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Master thesis

Study of value chain of apple in Mustang and Jumla district of Nepal

Undersøkelse av verdikjeden i epleproduksjon i distriktene Mustang og Jumla i Nepal

Sustainable Agriculture

(2018)

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CONVERSION

Currency

The unit of currency used throughout the thesis is Nepalese Rupees (Rs)

The currency exchange rate of Nepalese rupee to United States Dollar on January 1 2018 was:

1 USD = Rs 102.64679

1 Rs = 0.00974

Area

The unit of area used in this thesis is ropani. It is a unit of land measurement commonly used in Nepal although the value may differ within some region of Nepal.

1 hectare = 20 ropani

1 ropani = 0.05 hectares

1 ropani = 500 sq. Meters

ACRONYMS

AEC	Agro-Enterprise Centre
AP & MDD	Agribusiness Promotion and Marketing Development Directorate
B/C ratio	Benefit Cost ratio
CBS	Central Bureau of Statistics
DADO	District Agriculture Development Office
DCCI	District Chambers of Commerce and Industry
DFO	District Forestry Office
DLSO	District Livestock Services Office
DoA	Department of Agriculture
FAO	Food and Agriculture Organization
FDD	Fruit Development Directorate
FGD	Focus Group Discussion
GCC	Global Commodity Chain
GDP	Gross Domestic Product
GoN	Government of Nepal
HH	Household
HRS	Horticulture Research Station
HVAP	High Value Agriculture Project in Hill and Mountain Areas
JAPC	Jumla Apple Processing Center
JHRS	Jumla Horticulture Research Station

LARFs	Local Agricultural Resource Farmers
MDD	Marketing Development Directorate
MoAC	Ministry of Agriculture and Cooperatives
MoAD	Ministry of Agriculture Development
MoALC	Ministry of Agriculture, Land Management and Cooperatives
NARC	Nepal Agricultural Research Council
NGO	Non-Government Organization
NHPC	Nepal Horticulture Promotion Centre
NPHC	National Population and Housing Census
OCN	Organic Certification Nepal
RAP3	Rural Access Programme 3
RD	Regional Directorate
SEM	Standard Error Mean
SNV	Netherlands Development Organization
USAID	United States Agency for International Development
WVIN	World Vision International Nepal

ENGLISH SUMMARY (ABSTRACT)

A study was conducted on the value chain of apple in two apple producing mountainous districts of Nepal: Mustang and Jumla. The study focused on increasing the access of rural farmers to the market by identifying the actors of the value chain and the problems and prospects associated with apple production and marketing.

The survey with 30 apple producers in each district along with the survey of the market actors was done in December 2017 and January 2018 with a semi-structured questionnaire. The contribution of apple production in the household economy was found to be 68.27 % in Mustang district and 44.8% in Jumla district. The cost of production of apple per kg was found to be Rs 47.24 and 19.53 per kg in Mustang and Jumla respectively. Labour cost was found to be the highest factor for the cost of production of apple in both the districts with a total share of 68% and 64% in Mustang and Jumla respectively. The other factors of cost of apple production analyzed were cost of fertilizer, plant protection and farm equipment.

Economic analysis revealed that the benefit cost ratio for production of apple in Mustang and Jumla were 1.98 and 2.44 respectively. Marketing margin was Rs 95.33 per kg in Mustang and Rs 107 per kg in Jumla district. Similarly, producer's share was 47.03% in Mustang whereas only 28.67% in Jumla.

The major problem for production of apple in both the districts was found to be the disease and pest infestation requiring a good consideration from the concerned authorities. The study was concluded with identifying the apple production as a viable option to the farmers from the rural high lands of Nepal with a need of further development in the marketing system of apple.

NORWEGIAN SUMMARY

En studie er gjennomført for å undersøkelse verdikjeden i epleproduksjon i distriktene Mustang og Jumla i Nepal. Studien har fokusert på å øke arealet til lokale bønder ved å identifisere aktører i verdikjeden i epleproduksjon, og se på utfordringer ved produksjon og markedsføring av produktene.

En spørreundersøkelse hos 30 epleprodusenter i hvert av distriktene ble gjort i desember 2017 og januar 2018, ved hjelp av et strukturert spørreskjema. Bidraget av epleproduksjon i den totale økonomien hos produsentene ble funnet til 68,27% i distriktet Mustang, og 44,8% i området Jumla. Produksjonskostnaden pr. kilo produserte epler ble funnet til å være Rs 47,24 og Rs 19,53 i henholdsvis Mustang- og Jumla-området. Arbeidskostnaden ble funnet til å være den høyeste kostnadsfaktoren ved produksjon av epler i begge distriktene, med 68% i Mustang og 64% i Jumla. Andre kostnadsfaktorer ved epleproduksjonen vist i analysen var knyttet til gjødsel, plantevernmidler og maskiner.

