45 anti-hail Net users of Thanedhar block, 38 users (84.44 %) received assistance on Nets and 7 users (15.56 %) did not receive assistance. In terms of classifications, 93.33 per cent small farm orchardists received assistance and 6.67 per cent did not receive subsidy on their purchase of Nets. Whereas, 66.67 per cent marginal farm orchardists received assistance and 33.33 per cent marginal users did not receive assistance on their purchase of Nets. Therefore, the maximum small farm users got assistance on Nets as compared to marginal farm users in Thanedhar block.

**Table-6.2: Responses of Anti Hail Net Users Regarding Financial Assistance/Subsidy Received on Nets** **(No. of HH.)**

| Nature of Responses | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|
| | Marginal | Small | Total |
| Yes | 10<br>(66.67) | 28<br>(93.33) | 38<br>(84.44) |
| No | 5<br>(33.33) | 2<br>(6.67) | 7<br>(15.56) |
| Total | 15<br>(100.00) | 30<br>(100.00) | 45<br>(100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 6.3 Financial Assistance/Subsidy Received by Anti-Hail Net Users

The results of analyses about the percentage of subsidy and per household subsidy received by anti-hail Net users are presented in Table-6.3. Area covered under subsidy (in hectares) for both the classifications is also given in table, which was 5.95 hectares for marginal farmers and 19.46 hectares for small farmers. For marginal farmers, total 10 users got subsidy, out of which 8 users (80%) got 80 per cent subsidy and rest 2 users (20%) got 50 per cent subsidy. Similarly, for small farmers, total 28 users got subsidy out of which 19 users (67.86%) got 80 per cent subsidy, and rest 9 users (32.14%) got 50 per cent subsidy. Total subsidy given to marginal farmers was Rs. 8,85,700 and to small farmers was Rs. 24,33,304. Per household subsidy to marginal farmers (Rs. 88,570) was higher than to small farmers (Rs. 86,900.14).

The total subsidy given to all the Net users was Rs. 33,18,904 and total subsidy per household was Rs. 87,339.58.

**Table-6.3: Financial Assistance/Subsidy Received by Anti-Hail Net Users**

| Particulars | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|
| | Marginal | Small | Total |
| Area covered under Subsidy (in Ha.) | 5.95 | 19.46 | 25.41 |
| **Percentage of subsidy received by HH (in numbers)** | | | |
| 50% | 2 (20.00) | 9 (32.14) | 11 (28.95) |
| 80% | 8 (80.00) | 19 (67.86) | 27 (71.05) |
| Total | 10 (100.00) | 28 (100.00) | 38 (100.00) |
| Total Subsidy (In Rs.) | 885700.00 | 2433204.00 | 3318904.00 |
| Subsidy (Rs./H.H.) | 88570.00 | 86900.14 | 87339.58 |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

## 6.4 Time Taken for Processing and Sanctioning of Subsidy Applications

Table-6.4 shows the details about time lag between processing and sanctioning of subsidy to anti-hail Net users. The time lag shown is less than 2 months, 2-3 months, and more than 3 months. For marginal farm orchardists, 70 per cent of the users faced time lag of more than 3 months between processing and sanctioning of subsidy. The rest 30 per cent users faced time lag of 2-3 months. Whereas, for small farm orchardists, 82.15 per cent of the users faced time lag of more than 3 months, 10.71 per cent of 2-3 months and 7.14 per cent of less than 2 months between processing and sanctioning of subsidy. In totality, 78.95 per cent Net users faced time lag of more than 3 months, 15.79 per cent of 2-3 months and 5.26 per cent of less than 2 months.

**Table-6.4: Views of Anti Hail Net Users on the Time Lag between Processing and Sanctioning of Subsidy** **(No. of HH.)**

| Time lag | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|
| | Marginal | Small | Total |
| < 2 months | 0 (0.00) | 2 (7.14) | 2 (5.26) |
| 2-3 months | 3 (30.00) | 3 (10.71) | 6 (15.79) |
| > 3 months | 7 (70.00) | 23 (82.15) | 30 (78.95) |
| Total | 10 (100.00) | 28 (100.00) | 38 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.
.

Therefore, the results of analyses concluded that majority of anti-hail Net users responded that the Horticulture Department took a period of more than 3 months between processing and sanctioning of their subsidy applications.

### 6.5 Per Farm Area covered under anti-hail Net during study period in Thanedhar Block

Details of per farm area covered under anti-hail Nets by net users is given in Table-6.5. The data is for the study period of 2018-19. Particulars depicted are total area covered, area covered with subsidy, and area covered without subsidy. For marginal farm users, total per farm area covered was 0.80 hectare, out of which 0.40 hectare (50%) was covered with subsidy and remaining 0.40 hectare (50%) was covered without subsidy. For small farm users, total per farm area covered was 0.99 hectare, out of which 0.65 hectare (65.66%) was covered with subsidy and remaining 0.34 hectare (34.34%) was covered without subsidy. Therefore, small farm users had higher per farm area covered with subsidy as compared to marginal farmers.

In total, the total per farm area for Net users was 0.93 hectare, out of which 0.56 hectare (60.22%) was covered with subsidy and remaining 0.37 hectare (39.78%) was covered without subsidy.

**Table-6.5: Details of Per Farm Area Covered Under Anti-Hail Nets by Net Users during Study Reference Year (2018-19)**

| Particulars | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|
| | Marginal | Small | Total |
| Total area covered | 0.80<br>(100.00) | 0.99<br>(100.00) | 0.93<br>(100.00) |
| Area covered with subsidy | 0.40<br>(50.00) | 0.65<br>(65.66) | 0.56<br>(60.22) |
| Area covered without subsidy | 0.40<br>(50.00) | 0.34<br>(34.34) | 0.37<br>(39.78) |

**Note:** Figures in parenthesis indicate percentage to total.
**Source:** Data from Field Survey.

### 6.6 Adequacy of Financial Assistance

Table-6.6 shows the adequacy of financial assistance to meet Net users requirements, that is, whether the users found the subsidy on Nets given by the government helpful or not. For marginal farm orchardists, out of 15 users only one user (6.67%) said the financial assistance to be adequate. Rest of the 14 farmers (93.33%) said it to be inadequate. Similarly, for small

farmers, only 3 out of 30 farmers (10%) found the financial assistance to be adequate, rest 27 farmers (90%) found it to be inadequate.

In total, majority of the Net users (91.11%) found the financial assistance on Nets to be inadequate.

