AN ASSESSMENT OF APPLE POST-HARVEST LOSSES
THE CASE OF NERKH DISTRICT, AFGHANISTAN

A Thesis Submitted to Van Hall Larenstein University of Applied Sciences in Partial Fulfillment of the Requirements for the Degree of Masters in Agriculture Production Chain Management,
Specialisation Horticulture Chain Management

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DEDICATION

This thesis is dedicated to my mother, my elder brothers Alhaj Engineer Mohammad Arif “Ibrahimkhail” and Engineer Mohammad Daud “Ibrahimkhail” who taught me that working hard is the way to success.

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ABBREVIATIONS

AISA	Afghanistan Investment Support Agency
BDS	Business Development Services
CSO	Central Statistics Office
DAIL	Directorate of Agriculture, Irrigation and Livestock
FAO	Food and Agriculture Organisation
FI	FLAG International
FLAG	Firm Level Advisory Group
GDP	Gross Domestic Product
HLP	Horticulture and Livestock Project
IALC	International Arid Lands Consortium
LGCD	Local Governance and Community Development
MAIL	Ministry of Agriculture, Irrigation and Livestock
NGO	Non-Governmental Organisation
PAL	Project for Alternative Livelihoods
RAMP	Rebuilding Agricultural Markets Program
ROP	Roots of Peace
SWOT	Strengths, Weaknesses, Opportunities and Threats
UNFPA	United Nation Population Fund
UNHCR	United Nation High Commissioner for Refugees
USAID	United State Agency for International Development

ABSTRACT

The majority of farmers in the Nerkh district of Afghanistan are small scale farmers and the current post-harvest practices and marketing system are strongly affecting them. The current post-harvest practices of apple have resulted in great losses and have affected the chain actors due to quality and quantity losses. It is therefore, the aim of this study to identify and explore the causes of apples post-harvest losses and where these losses occur in the chain by assessing the current post-harvest practices in Nerkh district, to be able to give possible recommendations to minimize post-harvest losses and contribute to improve the quality.

Nerkh district is located in western part of Wardak province. The study was conducted in 5 villages including Bazi khail center of the Nerkh district, Two villages are located next to the district center (0.5-1 km), and three villages are located about 10 km far away from the district center. Study was conducted through survey and interview with different chain actors. Survey of 30 farmers, 30 retailers and interview of 6 local and 6 regional traders to find out about their harvesting, sorting, grading, packaging, transporting and storing methods and to determine the level of losses in each step of post-harvest practices. Interview with chain supporters such as DAIL and NGO's (FI and ROP) was conducted to find out what are their roles with regard to post-harvest practice of apples.

There are three main variety of apples has been grown in the Nerkh district. Apples produced in the Nerkh district is marketed through three different chains. Farmers, local and regional traders are involved in post-harvest practices such as harvesting, sorting, grading, packaging, transporting and storing. There are significant losses in terms of quality and quantity in each stage of post-harvest practices. The level of losses (quality and quantity/physical) is different among chain actors at different stages of the chain. Farmers encountering 31% losses, regional traders 40.7% and local traders 21.6% losses of their total products.

The storage stage of the post-harvest practices contributed mainly to the losses of apples both at famer and trader level. The local variety apples are immediately marketed after the harvest by the farmers while the improved variety apples were store either by farmers or by regional traders. At the farm level apple were stored for 2.5 months as an average in their locally made rooms while at the trade level (Kabul) apples were stored for 3.8 months as an average in local shops in the market without cooling facilities and were subjected to extremely high losses. However, the local traders do not store their products; therefore no losses have been noticed by local traders.

It can be concluded that post-harvest losses in apples occur at harvesting, sorting, grading, packaging, transporting and storing stages. However, the maximum losses were noticed at the storing stage. There were several reasons behind the post-harvest losses which included poor harvest techniques, poor and improper harvesting and packaging materials and absence of cold storage rooms.

To reduce the physical/quantity losses and protect the quality of apples, training about the post-harvest practices to the farmers, local and regional traders as well as DAIL extension officers is recommended. Moreover distribution of proper harvesting materials such as ladder and fruit baskets to the farmers, also can contribute to reduce the physical losses during post-harvest practices.

Key words: post-harvest practices, post-harvest losses (quality losses, quantity losses).

CHAPTER 1: INTRODUCTION

1.1 Agriculture in Afghanistan

Afghanistan is a land locked and mountainous country of about 65.223 million hectares (ha) of land, from which agricultural lands occupies 38.661 million ha (CSO, 2009). Agriculture is the main source of livelihood for the majority of Afghan population and about 80-85% of rural population in Afghanistan depended on agriculture (Pain and Shah, 2009). Agriculture sector contributes an estimated 53% to the Gross Domestic Products (GDP) and it provides employment for 67% of the labour force (HLP, 2009). Table 1 shows the economically important crops in Afghanistan.

Table 1: The economically important agricultural crops in Afghanistan

Category	Crops	Cultivated land area (ha)
Cereal crops	Irrigated and rain-fed wheat, maize, rain-fed barley and rice	3,008,000
Horticultural crops (fruits and vegetables)	Apples, pomegranates, grapes, almonds, apricots, pear, peach, stone fruits, nuts and citrus, potato, onion, tomato, carrot and melon	280,659
Industrial crops	Cotton, sugar beet and flax	63,698

Source: Roe, 2008 and CSO, 2009

Development of agriculture sector is a main source of the Afghan government strategy for strengthening and growth of economic and reduction of poverty.

Afghanistan's agriculture sector is suffered due to a long period of conflicts and social instability (30 years). Agricultural growth, markets, roads, irrigation, technology, reduction of rural poverty, education and information have all destroyed due to social conflict, lack of infrastructure maintenance and decreases of technical information and marketing systems. In addition, the last few years of drought conditions made the situation worse.

From 1979 to 2004 annual agricultural production grew at 0.85%, while before the conflict period (1964 to 1978), the annual agricultural production was grown 1.1%. To significantly reduce the rural poverty and to facilitate the overall economic growth, the annual agricultural production needs to grow at a minimum rate of 5% for over the next decade (HLP, 2009).

1.1.1 Fruit production

The climatic conditions of Afghanistan are favorable for the production of high quality fruits, due to availability of full sunlight, cold winter and warm summer (ROP, 2008). Therefore the development of orchards are one of the important priorities for the strengthening of agriculture in Afghanistan, this is why the strategy plan of the Ministry of Agriculture, Irrigation and Livestock (MAIL) has strong attention on the development of the orchards (PAL, n.d). The most common fruit species grown in Afghanistan are grape, apple, almond and pomegranate (FAO, 2003). Table 2 shows the production amount and land area used (ha).

Table 2: Fruits area and production by main provinces in Afghanistan

Area (ha), Production (MT)								
Province	**Almond**		**Pomegranate**		**Apple**		**Grape**	
	Prod	**Area**	**Prod**	**Area**	**Prod**	**Area**	**Prod**	**Area**
Baghlan	56	16	144	12	1320	120	3750	250
Balkh	1750	500	24000	2000	990	90	13500	900
Ghazni	2100	600	0	0	13200	1200	121800	8120
Herat	109	31	4560	380	1210	110	66000	4400
Kabul	0	0	0	0	2200	200	108000	7200
Kandahar	0	0	56004	4667	9273	843	17850	1190
Kunduz	567	162	0	0	880	80	3675	245
Paktia	1225	350	300	25	2200	200	2700	180
Parwan	875	250	600	50	2750	250	138750	9250
Samangan	14000	4000	0	0	770	70	3795	253
Wardak	350	100	0	0	27500	2500	0	0
Zabul	18900	5400	720	60	1320	120	175500	11700
Total	**41126**	**11750**	**95328**	**7944**	**64988**	**5908**	**665820**	**44387**

Source: CSO (2008- 2009)

The above table shows that Wardak province, followed by Ghazni and Kandahar, Parwan, Paktia and Baghlan provinces represents the highest amount of apple production in Afghanistan.

1.2 Wardak province

Wardak province has 9 districts that cover 10,921.01 km^2 of which 106,385.52 ha are used for agricultural purposes. There are 2,143 villages with an estimated population of 615,840 people as of 2008. Agriculture is a major source of income in Wardak province. About 79% of rural population manage or own agricultural land (UNFPA, 2003 and USAID, 2008).

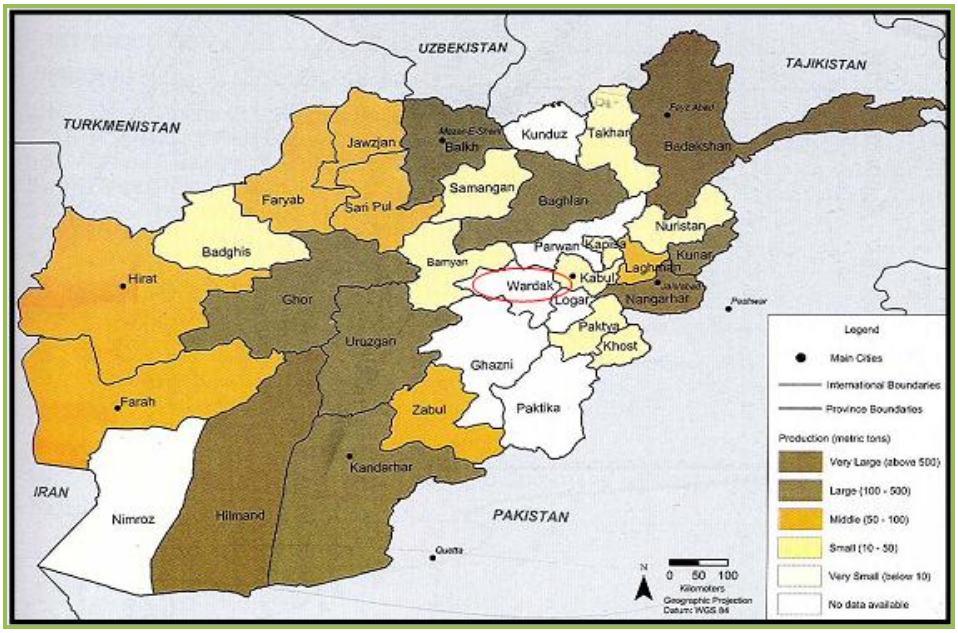

Figure 1: Map of Afghanistan with all provinces including Wardak province (Alumni, 2005)

The total crops production in Wardak province is 518,287 MT. Mostly it is consisted of fruits 49,578 MT (36.6%), followed by fodder crops 157,053 MT (30.3%), vegetable 121,618 MT

(23.47%), and grains 49,587 MT (9.57%). The total market value of the agricultural production in 2008 was estimated at US$ 505 million (USAID, 2008).

The annual fruits production of Wardak's province in 2008 was estimated at 190,030 MT, which generated over US$139 million that has been shown in Table 3. From total fruits production apples represented (68.15%), which were the highest profits US$77.6 million. The largest volume of apple produced in Chak-e-Wardak district (36.6%), followed by Dimerdad (24.4%) and Nerkh districts (19.1%) (USAID, 2008).

Table 3: The volume and value of different fruit in Wardak province

Fruits	Production (MT)	Value (US$)
Apple	129,494	77,696,100
Apricot	598	956,000
Peach	464	3,249,400
Almond	178	178,000
Walnut	43,542	43,542,400
Mulberry	65	77,400
Plum	15,125	12,099,800
Cherry	339	1,017,600
Other fruits	225	225,000
Total	**190,030**	**139,041,700**

Source: USAID (2008)

Nerkh district is well known because of agricultural extension services brought by the defunct Dr. Abdul Wakil, Agriculture Minister, who was from Nerkh district. About half of the agricultural irrigated land is covered by apple orchards in the Nerkh district due to its favourable climatic conditions for growing of apples. Nerkh district has partially well drained and loam soil that is suitable for growing of apples. Furthermore it has more sunshine for better colour development of apples (Mohammad, 2011).

1.3 Problem statement

The majority of farmers in the Nerkh district are small scale farmers and the current post-harvest practices and marketing system are strongly affecting them. Mohammad (2011) stated that regional[1] markets such as Kabul, has strong competition from imported fruits from Pakistan and Iran. However, growing is still extensive and mostly intended to satisfy the small local markets and the farmers are continuing production. Currently, apple production in Nerkh district highly depends on the foreign varieties (Red delicious and Golden delicious) imported about 20 years ago. However, the quality of the Nerkh districts' apples in terms of taste and colour is higher than the imported apples quality from Iran and Pakistan but due to current post-harvest practices, there are losses in terms of post-harvest quality and quantity that farmers, local/regional traders and retailers are affected.

The current post-harvest practices of apple have resulted in great losses and have affected the chain actors that lead to low income of the chain actors. It is therefore, necessary to investigate the causes of the post-harvest losses and identify where these losses occur in the chain by assessing the current post-harvest practices throughout the chain.

The research problem is that small scale farmers, local traders and other actors in the chain in Nerkh district are faced with post-harvest losses of their apple from the farm to the local and regional markets. Therefore, they supply low quality apples to the local and regional markets.

[1] There are 5 regional markets in Afghanistan namely Kabul, Jalalabad, Mazar e Sharif, Herat and Kandahar (Altai, 2004).

1.4 Problem Owner

FLAG International LLC (FI) has been working in Afghanistan since 2001. Under the contract with USAID, Rebuilding Agricultural Markets Program (RAMP), FI has been started to provide Business Development Services (BDS) to Afghan agribusinesses with the aim of supporting their access to credit. FI targeted small and medium sized agribusinesses along the value chain and offered BDS services to Afghan agribusiness to access loans and post-finance assistance in order to grow their businesses and make them sustainable after the completion of the program.

Under the contract with USAID, Local Government and Community Development (LGCD) project, FI has provided Training Support to Ministry of Agriculture, Irrigation and Livestock (MAIL) Extension Workers in Ghazni, Khost, Paktika, Paktiya, Zabul, Uruzgan, Logar and Wardak. The activities started in January 2008 and were designed to support the Local Governance and Community Development (LGCD).

FI has some budget to support small scale farmers, local traders as well as other actors in the chain through minimizing their apple post-harvest losses. Therefore, FI wants to know that where in the chain the post-harvest losses are that it can intervene to minimize the losses and improve the quality of the apples. Finally, it can contribute that the consumers receives better quality apples.

1.5 Research objective:

The main objective of this study is to identify the causes of post-harvest losses and where these losses occur in the chain by assessing the current post-harvest practices, to be able to give possible recommendations to minimize post-harvest losses and contribute to improve the quality.

1.6 Research Questions:

Q. 1: What are the causes of apple post-harvest losses in Nerkh district?

1.1. What are the post-harvest problems of apples with regard to quality?
1.2. What kind of methods do the farmers and local traders use for harvesting, sorting, grading, storing and transporting their products to the markets?
1.3. What are the roles of other actors (regional traders, retailers) in the chain with regard to post-harvest practices?

Q. 2: What are the opportunities and constraints of post-harvest practices?

2.1. What are the major challenges of the farmers and traders with regard to post-harvest practices?
2.2. What are the roles of supporters (agriculture department/NGO's) with regard to post-harvest practices?

1.7 Expected output

This research focuses on the post-harvest practices of apple (from farm gate to retailers) in Nerkh district of Wardak province. It is expected that the research would find out the main causes of post-harvest losses as well as the current problems and challenges of post-harvest practices of apple throughout the chain. The research will also come up with possible recommendations for the reduction of the post-harvest losses. This study will also recommend possible intervention plan for FI to contribute to provision of better quality apples for consumers.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

"The post-harvest system should encompass the delivery of a crop from the time and place of harvest to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for all involved" (CIRDAP, 2009).

Since the fruits are living biological systems they deteriorate after harvest. The rate of deterioration varies between different fruits depends on their overall rate of metabolism, but for many fruits it can be rapid. For small and simple marketing channels where the product is transferred from farm to the consumers within a short period of time, the deterioration rate of post-harvest is of little consequence. However, when crops are produced at an increasing distance from the inhabitant centers as they are in both developing and developed countries, the marketing becomes more complex and passes through many more intermediaries thus the time from farm gate to the market and consumption can be considerable. The role of post-harvest technology is to develop methods by which deterioration of the products are minimized during the period between harvest and consumption, and to ensure that maximum market value for the products are achieved (Wills *et al.,* 2007).

The post-harvest losses of horticultural crops in Afghanistan have been estimated over 40% which represents a major challenge in any agricultural marketing (ICARDA, 2003). The Pakistan National Commission on Agriculture estimated that defects and inadequate facilities in post-harvest handling, transport, storage and marketing may cause up to 20-40% loss of fruits. Post-harvest loss of fruit affects both the nutritional status of the population and the economy of the country. Farmers and other value chain actors end up capturing much less value when post-harvest losses are large (Malik *et al.,* 1994).

a. **Nutrition:** Fruit and vegetables are a rich source of vitamins and minerals essential for human nutrition. The fruits and vegetables wasted in transit from harvest to consumer represent a loss in the quantity of available food. This is important not only in quantitative terms, but also from the point of view of quality nutrition.
b. **Economy:** careless harvesting and rough handling of perishables bruise and scar the skin, thus reducing quality and market price. Such damaged product also fails to attract the international buyer and brings the exporting country less profit and in many cases a bad reputation with importers. This results in economic losses to the country (Malik *et al.,* 1994).

2.2 Causes of apple post-harvest losses

The causes of post-harvest loss are many, but they can be classified into two main categories: physical loss and quality loss.

Physical loss arises from mechanical damage and/or pest and disease damage resulting in product tissue being interrupted to a stage where it is not acceptable for production, fresh consumption or processing. Physical loss can also come up from evaporation of intercellular water, which leads to a direct loss in weight. The resulting economic loss is primarily due to the reduced mass of produce that remains available for marketing but can also be due to a whole batch of a commodity being rejected because of a small proportion of wasted items in the batch (Wills *et al.,* 2007).

Quality loss can be due to physiological and compositional changes that change the appearance, shape, taste or texture and make the product less desirable to the end consumers. The changes may occur from normal metabolism of the product (i.e.

senescence) or abnormal events (i.e. chilling or excessive heat injury) arising from the post-harvest environment. Economic loss is incurred because such produce will obtain a lower price. In many markets there is no demand for second class products, even at a lower price, which can lead to a total economic loss even if the fruit is still edible (Wills *et al.,* 2007).

Apples can be also damaged either pre-harvest or post-harvest by other stresses. In some instances, pre-harvest stress conditions predispose the apple to develop symptoms of a disorder only after picking or storage. Thus, it is important for both growers and packers to be aware of these potential problems. The term “disorder” refers to the problems in the fruit that is not caused by pathogens. Symptoms are induced when the fruit reacts to some kind of stress connected with temperature, light, humidity, or handling.

For example sunburn occurs in apples that have been exposed to the sun and can also lead to several other heat and/or light-induced disorders. These other disorders will appear either at the same time or later in maturity or even in cold storage (post-harvest). Sunburn in apples is usually the largest source of waste in apples with losses in Washington State averaging about 10% of the crop. During 2003, over 25% of the crop was sunburned in several orchards. In apples with more than one disorder, sunburn damage is under-reported by the packinghouse, as apples are culled for only one disorder so even though the apple may have sunburn it may be rejected for bird pecks, stem punctures or other damage (Schrader *et al.,* 2003).