En økonomisk analyse viste at forholdet mellom inntekt og kostnad ved produksjon av epler var på 1,98 og 2,44 for henholdsvis Mustang og Jumla. Marginen ved salg var på Rs 95,33 pr. kg i Mustangdistriktet, og Rs 107 pr. kg i Jumladistriktet. Samtidig var produsentens andel på 47,03% i Mustang og kun 28,67% i Jumla.

Et stort problem ved produksjon av epler i begge distriktene var knyttet til sykdommer og smitte, som også er noe myndighetene er opptatt av. Studien konkluderte med at epleproduksjon er en mulighet for mange gårdbrukere i Nepal, der det er et behov for å øke produksjonen, samtidig som markedstilgangen på epler må bedres.

2. INTRODUCTION

Sustainable agriculture simply means to make agriculture sustainable. There are active debates on the definition of sustainable agriculture and ways to make agriculture sustainable. The definition of Sustainable Agriculture given by FAO in 1988 is mentioned by FAO (2014) as:

> "the management and conservation of the natural resource base, and the orientation of technological change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Sustainable agriculture conserves land, water, and plant and animal genetic resources, and is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (p. 12)

Ikerd (1997) has mentioned sound ecology, viable economy and responsible society in the agriculture system as its logical prerequisites.

Among the aforementioned dimensions of sustainable agriculture, one can find enough literatures on ecological aspect of sustainable agriculture. Most of them seem to agree on the importance of sound ecology for sustainable agriculture. Ikerd (1997) has discussed the nature of humans, being able to make purposeful and self-conscious actions with their economic and social motives. This self-conscious nature of human directed with such economic and social motives directly affects the level of intervention in agriculture and puts a question in its sustainability.

The economics in the agriculture depends on the nature of most of the agricultural products that are bulky in nature, perishable, dependent on weather conditions and specific to production zones. These characteristics lead to the volatile market of agriculture business. On the other hand, it has its importance in food security and fluctuations in supply and demand in market cause price change. This can be a threat to the producer and food security of the community (Hoshyari & Khadivar, 2015). The mispricing of produce to the producer thus can either over-exploit the agricultural system or make the producer quit the agribusiness.

Globalization and free international markets to trade as well as the fast-growing population with increased purchasing capacity is offering opportunities for the producers in developing country to operate in national and international markets. On the other hand, it is also a demand for more competitiveness in the agriculture entrepreneur. This requires producers to develop better control over production and marketing to ensure the quality and value of their products

and to operate in a cost efficient way. Moreover, these producers must deal with the uncompromising quality and safety standards set in the markets to create competitive advantage to their products (Dolan & Humphrey, 2004).

2.1 Agricultural marketing

Marketing is the end result of all the business activities involved in the flow of goods and services from production to consumption (Kohls & Uhl, 1990). It is an important function after production.

Agricultural marketing comprises a sequence of transformation of goods through input supply, production, processing, storage, certification and its distribution. According to Awasthi (2007), agricultural marketing starts at the farm when the farmer plans for the production of his produce to meet the demand and prospects of the market. It is marketing which provides the service to transform the good produced in the farm into consumer acceptable form through various steps like harvesting, cleaning, grading, packaging, storing, buying and selling. Each of these steps adds value to the goods in terms of time, place and farm utilities (Pokhrel, 2011)

2.1.1 Marketing system, marketing channel and marketing margin.

Marketing system constitutes various elements of marketing such as the products, the participants or the institutions, and the different functional activities performed by them for the profitable exploitation of the opportunities of the market (Mohy-ud-Din & Badar, 2011). It involves wide range of activities, institutions and process of delivering good from one step to another in a coordinated chain. Thus, according to Pokhrel (2011), understanding of the marketing system is essential to identify the bottlenecks in the system and to provide efficient service of the marketing channel.

According to Pelton, Strutton, and Lumpkin (1997, p. 1), “Marketing channel can be defined as an array of exchange relationships that create customer value in the acquisition, consumption, and disposition of products and services.” Pooled resources, collective goals, connected system and flexibility of the marketing channel are the four preliminary elements for the success of the marketing channel.