**Table-6.6: Adequacy of Financial Assistance to Meet Net Users Requirement**

**(Number of H.H.)**

| Nature of response | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|
| | **Marginal** | **Small** | **Total** |
| Yes | 1<br>(6.67) | 3<br>(10.00) | 4<br>(8.89) |
| No | 14<br>(93.33) | 27<br>(90.00) | 41<br>(91.11) |
| Total | 15<br>(100.00) | 30<br>(100.00) | 45<br>(100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 6.7 Per Farm Cost paid for anti-hail Nets in Thanedhar Block

Per farm cost paid by anti-hail Net users for this mechanism is shown in Table-6.7. The costs are divided into three parts, buying cost, installation cost, and un-installation cost. Buying costs include the costs for nets, bamboo sticks, carriage and threads. All these costs were higher for small farmers than marginal farmers. The total per farm buying cost for small farmers was Rs. 6,13,528.33 as compared to Rs. 4,93,776.67 for marginal farmers. Installation costs include labour and maintenance costs. These were also higher for small farmers than marginal farmers. The total per farm installation cost for small farmers was Rs. 33,260 as compared to Rs. 27,380 for marginal farmers. Finally, un-installation costs also include labour and maintenance costs, which are generally lower than installation costs. Here as well the costs were higher for small farmers. The total per farm un-installation cost for small farmers was Rs. 14,250 as compared to Rs. 11,353.33 for marginal farmers. In total, for all the Net users, per farm buying cost was Rs. 5,73,611.11, per farm installation cost was Rs. 31,300, and per farm un-installation cost was Rs. 13,284.44 for Net users.

Thus, it can be concluded that biggest land holding size group paid higher buying cost, installation cost, and un-installation cost for using anti-hail Nets in their farms.

**Table-6.7: Per Farm Cost Paid by Anti-Hail Net Users for This Mechanism**

| Particulars | | Thanedhar Block (anti-hail Net Users) | | |
|---|---|---|---|---|
| | | **Marginal** | **Small** | **Total** |
| **Buying Cost of Equipment/Material** | Nets | 456033.33 | 567333.33 | 530233.33 |
| | Bamboo sticks | 24526.67 | 29880.00 | 28095.56 |
| | Carriage | 1170.00 | 1655.00 | 1493.33 |
| | Threads | 12086.87 | 14300.00 | 13562.22 |
| | Total | 493776.67 | 613528.33 | 573611.11 |
| **Installation Cost** | Labour | 25366.67 | 30833.33 | 29011.11 |
| | Maintenance | 2013.33 | 2426.67 | 2288.89 |
| | Total | 27380.00 | 33260.00 | 31300.00 |
| **Un-installation Cost** | Labour | 6900.00 | 9283.33 | 8488.89 |
| | Maintenance | 4453.33 | 4966.67 | 4795.55 |
| | Total | 11353.33 | 14250.00 | 13284.44 |

**Source:** Data from Field Survey.

## 6.8 Summing Up

The analyses related to mechanism users responses about subsidy and cost components under anti-hail Net reveal that 100 per cent anti-hail Cannon and Net users were aware that the horticulture department provided subsidy on anti-hail Nets in the state. 100 per cent anti-hail Net users had applied for assistance on their purchase of Nets, but 100 per cent Cannon users did not apply for subsidy because they did not purchase any anti-hail Net due to anti-hail Cannons being installed in their areas. About 84 per cent anti-hail Net users received subsidy on their purchase of Nets. Maximum small farm users got financial assistance (subsidy) on Nets as compared to marginal farm users in Thanedhar block. Total area covered under subsidy was 25.41 hectares, which was highest among small farm orchardist (19.46 hectares). Majority of Net users (about 71 %) got 80 per cent subsidy on their purchase of Nets. Total per household subsidy was Rs. 87,339.58, which was higher among marginal farmers. Total subsidy given to all the Net users was Rs. 33,18,904, which was higher among small farm orchardists.

Further, the analyses reveal that majority of anti-hail Net users responded that the horticulture department took a period of more than 3 months between processing and sanctioning of their subsidy applications. Small farm Net users had higher per farm area covered with subsidy as compared to marginal farm orchardists. Total per farm area for Net users was 0.93 hectare, out of which 60 percent was covered with subsidy and remaining 40 per cent was covered without subsidy. Majority of Net users (about 91%) responded that the financial assistance on Nets to be inadequate and it is insufficient to meet their requirements. Total per farm buying cost, installation cost and un-installation cost of anti-hail Nets was Rs. 5,73,611.11, Rs. 31,300.00 and Rs. 13,284.44, respectively, which was higher among small farm orchardists than marginal farm orchardists. Thus, the bigger land holding size group paid higher costs for using anti-hail Nets in their farms.

# Chapter-VII

## BENFITS, DRAWBACKS AND TECHONOLOGICAL EFFECTIVENESS OF HAIL PROTECTION MECHNISM: STAKEHOLDERS PERSPECTIVES

The present chapter is based on the stakeholders perspectives about the effectiveness of anti-hail Cannon and anti-hail Net mechanisms in protecting their apple crop in study area during the study period, which highlights the opinions of various types of stakeholders like; government officials for government installed anti-hail Cannon, orchardists for privately installed Cannons, and sampled mechanism users for both the mechanism. Responses of non-users are also recorded about their other aspects due to their non-participation under this mechanism.

### 7.1 Government Officials Perspective on Government Installed Cannon

In the study sample block of Jubbal & Kotkhai two government Cannons are installed in Baraionghat and Kathasu. Only the one on Baraionghat is Functional.

According to the government officials in Jubbal and Kotkhai block, staff members from their offices are engaged in management of operation of the Cannon on basis of the duties allotted to them. Not more than two members are involved at a time. Need for the use of Canon is determined on the basis of clouds, i.e. if black clouds are seen forming then the Cannon is operated. For physical operation of the canon, tenders are given to the volunteering farmers for Rs. 20,000 per month. These farmers operate the Cannon, in the time of need through the lever or switch connected to the Cannon. The notified time for the operation of cannon is from Ist April till 30$^{th}$ June. The Cannon can be used as many times, wherever the weather is bad. The officials recommended the installation of weather radars for better weather assessment.

According to the officials, Cannons are more effective than Nets in protecting the apple crop. Also, farmers in their area preferred Cannons over Nets. When asked about how the loss assessment of crops after a hailstorm is done, the officials answer was that the farmers asses their loss themselves or officers from plant protection centres assess loss and maintain *Panchayat* wise data at district level.

The only drawback of the Cannon, according to the officials, was that it is not working effectively, which implies that it is not being operated at the right time due to no clear weather

forecast because of no radar. On the other hand, the biggest benefit of Cannons, according to the officials, is the protection it provides to the crops against hailstorm.