Post-harvest losses caused by post-harvest diseases are greater than generally realised because the value of fresh fruits increases significantly when moving up the value chain from the field to the consumer. Postharvest diseases affect a wide variety of crops particularly in developing countries which lack sophisticated postharvest storage facilities. Infection by fungi and bacteria may occur during the growing season, at harvest time, during handling, storage, transport and marketing, or even after purchase by the consumer. Some of the more common post-harvest diseases in pome fruits (apples and pears) are shown in Table 4 (Sholberg and Conway, n.d).

Table 4 Apples and pears post-harvest diseases

English name	Latin name	Causal effects
Bitter rot	*C. gloeosorioides*	Bitter rot infections produce slightly drawn, circular brown spots that may be surrounded by a red halo.
Black rot	*Sphaeropsis malorum Penicillium spp*	On mature fruit, diseased spots, surrounded by a red halo, appear black.
Brown rot	*Monilinia spp*	The primary and most frequent symptom in fruit, Initial fruit injury is brown, circular and firm. Eventually the entire fruit decays and turns brown.
Grey mould	*B. cinerea*	The fruit is decayed and appear light brown to dark brown. The decayed area is spongy, and diseased tissue is not separable from the healthy tissue
Moldy core	*Alternaria spp*	Symptoms include mould growth in the core region of the fruit. The rot does not spread into the flesh, and can be seen only when the fruit is cut open
White rot	*D. Gregaria*	Circular, brown spots, often with a dark halo, dotted clusters of fungal reproductive structures may appear on the surface. This can be seen by splitting the fruit open. The decay is soft and watery, having a clear to light tan color under warm weather conditions.

Source: Sholberg and Conway (n.d)

2.2.1 Harvesting

The harvest operation of the horticultural products may be completely by hand or by machine. Hand harvesting is mostly for fresh market products, especially those products, which are vulnerable to physical injury e.g. apples (Wills et al., 2007). Even when harvesting is done carefully, the following factors cause post-harvest spoilage of horticultural products (Malik *et al.,* 1994).

- Loss of moisture from the surface of the product through evaporation, transpiration and respiration. Loss of moisture from the product results in shriveling and loss of market value and can lead to wastage.
- When product is stored at higher than optimum temperatures, increased metabolic rate, especially respiration, results in the onset of early senescence (aging or ripening) and ultimately leads to the death of tissue.
- Interruption in the normal metabolic activity of the products, due to either extremely low or high temperature. At sub-optimal temperatures, the products may exhibit the physiological disorder chilling injury. At temperatures above 30^0C, the product overheats and boils. In this case, its external appearance deteriorates and it spoils quickly.
- Invasion of the products by various pathogens results in fruit rot. Injured and senescent tissue is more sensitive to the attack from decay causing microorganisms.

The determination of the maturity stage for the many varieties of apple is difficult. If apples are harvested too early, the apple will likely be sour, become harsh and poorly coloured, and if harvested overly-mature, it will likely breakdown internally and store poorly (IALC, 2006). Late harvested apples are also more susceptible to flesh and core browning (Thompson, 2003).

Thompson (2003) has stated that it is difficult to harvest the fruits which are bearing on trees e.g. apples, mangoes, citrus fruits and avocados. Conventionally the picker would carry a ladder and use that to reach the fruit.

“Maturity changes in apples include skin colour, seed colour, flesh firmness, soluble solids content, starch content, titratable acid content, respiratory rate, ethylene production, and production of other flavor and odor constituents. Suggested maturity indices have included all of these as well as time (days from full bloom), accumulated heat units (e.g. degree-days above 7 ^{0}C, fruit size and various combination of these.”The standards of ripening/maturity must take into consideration that whether apples are to be stored (and for how long) or transported immediately. The aim is to find out a reliable indicator, which can show the best harvest date for how long-term controlled atmosphere storage and/or for short term air storage (Mitcham and Mitchell, 2002).

Different picking dates of apples during the harvest season may have a significant impact on fruit quality. If harvested too early fruits are smaller, have reduced flavour and colour, and are more susceptible to scald, bitter rot and internal breakdown. Quantity reduction by water loss is greater in earlier picked apples because waxy surface is not yet completely formed. Early picked fruits are smaller and their surface in a storage unit is larger. Because water transpiration depends on fruit surface area, small fruits lose their weight faster (Mitcham and Mitchell, 2002, Kviklienė and Valiuskaite, 2009). Another contributor of more intensive evaporation is the structure of fruit cuticle, which is not fully developed when fruits are harvested too early. The cuticle is the first barrier that pathogens have to challenge (Kviklienė and Valiuskaite, 2009).

The high moisture content and soft texture of fruits make them susceptible to mechanical injury, which can happen at any stage from production to consumption. These injuries might be external (damage of skin) or internal (damage to internal tissues) bruising. External damage lead to entry points for fungi and bacteria, increase in water losses and respiration rate, and the internal bruising leads to internal discoloration, loss of flavour as well as an increase in the respiration rate (IALC, 2006).

A study by (IALC, 2006), indicates that the causes of losses during harvesting are:

- Mechanical injuries by nails, dropping and throwing.
- Immature or over-mature harvesting.
- Failure to protect the fruits from sun.
- Improper picking materials/baskets.
- Delay in transporting of the fruits to the storage and/or markets.

2.2.2 Packaging sorting and grading

The meaning of package is mainly to surround and protect the produce. There are often two levels of levels of packaging for fresh fruits and vegetables. First is the pack in which the products are offered to the consumers and second is the packs that are containing the consumers packs and are used to transport the products to the retail shops. Therefore the size of package is essential, the consumer pack should be considered in terms of the quantity, the market or customer needs in a single unit. In some conditions the overall package sizes may be stated by what a person can logically pick up and/or carry (Thompson, 2003).

Many materials, sizes and shapes are using for packing of the horticultural commodities. Packages for horticultural crops are sized to be suitable units for marketing and distribution of the horticultural commodities. They must take care from easily broken of commodities

against damage during distribution/transportation and must maintain their shape (Thompson and Mitchel, 2002).

After harvesting apples which are often stored in the field storages to wait for packaging might be drenched with a scaled inhibitor and fungicide and/or sometimes treated with calcium chloride for the control of apples bitter pit control before storage. Apples produce can benefit from pre-cooling before they shifted to the cold storage room. Pre-cooling could be accomplished by hydro cooling and/or forced air cooling. Hydro cooling is faster than the air cooling; there is the possibility of spreading disease organisms from diseased apples and/or soil to healthy apples. If liquid of chlorine is used to reduce the possibility of diseases extension, it is important to change the drench water every day to prevent the increase of sodium, which is resulting of fruit burn (Mitcham and Mitchell, 2002).

Produce with a waxy skin have a tendency to lose water slowly. This inspection has led to the application of wax to certain products that shrivel quickly and lose consumer demand during storing and marketing. Furthermore to reducing water loss, wax is also applied to improve the appearance of apple produce to the consumers (i.e. shiny apple). The rate of water loss can be reduced by 30 to 50 % under commercial conditions, especially if stem scares and/or other injuries are coated with wax. Waxes are using as brushing, spraying, fogging or foaming on the apple produce (Wills *et al.,* 2007).

ICARDA (2003) mentioned that most of the villages in Afghanistan (38.3 %) used jute bags for their produce (see Figure 2) However, it has been stated by Estrada (2005), that in eastern Afghanistan and Kapisa province the apples packed in polypropylene bags and brought to the market, that is resulting in average losses of 17 %.

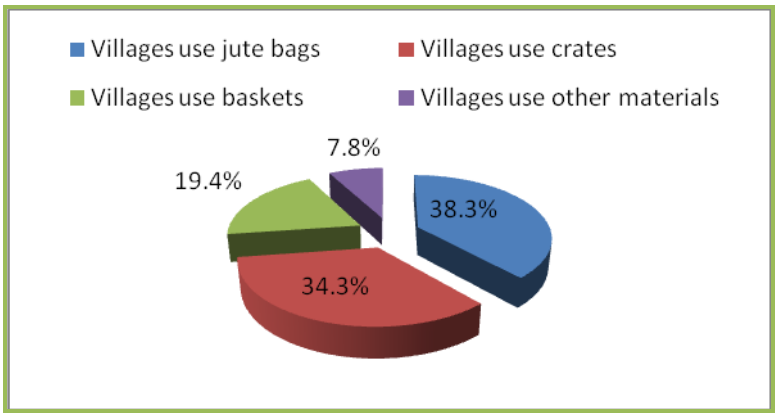

Figure 2: Percentage of villages using packaging materials in Afghanistan (ICARDA, 2003)

Physical injuries to the produce must be avoided wherever possible during handling and distribution. Some of the more observable open lesions (such as cuts or punctures), often happen before packing of the produce and could be eliminate by good supervision and sorting. However, certain bruises may build up during all stages of handling, including packaging and distribution. Bruising is caused by dropping of the produce onto a hard surface.
The lesions may not be observable immediately on the surface of the fruit; carefully quality control is needed against it. Dropping of the produce into the package is a common cause of impact damages during packaging (Mitcham and Mitchell, 2002). A large percentage of fruits are wasted yearly because of damage from bruising. A bruise is mostly caused by impact during packaging, and the transport of fruits (Kafashan, *et al*., 2007).

ICARDA (2003) has stated that if any of the horticultural products are exported, then international quality standards must be approved, both in grading norms and health-related

practices. Presently, packaging conditions in Afghanistan are sub-standard and result in an unacceptable level of damage for the international market.

Afghanistan agricultural products are great opportunity for the investors, but due to poor current packaging system there are some 20-40 % of the total products losses (AISA, n.d).

Sorting is done to separate the produce by colour, size and grade (Thompson, Mitcham and Mitchell, 2002). Grading is a vitally essential practice because product presentation, a feature of quality, is often judged by standardization/uniformity. Standardization and or uniformity are important in terms of presenting a standard product for handling (e.g. unitisation) and marketing. Products are usually graded by size, weight, colour, defects or composition, and/or a combination of these features (Wills *et al.,* 2007).

It is also important to maintain sanitary conditions in all areas where product is packed. Organic matter (irrelevant plant parts, soil) can act as substrates for decay (Ilyas, *et al*., 2007). Inadequate cleaning and sanitation, improper sorting, grading and packaging, over-packing crates, damage from long finger nails and dropping of the fruits in crates from a distance are the causes for post-harvest losses (IALC, 2006).

2.2.3 Transport and storage

Organization of storage room differs with the level of the operation. On-farm produce storage is regularly approved. Small farmers are often store very small quantity of the products, therefore complicated facilities may not be appropriate. In such case, if produce need to be stored it might be more economic for group of farmers to form a storage cooperative where the group join to buy and run central storage facilities. This is mostly important where compound systems are used such as controlled atmosphere stores. The expensive electronic materials that are used to sample and control the storage atmosphere is a fairly fixed cost for small or large stores. The facilities and organization of such an enterprise can allow for buying and marketing at more favorable rates. This centralized type of organization would require separate and specialized management (Thompson, 2003).

Thompson (2002) has mentioned that the aims of storage are as follows:

- Maintaining the lowest temperature which will not cause freezing or chilling injuries and by controlling atmospheric composition to slow biological activities of the commodities
- Maintaining the lowest temperature and reducing surface moisture on the produce to slow the growth and multiplication of microorganisms
- Minimizing the moisture loss of the produce and the resulting wilting and shrivel by reducing the difference between produce and air temperature and keeping up high humidity in the storage

A good storage condition for apples is a temperature at 2-2.5 ^{0}C with a relative humidity at about 90-92% (USAID, 2008). However, it has been stated by Wills *et al.* (2007) that the best storage temperature can be to some extent outside the ranges specified. For example, the best storage temperature reported for apples range from -1 ^{0}C to 5 ^{0}C at RH 90-95 %. ROP (2008) has noted that Apples can be kept for a long period of time in a cool storage area (3 ^{0}C, well-ventilated, dark and slightly humid).

Technologies available for some commodities i.e. certain apple cultivars, will allow a storage life of 12 months. Fruits are living organisms. Their marketable life is affected by such things as humidity, temperature, the composition of atmosphere which surrounds them, the point of damage that has been inflicted on them and the type and degree of infection with micro organisms (Thompson, 2003). They will deteriorate during storage through:

- “Loss of moisture
- Loss of stored energy i.e. carbohydrates
- Loss of other foods i.e. vitamins
- Physical losses due to attack of pest and diseases
- Losses in quality from physiological disorders” (Thompson, 2003).

Effective and regular control of storage diseases is dependent upon integration of the following practices:

- Selection of diseases resistant cultivars if possible
- Maintaining of the correct crops nutrition by using of leaf and soil analysis
- Irrigation should be based on the requirements of the crops and avoid overheating
- Pre-harvest treatments application to control pests and diseases
- Crops harvesting should be done at the proper maturity for storage
- Post-harvest treatments application for disinfest and control diseases and disorders on the product
- Packaging area should be clean and sanitized as well as dumped water should be free of contamination (Sholberg and Conway, n.d).

Table 5 shows the losses of apples in Pakistan from production to consumption. The damage and deterioration may result from physical injuries, enzymatic action by the attack of microorganisms or combination of both these factors. Injuries and damage to fruits may in turn result in loss of moisture due to faster surface evaporation. Injured fruits are attacked by microorganisms (fungi, bacteria) and then become diseased (Ilyas, *et al*., 2007).

Table 5: Apple post-harvest losses at different stages from production to consumption in Faisalabad, Pakistan

Apple transported		% of losses during				
From	To	Harvesting	Wholesale Market	Retail Market	Household consumption	Total
Quetta	Faisalabad	8	4	6	5	**23**
Swat	Faisalabad	7	3	6	4	**20**
Murree	Faisalabad	9	2	8	6	**25**
Quetta Kept in cold storage (Nov-Apr)	Faisalabad	8	9	7	4	**28**

Source: Ilyas, *et al,* (2007)

Maturity of the fruit at harvest, handling and type of storage has a great deal of influence on how long the fruit can be stored without decay. Pinpoint or storage scab of apples caused by a fungus that also causes apple scab. Grey mould is caused by the fungus *Botrytis cinerea.* Both grey mould and storage scab are very much influenced by the weather. Storage scab only occurs in years with unusually wet summers and early autumn, when the fruit are wet for a day or more. The late season infections may not become visible until the apples are in storage. Several fungi all over the world cause considerable post-harvest losses in apples, during storage and transportation.

More than 90 fungal species have been reported to cause decay of apples during storage. The relative importance of each pathogen depends upon the climate and storage conditions. The pathogens infect apple fruits through wounds or lentical in the growing season or after harvesting and aggravate the losses during storage (Ilyas, *et al*., 2007). Rough handling during loading and unloading of the fruit, mixing of non companionable fruits, delay in getting the fruits to the consumers, as well as lack of sanitation in the storage facilities are the causes of post-harvest losses in apples (IALC, 2006).

2.3 Marketing

"Marketing is the series of services involved in moving a product from the point of production to the point of consumption. It also involves finding out what your customers want and supplying it to them at a profit. Marketing of perishable products becomes increasingly important as the standard of living of consumers increases, because they require higher, more consistent quality of fruit and vegetables. They also want them when they are not in season" (Thompson, 2003).

In Afghanistan there are large numbers of actors from the production to the marketing which results in severe competition on prices but they are not considering about the quality (Altai, 2004). Figure 3 indicates that there are 5 regional markets in Afghanistan namely Kabul, Jalalabad, Mazar e Sharif, Herat and Kandahar.

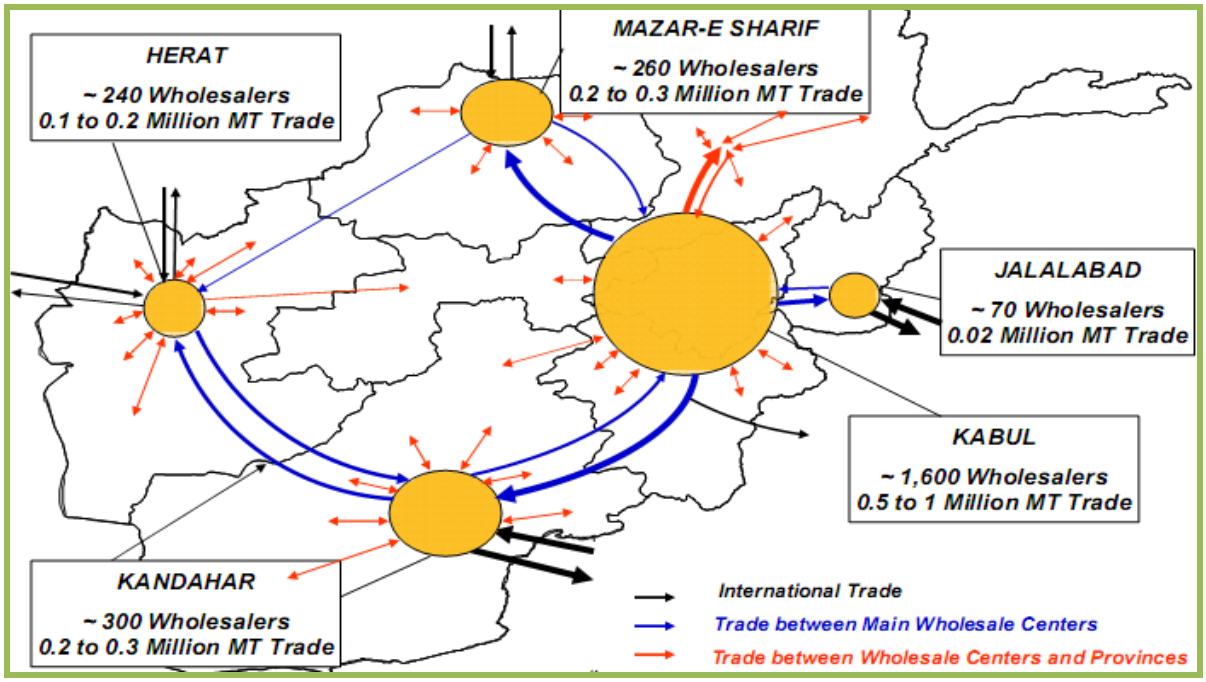

Figure 3: Main wholesale markets and 5 trading centers in Afghanistan (Altai, 2004)

CHAPTER 3: METHODOLOGY

3.1 Study area

Nerkh District is located in the western of Wardak province. The altitude from the sea level is 2200 m and covers 480 km^2. The distance from provincial capital (Miadan Shahr) is 20 km, and one and half hour's drive from Kabul. It has around 120 villages (UNHCR, 2002).