Dhakal, Tripathi, and Bhattarai (2005) conducted marketing survey of acid lime and hill lemon in Nepal and concluded following four major marketing channels:

Channel I: Producers → Retailers → Consumers

Channel II: Producers → Wholesalers → Retailers → Consumers

Channel III: Producers → Commission agent → Wholesalers → Retailers → Consumers

Channel IV: Producers → Collectors → Wholesalers → Retailers → Consumers

The marketing margin is the difference between the retail price and producer's price. It is the outcome of the various marketing costs like transport, storage, processing, advertising, buying and selling, etc. (Bakucs & Fertõ, 2005). Rural growth in agricultural based developing countries like Nepal can be achieved by betterment in agricultural product marketing which can have much higher returns on the nation than other sectors (Islam & Grönlund, 2010). Producer's share is the percentage share of the producer on price paid by the consumer (Colman & Young, 1989). Higher producer's share and lower marketing margin indicates the increased marketing efficiency according to Colman and Young. Long marketing channel consists of higher number of intermediaries and increases the marketing cost and margin and causes the marketing inefficiencies (Singbo, Lansink, & Emvalomatis, 2014).

2.2 Value Chain Analysis

Kaplinsky and Morris (2000) have defined Value chain as:

> The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use. (p. 4)

2.2.1 History of Value Chain

Stamm mentioned the history of value chain dates back to 1920, where "*Wirtschaftsformationen"* (meaning economic formations) was used in German and Dutch geography to describe the relation between agricultural production and the services supporting it (as cited in Schipmann, 2006). The development of value chain is mainly distinguished in four time periods as: i) the filière concept; ii) the sub-sector in 1970's iii) the conceptual framework described by (Porter, 1980) and iv) the global approach (Amosi, 2018; Hoshyari & Khadivar, 2015; Kaplinsky, 2000; Porter, 1980).

The **'filière concept'** was the concept of value chain developed in 1960s as an analytical tool for agricultural empirical research by French economists. This concept described the linear flow of material inputs and services for the production of a final output (a good or a service) without any specific time-frame (Raikes, Friis Jensen, & Ponte, 2000). Its framework had a major focus on the linkage of local production systems with the processing industry, trade, export and final consumer.

The filière concept, later, was viewed to have a static character. It showed relations between physical input and services to the production of a final product only at a certain period of time (Nang'ole, Mithöfer, & Franzel, 2011). It could not indicate the level of change in flows of either commodity or knowledge in the chain. This concept is still being applied in the domestic value chains within the national boundaries (Kaplinsky & Morris, 2000).

Shaffer (1970) introduced the concept of **sub-sector** which was an important conceptual development in development of value chains. Sub-sector was defined by Nang'ole et al. (2011) as "an interrelated array of organizations, resources, laws and institutions involved in producing, processing and distributing agricultural commodity." Thus, the sub-sector analysis was the analysis of the organizations, market and marketing linkages of a product or service under a meaningful grouping of economic activities. It focused more on relationship between actors of the value chain unlike the filière concept which more focused on the actors (Diallo, 2011).

In the mid 1980s, Porter developed the value chain analysis as a **conceptual framework** to analyze the value of specific activities through which firms may create value in every step in the production process. His value system includes the activities starting from raw materials to those involved to the delivery of good to the final consumer. Porter distinguished the value-adding activities of any enterprise into two groups; i) primary activities, which directly adds value to the final product (inbound logistics, operations, outbound logistics, marketing and sales); ii) support activities, which indirectly effects the value of the final product (strategic planning, management of human resource, technology development and procurement). However, Porter's framework is restricted to the firm level. It neglects the analysis of either upstream or downstream activities beyond the business (Faße, Grote, & Winter, 2009; Kaplinsky & Morris, 2000; Nang'ole et al., 2011).

Gereffi (1994) introduced **global commodity chain** (GCC) during the mid 1990s. It mainly focused on the power relations imbedded in value chain analysis. By its focus on the interrelationship of globally dispersed, but linked, production systems Gereffi (1994) has convinced that many chains are characterized by a dominant actor (or sometimes actors) who shape the overall character of the chain. The lead actor(s) is also the responsible one to upgrade activities within individual links and coordinating other links in the GCC. This responsibility is defined as 'governance' and Gereffi (1994) differentiated two types of governance; i) buyer-driven commodity chain (here, buyers play the key role in having the coordination) and ii) producer-driven commodity chain (here, coordination is undertaken by producers) (Faße et al., 2009; Gereffi, Humphrey, & Sturgeon, 2005; Kaplinsky & Morris, 2000; Nang'ole et al., 2011)

Based on Gereffi (1994), the concept of world economic triangle was developed and again Global Value Chain Concept is another concept developed from GCC (Faße et al., 2009; Gereffi et al., 2005; Nang'ole et al., 2011). These concepts focus on improving the entire regions or clusters to be well integrated in the chain and reflect a more dynamic view of governance in the value chain(Gereffi et al., 2005; Nang'ole et al., 2011; Schmitz, 2005).