Some suggestions and recommendations given by the officials were that functioning radars should be installed in various locations for better weather forecast. Also, more Cannons, preferably at a distance of 1 km, should be installed. Moreover, experts should be hired to monitor the working of the Cannons. And lastly, responsibility of working and operating of Cannons should be shifted under private supervision as this causes too much work pressure on already burdened government officials.

### 7.2 Stakeholder Orchardist's Perspective on Privately Installed Cannons

The study sample block of Jubbal and Kotkhai has four privately installed anti-hail Cannons in the village of Kalbog, Ratnari, Baghi and Mahasu. The orchardists who were involved in the importing and installing of these Cannons were interviewed. Their perspectives are mentioned in further paragraphs.

All the Cannons were imported from New Zealand from Mike Eggers Ltd. According to the orchardists, on 7$^{th}$ June 2015, severe hailstorm occurred in these areas for about 2 hours and 45 minutes. It took three years for the orchardists to regenerate their crops to the pre-loss state. As there was no initiative from the government to improve the condition of the orchardists, the farmers decided to get the Cannons themselves. Some orchardists from every village collected the lump sum amount to import the Cannons and after that, up to Rs. 3,000 per family are collected for the maintenance and functioning of the Cannons every year. Hence, according to the orchardists, the Cannons are way less expensive than Nets. When asked about how the need for use of Cannon is determined, the orchardists answered that in absence of a radar, Cannon is used every time clouds start to form in the sky in the time frame of 15$^{th}$ March to 15$^{th}$ June and 1$^{st}$ September to 15$^{th}$ October. The Cannon is operated through a lever.

When asked about how loss assessment of crops after hail storm is done, the orchardists answered that they assess the loss of their crop from the market value, i.e. the net profit they earn from apple in a year.

According to the orchardists, the chief advantage of the Cannon is that it disperses the clouds which cause hailstorm and so the crop is completely protected as no hailstone is formed. But the orchardists had concerns about the drawbacks as well. As no financial or otherwise assistance was given by the government, the orchardists had to bear heavy costs for installation of Cannons. Also, if Cannons are not operated on time, they do not stop hailstorm. One drawback worth mentioning, told by the orchardists, is that there is a risk of these Cannons being used to spread poisonous gas in an event of terrorism. This could be fatal for the farmers living around the Cannon.

Various suggestions and recommendations given by the orchardists were that the government should provide financial aid by refunding the installation charges to the orchardists and also help with annual subsidies on the components of Cannons used and with the building of platform on which the Cannons is installed. The orchardists also suggested installation of radars for accurate weather forecast, so that the Cannon can be operated on time. Another worthy suggestion by the orchardists was for the government of take up make in India initiative for the Cannons and manufactures this technology within the country. Further, according to the orchardists, at least 3-4 Cannons should be installed in every *panchayat*, and that too on the peak of the mountain for maximum impact.

Finally, the orchardists recommended that fire extinguishers must be placed in every Cannon point for safety purpose and the operator's health and life should be covered under insurance as he runs the risk of physical injury.

### 7.3 Mechanism Users Perspective on the Impact of Hail Protection Mechanism

This part of analyses include the sampled mechanism users perspectives about the role played by horticulture department for the mechanism, effectiveness of mechanism and its impact on their apple crop, and problems encountered by them in availing the benefits of hail protection mechanism in their areas.

#### 7.3.1 Mechanism Users Opinions on Horticulture Department Meetings, Advice and Effectiveness of Information given

This part of analyses elaborate users perceptions about two types of aspects of horticulture department viz; meetings convened and advices provided, and users consciousness on the

improvement of mechanism services. Mechanism users responses on these aspects are presented in Table-7.1.

The Table-7.1 indicates that, in Jubbal and Kotkhai block, majority (75.55%) of anti-hail Cannon users responded no to any meetings convened by the horticulture department and any advice given about hail protection mechanism. Only 20.00 per cent users responded yes to this view. Majority of Cannon users (66.67%) believed these meetings and the information given in these to be ineffective, and 22.22 per cent believed it to be effective.

**Table-7.1: Mechanism Users Opinions on Horticulture Department Meetings, Advice given and Effectiveness of the Information given** **(No. of HH.)**

| Nature of Response | | Mechanism Users | | Total |
|---|---|---|---|---|
| | | anti-hail Cannon | anti-hail Net | |
| Convene any meetings and advise | Yes | 9 (20.00) | 7 (15.55) | 16 (17.78) |
| | No | 34 (75.55) | 35 (77.78) | 69 (76.67) |
| | Unaware | 2 (4.45) | 3 (6.67) | 5 (5.55) |
| | Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |
| Effectiveness of the Meetings | Effective | 2 (22.22) | 1 (14.29) | 3 (18.75) |
| | Not effective | 6 (66.67) | 4 (57.14) | 10 (62.50) |
| | No opinion | 1 (11.11) | 2 (28.57) | 3 (18.75) |
| | Total | 9 (100.00) | 7 (100.00) | 16 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

In Thanedhar block, majority of Net users (77.78%) responded no to any meetings convened by the horticulture department or any advices given. 15.55 per cent users responded yes to this. For anti-hail Net users, majority (57.14%) of users opined that the meetings convened and information given by the horticulture department was not effective and only 14.29 per cent users were satisfied with the effectiveness of these meetings. The table also indicates that out of total mechanism users, majority (76.67%) of users responded no to any meetings convened by the horticulture department and advice given about hail protection mechanism, whereas, 17.78 per cent users responded yes to this. 5.55 per cent users were unaware about this aspect. Majority

of users (62.50%) found the meetings and information given to be ineffective, only 18.75 per cent users found the meetings and information given to be effective.

Thus, it can be concluded that the majority of users for both mechanisms opined that the horticulture department did not convene any meeting and given advice about hail protection mechanism in study area and the meetings held and information given about hail protection mechanism was ineffective.

### 7.3.2 Responses about the Effectiveness of Mechanism in Protecting Apple Crop

Table-7.2 shows the mechanism user's responses on effectiveness of hail protection mechanism in protecting apple crop. For Cannon and Net users, 100 per cent (45 households each) of the users responded it to be effective in protecting their crop against hail. The range of protection was perceived differently by Cannon and Net users, this is discussed in further tables.