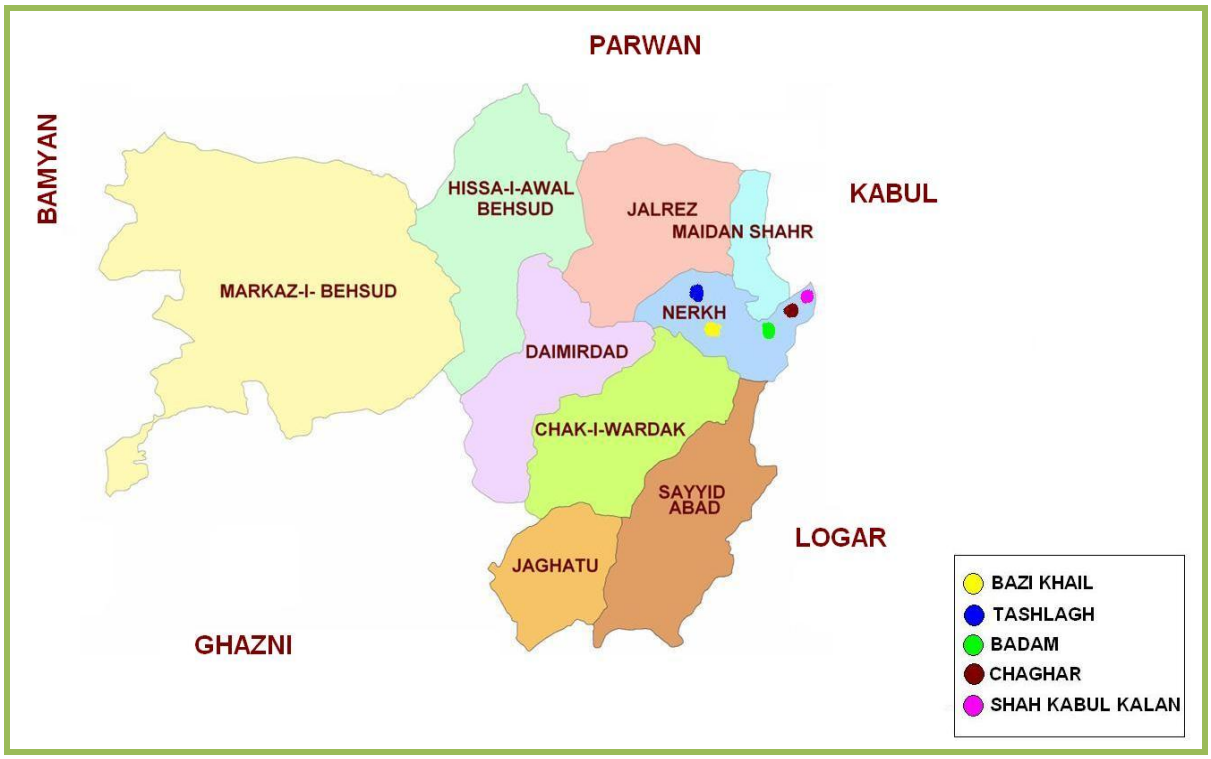

Figure 4: map of Wardak province with all districts (USAID, 2008)

This study was conducted in 4 villages including Bazi khail center of the Nerkh district, Shah Kabul Kalan, Tashlagh e Nerkh, Badam, and Chaghar villages, which have been indicated in Figure 3 with coloured dots. Two villages (Bazi khail and Tashlagh e Nerkh) are next to the district center (0.5-1 km), and three villages (Shah Kabul Kalan, Badam and Chaghar) are located about 10 km far away from the district center. The 3 villages that are located far from the district center, they are closer to the provincial capital (Maidan Shahr) and Kabul, while those which are located next to the district center they are far from the provincial capital and Kabul.

3.2 Data collection

The research has qualitative and quantitative approach and based on desk study and field study. The desk study was involved the review of books, journals, magazines and reports and visiting of some relevant websites to describe the literature review theoretical concept and also giving some general information about research topic.

The field study was carried out by the survey and interview. Survey was conducted for 30 farmers from the selected villages of the Nerkh district (six farmers from each district), as well as 30 retailers from the district, province and Kabul were surveyed. Local traders from local (district/provincial) and regional traders from (Kabul) market were interviewed. Interviewing of these stakeholders was very important for collection of both quantitative and

qualitative data. Furthermore field observation was also conducted for collection of qualitative data.

3.2.1 Primary data

The primary data was collected through survey, interview and field observation.

Survey
The survey was conducted through pre-structured questionnaire (see Annex 1) in the five villages of Nerkh district. A total of 30 farmers have been surveyed. Farmer's survey was helped the author to find out issues related to post-harvest practices from farm gate to the end consumer that are affecting the apples quality, such as methods of the harvesting, packaging, sorting, grading, storing and transporting as well as selling mode and marketing channels of their products.

A total of 30 retailers were also surveyed to find out that how is their buying mode from different actors (farmers, local and/or regional traders), as well as to find out what is the consumers expectation with regards to the apples quality. It was also helped the author to determine that do they re-sort and grading and storing their products, and how are these practices affecting the apple quality and the losses during re-sort, re-grade and store. For the questionnaire (see Annex 2).

Interview
A total number of 6 local traders and 6 regional/Kabul market traders were interviewed, that have been helped to collect data about the harvesting, packaging, sorting and grading, storing and transporting of apple from the farm gate to the local and regional/Kabul markets for detailed information (see Annex 3 trader's questionnaire).

Interview also has been conducted with the 3 extension workers of the Directorate of Agriculture, Irrigation and Livestock (DAIL) and related NGO's e.g. one representative from FI and another one from Roots of Peace (ROP), which are working in agriculture sector (see Annex 4), to find out that which kinds of services and supports do they provide to the farmers and traders with regards to post-harvest practices of apples i.e. trainings about post-harvest handlings, transportation and storage facilities.

Field observation
Observation of randomly selected 5 villages, based on their distance from the district center as well provincial capital and Kabul for comparison of the affects the different distances on post-harvest losses and quality of the apples. Furthermore, to see how the farmers are harvesting, sorting, grading, packaging and storing their apples. Table 6 shows the summery of the survey and interview participants, number of orchards, wholesale and retail that have been observed during the survey and interview of the farmers, traders and retailers.

Table 6: Summery of survey and interview participants

No	Actors in the chain	Survey	Interview	Observation
1	Farmers	30		5 Orchards
2	Local traders		6	
3	Regional traders		6	6 Shops/stores
4	Retailers	30		10 Retail stores
5	Supporters		2	
Total		**60**	**14**	**26**

Table 7 is indicating the summery of the information sources that have been answering the research sub-question.

Table 7: Summery of information and their sources

Sub Q	Information/data	Source of information
1.1	Problems related to post-harvest practices with regards to quality and losses i.e. harvesting, sorting, grading, packaging, storing and transporting	Survey of farmers, field observation, local/regional traders, retailers as well as interview with DAIL/NGO's extension officers, and literature review
1.2	Apples harvesting, sorting, grading, packaging, transporting and storing methods	Survey of farmers, field observations, interview of local and regional traders
1.3	Kinds of packaging materials, Re-sorting, grading, packaging, storing and transporting of apples at Kabul and retail level	Interview with regional traders and survey of the retailers
2.1	Problems of the farmers and traders in regards to post-harvest practices of apples	Survey of farmers and local/regional traders
2.2	Role of the supporter in regards to post-harvest handling of apples	Interview with provincial agriculture department and NGO's (FI and ROP)

3.3 Data analysis

The data has been arranged according to questions and sub-questions. Data has been analysed by Statistical Package for Social Sciences (SPSS) and/or Excel sheet, after that data was presented in graphs/figures and tables. SWOT analysis also has been used.

3.4 Conceptual Framework

The field research was based on the information and data, which had been collected from different apple chain actors in the Nerkh district. The key respondents were farmers, local traders, regional traders and retailers. However, the supporters (Government/ Directorate of Agriculture, Irrigation and livestock, NGO's FI and Roots of Peace (ROP) were focused as key informants for field research (see Figure 5).

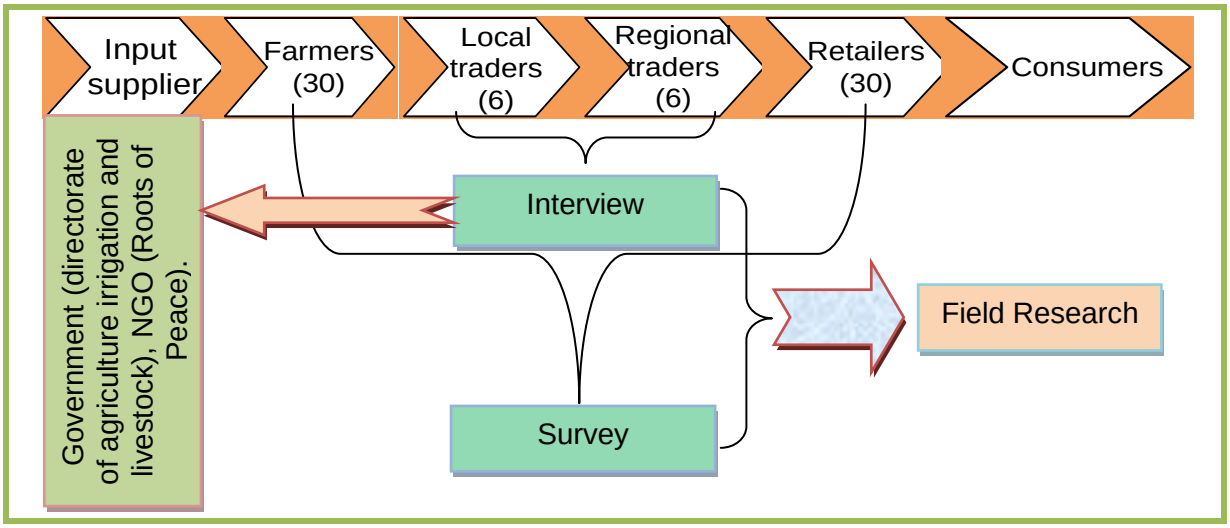

Figure 5: Conceptual framework of the study

3.5 Research framework

As mentioned earlier that the research has been conducted through survey and interview that has shown in Figure 6. However, field observation was included in both survey and interview.

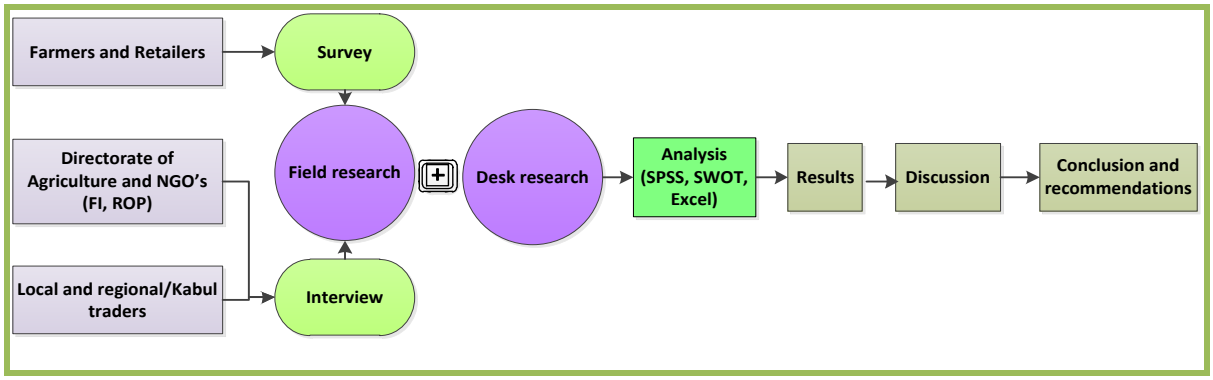

Figure 6: Research framework of the study

3.6 Limitation of the study

Security situation in the Nerkh district was the main restriction for this research. However, the author went to all five villages, only for observation of the orchards and harvesting methods of the farmers as well as to survey the 12 farmers of the two villages (Bazi khail and Chaghar), but due to bad security situation he was not able to survey the farmers in Shah Kabul Kalan, Tashlagh and Badam villages. Therefore a surveyor, who was from Shah Kabul Kalan village, has been trained and hired to survey 18 farmers from the mentioned villages.

However, the questionnaires for farmers were translated into local language (Pashtu[2]), used in all five villages, because of mistrust of the farmers, which they taught that the author may written something different than he is asking. The translated questionnaires were given to the surveyor.

[2] Pashtu is Afghanistan's national language

CHAPTER 4: RESULTS

4.1 Introduction

This chapter deals with the findings and result of the study. A number of figures and tables have been used for data presentation. Figure 7 presents the apple value chain map using volumes and supply relationships between different actors (farmers, local/regional traders and retailers) in the Nerkh district.

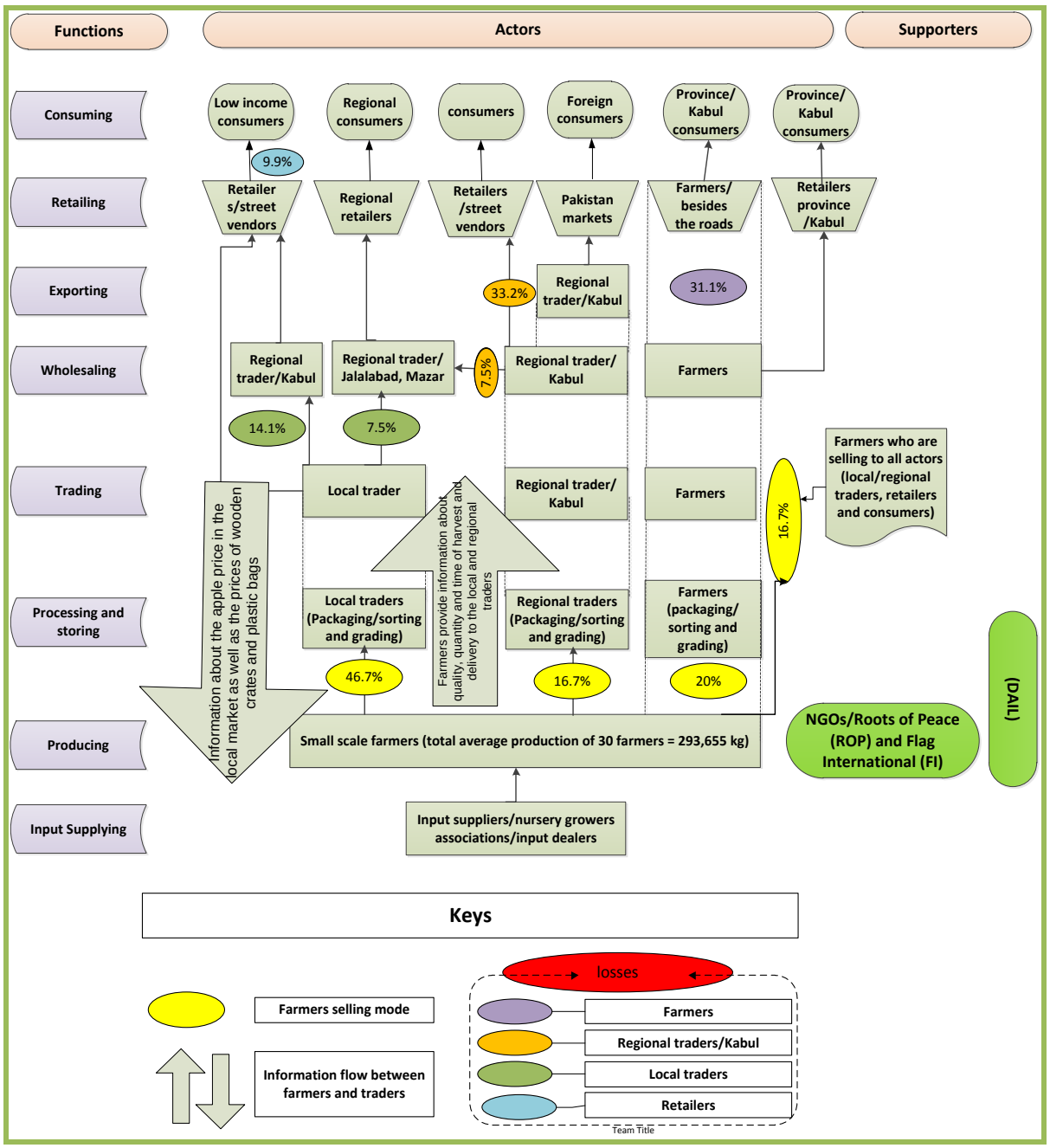

Figure 7: Nerkh district apples value chain map

The above figures have been estimated based on volumes/percentages of production from Nerkh district, which has been given by apple growers during survey and interviews with

other chain actors (e.g. local/regional traders and retailers), which will be describe with detail in coming pages of this report.

Figure 7 has indicated that there are three different chains of apples in the Nerkh district. Apple growers sell their products to the local traders (46.7 %) and regional traders (16.7 %) before harvest on lump sum basis by unit size of land (Jerib[3]) and/or after harvest on Kharwar[4] ((560 kg) basis. Besides they are also involved in selling their apples to retailers and directly to the consumers (20 %).

4.2 Farmers

4.2.1 Background information of the farmers

The results of the survey from the 30 individual farmers have shown that the farmers in the Nerkh district have the average age of 47 years old. More than 50 % of them are never been to school and illiterate.

Orchard size and number of trees/jerib
Figure 8a shows the average orchard size in the Nerkh district is 2.2 jeribs, and Figure 8b indicates that the average number of trees per jerib is 96. Three major varieties of apple are grown by the farmers are Golden delicious, Red delicious and local/Jawrasi.

(a) **(b)**

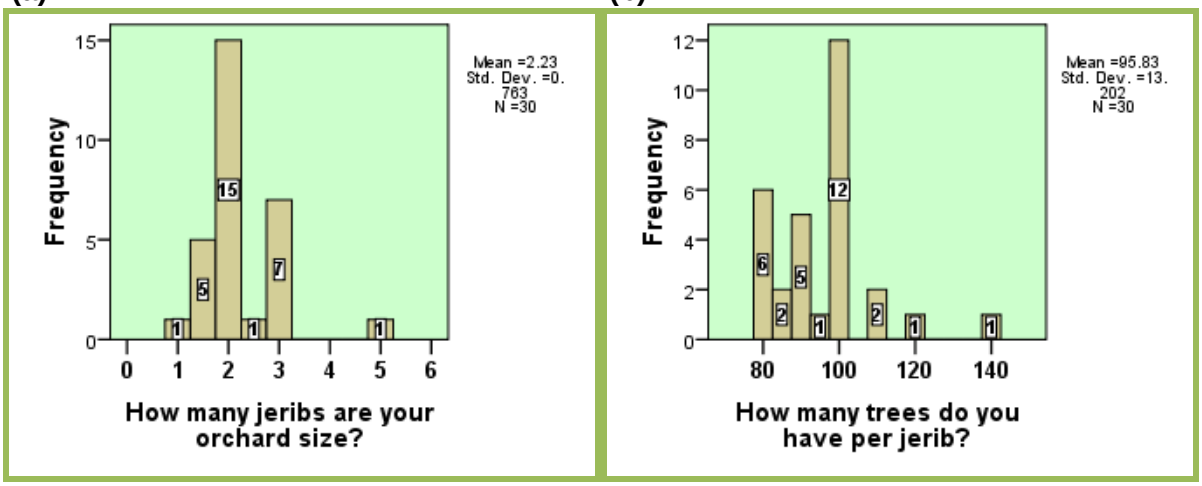

Figure 8: The average orchards size (a) and number of trees/jerib (b) in the Nerkh district

Yield per tree and total losses
Figure 9a shows that the average yield per tree in the Nerkh district is 46.3 kg, Figure 9b indicates that the average total losses from harvest to the end consumer are 31.1 %.