2.3 Value chain of apple in Nepal

Nepal is one of such developing countries with overwhelming opportunities and potential in agriculture along with prominent tougher curbs in agriculture development. With two huge economic giants India and China on its border, the challenge to outstand economically is even higher for such a country. Out of total 147,181 sq. km land in Nepal, 28.75% is agricultural land. Out of the total GDP of Nepal, 28.89% is contributed by agriculture and forestry sector with its annual growth rate of 5.25 in fiscal year 2016/17(MoALC, 2016/17). The latest survey for poverty in Nepal was done by Central Bureau of Statistics (CBS) through Nepal Living Standards Survey (NLSS-III) in 2010/11 which showed 25.2% of population under poverty line (Khatiwada, Khanal, & Poudel, 2016).

Several government and non-government organizations have been actively engaged for the development of agriculture sector in Nepal by formulating several programs and policies. Despite of this, most of them seem to be limited only in the planning level without having a remarkable impact on farmer's level. Upon visit to the field level, farmers are found to be

following old traditional and labour intensive farming, harvesting and marketing practice which are incurred with high cost of production, less productive and less profitable.

2.3.1 Current scenario of apple production and marketing in Nepal

Apple with almost 89.33 million tons of production, harvested from almost 5.29 million hectors as shown by FAO (2016) is the most ubiquitous temperate fruit all over the world. The total fruit production of Nepal in 2016/17 was 1.02 million metric tons with a productivity of 9.22 Mt/Ha. Out of the total, there was 93,592 Mt deciduous fruits produced with a productivity of 6.72 Mt/Ha. The total production of apple in 2015/16 in Nepal was 5,625 Mt with a productivity of 7.3 Mt/Ha (MoAD, 2015/16; MoALC, 2016/17). Apple is the most important fruit among the deciduous fruits of Nepal in regard to area, production and household economy for the rural mountainous districts of Nepal (Atreya & Kafle, 2016).

Apple is one of the important high value cash crops envisaged by Government of Nepal (GoN) for the development of mountainous rural areas of Nepal. Among all fruits grown in Nepal, mango covered the largest productive area of 38,385 ha followed by citrus (24,854 ha) and by apple (5,625 ha) (MoAD, 2015/16). These mountainous remote areas by default has a tough topography and are more inaccessible. The production units here are smaller and isolated from the bigger market place with less access to other development infrastructures such as road, irrigation, and storage facilities (SNV Nepal, 2011).

Fruit production in Nepal are increasing but at very slow rate. (Thapa, Saraf, & Gaire, 2004) mentioned that most of the increased production are from the increased area but not from the increased productivity. The other issue in fruit production in Nepal is its seasonal nature (Thapa et al., 2004). This causes abundant domestic production in short peak seasons and low domestic supply at other times.

A total of 54 districts in Nepal are now growing apple among which 12 districts lying in the mountainous region are the major ones. Largest area under apple farming in Nepal is in Jumla district (3,100 ha) followed by Kalikot (1,613 ha), Mustang (957 ha), Mugu (950 ha), Dolpa (850 ha) respectively (MoAD, 2015/16). Of these total area under apple cultivation, the productive area for Jumla, Kalikot and Mustang are 850 ha (27.41%), 1451 ha (89.95%) and 330 ha (34.48%) respectively. The total production of apple in Jumla, Kalikot and Mustang in was 3150 Mt, 11,027 Mt and 5000 Mt (MoAD, 2015/16).

At present, Jumla has the highest area under apple production though the productive area is very less and same is the case with Mustang district. This case is even worsening as the area under cultivation is increasing but the productive area and yield are either decreasing or increasing at very slow rate.

2.4 Land use pattern of Mustang and Jumla

Out of the total 3563100 ha area, Mustang had 2% (5827 ha) of cultivated land. 58% (205600 ha) of the total land was barren whereas Jumla had 30% (107811 ha) of grass land. Forest and bushes had covered 5% (5827 ha) of the total land of Mustang district (figure. 1)