**Table-7.2: Mechanism Users Responses on Effectiveness of Hail Protection Mechanism in Protecting Apple Crop** **(No. of HH.)**

| Nature of response | Mechanism Users | | Total |
|---|---|---|---|
| | anti hail Cannon | anti-hail Net | |
| Effective | 45<br>(100.00) | 45<br>(100.00) | 90<br>(100.00) |
| Non-effective | 0<br>(0.00) | 0<br>(0.00) | 0<br>(0.00) |
| Total | 45<br>(100.00) | 45<br>(100.00) | 90<br>(100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 7.3.3 Mechanism's Impact on Apple Production

Table-6.10 depicts the mechanism users perception about the impact of hail protection mechanism on the production of apple crop. The range of impact studied is good, average, and poor. For Cannon users, 37 out of 45 households (82.22%) perceived the impact of Cannon to be good for apple production. The remaining 8 households (17.78%) perceived the impact to be average. For Net users 35 out of 45 households (77.78%) perceived the impact of Net to be good for apple production the remaining 10 households (22.22%) perceived the impact to be average. No Cannon users or Net users perceived the impact of mechanism to be poor.

In total, 80 per cent of the users perceived the mechanism to be good for apple production and the remaining 20 per cent perceived it to be average.

**Table-7.3: Mechanism Users Perception about Impact of the Mechanism on Apple Production**

**(No. of H.H.)**

| Nature of perception | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| Good | 37 (82.22) | 35 (77.78) | 72 (80.00) |
| Average | 8 (17.78) | 10 (22.22) | 18 (20.00) |
| Poor | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 7.3.4 Approximate Protection of Users Orchards by Hail Protection Mechanism

Table-7.4 gives the mechanism users responses on approximate protection of orchards by hail protection mechanism. Protection is assessed in both quantitative and qualitative form, in the range of 0-25%, 25-50%, 50-75%, and 75-100%. For Cannon users, maximum number of households responded the protection to be 75-100%. This was 57.78 per cent for quantitative protection and 55.56 per cent for qualitative protection. For Net users as well, maximum number of households (even higher than Cannon users) responded the protection to be 75-100%. This was 80 per cent for quantitative protection and 88.89 per cent for qualitative protection.

In total, 68.89 per cent users responded 75-100% quantitative protection and 72.23 per cent users responded qualitative protection from this mechanism to the apple crop.

**Table-7.4: Mechanism Users Responses on Approximate Protection of Orchards Due to Hail Protection Mechanism**

**(No. of HH.)**

| Particulars | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| **Quantitative Protection** | | | |
| 0-25% | 1 (2.22) | 0 (0.00) | 1 (1.11) |
| 25-50% | 2 (4.44) | 4 (8.89) | 6 (6.67) |
| 50-75% | 16 (35.56) | 5 (11.11) | 21 (23.33) |

| | | | |
|---|---|---|---|
| 75-100% | 26 (57.78) | 36 (80.00) | 62 (68.89) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |
| **Qualitative Protection** | | | |
| 0-25% | 2 (4.44) | 1 (2.22) | 3 (3.33) |
| 25-50% | 3 (6.67) | 0 (0.00) | 3 (3.33) |
| 50-75% | 15 (33.33) | 4 (8.89) | 19 (21.11) |
| 75-100% | 25 (55.56) | 40 (88.89) | 65 (72.23) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 7.3.5 Users Preference for Better Mechanism

Table-7.5 shows the preference of mechanism users i.e. which mechanism, Cannon or Net, they would like to use to protect their apple crop. 42 out of 45 Cannon users (93.33%) preferred Cannon over Net. Whereas, 38 out of 45 Net users (84.44%) preferred Net over Cannon.

In total 54.44 per cent users preferred Cannon over Net, and 45.56 per cent preferred Net over Cannon.

**Table-7.5: Mechanism Users Preference for Better Hail Protection Mechanism for Protecting Apple** **(No. of HH.)**

| Type of Mechanism | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| Anti-hail cannon | 42 (93.33) | 7 (15.56) | 49 (54.44) |
| Anti-hail net | 3 (6.67) | 38 (84.44) | 41 (45.56) |
| Total | 45 (100.00) | 45 (100.00) | 90 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

### 7.3.6 Reasons behind Users Preference for Better Hail Protection Mechanism

Table-7.6 shows mechanism users reasons behind the preference for their hail protection mechanism, which as shown in Table 6.12 was Cannon for Cannon users and Net for Net users. The reasons assessed here are that the mechanism is less expensive to install and use, mechanism

provides maximum protection to the crop, the mechanism is easy to operate, and the mechanism requires lesser effort to be used. For Cannon users, 66.67 per cent of the users preferred Cannon because it was less expensive than Net, 80 per cent users preferred Cannon for maximum protection, 31.11 per cent users preferred it for easy operation, and 48.89 per cent users, for minimum effort. In case of Net users, there was only one reason stated for preference of Net over Cannon, which was maximum protection. 100 per cent Net users responded this to be the reason of preference.

In total, the users preference for their mechanism (whether Cannon or Net) was mostly due to the protection it provided. 90 per cent of users preferred the mechanism for the safety of their crop.

**Table-7.6: Mechanism Users Reasons behind their Preference for Better Hail Protection Mechanism** **(% of Total Sample)**

| Reasons | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| Less expensive | 66.67 | 0.00 | 33.33 |
| Maximum protection | 80.00 | 100.00 | 90.00 |
| Easy operation | 31.11 | 0.00 | 15.56 |
| Minimum efforts | 48.89 | 0.00 | 24.44 |

**Source:** Data from Field Survey.

### 7.3.7 Problems suffered by Users in Availing the Benefits of Hail Protection Mechanism

Problems suffered by mechanism users in availing benefits of this mechanism are given in Table-7.7. All figures are given in percentage of total. Various problems listed in this table are high installation cost of the mechanism, less subsidy provided, no subsidy at all, lesser area covered under the protection of this mechanism, the mechanism not operated timely, no radar system, hampering of apple fruit growth, and lack of labour for operation of this mechanism. For Cannon users, no radar system, not operated timely, and no subsidy were the top three problems (in order). The percentages of users suffering these problems were 86.67, 75.56 and 57.78 per cent, respectively. For Net users, high installation cost, lack of labour, and lesser area coverage were the top three problems (in order). The percentages of users suffering these problems were 100, 75.56 and 66.67 per cent, respectively.

In total, majority of users suffered high installation cost (67.78%), followed by lesser area coverage (47.78%), and mechanism not operated timely and no radar system (43.33% each).