[3] It is an Afghan measure of land, equal to 2,000m^2 of land.
[4] 1 Kharwar in Wardak is 80 sers. 1 ser = 7 kg, so one Kharwar is equal to 80x7 = 560 kg

(a) (b)

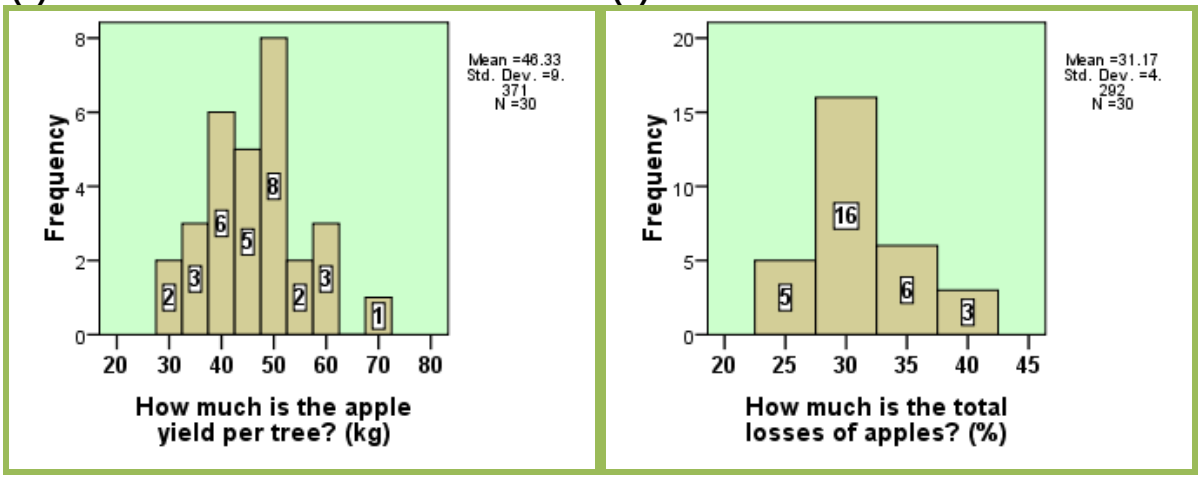

Figure 9: The average yield per tree (a) and the percentage of total losses (b)

Figure 8 and Figure 9 resulted that the average production per jerib is (46.3 kg*96 trees/jerib = 4444.8 kg). Thus the average production per farmer is (4444.8 kg*2.2 Jerib = 9788.5 kg) and average production of total respondents (30 farmers) is (9788.5*30 = 293,655 kg).

Input supply

Almost all of the respondents have mentioned that they purchase their apple tree saplings from the nursery growers associations which are available in the district level. There are five nurseries providing tree saplings of apples, apricots, peaches and plums.

Most of the apple growers in the Nerkh district (53 %) are buying their inputs (e.g. fertilizers and agriculture chemicals from Kabul market. Only 27 % of the farmers are purchasing their inputs from district and 20 % of them from provincial markets.

4.2.2 Harvesting

Farmers in the Nerkh district are involved in agricultural practices, harvest and post-harvest handling such as sorting, grading, packaging, transporting as well as storing of their produce. Hand harvest is done by farmers themselves or hired labours. Almost all of the apple growers have 10-20 local variety (Jawrasi) trees. Local variety that have short shelf life (maximum a month), therefore they have to transport their produce as soon as possible because there is shortage of cold storage facilities for their produce.

Harvesting time varies for each variety. Jawrasi variety is harvesting in July, Golden delicious and Red delicious variety is harvesting in September and October respectively.

A critical time for most of the apple growers in the Nerkh district is that the period of decision on when to harvest the apples. For example according to the author observation from the farm during harvesting as well as market observation, the farmers harvested and transported immature (green and small) apples to the market (see Figure 10). It is because at this time of the year the prices of apple are 50 % higher than their peak season.

Figure 10: Immature apples being sold in plastic bags at the road side

Almost all of the respondents have mentioned that after harvesting of their apples they dumped their produce inside the orchards under the shade of the trees for a week as a “pre-cooling”. Farmers often do not wash or clean their produce, because they think that dust which covers the apples is protect fruits from decay and spoilage in the storage.

Farmers indicated that they knew the different maturity indices (e.g. colour, size, taste and shape) that they can realise the maturity of their produce.

The main problems that the farmers are facing when harvesting their apple produce are bruising and absence of harvesting tools and materials (e.g. ladder, basket and apple pickers) that is shown in Figure 11. However, according the author observation their main problem, especially with regards to Jawrasi variety is early harvesting of the products.

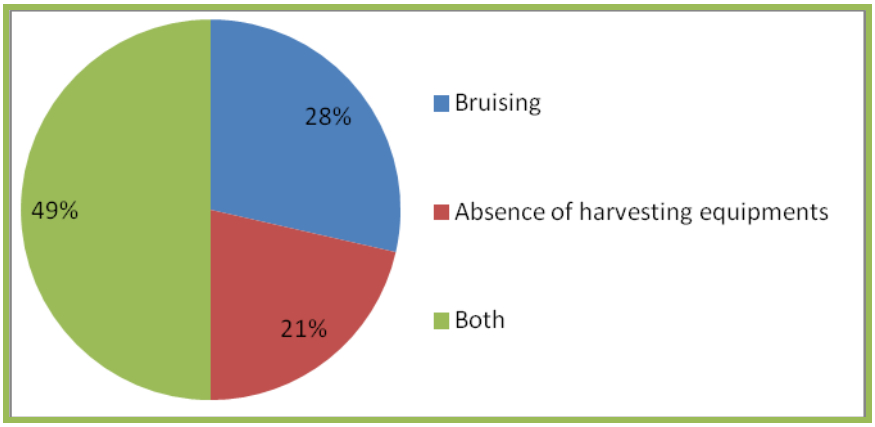

Figure 11: Farmers problems when harvesting apples in the Nerkh district

Figure 12 is expressing that the average losses of apples during harvesting is 5.8 %. Due to absence of proper harvesting materials and little care is taken by the picker during harvesting as well as non-availability of skilled labours for harvesting of apples in the Nerkh district.

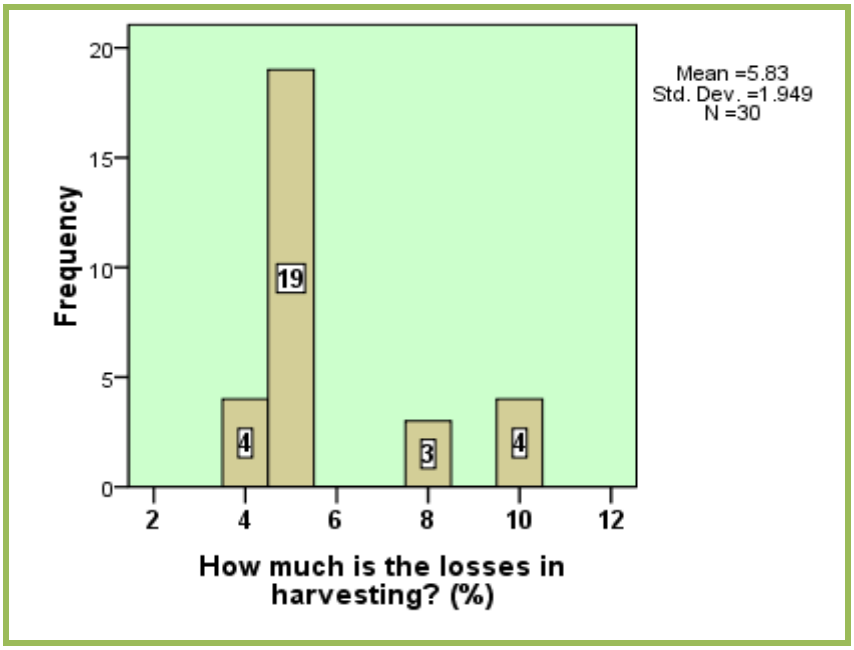

Figure 12: Losses of apples during harvesting in the Nerkh district

4.2.3 Sorting, grading and packaging

Farmers in the Nerkh district have mentioned that they are sorting and grading their apple produce by size colour and shape (see Figure 13a). However based on the authors' field observation, sorting and grading of the apple is limited. The apple growers in the Nerkh district are unaware about sorting; grading and packing techniques as they did not received any training about it.

In order to gain an average price for the different quality of apples farmers simply put the apples in to wooden crates and/or plastic bags, and held those together by wire in such a way that the big size, good coloured and high appearance apples are in the top of the crates and/or plastic bags. While low quality apples (small size and immature) are putting in the middle of the crates and/or plastic bags were presenting to the markets.

Figure 13b is showing that the majority of apple growers (57 %) are using wooden crates, plastic bags and polypropylene bags for packaging their apples.

(a) **(b)**

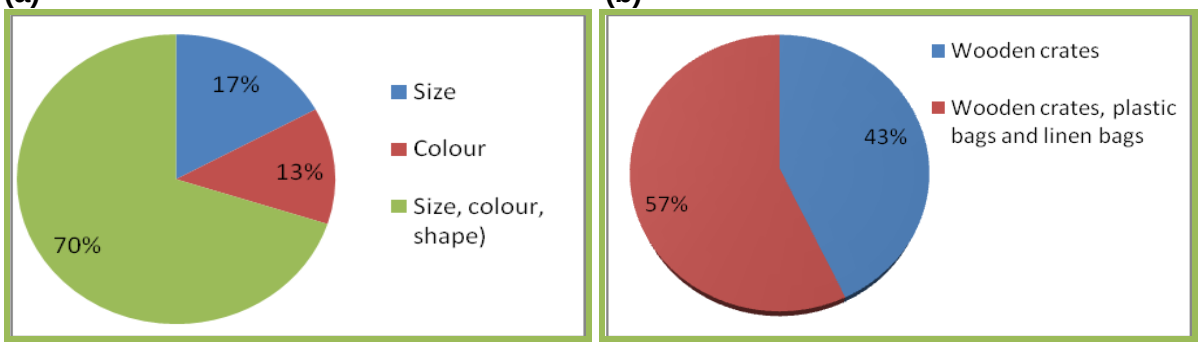

Figure 13: Sorting and grading incidents (a) and different packaging materials used by apple growers (b)

Those farmers who are selling their products in the cart beside the roads, they are packing their products in to plastic bags and polypropylene bags, others who are only selling their apples to the retailers in the markets they are using wooden crates for packing of apples. While those who are selling to the retailers as well as by themselves as a street vendor using all of the packaging materials (wooden crates, plastic bags and polypropylene bags).

Figure 14a and 14b shows the problems of the farmers when sorting/grading and packaging respectively. Bruising and pests and diseases are the main problem when sorting and grading, and non availability of skilled labours and bruising are the main problem of the Nerkh district farmers' during packaging their apple products. However, during field observation the improper packaging materials (e.g. plastic bags and polypropylene sacks) are also the main problem of the apple growers.

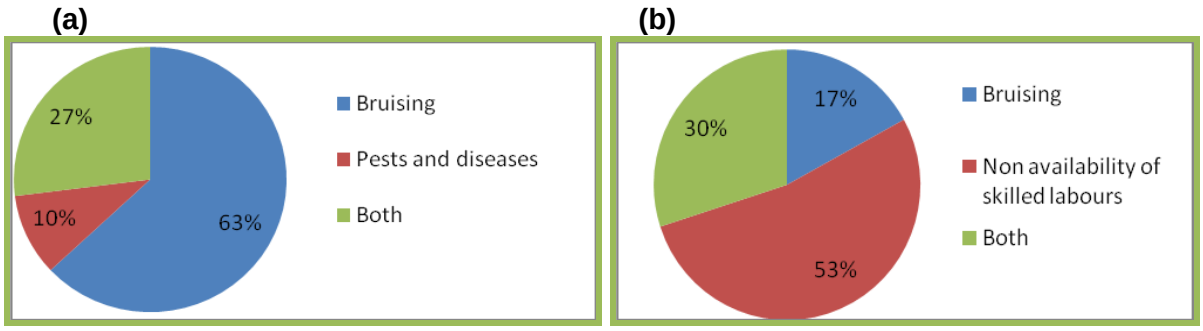

Figure 14: Problems of the farmers during sorting and grading (a) and problems in packaging of apple (b)

Based on the above mentioned problem in sorting, grading and packaging of apples, there are significant losses (11.2 %) that the farmers are encountered during sorting, grading and packaging, that has shown in Figure 15.

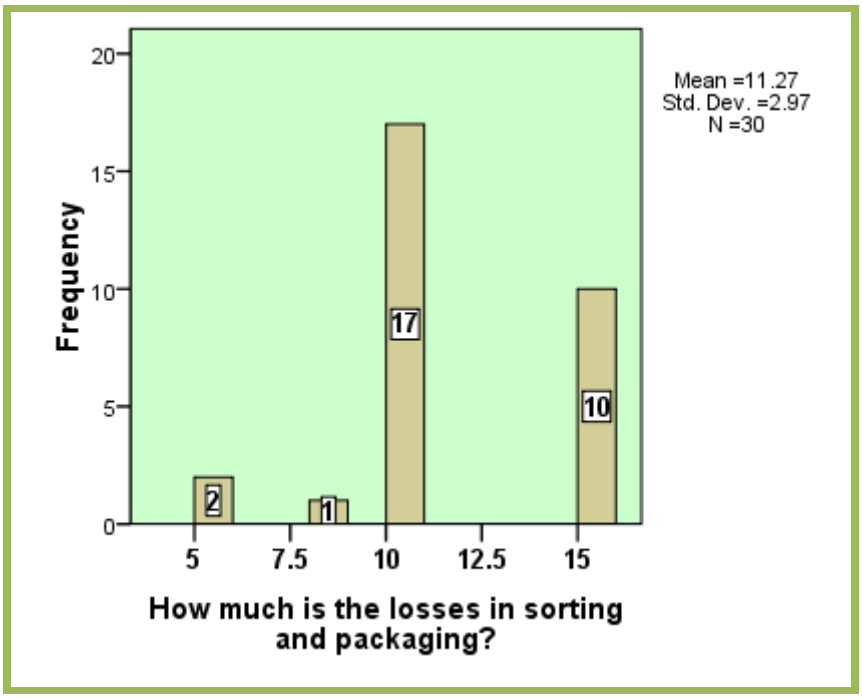

Figure 15: Losses of apple during sorting, grading and packaging

4.2.4 Storing

The apple growers in the Nerkh district have no access to store their apple products at proper storage conditions (controlled temperature and relative humidity). However, they are storing their apple products in their rooms for different periods of time. Figure 16 has indicated that the average storage duration for apples in the Nerkh district is 2.5 months, which is storing in locally made rooms, which has been not built exactly for the purpose of storing their apples. Indeed the rooms are built for their own living purpose. Whenever they are harvesting their apples they are storing in these rooms.

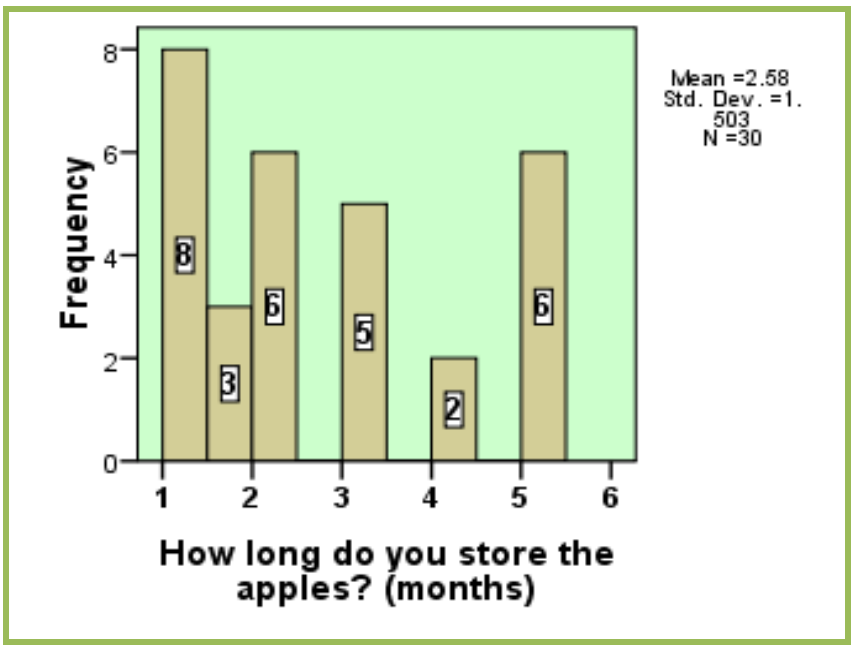

Figure 16: The apples storage duration in the Nerkh district

It had been realised by the farmers that improved varieties of apple (Golden delicious and Red delicious) can be kept longer than the local variety (Jawrasi). Farmers are affecting from pest and diseases, weight losses and over-ripening, that are occurring in their local storage rooms (see Figure 17). It has been also indicated by the respondents that they have problem of the low capacity of their rooms.

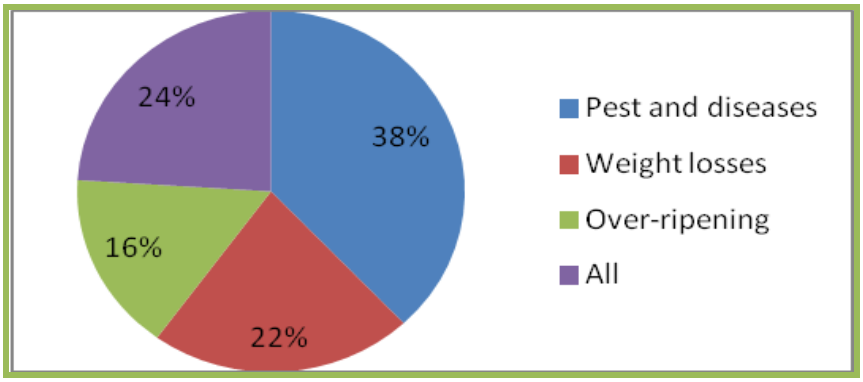

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Figure 17: Different affects of local storage on apples

Apples are simply dumped in their rooms under room temperature, which has been resulted about 14 % (as an average) losses in terms of quality (flavour, colour and shape) and weight losses arise from the improper storage of apples (see Figure 18).