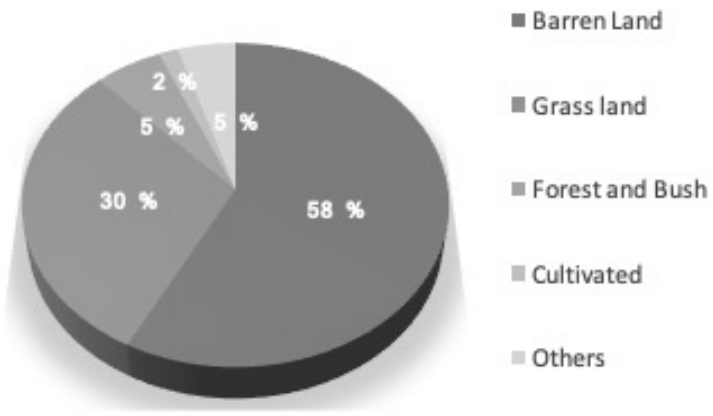

Figure 1. Land use pattern of Mustang district

(Source: (KC, Poudel, Paudel, Pokharel, & Koirala, 2014))

The total area of Jumla was 253100 ha. Out of this, 8% (19189 ha) land was covered by cultivated land as well as grassland. Forest and shrubs covered 44% (111649 ha) whereas 39% (98595 ha) was barren land in Jumla district.

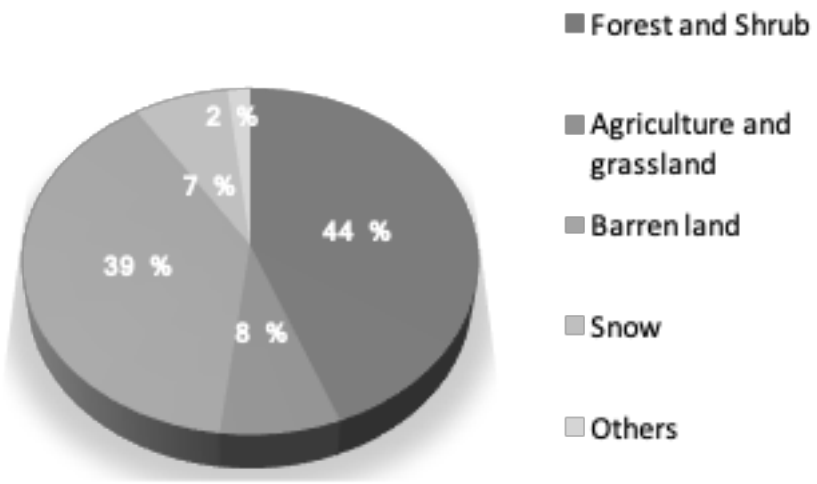

Figure 2. Land use pattern of Jumla district

(Source: (MoAD, n.d.).)

2.5 Production and productivity of different crops in Mustang and Jumla

Mustang, had very less land suitable to cultivate crops and the productivity of all the cereals produced was less than 2 mt/ha. Productivity of potato was found 11.21 mt/ha. Similarly, the registered area under apple production was 957ha though the productive area under apple cultivation was 330 ha with a productivity of 15.15 mt/ha (Table 1).

Jumla, though lying in high altitude, had the favorable condition for certain landraces of rice to grow during the summer. It has been established that the highest altitude to grow rice in the world is Jumla (Paudel, 2011; Sapkota, Paudel, Thakur, Nepali, & Neupane, 2010). The productivity of rice in Jumla district was 2.1 mt/ha whereas other cereals had a low productivity below 2mt/ha. Productivity of potato was 10.19 mt/ha. Similarly total area under apple orchard in Jumla was 3100 ha, of which only 850 ha was the productive area (MoAD, 2015/16). The productivity of apple in Jumla was 3.71 mt/ha (Table 2). Similarly, other fruit crops grown in Jumla were apricot, walnut, peach, pear, plum.

Table 1. Production and productivity of different crops in Mustang district

Crops	Area (ha)	Production (mt)	Productivity (mt/ha)
Maize	516	760	1.473
Wheat	572	822	1.437
Barley	280	472	1.685
Buckwheat	582	993	1.706
Potato	285	3699	11.21
Apple	330	5000	15.15

(Source: (MoAD, 2015/16; MoALC, 2016/17))

Table 2. Production and productivity of different crops in Jumla district

Crops	Area (ha)	Production (mt)	Productivity (mt/ha)
Paddy	2900	6090	2.1
Maize	4500	6307	1.402
Wheat	2382	4400	1.847
Millet	3750	3750	1
Barley	3750	5625	1.5
Buckwheat	85	87	1.024
Potato	2600	26500	10.19
Walnut	77	605	7.85
Apple	850	3150	3.71

(Source: (MoAD, 2015/16; MoALC, 2016/17))

2.6 Population and demographic setting of Mustang and Jumla

The total population of Mustang was 13452 (CBS, 2014b). The dependency ratio for Mustang district was 52.09 with a sex ratio of 111.54.

Similarly, the total population of Jumla was 45089 with a dependency ratio of 88.40 and sex ratio of 101.62(CBS, 2014a).