**Table-7.7: Problems Suffered by Mechanism Users in Availing the Benefits of Hail Protection Mechanism** **(% of Total Sample)**

| List of Problems | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| High installation cost | 35.56 | 100.00 | 67.78 |
| Less subsidy | 0.00 | 62.22 | 31.11 |
| No subsidy | 57.78 | 13.33 | 35.56 |
| Lesser area coverage | 28.89 | 66.67 | 47.78 |
| Not operated timely | 75.56 | 11.11 | 43.33 |
| No radar system | 86.67 | 0.00 | 43.33 |
| Apple growth hampered | 0.00 | 55.56 | 27.28 |
| Lack of labour | 0.00 | 75.56 | 37.78 |

**Source:** Data from Field Survey.

### 7.3.8 Recommendations Given by Mechanism Users

Mechanism users recommendations for improvement of hail protection mechanism are given in Table-7.8. All figures are in percentage of total. Various recommendation listed are radar installation, more Cannons installation, government taking over the operations of Cannons, expenses of the mechanism undertaken by the government, scientific research on effects of the mechanism on the crop and environment, trained/skilled operators to be employed for operating the mechanism, easy maintenance/servicing provision, Net structure provision, and subsidy area under mechanism increased. For Cannon users, radar installation, government takeover of Cannons, and more Cannons installation were the top three recommendations (in order). The percentages of users recommending these were 71.11, 40.00, and 64.44 per cent, respectively. For Net users, net structure provision, subsidy area increased, and maintenance/servicing were the top three recommendations (in order). The percentages of users recommending these were 88.89, 80.00, and 75.56 per cent, respectively.

In total, majority of users recommended maintenance/servicing (46.67%), followed by Net structure provision (44.44%), and subsidy area increased (40%).

**Table-7.8: Mechanism Users Recommendations for Improvement of Hail Protection Mechanism for Apple** **(% of total sample)**

| Recommendations | Mechanism Users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| Radar installation | 71.11 | 0.00 | 35.56 |
| More cannons installation | 40.00 | 0.00 | 20.00 |
| Govt. takeover of cannons | 64.44 | 0.00 | 32.22 |
| Expenses undertaken | 33.33 | 0.00 | 16.67 |
| Scientific research | 33.33 | 11.11 | 22.22 |
| Trained/skilled operators | 31.11 | 4.44 | 17.78 |
| Maintenance/servicing | 17.78 | 75.56 | 46.67 |
| Net structure provision | 0.00 | 88.89 | 44.44 |
| Subsidy area increased | 0.00 | 80.00 | 40.00 |

**Source:** Data from Field Survey.

### 7.4 Non-Users Perspective about their participation under Hail Protection Mechanism

This part of analyses elaborate the non-users reasons about their non participation under the mechanism, their preferences for both mechanisms in future and suggestions given by them about requirement for their participation under hail protection mechanism.

#### 7.4.1 Non-users Perspective on their Non-Participation under Hail Protection Mechanism

Table-7.9 shows the reasons given by non-users for not opting for hail protection mechanism. Various reasons listed are that this mechanism is expensive, no awareness on how to use this mechanism, there is no loss to crop by hailstorm, there is no willingness to use this mechanism, labour efforts required to use this mechanism are high, paper work involved in acquiring this mechanism is cumbersome, this mechanism is not taken care of by the government, and this mechanism causes damage to apple trees. For Cannon non-users, all the non-users (100%) gave government not taking care of this mechanism as the chief reason for not opting this mechanism, followed by expensive and more labour effort (33.33% each) as other two reasons. For Net non-users, all the non-users gave expensive and more labour effort (100% each) as main reasons for not opting this mechanism, followed by cumbersome paper work (66.67%).

In total, the two primary reasons given by non-users for not opting this mechanism were expensive (66.67%) and more labour effort (66.67%). And the third reason was that government was not taking care of this mechanism (63.33%).

**Table-7.9: Non-users Reasons for Not Opting for Hail Protection Mechanism in Their Orchard** **(% of total sample)**

| Persons | Mechanism Non-users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| More expensive | 33.33 | 100.00 | 66.67 |
| No awareness | 0.00 | 6.67 | 3.33 |
| No losses by hailstorm | 0.00 | 0.00 | 0.00 |
| No willingness | 20.00 | 46.67 | 33.33 |
| More labour efforts | 33.33 | 100.00 | 66.67 |
| Cumbersome paper work | 26.67 | 66.67 | 46.67 |
| Govt. not taking care of this mechanism | 100.00 | 26.67 | 63.33 |
| Damage to apple trees | 0.00 | 60.00 | 30.00 |

**Source:** Data from Field Survey.

### 7.4.2 Non-users Willingness and Preference for hail protection mechanism

Table-7.10 shows the willingness and preference of non-users for hail protection mechanism.

**Table-7.10: Non-users Willingness and Preference for Hail Protection Mechanism**

**(No. of HH.)**

| Particulars | Mechanism Non-users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| **Willingness** | | | |
| Yes | 15 (100.00) | 15 (100.00) | 30 (100.00) |
| No | 0 (0.00) | 0 (0.00) | 0 (0.00) |
| Total | 15 (100.00) | 15 (100.00) | 30 (100.00) |
| **Preference** | | | |
| anti-hail Cannon | 15 (100.00) | 4 (26.67) | 19 (63.33) |
| anti-hail Net | 0 (0.00) | 11 (73.33) | 11 (36.67) |
| Total | 15 (100.00) | 15 (100.00) | 30 (100.00) |

**Source:** Data from Field Survey.
**Note:** Figures in parenthesis indicate percentage to total.

In terms of willingness, a total of 15 households (100%), for both, Cannon and Net non-users expressed willingness to use this mechanism to protect their crop from hail storms.

Further, in terms of preference, for Cannon non-users, total 15 households (100%) preferred anti-hail Cannon over Net, whereas, for Net non-users, 11 out of 15 households (73.33%) preferred Net over Cannon and the remaining 4 households (26.67%) preferred Cannon over Net.

In total, 100 per cent of the non-users were willing to use this mechanism, out of which, 63.33 per cent preferred Cannon and 36.67 per cent preferred Net.

### 7.4.3 Non-users Suggestions about Requirements for their Participation under Hail Protection Mechanism

Table-7.11 gives the types of suggestions given by mechanism non-users, about their requirements, for them to use hail protection mechanism. Types of suggestions listed in this table are government should take over the installation and operation of this mechanism, trained/skilled staff should be employed for operation of this mechanism, training camps should be organised for spreading awareness, more Cannons should be installed, procedure to acquire this mechanism should be made easy, and subsidy area under this mechanism should be increased.

For Cannon non-users, government control/takeover of mechanism, more cannon installation, and trained/skilled staff were the top three suggestions (in order). The percentages of Cannon non-users suggesting these were 100.00, 60.00 and 33.33 per cent, respectively. For Net non-users, subsidy area increased, government control/takeover of mechanism, and to make acquiring procedure easy were the top three suggestions (in order). The percentages of Net non-users suggesting these were 80.00, 60.00 and 53.33 per cent, respectively.