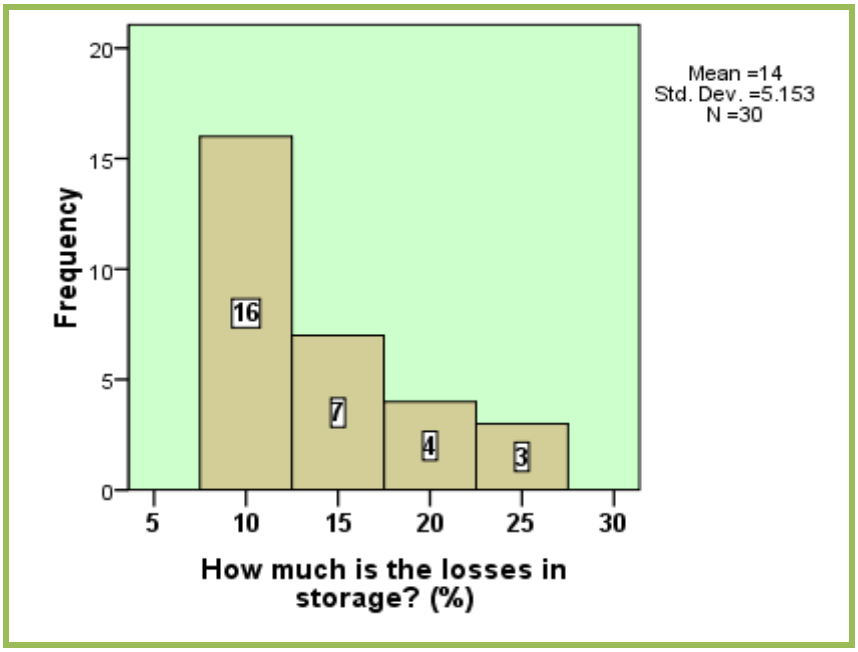

Figure 18: Different percentage of the apple losses arise from the improper storage

4.2.5 Transporting

As mentioned earlier that almost all apple growers in the Nerkh district involved in transporting their products to the local and regional/Kabul markets. They are transporting their product in non-cooling small trucks (locally called Mazda[5]), as well as in Townace[6] vehicles. Table 8 indicates the answers of all respondents.

Table 8: Transportation questions and answers of the respondents (farmers)

No	Question	Answers		Total respondents
1	Do you transport your products?	Yes		30
2	Is it affecting the quality of your product?		No	30
3	Are there any losses in transportation?		No	30

However, all of the apple growers are transporting their products in non-cooling vehicles, there is no affects and losses has been occur from transportation, due to the closeness of the area (district) to local and regional markets, as well as good conditions of roads (paved roads).

4.2.6 Marketing

Almost all farmers in the district are involved in marketing of their apple products. Farmers are selling their apples to the local, regional traders as well as retailers and directly to the consumers. For more details about marketing channels refer to the chain map (see Figure 7). Farmers are selling their apples individually. Their selling mode is indicated in Figure 19. For more detail about the selling mode of the farmers and number of actors that farmer dealt with see Annex 5A.

[5] Mazda is a small truck that is very often used for transporting of commodities.
[6] Townace is a kind of vehicle, which is in fact for transportation of human not for loading of the commodities.

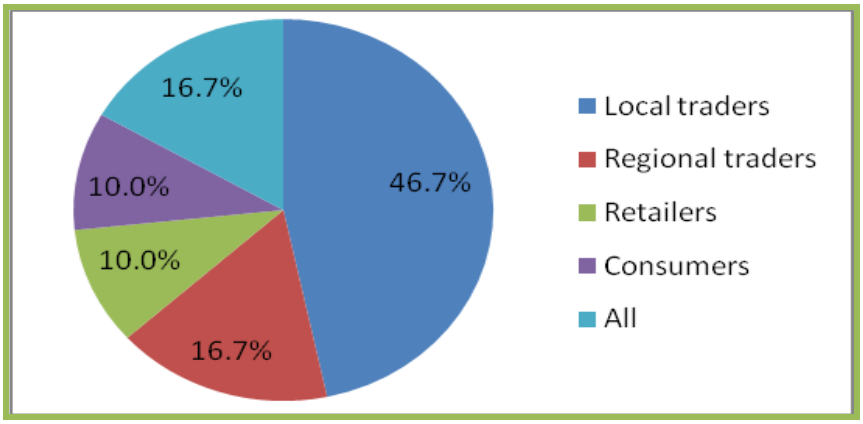

Figure 19: Selling mode of farmers in the Nerkh district

Farmers who are marketing their apple produce through Kabul trader and traders in the district or provincial town are dealing as pre-harvest contract. In this type of contractual agreement, generally the whole crop is sold on lump sum basis to the traders/contractors 15-20 days before harvesting time (e.g. 50,000 Afs[7]/jerib for Golden delicious and 55,000 Afs/jerib for Red delicious), and hence the subsequent management practices like disease, insect/pest control, picking, sorting/grading, packaging and marketing are left to the traders/contractors. In other words, the responsibilities and risks are shifted from the growers to the traders/contractors. The farmers get paid as 33 % before harvest and the rest 67 %, they are getting after harvest. They also sell their produce after harvest in the field on basis of Kharwar (560 kg). They offer as an average 8,000 Afs for Golden delicious and 9,000 Afs for Red delicious variety per Kharwar and the transaction is finalized on the price as mutually agreed upon.

Table 9 show the average prices of two main varieties of apple in the Nerkh district that farmers are dealt with.

Table 9: Average selling price of apples Afs/kg

	Before harvest		**After harvest at farm gate**		**Farmers store and deliver after**	
Varieties	Golden delicious	Red delicious	Golden delicious	Red delicious	Golden delicious	Red delicious
Average /price/kg	11.2	12.3	14.2	16	26	30

4.2.7 Information system

Figure 20 shows different information systems, which the apple growers are dealing with. Most of the apple growers (53 %) are getting information about the apples market prices from their neighbouring farmers. Farmers, are also getting information about the prices of apple from the local traders as well from local markets (district, provincial and Kabul). Farmers provide information about variety of their apples, quality, quantity and time of harvest and delivery to the local and regional traders.

[7] Afghanistan currency (1 dollar is equal to 47 Afs)

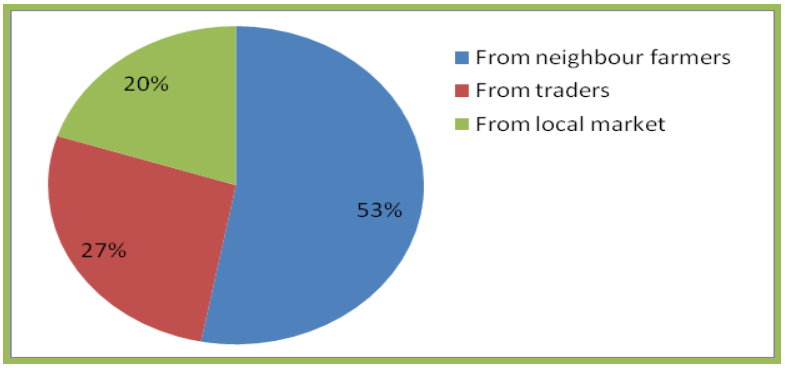

Figure 20: Different information systems used by growers in the Nerkh district

4.3 Local and regional traders

4.3.1 Background information of the local and regional traders

Interview of the 12 local and regional traders has resulted that the average age of the traders is 42 years and about 50 % of them are illiterate and never been to school.

4.3.2 Purchasing of apples

Local traders are buying all of their products directly from the farmers either pre-harvest and/or after harvest. Regional/Kabul traders are buying their produce from the farmers as well as local traders (see Figure 7 chain map).

In case of pre-harvest local and regional traders offer some advance (one third) of all product cost, and tie the farmer and fix a week for bringing the empty wooden crates to the orchard when they hired labours and would start the harvesting of apples. All the harvesting cost and food charges of labours are borne by the traders. The harvesting, packaging, transportation costs are borne by the traders. This type of transaction is generally made 15 days or a month before from the harvest time. In this type of agreement the price of the whole orchard is paid as a lump sum to the farmers. While, in case of after harvesting of the product by farmers, transaction is done on bases of Kharwar immediately after harvesting.

Local and regional traders are paying according to quality of apples to the farmers when they are buying after harvest on spot. The quality criteria for the traders after harvest at the farm gate and at market have been shown in Table 10.

Table 10: Quality criteria of apples for the traders

Quality criteria	High quality	Medium quality	Low quality	Total respondents
Variety	Golden delicious	Red delicious	Jawrasi/ Summer red	12
Size	Large	Large	Large	12
Colour	Greenish yellow, golden yellow	Flushed bright red	Bright red	12
Taste	Flavour sweet, aromatic	Sweet, aromatic, honeyed flavour.	Light flavour, sweet to sour, aromatic	12
Shape	Round-conical to oblong	Round	Hard and crisp	12

Table 10 indicated that all of the respondents mentioned that the Golden delicious variety is the high quality followed by Red delicious and Jowrasi. However, both local and regional traders expressed that the average price of the Red delicious variety is higher (10-20 %) than the Golden delicious average price.

Total losses of the local traders from harvest to retail are 21.6 % when they transporting their produce to the other regional (Jalalabad and Mazar) markets and 14.1 % when they are selling to local and Kabul markets. While regional traders total loss are 40.7 % of their total products in Jalalabad and Mazar markets and 19.1 % in Kabul market during harvesting, sorting, grading, transporting and storing. Each of these losses and causes will be explained in coming pages.

4.3.3 Harvesting, sorting, grading and packaging

As indicated earlier that besides sorting, grading and packaging, traders is also involved in harvesting of apple when they buy before harvest. Harvest is done by hired labours from the villages. Sorting and grading is done separately for each variety by size, colour and shape. Almost, all of the respondents have mentioned that they are facing with the problems of physical and mechanical damages (bruising of the fruits), pest and diseases, and non-availability of skilled labours during harvesting, sorting, grading and packaging. According to observation of the author the improper harvesting and packaging materials such as re-used wooden crates and polypropylene sacks are also their problems. Therefore there are significant losses (14.1 %) during harvesting, sorting, grading and packaging, which have been shown in Figure 21.

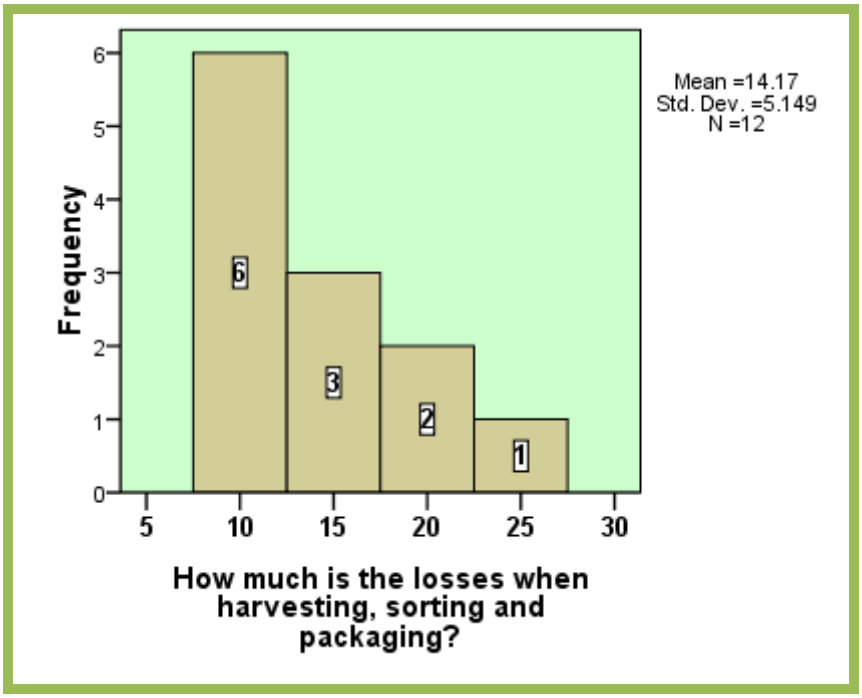

Figure 21: Average losses of apple during sorting, grading and packaging

Both local and regional traders are packing their products into wooden crates, and transport them to the regional markets (Kabul and/or other regional markets in Afghanistan e.g. Jalalabad and Mazar e Sharif). Out of 6 regional traders only 1 of them is exporting his products to Pakistan, which is packed into cardboard boxes (see Annex 6 C regional traders selling mode). Both wooden crates and cardboard boxes are importing from Pakistan.

4.3.4 Storing

Almost all of the traders (local and regional), mentioned that they do not have cold storage facilities. However, the regional traders are storing their products in their shops, which they cannot control the relative humidity and temperature, as they are not functioned well as cold storage. Regional traders mentioned that they are storing their produce for up to 3.8 months (see Figure 22).

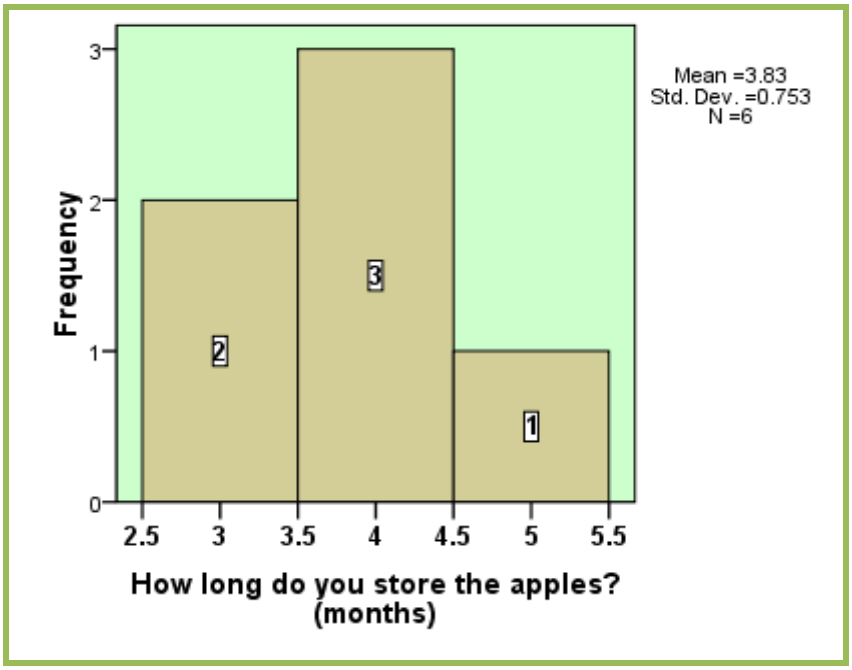

Figure 22: Apples storage duration in Kabul wholesale market

Local traders mentioned that they do not store their products. They just buy form the farmers in the orchards and directly transport them to Kabul, Jalalabad and Mazar e Sharif markets and sell them either to regional traders and/or retailers.

As indicated earlier that the traders do not have cold storage facilities, therefore their local storages (shops) has negative effects on their apple products, when they are re-sorted and re-graded after storage. Figure 23 shows the different affects of the storage on apples in Kabul wholesale market that the regional traders are suffering from them.

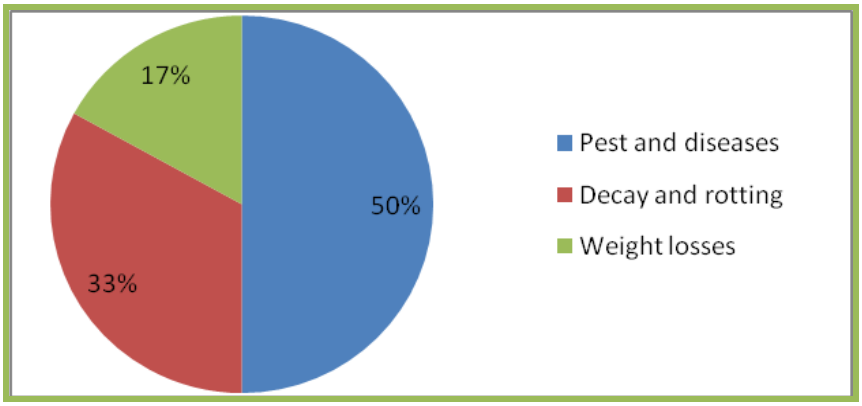

Figure 23: Different affects of storage on apples in Kabul wholesale market

There are significant losses due to improper storage facilities on apples in the Kabul wholesale market when they re-sort and re-grade their products. The average losses are about 19.1 %, which has been shown in Figure 24.

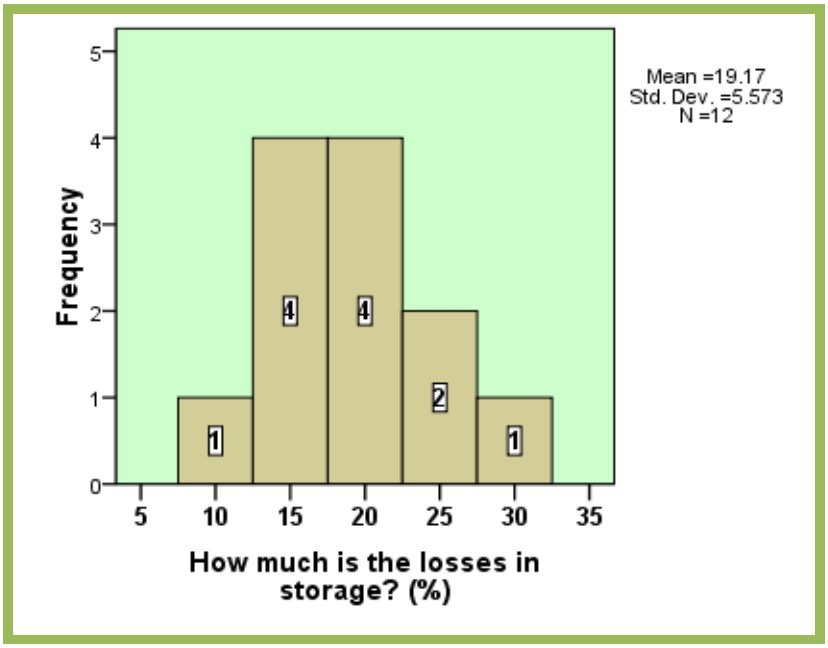

Figure 24: Average apple losses during storage in Kabul market

4.3.5 Transporting

Almost all of the traders involved in transporting apples from the farmers to the local regional markets. Table 11 is showing the answers of the questions that have been asked during interview from the local and regional traders.

Table 11: Transportation questions and answers of the respondents (traders)

No	Question	Answers		Total respondents
1	Do you transport your products?	Yes		12
2	Is it affecting the quality of your product?		No	12
3	Are there any losses in transportation?		No	12

Table 11 has shown that there is no affects on quality deterioration and quantity losses have been occur from transportation, due to the closeness of the area (district) to local and regional/Kabul markets, as well as good conditions of roads (paved roads). However, the respondents noted that there is about 5-10 % losses (see Figure 7 the chain map which shows the average of 7.5%), due to 6 hours drive from Kabul to Jalalabad and 10 hours to Mazar e Sharif markets.

4.3.6 Marketing

Different marketing channels used by the local and regional traders in the Nerkh district. Local traders are selling their products to the regional traders, retailers and regional traders in Jalalabad and Mazar (see Figure 25a). While, the regional traders are marketing their products through retailers in Kabul, traders in Pakistan and regional (Jalalabad/Mazar e Sharif) markets (see Figure 25b). For more detail about the figures see Annex 5B and 5C.