The sex ratio and dependency ration of Nepal was 94.16 and 66 respectively (CBS, 2014c).

Sex ratio was calculated by taking the ratio of male population with respect to the female population and multiplying by 100 of the respective districts. The obtained figure represented the number of males per 100 females in that area at that point of time. Sex ratio was higher in Mustang district than at Jumla district.

Similarly, dependency ration of Mustang was lower than that of Jumla district. It showed the proportion of the dependent people upon the economically active population. Dependency ratio was calculated using following formula:

$$\text{Dependency ratio} = \frac{\%\text{ of population aged below 15 and above 59 years}}{\%\text{ of population between 15 and 59 years}} \text{ X } 100$$

Table 3. Population, gender, age distribution and dependency ratio in the study districts

District	Sex	Age group				Dependency ratio
		<15	15-59	>59	Total	
Mustang	Male	1514	4791	788	7093	48.05
	Female	1502	4054	803	6359	56.86
	Total	3016	8845	1591	13452	52.09
Jumla	Male	22639	29184	3075	54898	88.11
	Female	22450	28630	2943	54023	88.69
	Total	45089	57814	6018	108921	88.40

(Source: (CBS, 2014a, 2014b, 2014c))

2.7 Problem statement

The study of value chain of apple in the mountainous regions of Nepal became imperative as apple would give more competitive return than other crops being produced in the same region (AP & MDD, 2017). Beside this, a total of 83,000 metric tons of fresh apple was imported to Nepal in fiscal year 2016/17 (MoALC, 2016/17). It indicated the marketing possibility of domestic apples produced. Moreover, it was a good option to uplift the economic status of the remote rural area and move a step forward to eliminate poverty as per the Sustainable Development Goal of "No Poverty". It would also help in the sustainable use of the resources providing a sustainable agricultural environment. Thus this paper has tried to address the following research question

> *What are the possible interventions for strengthening the value chain of apple in Mustang and Jumla district?*

More precisely, the research questions were formulated as:

- What is the contribution of apple farming in the household economy of the farmers?
- What are the actors influencing the apple value chain of Mustang and Jumla district of Nepal?
- What are the economic relations between the actors of the value chain?
- What are the major prospects and constraints of apple production and trading in Nepal?

2.8 Objectives

This research was conducted with a general objective to assess the economics of production and marketing of apple in Jumla and Mustang district of Nepal for addressing the aforementioned research questions.

The specific objectives for this study were to:

- Examine the contribution of apple farming in the household economy
- Identify the actors of the apple value chains of both the districts and analyze the structure of value chain map and operation mechanism of the identified actors.
- Analyze the price, cost, margins and profit sharing at each stage of the apple value chains
- Identify the prospects and problems associated with the apple production and trading in Nepal.

3. MATERIALS AND METHODOLOGY

3.1 Methodological framework

The research methodology consists of procedures involved in the site selection, literature review, sample design, source of information, data collection, data analysis and interpretation as illustrated in the figure 3.