In total, maximum non-users suggested government control/takeover of the mechanism (80%), followed by more Cannon installation (43.33%), and finally subsidy area increased (40%).

**Table-7.11: Non-users Suggestions about Requirements for Their Participation under Hail Protection Mechanism** **(% of total sample)**

| Type of Suggestion | Mechanism Non-users | | Total |
|---|---|---|---|
| | anti-hail Cannon | anti-hail Net | |
| Govt. control/takeover of the anti- hail Cannons | 100.00 | 60.00 | 80.00 |
| Trained/skilled staff | 33.33 | 26.67 | 30.00 |
| Training camps | 20.00 | 46.67 | 33.33 |
| More cannons installations | 60.00 | 26.67 | 43.33 |
| To make acquiring procedure easy | 0.00 | 53.33 | 26.67 |
| Area under subsidy increased | 0.00 | 80.00 | 40.00 |

**Source:** Data from Field Survey.

## 7.5 Summing up

The analyses reveal that the government officials recommended the installation of weather radars for better weather assessment. According to them, Cannons are more effective than Nets in protecting the apple crop from hailstorms. Farmers in their area preferred Cannons over Nets. Only drawback of the Cannons, according to the officials, was that it is not working effectively. Biggest benefit of Cannons, according to them, is the protection it provides to the crops against hailstorm. As no financial or otherwise assistance was given by the government, the orchardists had to bear heavy costs for private installation of Cannons. The orchardists suggested installation of radars for accurate weather forecast, and that at least 3-4 Cannons should be installed in every *Panchayat*, on the peak of the mountain for maximum impact.

Majority of users for both mechanisms responded that the horticulture department did not convene any meeting and give advice about hail protection mechanism in study area and the meetings held and information given about hail protection mechanism was ineffective. In total, 80 per cent of the users perceived the mechanism to be good for apple protection and the remaining 20 per cent perceived it to be average. In total, 68.89 per cent users responded 75-100% quantitative protection to apple crop and 72.23 per cent users responded same percentage of qualitative protection for both mechanisms. In total, 54.44 per cent users preferred Cannon over Net, and 45.56 per cent users preferred Net over Cannon. Out of total mechanism users, Majority of them preferred Cannon as a better hail protection mechanism for protecting their apple crop from hailstorms. The users preference for their mechanism (whether Cannon or Net)

was mostly due to maximum protection of apple crop i. e., 90 per cent of users preferred the mechanism for the safety of their crop.

The analyses of problems suffered by mechanism users in availing the benefits of hail protection mechanism concluded that majority of users suffered high installation cost (67.78%), followed by lesser area coverage (47.78%), and mechanism not operated timely and no radar system (43.33% each). Majority of mechanism users recommended that maintenance/servicing (46.67%), followed by Net structure provision (44.44%), and subsidy area increased (40.00%). Radar installation, government takeover of Cannons, and more Cannons installation were the top three recommendations given by the majority of anti-hail Cannon users. Net structure provision, subsidy area increased, and maintenance/servicing were the top three recommendations given by the majority of anti-hail Net users.

The two primary reasons given by non-users for not opting this mechanism were expensive and more labour effort (66.67% each) and the third reason was that government was not taking care of this mechanism in their areas (63.33%). 100 percent of the non-users were willing to use this mechanism, out of which, 63.33 per cent preferred Cannon and 36.67 per cent preferred Net. Majority of non-users suggested government control/takeover of the mechanism (80%), followed by more Cannons installation (43.33%), and finally area under subsidy increased (40.00%).

# Chapter-VIII

## MAJOR FINDINGS AND POLICY RECOMMENDATIONS

In the present chapter efforts have been made to summarise the whole study, to draw conclusions. The present chapters has been divided in to two parts viz, major findings and policy recommendations.

### 8.1 Major Findings of the Study

Apple is the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. The analyses reveal that the area under apple in the state has increased significantly from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and to 1,12,500 hectares in 2017-18, respectively. Following points are the major findings of the study;

- Shimla district alone accounts for about 55-60 per cent of total production in the state during all years (2009-10 to 2017-18). This district has accounted highest production of apple among all districts of the state and showed increasing trend in production of apple, as it was 1,71,945 MT in 2009-10, which was increased to 2,51,897 MT in 2017-18.
- Block-wise area and production of apple in district Shimla: Jubbal & Kotkhai block had accounted highest area and production among all 10 blocks of the district during all years (2009-10 to 2017-18 followed by Rohru and Narkanda blocks, respectively.
- The analyses reveal that there were two types of mechanism, anti-hail Cannons and Nets used to protect apple crops from hailstorm in the state. Hail protection mechanism was mostly installed and used in district Shimla. Department of horticulture was the main implementing agency for these mechanism, which monitors the functioning of anti-hail Cannons and Nets used for protecting apple crop in study areas. In Jubbal & Kotkhai block of district Shimla, farmers Committees were formed by the orchardists themselves, to monitor the functioning of privately installed Cannons in their areas during 2016. To protect fruit crops, especially apple, from hailstorms the state government enhanced subsidy on anti-hail Nets from 50 per cent to 80 per cent during the year 2015-16. The horticulture department provided 80 per cent subsidy to farmers for their purchase of anti-hail Nets and maximum limit for availing assistance was restricted to 5,000 square

meters per beneficiary/family. But there was no provision for availing assistance on anti-hail Cannon before the year, 2018. Ever since, the State government introduced 60 per cent subsidy on the Cannons.

- The analyses reveals that Jubbal & Kotkhai block had highest coverage under the installation of anti-hail Cannons among all blocks of district Shimla, whereas, some Cannons were installed by government and some privately by the apple orchardists, incurring various installation and operation costs of anti-hail Cannons themselves. One time installation cost of government installed Cannon at Braionghat was Rs. 47,54,000 during 2016-17. Whereas material cost of its every operations like, Cannon shots, cost of cylinder, freight charges, Cannon operator and labour were also incurred by the government during the year, 2013-14 to 2018-19. Highest Cannon shots were used against adverse weather condition during the year 2016-17 and cost of cylinder refills and labour cost was also highest for this year. In case of privately installed Cannons at Kalbog, Ratnari, Baghi and Mahasu villages of Jubbal & Kotkhai block, one time total installation cost was Rs. 2,87,99,525, which was Rs. 76,99,525, Rs. 68,00,000, Rs. 55,00,000 and Rs. 85,00,000 for Kalbog, Ratnari, Baghi and Mahasu villages, respectively. Installation cost was highest for Mahasu village. Cost of cylinder refills and freight charges were highest for village Baghi. Cannon operator charges were highest for Kalbog village.
- The analyses of physical and financial achievements of anti-hail Nets reveal that district Shimla had highest coverage under physical achievements of area covered under subsidy on Nets and financial achievements of subsidy provided on Nets. Block-wise analyses show that Thanedhar block had highest coverage area under Nets with subsidy and also attained highest share of subsidy on Nets among all blocks of district Shimla.
- The analyses reveal that majority of the sample of anti-hail Cannon and Net users and non-users belonged to general category. In both the blocks, total males were more than total females. Majority of sampled orchardists were in the age group of 18-60 years. Educational status of sampled orchardists revealed that majority of anti-hail Cannon users and non-users were graduates and semi-medium farm orchardists had highest share of graduates among all farm orchardists. Majority of anti-hail Net users were secondary level educated and non-users were graduates. Agriculture (horticulture) was the main and