(a) (b)

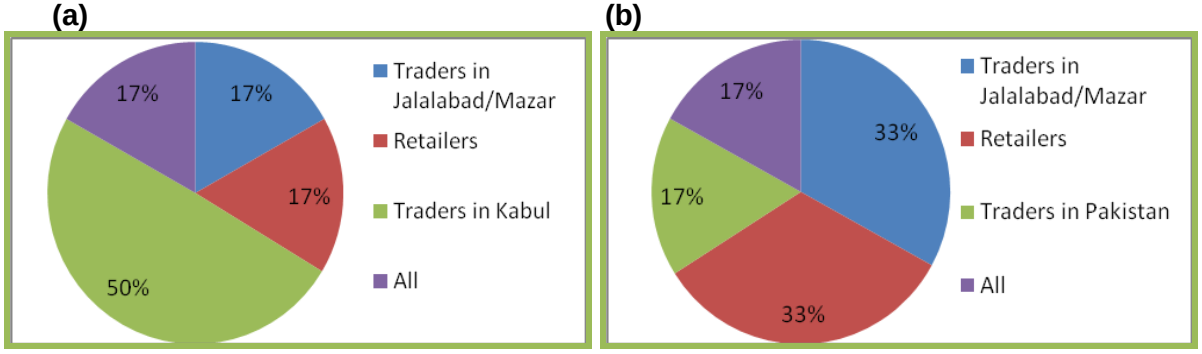

Figure 25: Local traders selling mode (a) and regional trader selling mode of apples (b)

4.4 Retailers

Retailers are purchasing their products from different actors in the chain (e.g. farmers, local traders and regional traders/wholesalers). Their buying mode of apples has been shown in Figure 26 and for more detail refers to the chain map.

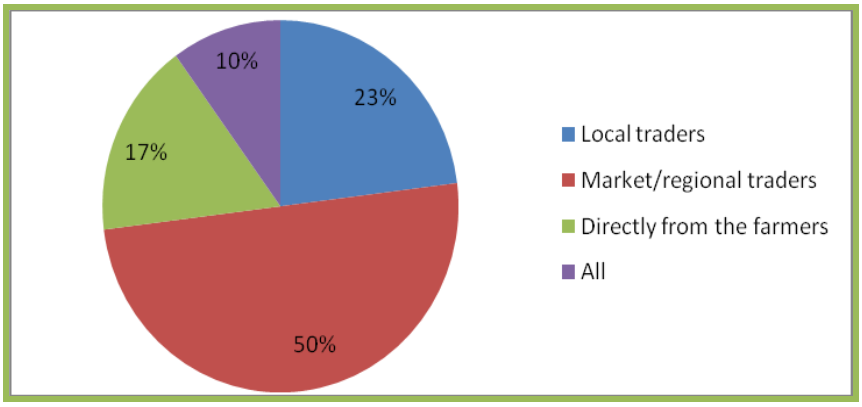

Figure 26: Retailers buying mode of the apples

Figure 26 show that most of the retailers (50 %) are buying their products from the regional/Kabul market, and 23 % are buying from local traders therefore they are agreeing on prices for each grade and quality and/or current prices of apples in the market. Those (17 %) who are buying directly from the farmers are agreeing on currently exist prices in the market, while those who are buying from all (farmers, local and/or regional traders), they are agreeing according to their rules (e.g. each grade/quality and current price of apples in the market).

The quality criteria of the retailers are the same as quality criteria for the local and regional traders, which have been mentioned in Table 10. The only difference is that they prefer the Golden delicious variety than the Red delicious, because Red delicious variety is mostly for export purpose. The purchase price of the retailers is 10-20 % higher than the purchase price of traders.

Almost all of the retailers re-sort and re-grade their products. They re-sort and re-grade each variety by size, colour and shape. Retailers have the problem of different quality of apples mixed in the same package by farmers, local and regional traders. Therefore retailers are affecting from the losses (4.9 % as an average) during sorting and grading, which has been shown in Figure 27a. About one third of these losses are consumed by the family of the retailers, the remaining two third they are selling to the low income families at (30 %) lower prices. Retailers are selling their products directly to the consumers, so they do not practice

the packaging of their products. They only pack the product during selling in the plastic bags. Retailers have no proper storage room to control the relative humidity and temperature. However, they store their apples in their shops but, for 1.5 months as an average (see Figure 27b).

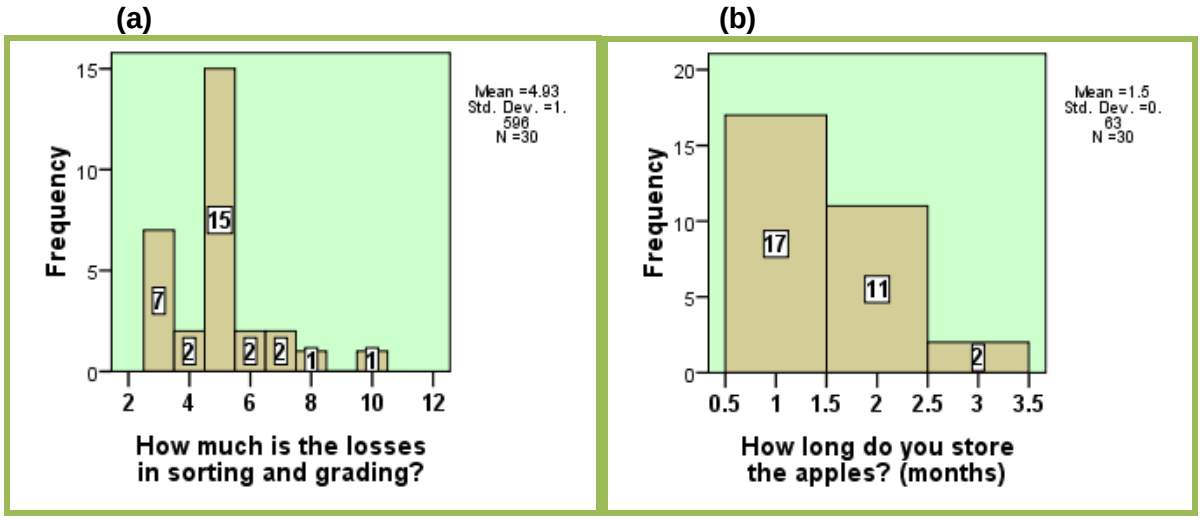

Figure 27: Average losses of apple during sorting and grading (a) and average storage duration (b) at retail level

Losses in terms of quality and quantity during storage are because of rotting, attack of pests and diseases and weight losses are occurring in retail shops (see Figure 28).

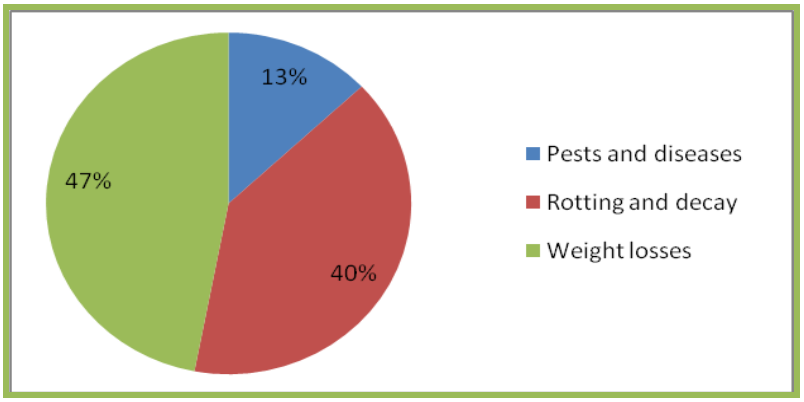

Figure 28: Different storage affects on apple quality at retail level

As the apple quality is deteriorated due to several reasons indicated in Figure 28. Therefore retailers are suffering 5 % from losses of their produce during storage. Total retail loss is 9.9 % (4.9 % during re-sorting and grading and 5 % during storing their apples).

4.5 Supporters (DAIL, FI and ROP extension services)

Directorate of Agriculture, Irrigations and livestock (DAIL) is providing extension services to the apple growers in the Nerkh district. All of their services cover the pre-harvest practices at production level. DAIL is acting as a coordinating and facilitating body between NGO's (FI and ROP). The only post-harvest services that they are providing to the farmers are training of the farmers about the drying methods of the apricots. Table 12 shows some of their activities and needs regarding the post-harvest practices of apples.

Table 12: Answer of some questions during interview of the extension department

Question	Answer
How often do you visit the farmers?	Once every week
What types of services do you generally provide when you visit the farmers?	Training them about the grafting and budding of the trees, pruning, pest and diseases control as well as how to make and apply lime sulfur. Coordination between farmers and NGO's
What kinds of services/supplies do you provide related to post-harvest practices?	Training of the farmers how to dry their apricots, especially use of sulfur for drying apricots.
What are the problems you think as an extension worker that the farmers have in regards to post-harvest processes?	Lack of knowledge about post-harvest practices (e.g. harvesting, sorting, grading, packaging and storing), unavailability of cold storage facilities,
What are the problems you feel you have as an extension worker?	Security is the main problem; they have limited knowledge and skills about the post-harvest practices as they did not attend any training about the post-harvest of horticultural crops.

During interview with DAIL extension workers, they expressed that they never been to the markets to ask the traders about their problems and needs. Thus they are not providing any kinds of services to the trader. The only activity that they are doing is coordination/facilitation between traders and NGO's. However, they mentioned that FI has conducted a need assessment survey in Wardak province, which covered the needs of the extension workers, farmers as well as traders at DAIL office. Table 13 shows the result of the interview with FI Agriculture officer, which is indicating that all of their services cover the pre-harvest practices.

Table 13: Answer of some questions during interview of the FI Agriculture officer

Question	Answer
How often do you visit the farmers?	FI has locally community mobilizer from the community who is in close contact with community
What types of services do you generally provide when you visit the farmers?	Training of farmers about the design and layout of the orchards, integrated pest and disease management, irrigation and fertilizers application.
What kinds of services/supplies do you provide related to post-harvest practices?	No services for the moment, but they have some budget from USAID allocated for minimizing post-harvest losses of apples and improvement of apples' quality.
What are the problems you think as an agriculturist that the farmers have in regards to post-harvest processes?	According to him the farmers are affecting from their apples' losses as well as poor quality of their apples supplying to the local and regional markets.
What are the problems you feel you have as an extension worker?	Security is the main problem.

With regards the traders FI representative has mentioned that traders are also encountering from the losses of their produce, due to receiving low quality of apples from the farmers, after harvest.

ROP had a project by the name of Commercial Horticulture and Agriculture Marketing Program (CHAMP), which had about five demonstration orchards in the Nerkh district; they

had conducted only one day training for traders about the marketing of apples (e.g. how to find new markets for their products). Table 14 shows the result of the interview with the ROP extension services department, which is indicating that most of their services covers the pre-harvest practices.

Table 14: Answer of some questions during interview of the ROP extension worker

Question	Answer
How often do you visit the farmers?	Once a month
What types of services do you generally provide when you visit the farmers?	Establishment of demonstration orchards, training the farmers about the integrated pest and disease management, irrigation and fertilizers application.
What kinds of services/supplies do you provide related to post-harvest practices?	ROP has exported 3 MT tons of Nerkh district apples to India by air freight, three days training of the farmers about how to find new markets for their apples.
What are the problems you think as an extension worker that the farmers have in regards to post-harvest processes?	Lack of knowledge about post-harvest practices (e.g. maturity indices, sorting, grading, packaging and storing), lack of cold storage facilities,
What are the problems you feel you have as an extension worker?	Security is the main problem.

CHAPTER 5: DISCUSSION

5.1 General overview

The study results revealed that apple value chain in the Nerkh district of Afghanistan is characterized by the existence of a diver's potential sellers and buyers at the farm gate, local markets, regional markets and retail shops. Apples produced by small scale farmers in the Nerkh district are marketed through three different chains (see Figure 7 in Chapter 4 chain map). The apple growers are selling their products individually possibly because of low marketing knowledge and skills of the farmers. However, it could be also because of their weak economic conditions during the harvesting season.

It can be argued that apple grower, local and regional traders as well as retailers are significantly affecting the post-harvest losses of their apple in terms of quality and quantity/physical losses during harvesting, sorting, grading, packaging, transporting and at storage. Quality losses could be due to immaturity, discolouration, over-ripening and off-flavour in/of the apple and quantity losses are likely due to bruising, decay and rotting. It is noted by (Wills et al., 2007) that quality loss will possibly be arising from physiological changes that result to change in the appearance, colour, flavour and shape of the fruit that is not acceptable to the consumers. Quantity and physical loss also occurs from the mechanical damage and/or pest and disease damage resulting in product tissue being interrupted to a stage where it is not acceptable for fresh consumption or processing.

The level of losses (quality and quantity/physical) is different among chain actors at different stages of the chain (farmers, local and regional traders and retailers). The magnitude of losses for each actor will be discussed separately.

5.2 Farmers

It is acknowledged that the apples' quality loss and quantity/physical loss that farmers are encountering have several reasons from harvesting to the retail level. Figure 29 has stated the different proportion of losses and causes of the losses during harvesting, sorting, grading, packaging and storing that the farmers are affecting from them.

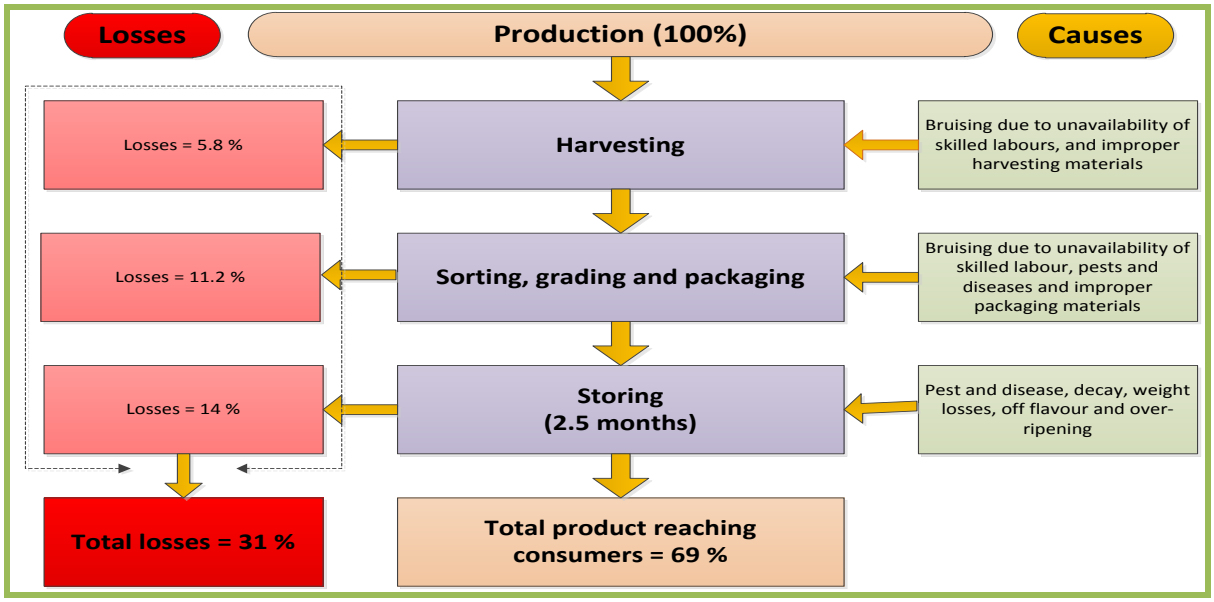

Figure 29: Causes and losses of apples during different practices by farmers from harvest to consumption

5.2.1 Harvesting

There are three major varieties Jawrasi, Golden delicious and Red delicious that are grown in the Nerkh district. Apple growers in the Nerkh district are harvesting their apples earlier, especially the local variety (Jawrasi). It was mentioned by Samadi (2011) head of the horticulture department of Kabul university during personnel communication, that appropriate harvesting time of Jawrasi variety in the Nerkh district is the beginning of August, but the farmers are harvesting it even 20 days earlier, without consideration of quality. Therefore the apples cannot get its optimum weight and shape and resulting to green colour, small size and sour taste (see Figure 30). The reason behind this could be that at this time of year there is no apple production in Afghanistan, and apples that are stored from the last year also have been exhausted in the markets, thus there is a high demand for locally produced apples and the prices are also higher than during the peak supply season.

Figure 30: Immature apples being sold in plastic bags at the road side

It is also important to mention that according to open discussion with the chain actors (especially retailers), who noticed that consumers prefer locally produced apples than the imported apples likely because of their higher quality in terms of sweetness and cheaper price (50 % less than imported once). Moreover, Bruhn (2002) noticed that consumers tend to prefer locally grown produce, due to their perceptions of high quality of local apple and to support the local economy.

It is revealed by the study that all apple growers have a few numbers (10-20) of Jawrasi variety apple trees. However, if this variety is harvested at proper harvest time (August), the quality of the apple will be better in terms of colour (light red), shape (good appearance) and flavour (sweet and juicy), as well as the apples will be resistant against bitter rot and internal breakdown. Besides, it will also not lose weight faster. Similarly, stated by Kvikliene and Valiuskaite (2009) that smaller fruits lose their weight faster because the cuticle of the fruit is not completely developed when the fruits are harvest too early. Thus the pathogen can attacked easily on apples, because the cuticle is the first barrier against pathogens.

It has been well recognized that the quality of Jowrasi deteriorates due to immature harvesting therefore the retailers cannot receive good quality of this apple variety. The other two varieties Golden delicious and Red delicious are also very good quality in terms of taste, size, shape and colour. During their harvesting time there is limited import of apples from Pakistan and Iran, possibly because of high supply and production of apples in Afghanistan.

In case of Golden delicious and Red delicious varieties, the appropriate harvesting time is September and October, respectively. It is also noticed by AKFA (2010) that that harvest time for Golden delicious variety apple is September. Therefore during this study, it was not

the time of harvest for these varieties to realise that whether farmers are harvesting at proper time or not.

Quality loss and deterioration as well as quantity/physical losses start from harvesting of apples. It is possibly due to physical and mechanical damages to fruits resulting from the unavailability of skilled labour as well as improper harvesting materials (barrels and bags), used by farmers. It has been also stated by (Malik *et al.,* 1994) produce may be injured mechanically or by the picker if he/she has long nails, handles the produce in a rough manner, drops the fruit or throws it on the ground. The proper harvesting materials like ladder and baskets could be available in Kabul markets. Due to poor economic conditions of the farmers, their low level of knowledge and skills and probably because of little information about the availability of these harvesting equipments in Kabul due to weak linkages/communications with the traders, the farmers are not able to buy those equipments.

Apples are harvested by hand and placed in attached bag made from cloth fixed besides the picker. Bruising and internal breakdown to the fruits occur possibly because of farmers are using improper harvesting materials. For example they are using empty barrel to pick the fruits from the top of the tree. Sometimes the clothes and/or bags attached besides the picker is hanged on the branches of trees and the apples drop down. The apples are broken down from inside that is not visible on the fruits surface, and it result to decay and rotting during storage and/or bruised or damaged on the surface. As a result, the farmers are losing about 5.8 % of their products due to improper harvesting (see Figure 30). It has been also noted by Mitcheam and Mitchell (2002) that to avoid such bruising, trainings about carefulness and how to manage harvesting of apples become very important for the farmer/pickers.