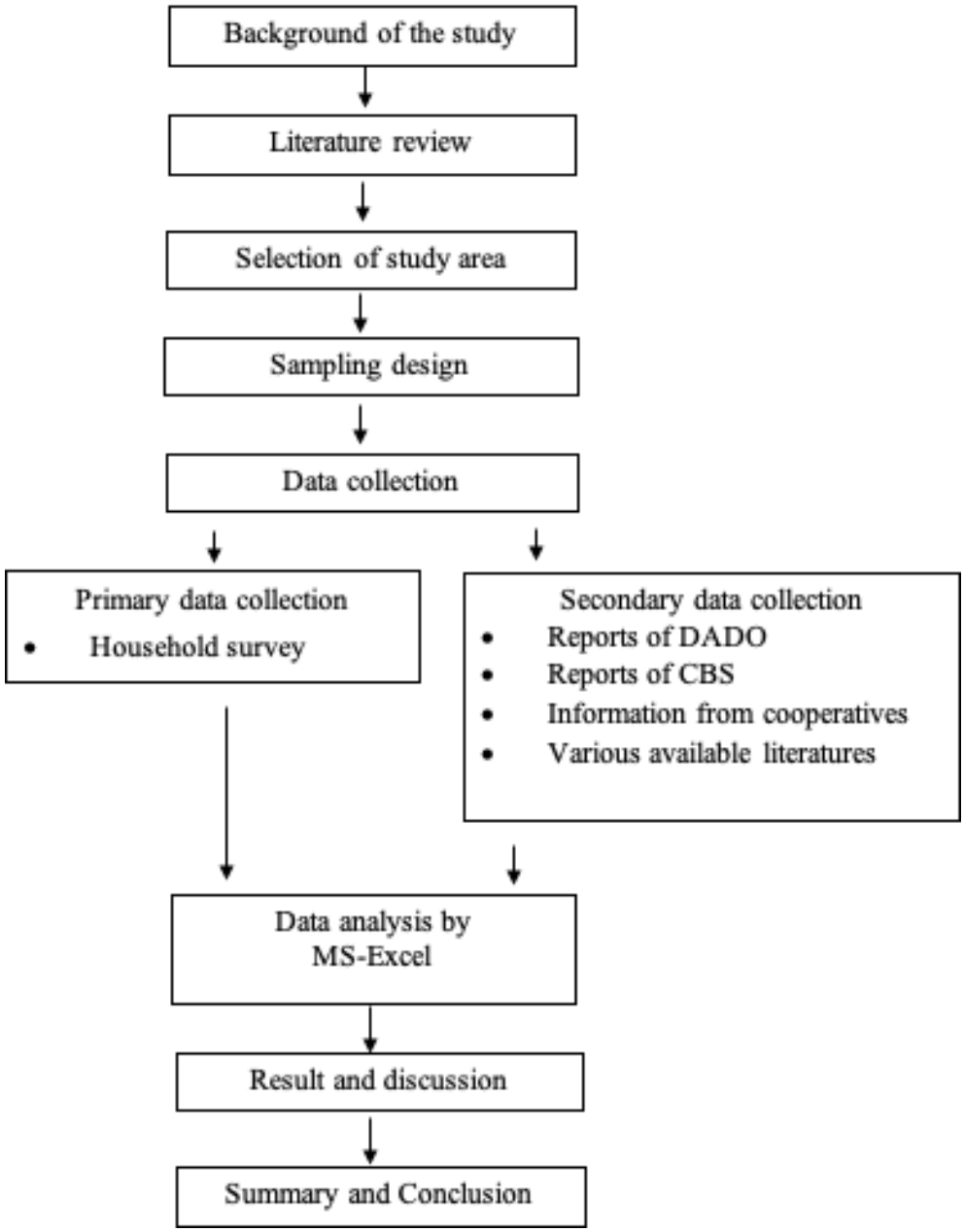

Figure 3. Methodological framework of the research

(Source: Own source)

3.2 Selection of study area

This study was conducted in two apple producing districts of Nepal, Mustang in Western Development Region and Jumla in Mid-Western Development Region of Nepal. Both of these districts were purposively selected for the study as they occupy the leading position in apple production in Nepal and are the potential regions for apple production in terms of area and production. Jumla has been certified as an organic district by Organic Certification Nepal (OCN). Mustang has a potential for internal and external tourism because of its beautiful landscape. The tourism potential of Mustang district also adds the market potential for apples produced in this district. The economy of most of the farmers in these two districts is shaped by the apple production.

Mustang district lies in province no. 4 of Nepal and is also known as the district across the mountains in Nepal. It lies in the Trans-Himalayan region in the North of Central Greater Himalaya named as Annapurna and Dhaulagiri ranges. This district is surrounded by Manang district in the East, Myagdi in the South, Dolpa in the West and Tibet Autonomous Region of China in the North-East, North and North-West. Besides apple, this district is also very famous for its pristine biodiversity and spectacular scenery. It is located in between 28°33'51" North to 29°19'52"North latitude and 83°28'54" East to 84°14'58" East longitude in the world map. The altitude of this district ranges from 1640 m in Kopchepani of Kunjo VDC to 7061m of Nilgiri North above sea level. Mustang receives an average of less than 260 mm rainfall annually as recorded in lower Mustang, Jomsom. This district experiences an average minimum temperature of -2.7 °C in the winter and an average maximum temperature of 23.1°C in the summer. It covers an area of 3563.21 sq.km of which 57.7% is barren land, 30.26% is grassland2.91% forest, 1.6% cultivated land and rest others (KC et al., 2014).

Jumla lies in province no. 6 of Nepal and is one of the poorly developed mountainous district of Nepal. It lies in 25°58' to 29 North latitude and 81°51' to 82°35' East longitude. It is surrounded by Dolpa in the East, Jajarkot on the South, Kalikot in the West and Mugu in the North with a total area of 2531 sq.km. Jumla has a 39,486 ha cultivable land out of which, 26,761 ha is cultivated (RAP3, n.d.). The elevation of Jumla ranges from 915m to 4679m above sea level. This district experiences a variation in temperature from 18°C to 30°C in the summer and -14°C to 8°C in winter. The annual average rainfall in Jumla is 1343mm. The main economic activity of Jumla is agriculture. The usual cereal crops grown in Jumla are

paddy, maize, wheat and barley whereas apple, potato, beans, oil seed and herbal products are the cash crops of Jumla.