subsidiary occupation for majority of sampled orchardists. In both the blocks, anti-hail Cannon and Net users and non-users generated highest income from their apple orchard produce sale. Per household annual income was higher among users than non-users in both the block. It was highest among medium farm orchardists for users and semi-medium farm orchardists for non-users categories for Cannon block and small farm orchardists for users and non-users categories for Net block.

- Per farm own land area and gross cropped area (GCA) of users was more than of non-users in both the blocks. It was highest among medium and semi-medium farm orchardists for anti-hail Cannon users and non-users, and small farm orchardists for anti-hail Net users and non-users. Maximum area of their land was under apple crop, which was about 95 per cent for anti-hail Cannon users and non-users and about 92 per cent for anti-hail Net users and non-users. Here, marginal farm orchardists had highest share of apple in their cropping pattern. Per farm production of apples was higher among users than non-users under both mechanisms. This was 1,937 and 1,056 boxes per farm in case of Cannon and Net users and 1,152 and 995 boxes per farm in case of non-users. Further, per farm quantity sold, total price and average price per box of apples and other fruits was higher among anti-hail Cannon and Net users than non-users. Here, medium and semi-medium farmers had highest share among all farm orchardist for Cannon users and non-users, and small farmers among all farm orchardists for Net users and non-users.
- Number and value of equipment and machinery was higher among users in both the blocks. For anti-hail Cannon users and non-users, highest value was attributed to grading and packing machine of apple, and for anti-hail Net users and non-users, this was attributed to petrol/diesel spray machine. Per household total value of equipment and machinery was higher among users (Rs. 1,67,317.78 and Rs. 67,371.11) as compared to non-users (Rs. 1,06,433.33 and Rs. 52,680) of anti-hail Cannon and Net. This value was highest among medium and semi-medium farm orchardists for Cannon user and non-users, and small farm orchardists for anti-hail Net users and non-users.
- Per household value of buildings; dwelling house, cattle shed and storage/shop was higher among users as compared to non-users in both the blocks. Per household number and value of other assets was also higher among users, where, four-wheeler had highest value in other assets owned by sampled orchardists. But, per household number and value

of livestock was higher for non-users than users. Cattle were the major livestock rearing by sampled orchardists in both the blocks.

- Thus, it can be concluded that anti-hail Cannon and Net users attained better socio-economic profile and farm level characteristics than non-users. They also attained better living standards as compared to non-users, this was due to increased production and orchards sale and income from orchard produce because of protecting their orchards with anti-hail Cannons and Nets.
- The analyses reveal that anti-hail Cannon users and non-users mentioned hailstorm, as the biggest cause of loss of apple crop. Maximum loss due to hailstorms occurred during fruit setting season for Cannon users and flowering season for Cannon non-users. For anti-hail Net users and non-users also, maximum loss of apple crop was due to hailstorm during all seasons. Maximum loss due to hailstorm occurred during flowering season for both, users and non-users of anti-hail Net mechanism. Thus, before the installation of hail protection mechanism in the study area, hailstorm was a major event of loss for apple crop of sampled orchardists of district Shimla and this mostly happened during flowering and fruit setting seasons. In both the blocks occurrence of hailstorms was more for non-users than users during study reference period. Higher frequency, duration and intensity of hailstorm accounted for non-users of anti hail Cannon in Jubbal & Kotkhai block. The frequency of hailstorm was highest (>3 times) for both users and non-users of anti-hail Net in Thanedhar block. The duration and intensity of hailstorm was higher for non-users of anti-hail Net.
- Non-users of both mechanisms in the district reported higher expected loss of apple (in terms of affected area, quantitative and qualitative loss) due to hailstorms as compared to mechanism users. Thus, the hail protection mechanism had positive impact on its users of study area. Further, the analyses reveal that majority of users and non-users of both blocks (both mechanism) were not satisfied about the role of horticulture department in terms of visits undertaken and mechanism advised post loss of apple crop due to hailstorm in their areas.
- Hail protection mechanism has a two way impact on apple produce. Firstly, it increase the quantity of apple production by protecting the crop from hail damage during flowering and fruit setting period and secondly, the mechanism improve the quality of the

produce by substantially reducing the hazards of marks and dents on the fully ripe fruit, hence, giving the mechanism users a better price for their produce. Whereas, for non-users, quantity of apple is reduced by early damage to the crop from hail and also the quality of produce is compromised by marks and dents in the fully ripe fruit. Thus giving the non-users comparatively lesser price for their apple produce in the market. Therefore, hail protection mechanism has a positive impact on the income and the production apple crop for the users compared to non-users.

- All the users and non-users of anti-hail Cannon and Net Mechanism were aware about hail protection mechanism in the district. Horticulture department was the main source of information about this mechanism for majority of users and non-users of both blocks in study area.
- The analyses related to mechanism users responses about subsidy and cost components under anti-hail Net reveal that 100 per cent anti-hail Cannon and Net users were aware that the horticulture department provided subsidy on anti-hail Nets in the state. 100 per cent anti-hail Net users had applied for assistance on their purchase of Nets, but 100 per cent Cannon users did not apply for subsidy because they did not purchase any anti-hail Net due to anti-hail Cannons being installed in their areas. About 84 per cent anti-hail Net users received subsidy on their purchase of Nets. Maximum small farm users got financial assistance (subsidy) on Nets as compared to marginal farm users in Thanedhar block. Total area covered under subsidy was 25.41 hectares, which was highest among small farm orchardist (19.46 hectares). Majority of Net users (about 71 %) got 80 per cent subsidy on their purchase of Nets. Total per household subsidy was Rs. 87,339.58, which was higher among marginal farmers. Total subsidy given to all the Net users was Rs. 33,18,904, which was higher among small farm orchardists.
- Further, the analyses reveal that majority of anti-hail Net users responded that the horticulture department took a period of more than 3 months between processing and sanctioning of their subsidy applications. Small farm Net users had higher per farm area covered with subsidy as compared to marginal farm orchardists. Total per farm area for Net users was 0.93 hectare, out of which 60 percent was covered with subsidy and remaining 40 per cent was covered without subsidy. Majority of Net users (about 91%) responded that the financial assistance on Nets to be inadequate and it is insufficient to

meet their requirements. Total per farm buying cost, installation cost and un-installation cost of anti-hail Nets was Rs. 5,73,611.11, Rs. 31,300.00 and Rs. 13284.44, respectively, which was higher among small farm orchardists than marginal farm orchardists. Thus, the bigger land holding size group paid higher costs for using anti-hail Nets in their farms.