5.2.2 Washing and cleaning

Results of the study revealed that apple growers are not washing and cleaning their apples after harvesting. They have mentioned that if they wash and clean their product, it will negatively affect the shelf-life of produce and will result to decay and spoilage of apples. They argue that apples covered with dust have longer shelf life than the cleaned and washed apples. It can be established that the dust protects apples from decay and spoilage. Instead it would be possibly because of the fungicides and insecticide used before harvest for elimination of the pests and diseases. On the other hand mis-perception among the farmers could be possibly of the labours low level of knowledge about how to carefully wash and clean the apples and/or because of the dirty and contaminated water and piece of cloth infested by pathogens that they are using for cleaning the apples.

However, if they wash and clean their products carefully by clean water (e.g. chlorinated water), apples shelf-life may extend. It is also indicated by Mitcham and Mitchell (2002) that after harvesting the apples which are often stored in the field storages to wait for packaging might be drenched with a scaled inhibitor and fungicide and/or sometimes treated with calcium chloride for the control of apples bitter pit before storage. It is important to change the drench water every day to prevent the increase of sodium, which could result to fruit burn.

5.2.3 Sorting, grading and packaging

It is acknowledged that all of the apple growers are sorting and grading their apples by size, colour and shape. However, according to author's observation they do not sort and grade especially the local variety (Jawrasi). On the other hand in order to gain better price from different qualities (large size, good appearance vs small size and green), they just dump

high quality apples on the top of the crates and/or plastic bags, and low quality at the middle and bottom of the crates and plastic bags. Therefore, due to the transfer of diseases from the diseased apples to healthy ones, significant quantity/physical losses arise during storage. Thus, retailers and consumers are negatively affected due to buying of such mixed (low and high) quality apples.

Improper packaging materials and un-availability of skilled labours cause bruising during, grading and packaging. This is possibly because of their longer nails, throwing apples from a distance to wooden crates and often the wooden crates and/or plastic and polypropylene bags are over loaded. Such situation has negative effects on prices of apples. For example, apples from Pakistan and Iran that are imported at the time of production of local/Jawrasi variety in the Nerkh district are fetching higher prices (50 % more) than the local varieties, simply because they are packed them very nicely and the appearance of their apples seems better than the locally produced varieties. Figure 31a shows the packed apples imported from Pakistan and Figure 31b shows local packed apples in plastic bags.

(a) **(b)**

Figure 31: Packed apples from Pakistan (a) compare to packed local apples (b)

5.2.4 Storing and transport

The result of this study revealed that apple growers in the Nerkh district do not have access to proper storage rooms (controlled temperature and relative humidity). However, those who are selling their apples themselves (see Figure 7 in Chapter 4), store their apples for duration of 2.5 months (see Figure 29) under room temperature. Most of the quality and quantity losses (see Figure 29) are arising from storage rooms. However, the reasons of these losses could be linked to harvesting, sorting, grading, packaging and even before harvest (as mentioned in previous sections), or to farmers low level of knowledge and skills with regard to local storages ventilation (opening of windows). It is also possibly due to over loading of their local storage rooms.

Ilyas, *et al* (2007) reported that there are more than 90 fungal species causing decay of apples during storage. Figure 17 in Chapter 4 also revealed that quantity and quantity loss of apples is mostly due to attack of pest and diseases in the local storage rooms. This is possibly due to removing of the pedicle[8] of the apple, during harvesting, sorting, grading and packaging. Apples that are harvested with pedicle could be kept longer than those which are without pedicles. It is likely because, of the water losses that ultimately resulted to quality and quantity losses when storing, because of losses of the moisture ultimately resulted to shrivel, shrinkage, off-flavour, and weight losses of the apples. Therefore quality of apples

[8] Pedicle is a small stem that is attached to the fruit.

has been deteriorated and thus retailers and consumers are receiving low quality apples, in terms of healthy, un-damaged and un-spoiled apples.

Decay and rotting are also likely because of pests and diseases that have attacked the fruits before harvest, which are not visible during harvest time but after harvest it would resulted to decay and spoilage in the storages also transmission of diseases from the spoiled and diseased fruits to the healthy ones at storage is another reason for fast decay of fruits. It has been also indicated by Thompson (2003) that fruits are infected with microorganisms or infested with pests along the production season. They may be on or in the fruits at harvest and taken into storage or through the marketing chain. Almost all of the post-harvest pests are originated from field contaminations, and if the storage conditions are favorable they can raise on or in the fruit. To avoid decay and spoilage in the storage it is important to clean and wash apples with chlorinated water, take care of broken and bruised apples during harvesting, not packing injured and bruised apples with healthy ones and avoid re-using of packaging materials.

Farmers do not store local variety (Jawrasi), due to its limited shelf-life in the storage. While, the other two varieties (Golden delicious and Red delicious) have long shelf life (Golden delicious can be kept up to December and Red delicious even up to January), at room temperature. It has been also stated by AKFA (2010) that Golden delicious variety can be kept naturally until December. Therefore if the farmers take well care of post-harvest handling Golden delicious can be kept up to December and Red delicious kept even up to January without any losses. Thus local/regional traders and retailers will get better quality apples.

Table 18 in Chapter 4 indicated that there are no quantity and quality losses during transportation. However, there could be losses during loading and unloading of crates, polypropylene sacks and plastic bags, but they cannot realise such losses due to their low level of knowledge and skills. They imagine that quality deterioration and losses are from sorting, grading, packaging and/or storing alone.

5.2.5 Marketing

As mentioned earlier the apples growers in the Nerkh district are selling their apples through three different channels. Table 9 in Chapter 4 has shown that the average selling price for those farmers who are selling their product before harvest and after harvest at farm gate is much lower than those who are selling themselves to the market. It is possibly because of their low bargaining power as well as their low information about the prices at Kabul and other regional markets. However, it is mentioned earlier (see Figure 7 chain map) that local and regional traders are providing information about the prices in the market, but the average prices (see Table 9 in Chapter 4) resulted that they might provide wrong information. This is possibly because of their own benefits and to keep themselves powerful in the chain and low bargaining power of the farmers.

Those farmers, who keep their products in their local storage rooms and sell them after, could be due to their room's availability and/or have more labours in their family. It is also possibly due to their other sources of income such as livestock rearing and/or shop keeping. While those who are selling their products before harvest and or after harvest could be due to their limited source of income and they only rely on their farm production. It could be also due to their poor economic status that they are not able to pay for labours during post-harvest handlings.

5.3 Local and regional traders

Results of the study indicate that the local traders are involved only in harvesting, sorting, grading and transporting their products to local and regional markets. They do not store their products. This is likely because they do not have shops to store or they are multi functionaries' (e.g. trading of different fruits and vegetables). However, the regional traders besides the post-harvest handlings also store their products for about 4 months (see Figure 32). Therefore they are encountering more than the local traders. Figure 32 indicate the causes and losses that local and regional traders are incurring in each step of the post-harvest practices.

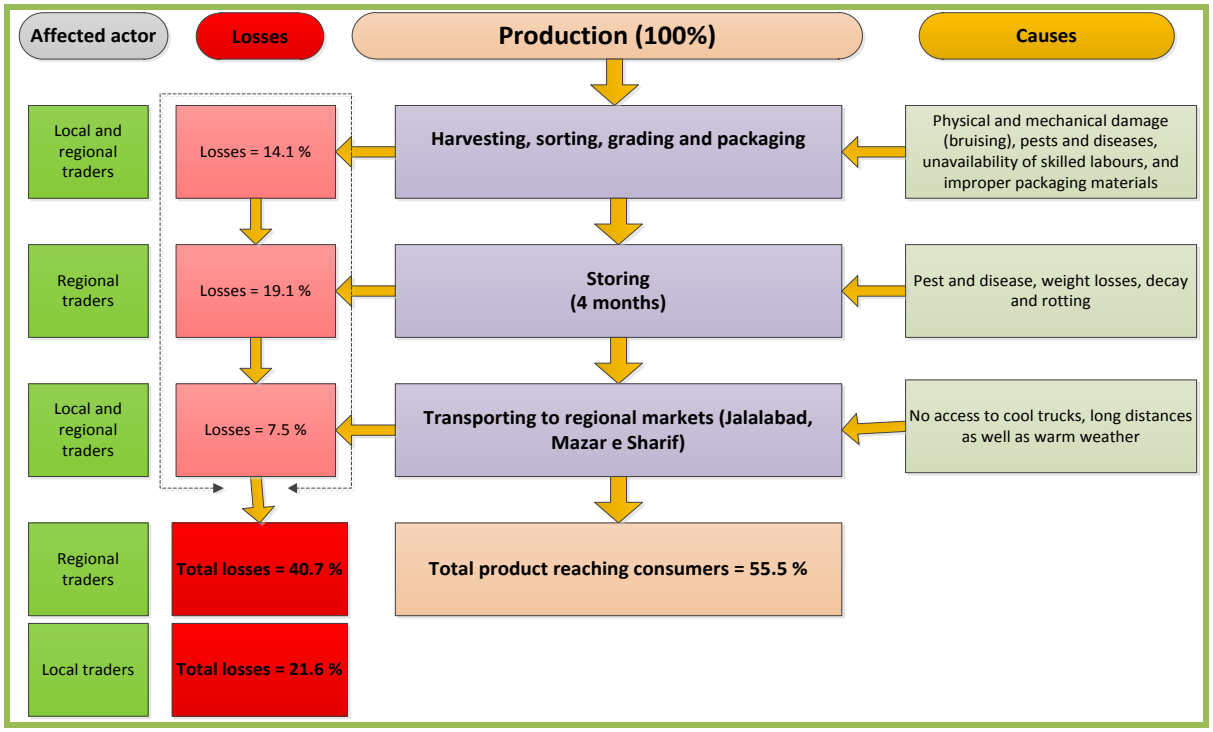

Figure 32: Causes and losses of apples during different practices from harvest to retail shops by traders

Regional traders are encountering from the quality deterioration and physical losses from bruising, pests and diseases, decay and rotting, improper packaging materials, resulting to 40.7 % of losses from the total products that they purchased from the farmers on the trees before harvesting.

It has been acknowledged that both the local and regional traders are affecting due to non-availability of skilled labours during harvesting, sorting, grading and packaging (see Figure 32). However, there could be skilled and experienced labours in Kabul and/or other districts of Wardak province, who know how to handle the post-harvest practices, but they could not employ them because of their very high expectation of daily which is much higher than the non-skilled local labour (e.g. 600 Afs/day compared to local unskilled labours 250 Afs/day).

Bruising is possibly because of labours' low level of knowledge and little care during post-harvest practices e.g. damaging of apples due to their long nails, throwing apples from a distance to the crates. It is also might be because of improper packaging materials such as plastic bags, re-used wooden crates and polypropylene sacks. Wooden crates and card board boxes are imported from Pakistan, therefore the wooden crates and card board boxes are very costly (50 Afs/wooden crate) and thus the traders are re-cycled wooden crates especially the local trader when they transport their products to Kabul market and sell to the regional traders.

Regional traders are more affecting than the farmers especially during storing products (after storing when they re-sort and re-grade apples). It is possibly the weather of Kabul wholesale market is warmer than the Nerkh district. On the other hand it is also likely because of more contamination e.g. dust in Kabul wholesale market than the villages. It could be also because the apple growers after harvesting their products, dumped the apples inside the orchards under the shade of the trees for a week as a "pre-cooling". It is also noticed by (Wills *et al.,* 2007) that harvested produce should be kept shaded either by natural (e.g. tree canopy) or artificial means (e.g. tarpaulins). It is also possibly due to longer storage duration of the regional traders (4 months) than the farmers (2.5 months). The local and/or regional traders after harvesting their products, sort, grade and pack, and then directly transport to local and or regional/Kabul wholesale markets without dumping under the shade of the trees as the farmers do.

Traders have the problems of pests and diseases during sorting, grading packaging and storing of their products. This is possibly because of the infected fruits by diseases and pests which the traders cannot segregate and therefore resulting to decay and rotting during storage. It is also likely because of improper re-loading and unloading by labours as well as over stacking/loading of the wooden crates and/or polypropylene bags.

Rotting/decay and bruising possibly also due to long distance hauling to the regional markets such as Mazar e Sharif (10 hrs) and Jalalabad (6 hrs), and the non-availability of cool trucks to haul such distance.

5.4 Retailers

The study result shows that the retailers do not harvest apples. They re-sort and re-grade their products when they purchase from the farmers, local and regional traders. Therefore, during re-sorting and grading they are facing with problems of separating the high quality (large size, better colour and appearance) from the low quality (small size and green) because the consignments they receive from the farmers and traders mixed. It is possibly because that the farmers and traders want to get better price from different qualities mixed together. Figure 33 show some of the problems and causes of the quality deterioration at retail level.

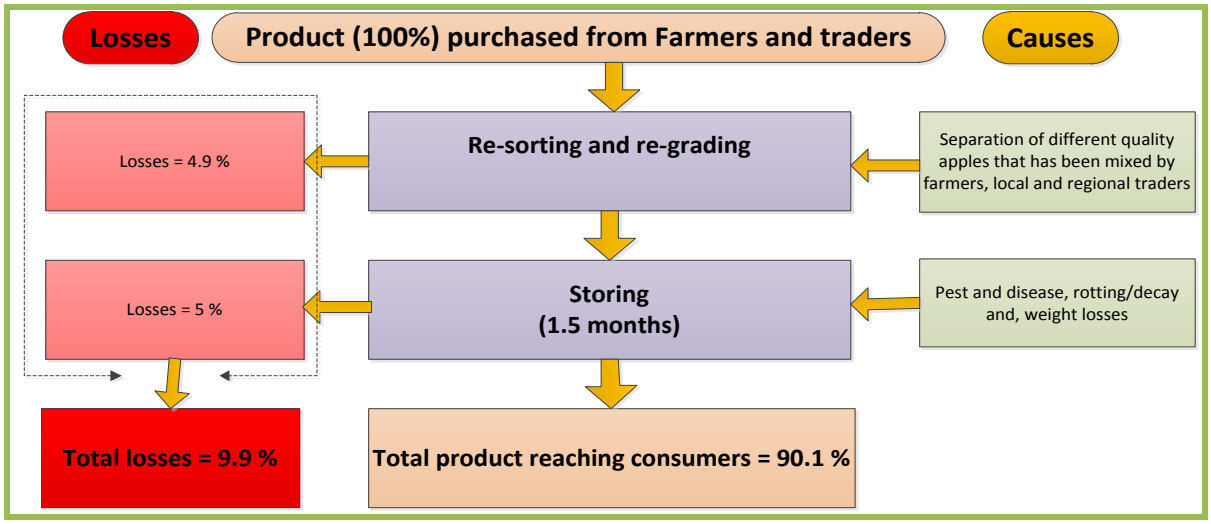

Figure 33: Causes and losses of apples during different practices by retailers

Figure 33 indicates that retailers are affecting from the quality and quantity losses of their products resulting to (9.9 %) losses during re-sorting, re-grading and storing, which is lower than the farmers and traders. It is possibly because, they are dealing with less quantity of

apples than the farmers and traders and thus they can handle them well. Also they store their products for only 1.5 months.

5.5 Supporters (DAIL, FI)

Directorate of Agriculture, Irrigation and Livestock (DAIL) and FI are engaged in provision of pre-harvest services to the farmers. These pre-harvest services are focused more on trainings at different level of productions (e.g. demonstration orchards, training of farmers about pruning, budding, grafting, integrated pest and disease management, irrigation and fertilizers application). Therefore, at the production level the farmers are well trained and are able to produce good quality and quantity of apples and other fruits.

Unfortunately, very little attention is paid by the supporting NGOs to post-harvest services. As a result, the farmers, local and regional traders are not good in post-harvest practices and face post-harvest qualitative and quantitative losses. It is a good time for the supporting NGOs to help farmers, local and regional traders to improve their post-harvest practices to reduce the post-harvest losses. The potential areas where DAIL and FI can help are proper harvesting time and improved harvesting techniques such as taking care that do not harvest immature (small size and green colour) apples, avoiding to remove pedicle (stem attached with the fruit) during harvest. Moreover, proper sorting, grading, packing such as prohibit mixed (low and high) quality packing of apples and storing techniques for example ventilation consideration by opening the window of their local storage rooms.

The extension department of DAIL has extension workers but they are not well trained in post-harvest handlings of produce. Their level of knowledge and skills are limited to the pre-harvest level. The DAIL department itself should pay attention to train their extension staff in post-harvest handlings. The extension officers will then help the farmers in improving their post-harvest practices.

Recently FI has found some budget from USAID to help apple growers, local and regional traders to improve their post-harvest handling. The potential areas for FI to take intervention in post-harvest handling are provision of trainings in proper harvesting, packing, grading, sorting and storing. FI can also help the extension department of DAIL to improve their knowledge and skills in post-harvest handling to make them capable enough to provide extension services to the farmers in post-harvest handling.

5.6 SWOT analysis

A SWOT analysis is useful tool for analysing the post-harvest practices (harvesting, sorting, grading, packaging and storing) of apples in the Nerkh district. Table 15 shows strengths, weaknesses, opportunities and threats of the apples post-harvest practice.

Table 15: SWOT analysis of the Nerkh district apples' post-harvest practices

Strengths	**Weaknesses**
• Potentially excellent climatic condition for apple production • Quality of local variety apple is good and valued before harvest • Availability of adaptable varieties (Golden and Red delicious) • High price of apples during harvesting of local varieties	• Unavailability of skilled labours for harvesting, sorting, grading and packaging • High wages of skilled labour • Low price before harvest • Low bargaining power of the farmers • Unavailability of harvesting materials • Improper packaging materials • Insufficient market information • Mistrust among actors
Opportunities	**Threats**
• Agencies (FI) and DAIL is interested to support this area • High demand for locally produced apples • Export opportunity for Red delicious variety • Potentially higher shelf-life of Golden and Red delicious varieties • Availability of chlorine	• Improper storage rooms • Lack of post-harvest management services by chain supporters DAIL and ROP • High competition of Imported apples from Pakistan and Iran with local variety • Different pre-harvest and post-harvest diseases and pests

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study examined the apples post-harvest practices from harvest to retail level. Based on the discussion it is acknowledged that the post-harvest problems and losses such as quality losses through physiological changes like off-flavour, over-ripening and rotting are in each stage of the post-harvest practices namely; harvesting, sorting, grading, packaging, transporting and storing. However, farmers are not affected by transportation of their apples from their orchards to the local and Kabul markets while local and regional traders' products quality is deteriorating when they are transporting to the regional markets (e.g. Jalalabad and Mazar e Sharif).

The harvesting techniques used by farmers, local and regional traders were based on their poor local knowledge and resources which contributed in both qualitative and quantitative losses of apples. Moreover, cleaning and washing is not often practiced by farmers, the improper sorting, grading, and packing (over packing) and packaging materials (especially plastic, re-used wooden crates and polypropylene bags) were also contributing in the losses.

Local and regional traders are usually buying their products before and/or after harvest on spot. There is mistrust, low coordination and cooperation between farmers and traders, which resulted that farmers cannot get optimum prices from their products.

The storage stage of the post-harvest practices contributed mainly to the losses of apples both at famer and trader level. The local variety apples are immediately marketed after the harvest by the farmers while the improved variety apples were dumped under the trees in the orchard for a week or more which contributed to longer shelf-life of apples than those which are harvested and directly sort, pack, transport and store by regional traders. At the farm level apple were stored in their locally made rooms that are not actually made for storage purpose while at the trade level (Kabul) the apples were stored in local shops in the market without cooling facilities and were subjected to extremely high losses. However, the local traders do not store their products; therefore no losses have been noticed by local traders.

Since farmers and traders have limited knowledge and skills about post-harvest practices. They are not taking care of their products during harvesting, sorting, grading, packaging and storing. Therefore they are affecting from both quality and quantity losses of their products during storage.

Losses during transportation of the products were noticed by local and regional traders, when they are transporting to regional markets (Jalalabad and Mazar e Sharif). The prolonged distance from one to other market, traffic jam as well as improper loading, unloading and overloading were the main causes of losses during the transportation. However, the farmers did not notice any losses during transportation because they were selling their produce in nearby markets such as local (district and provincial) and Kabul. Re-sorting and grading of the apples to throughout the decayed/rotted or poor quality produce was a common practice at the retailer level.

DAIL extension workers as well as other NGO's like FI does not pay attention to train farmers on post-harvest practices. They usually concentrate on pre-harvest trainings and demonstration orchards. Therefore, chain actors encounter significant post-harvest qualitative and quantitative losses. On the other hand DAIL directorate extension workers have limited knowledge and skills about post-harvest practices as they did not receive any training themselves. However, the potential areas where FI and DAIL directorate can support

the farmers and traders are appropriate harvesting time and methods as well as proper sorting, grading, packaging and storing techniques. Recently USAID has donated FI some budget to help apple growers, local and regional traders as well as retailers to improve their post-harvest practices. The post-harvest potential area for intervention of FI is provision of trainings to the chain actors as well as DAIL extension workers to improve their knowledge and skills in post-harvest practices.

It can be concluded that post-harvest losses in apples occur at harvesting, sorting, grading, packaging, transporting and storing stages. However, the maximum losses were noticed at the storing stage. There were several reasons behind the post-harvest losses which included poor harvest techniques, poor harvesting resources, improper packing, packaging materials, overloading, prolonged transportation to Jalalabad and Mazar markets and poor storing facilities.

6.2 Recommendations

In the focus areas of this study, low level of knowledge and skills of farmers, local and regional traders and retailers with regard to post-harvest practices and unavailability of cold storage rooms are the key constraints for reducing the post-harvest quality and quantity losses of apples. To deal with these current challenges the following themes are suggested.

Training of the Farmers and traders by FI: To reduce the physical losses and protect the quality of apples, awareness and training of the farmers and traders is very important about some basic and simple information such as:

- ✓ Importance of appropriate harvesting time especially for local variety apples (beginning of August) that can contribute to improve the colour, flavour and size. Besides appropriate harvesting time can avoid from bitter rot and internal breakdown.

- ✓ Importance of proper picking/harvesting methods of apples: Avoid from removing of pedicle (stem attached to apple) that can help to reduce the losses (quality and quantity) by maintaining the freshness and reducing water losses. Besides cutting of nails can be reduced bruising not only during harvest but also during sorting, grading and packaging is very important. Therefore it helps to longer shelf-life of the product.

- ✓ Importance of cleaning and washing methods by chlorinated water after harvesting will contribute to longer shelf-life due to prevention of disease transmission from diseased apple to healthy ones.

- ✓ Importance of proper sorting, grading and packaging methods of apples: Avoidance from mix packing can contribute from dissemination of diseased fruits to healthy ones.

- ✓ Importance of ventilation of their local storage rooms: air circulation by opening the windows for removing of heat and flow of oxygen helps the apples to be kept longer in the storage rooms.

Suggested Interventions for FI at farm level: As unavailability of cold storage rooms are the key constraints for reducing the post-harvest losses, therefore besides trainings it is recommended to:

- ✓ Construct local storage rooms as a model with locally available materials such as brick and wooden beams with bringing little bit improvements to compare with their local storage rooms. For example these storage rooms should be built 1 meter higher from the ground surface, should have smaller windows 0.60m*1m in the north

and south directions for ventilation purpose. However, the existing storages are not for the purpose of apple storing. Therefore their windows sizes are usually 2m*2m that also lead directly sun-shine inside the rooms. This model storage room can contribute to reduce the losses and on the other hand the farmers can copy easily, because the construction materials are locally available and on the other hand it is not costly.

- ✓ It is also suggested to FI that undertake to distribute some locally available harvesting tools such as ladders and fruit baskets for harvesting to avoid physical injuries such as bruising and damage of fruits during harvesting that will contribute to reduce decay and losses during storage.

- ✓ To enhance the farmers knowledge and skill distribution of some printed brochures and booklets showing the harvesting, sorting, grading and packaging methods practically.

Suggested Interventions for FI to improve bargaining power of the farmers: To reduce mistrust and improve coordination and cooperation among the farmers and traders it is necessary to organize farmers into marketing association/cooperatives that can help farmers for two reasons. First farmers can improve their bargaining power in the markets and secondly farmers can get prices information from different markets in Afghanistan by sending one of the cooperative members to other markets that allows farmers to move their products from one part of the country to another to take advantage of price differences between markets.

Recommendation for retailers: To reduce losses during storage is recommended for retailers that take care of hygiene of their storages/shops for example removing the wastes of their other products.

Directorate of Agriculture, Irrigation and Livestock (DAIL): It is suggested to DAIL directorate that pays more attention to post-harvest practices besides the production level practices. It could be done by contacting donors such as USAID, World Bank, Asian Development Bank to concentrate on post-harvest practices. These donors are interested to promote the fruits sector in Afghanistan. Therefore they can contribute to minimize the post-harvest losses by providing of trainings to DAIL extension workers. The extension workers will then support the farmers in improving their post-harvest practices.

The above recommendations are given to related actors in the Nerkh district apples post-harvest chain to minimize the post-harvest losses and contribute to improve the quality of apples.

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ANNEXES

Annex 1: Growers questionnaire

Name of interviewer_____ Date of interview _____/_____/_____

1. **Particular of the grower/local traders**
   a) name of farmer_____ village name_____
   b) Age_____years. Qualification _____
   c) Distance of orchard from the main road _____km.
   d) Distance of orchard from markets: local____ km regional_____km.

2. **Tenure status and size of holding (Jerib)**
   a) Owner Share orchards Tenant
   b) Area owned _____ Area rented _____ Total area operated_____
   c) Size of orchard_____
   d) Number of tree/ Jerib_____
   e) Which variety of apples do you grow?
   a. _____ b._____ c._____ d._____

3. **Input supply**
   a) From where do you get your inputs? (Tick mark only)
      a. tree saplings: (Kabul) (district) (province)
      b. fertilizers and agro-chemicals: (district market) (provincial market) (Kabul market)

4. **Yield and losses of apples**
   a) Approximate yield/ tree_____kg
   b) Total losses of apples _____%

5. **Harvest and maturity of apples**
   a) Do you harvest? Yes ( ) no ( )
   b) If yes, how do you harvest?
      a. By hand b. shaking the tree
   c) Harvesting time _____
   d) How do you know the harvesting time/maturity of apples? (Tick mark only)
      a. By colour b. by size c. by taste
      d. others (please specify)_____
   e) What are your problems in harvesting? (Tick mark only)
      a. Non availability of skilled labor
      b. Absence of harvesting equipments
      c. Others (please specify)_____
   f) Are there any losses when harvesting/picking? Yes ( ) no ( )
   g) If yes, how much will be the losses? (%) ( )
   h) Are there any affects on quality? Yes ( ) no ( )
   i) If yes, how? (Tick mark only)
      a. bruising b. nail damaging c. both

d. others (please specify)_____

6. Post-harvest processes of apples

Cleaning and washing

a) Do you clean or wash your products? Yes ( ) no ( )
b) If yes, how? (Tick mark only)
   a. by water b. by hand
   c. others (please specify)_____
c) Is it affecting the quality of your product? Yes ( ) no ( )
d) If yes, how? (Please specify)_____

Sorting and grading

a) Do you perform sorting and grading? Yes ( ) no ( )
b) If yes, how? (Tick mark only)
   a. By size b. by colour c. by shape d. all
   e. others (please specify)_____
c) What kinds of problems do you face in sorting and grading?
   a. Non availability of skilled labor b. high skilled labour cosot
   c. both d. others (please specify)_____
d) Are there any losses when sorting and grading? Yes ( ) no ( )
e) If yes, how much will be the losses? (%) ( )

Packaging

a) Do you perform packaging? Yes ( ) no ( )
b) If yes, which kinds of packaging materials do you use? (Tick mark only)
   a. Wooden crates
   b. Cardboard boxes
   c. Plastic bags
   d. Polypropylene bags
   e. Others (please specify)_____
c) From where do you buy? (Tick mark only)
   a. Locally available
   b. From district/provincial markets
   c. From regional markets/Kabul
   d. Others (please specify)_____
d) What kinds of problems are you facing in packaging? (Tick mark only)
   a. Non availability of skilled labor
   b. Non availability of packing materials
   c. High cost of packing materials
   d. Others (please specify)_____
e) Are there any losses when packaging? Yes ( ) no ( )
f) If yes, how much will be the losses? (%) ( )

Storing

a) Do you have storage? Yes ( ) no ( )
b) If yes, which kinds of storage do you have? (Tick mark only)
   a. Local b. improved others (please specify)_____
c) How much is the storage capacity? MT ( )
d) For how long do you store? Months ( )

e) Is it affecting the quality of your product? Yes ( ) no ( )
f) If yes, how? (please specify)_____
g) Before storing do you perform pre-cooling? Yes ( ) no ( )
h) If yes how? _____
i) Are there any losses when storing? Yes ( ) no ( )
j) If yes, how much will be the losses? (%) ( )
k) Is it affecting quality? Yes ( ) no ( )
l) If yes, how? (Tick mark only)
   a. weight losses b. pest and disease e. decay/rotting
   f. rodents d. others (please specify)_____

Transporting

a) Do you transport your products? Yes ( ) no ( )
b) How do you transport your product to the markets?
   a. By truck b. by other vehicles (please specify)_____
c) Is it affecting the quality of your product? Yes ( ) no ( )
d) If yes, how?
   a. Bruising b. rotting c. others (please specify)_____
e) Are there any losses when transporting? Yes ( ) no ( )
f) If yes, how much will be the losses? (%) ( )

7. Selling mode of apples

a) To whom do you sell? (Tick mark only)
   a. Traders in district/provincial town ( )
   b. Traders in Kabul ( )
   c. Retailers in provincial/Kabul town ( )
   d. Directly to the consumers ( )
   e. Others (please specify)_____
b) When do you sell? (Tick mark only)
   a. Before harvest (traders are doing the harvest) ( )
   b. At harvest time (I do the harvest) ( )
   c. After harvest (I store the product and deliver to the markets ( )
   d. Others (please specify)_____
c) How much is the price per ser?
   a. Before harvest? ( ) b. at harvest time? ( ) c. after harvest? ( )
d) When do you get paid? (In %)
   a. I get paid in advance ( )
   b. I get paid cash when I deliver the product ( )
   c. Any other time (please specify)_____
e) How is the price agreed upon? (Tick mark only)
   a. I sell my product for an agreed, standard price not respective of quality
   b. I get paid according to quality
   c. Both
f) Where do you get information about the market prices?
   a. From neighbour farmers
   b. From traders
   c. From the local markets
   d. From extension workers
   e. From the media (radio, television)
g) Do you try to find new markets for your product? Yes ( ) no ( )

Annex 2: Retailer questionnaire

1. Respondent identification

Name _____address_____
Telephone no_____

2. Purchasing of apples

a) From whom do you buy? (Tick mark only)
   a. Local traders
   b. From the market
   c. Directly from the farmers
b) How is the price agreed upon? (Tick mark only)
   a. We agree on an average price per ser (7kg), measure total production and calculate the prices
   b. We agree price/ser for each grade, measure each grade and pay accordingly
   c. We agree upon current price in the market

3. Quality of apples

a) What are the quality criteria of consumers? (Tick mark only, and variety should be specify)

Quality criteria	High quality	Medium quality	Low quality
Variety			
Size			
Colour			
Taste			
Shape			
Ripeness			

4. Sorting and grading of apples

a) Do you perform sorting and grading? Yes ( ) no ( )
   a. If yes, how? a. by size b. by colour c. by variety d. shape
b) Are there any losses when sorting and grading? Yes ( ) no ( )
c) If yes, how much will be the losses? (In %) ( )

5. Storing

b) Do you have storage? yes ( ) no ( )
c) If yes, which kinds of storage do you have?
a. Local b. improved
   c. others (please specify)_____
d) Do you control the temperature and relative humidity of the storage? yes ( ) no ( )
e) How much is the better temperature? (^{0}C) ( )
f) How much is the best relative humidity? (%) ( )
g) How much is the storage capacity? MT ( )
h) For how long do you store? Months ( )
i) Is it affecting the quality of your product? Yes ( ) no ( )
j) If yes, how? (Tick mark only)
   a. weight losses b. pest and diseases c. rodents
   d. others (please specify)_____
k) Are there any losses when storing? Yes ( ) no ( )
l) If yes, how much will be the losses? (%) ( )

Annex 3: Regional/local traders Questionnaire

Name of interviewer_____ Date of interview ____/_____/_____

1. Respondent identification

Name of trader_____ address _____
Age_____years. qualification _____
Telephone no _____

2. Purchasing of apples

a) When do you buy? (Tick mark only)
   a. Before the harvest (I do the harvest) ( )
   b. I buy at the farm gate (after farmer harvested) ( )
   c. Farmer deliver to me after harvest ( )
   d. Farmer stores and delivers later ( )

b) How is the price agreed upon? (Tick mark only)
   b. I assess the yield before buying the whole orchard for an agreed price
   c. We agree on an average price per ser (7kg), measure total production and calculate the prices
   d. We agree price/ser for each grade, measure each grade and pay accordingly
   e. We agree upon current price in the market

c) Do you have a contract about the buying deal? (Tick mark only)
   a. Yes, a written contract
   b. Yes, an oral contract
   c. No specific contract, only a general understanding that I will buy from him

d) When do you pay? (In %)
   a. I pay in advance ( )
   b. I pay when I get the product ( )
   c. Any other time (please specify)_____

3. Quality of apples

b) What are the quality criteria? (Please specify)

Quality criteria	High quality	Medium quality	Low quality
Variety			
Size			
Colour			
Taste			
Shape			
Ripeness			

4. Sorting and grading of apples

d) Do you perform sorting and grading? Yes ( ) no ( )
   a. If yes, how? a. By size b. by colour c. by variety d. shape

e) What kinds of problems do you face in sorting and grading?
   a. Non availability of skilled labor
   b. Others (please specify)_____

f) Are there any losses when sorting and grading? Yes ( ) no ( )

g) If yes, how much will be the losses? (%) ( )

5. Packaging

a) Do you perform packaging? Yes ( ) no ( )

b) Which kinds of packaging materials do you use?

f. Wooden crates
g. Cardboard boxes
h. Plastic bags
i. Polypropylene bags
j. Others (please specify)_____

c) From where do you buy?

a. Locally available
b. From other provincial markets
c. Others (please specify)_____

d) What kinds of problems are you facing in packaging?

a. Non availability of skilled labor
b. Non availability of packing materials
c. High cost of packing materials
d. Others (please specify)_____

e) Are there any losses when packaging? Yes ( ) no ( )

f) If yes, how much will be the losses? (%) ( )

6. Storing

m) Do you have storage? Yes ( ) no ( )

n) If yes, which kinds of storage do you have?

a. Local b. improved
c. others (please specify)_____

o) Do you control the temperature and relative humidity of the storage? Yes ( ) no ( )

p) How much is the better temperature? (^{0}C) ( )

q) How much is the best relative humidity? (%) ( )

r) How much is the storage capacity? MT ( )

s) For how long do you store? Months ( )

t) Is it affecting the quality of your product? Yes ( ) no ( )

u) If yes, how? (Tick mark only)

a. bruising b. pest and diseases c. rodents d. chilling injury
e. others (please specify)_____

v) Are there any losses when storing? Yes ( ) no ( )

w) If yes, how much will be the losses? (%) ( )

7. Transporting

g) How do you transport your product to the markets?

a. By cool truck b. by other vehicles (please specify)_____

h) Is it affecting the quality of your product? Yes ( ) no ( )

i) If yes, how?

a. Bruising b. rotting c. others (please specify)_____

8. Selling mode of apples

b) To whom do you sell? (In %)

b. Traders in Jalalabad, Mazar and Herat provinces ( )
c. Traders in Pakistan ( )
d. Others (please specify) ( )

c) Do you try to find new markets for your product? Yes ( ) no ( )

d) If yes, where (please specify)_____

Annex 4: Checklist for extension workers of DAIL and NGO

Name of interviewer_____ Date of interview ____/_____/_____

1. Respondent identification

Name of extension worker_____ department_____
Qualification _____telephone no _____
Email add_____

2. Services to the farmers

a) How often do you visit the farmers?
b) What types of services do you generally provide when you visit farmer?
c) What kinds of services/supplies do you provide related to post-harvest practices?
d) What are the problems you think as an extension worker that the farmers have in regards to post-harvest processes?
e) What are the problems you feel you have as an extension worker?

3. Services to the traders

a) How often do you visit?
b) What types of services do you generally provide when you visit traders?
c) What kinds of services/supplies do you provide related to post-harvest practices?
d) What are the problems you think as an extension worker that the traders have in regards to post-harvest processes?
e) What are the problems you feel you have as an extension worker?

Annex 5 Selling modes of farmers, local and regional traders

A: Selling mode of farmers in the Nerkh district

To whom do you sell?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Local traders	14	46.7	46.7	46.7
	Regional traders in Kabul	5	16.7	16.7	63.3
	Retailers	3	10.0	10.0	73.3
	Directly to consumers	3	10.0	10.0	83.3
	All	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

Annex 5 B: Local traders selling mode of apples in the Nerkh district.

To whom do you sell?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Traders in Kabul	3	50.0	50.0	50.0
	Traders in Jalalabad/Mazar	1	16.7	16.7	66.7
	Retailers	1	16.7	16.7	83.3
	All	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

Annex 5 C: Regional traders selling mode of apples in the Nerkh district.

To whom do you sell?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Traders in Jalalabad/Mazar	2	33.3	33.3	33.3
	Retailers	2	33.3	33.3	66.7
	Treders in Pakistan	1	16.7	16.7	83.3
	All	1	16.7	16.7	100.0
	Total	6	100.0	100.0	

Annex 5: Field picture