- The analyses reveal that the government officials recommended the installation of weather radars for better weather assessment. According to them, Cannons are more effective than Nets in protecting the apple crop from hailstorms. Farmers in their area preferred Cannons over Nets. Only drawback of the Cannons, according to the officials, was that it is not working effectively. Biggest benefit of Cannons, according to them, is the protection it provides to the crops against hailstorm. As no financial or otherwise assistance was given by the government, the orchardists had to bear heavy costs for private installation of Cannons. The orchardists suggested installation of radars for accurate weather forecast, and that at least 3-4 Cannons should be installed in every *Panchayat*, on the peak of the mountain for maximum impact.
- Majority of users for both mechanisms responded that the horticulture department did not convene any meeting and give advice about hail protection mechanism in study area and the meetings held and information given about hail protection mechanism was ineffective. In total, 80 per cent of the users perceived the mechanism to be good for apple protection and the remaining 20 per cent perceived it to be average. In total, 68.89 per cent users responded 75-100 per cent quantitative protection to apple crop and 72.23 per cent users responded same percentage of qualitative protection for both mechanisms. In total, 54.44 per cent users preferred Cannon over Net, and 45.56 per cent users preferred Net over Cannon. Out of total mechanism users, Majority of them preferred Cannon as a better hail protection mechanism for protecting their apple crop from hailstorms. The users preference for their mechanism (whether Cannon or Net) was mostly due to maximum protection of apple crop i. e., 90 per cent of users preferred the mechanism for the safety of their crop.
- The analyses of problems suffered by mechanism users in availing the benefits of hail protection mechanism concluded that majority of users suffered high installation cost (67.78%), followed by lesser area coverage (47.78%), and mechanism not operated timely and no radar system (43.33% each). Majority of mechanism users recommended

that maintenance/servicing (46.67%), followed by Net structure provision (44.44%), and subsidy area increased (40.00%). Radar installation, government takeover of Cannons, and more Cannons installation were the top three recommendations given by the majority of anti-hail Cannon users. Net structure provision, subsidy area increased, and maintenance/servicing were the top three recommendations given by the majority of anti-hail Net users.

- The two primary reasons given by non-users for not opting this mechanism were expensive and more labour effort (66.67% each) and the third reason was that government was not taking care of this mechanism in their areas (63.33%). 100 percent of the non-users were willing to use this mechanism, out of which, 63.33 per cent preferred Cannon and 36.67 per cent preferred Net. Majority of non-users suggested government control/takeover of the mechanism (80%), followed by more Cannons installation (43.33%), and finally area under subsidy increased (40.00%).

### 8.2 Policy Recommendation

Following are the major policy recommendation suggested by stakeholders for the improvement in the services of hail protection mechanism in district Shimla of the State.

- As can be concluded form the study that agriculture (horticulture), especially cultivation of apple crop is the main source of income for majority of sampled orchardists and as hailstorms were reported to be the biggest cause of loss to apple crop, special emphasis should be paid on protecting the apple crop from any kind of losses (particularly hailstorms) and to increase its production and sale.
- As department of horticulture is the main implementing agency for monitoring the government installed anti-hail Cannons, it does not help with installation or operation of the privately installed Cannons. Thus, the government should help through the horticulture department, the orchardists by undertaking the financial and physical aspects of the functioning of the privately installed Cannons. The government can keep the management in the private hands by letting the orchardists operate the Cannons, but provide financial help by fully funding the installation and annual operation costs like the costs of cylinder refills, labour costs etc.

- The horticulture department also provides financial assistance on anti-hail Nets, which is presently 80 per cent in the state. Orchardists face a lot of troubles in installing and un-installing these Nets every year in their orchards. Hence, the horticulture department can help provide suitable Net structures, and also organized well trained/professional labour force every year, so as to make the use of anti-hail Nets more efficient.
- Presently, five functioning anti-hail Cannons (1 government, 4 private) are installed in the sample block (Jubbal & Kotkhai). More number of Cannons should be installed in the hailstorm prone areas. The placement of these Cannons should be of the peak of the hill for maximum impact.
- Anti-hail Nets can be used for a time span of 4-5 years after that these needs to be discarded. As these Nets are made of plastic, proper provision should be made to discard these Nets after they have served their utility.
- Hail protection mechanism users attained better social economic profile and farm level characteristics than non-users, hence, the use of this mechanism (anti-hail Cannons and Nets) should be propagated in the apple producing belt of the state.
- As seen from the study, non-users of hail protection mechanism reported higher expected loss of apple crop due to hailstorm as compared the users, which proves that the mechanism was effective in preventing the losses from hailstorm, thus, use of this mechanism should be advertised and also incentivised.
- As seen from the study, horticulture department is the main source of information about this mechanism for majority of users and non-users of hail protection mechanism, hence, the horticulture department should organize information dissemination, and training and skill development camps, where better and more effective and efficient use of this mechanism can be taught to the orchardists for helping them protect their crop from hailstorms.
- Anti-hail Net users, who had applied for subsidy, received subsidy after a time lag of more than 3 moths, this problem should be rectified. Also, despite 80 per cent subsidy on Nets, orchardists still find this aid to be insufficient. Hence, the government should work upon providing more financial aid to the orchardists. Further, subsidy is given on 5,000 square meters area only, thus, government should provide subsidy for the entire orchard land.

- Weather radars should be installed for every existing anti-hail Cannon and also for the future ones, so that Cannons can be operated effectively if and when the need will be.
- More per cent of mechanism users and non-users preferred Cannons over Nets as it saves them the annual effort of installing and un-installing Nets on trees, thus, emphasis should be paid on long term use of Cannons and its implications on the productivity of apple crop. Also, the government should conduct scientific research on the effects of this mechanism on the environment, i. e., the impact of anti-hail Cannon on the clouds and the weather and the impact of anti-hail Nets on the health of the trees and fruit and also the soil, keeping in terms with the sustainable development aspect of agriculture economics.

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