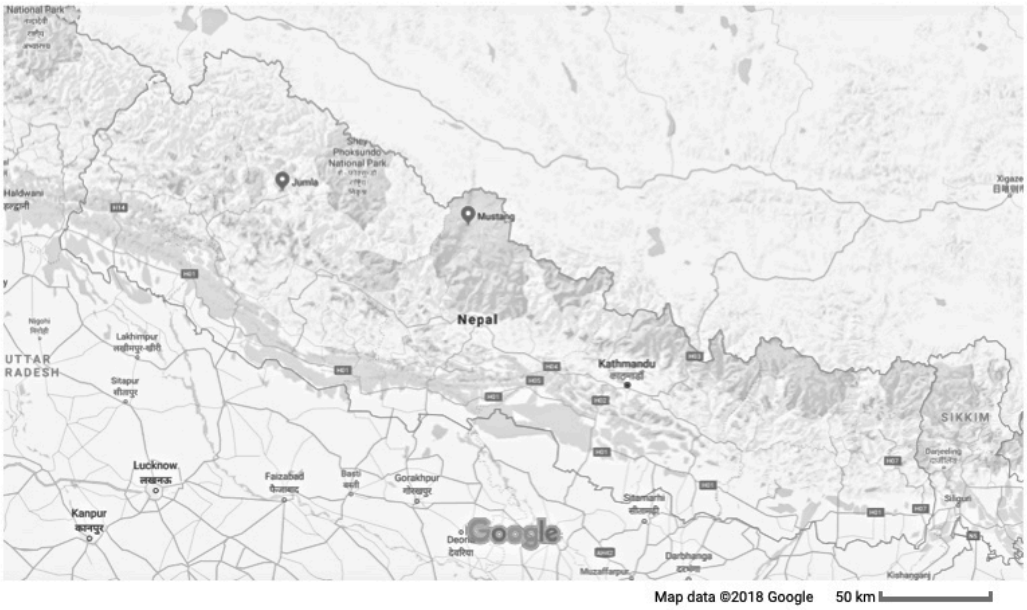

Figure 4. Map of Nepal showing Jumla, Mustang and Kathmandu

(Source: (Map: Google Map).)

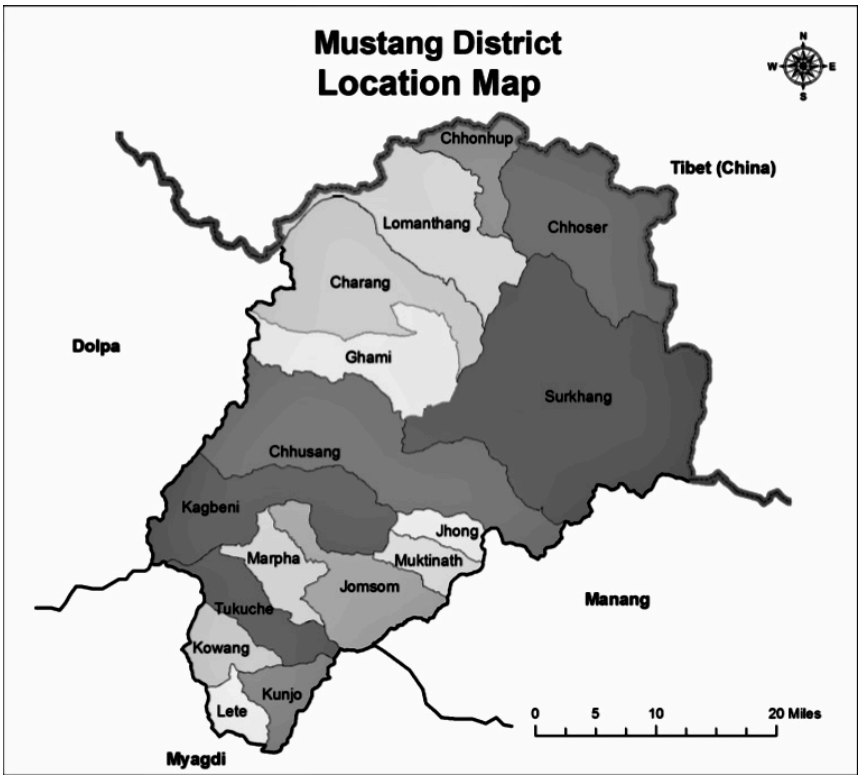

Figure 5. Map of Mustang district

(Source: (KC et al., 2014))

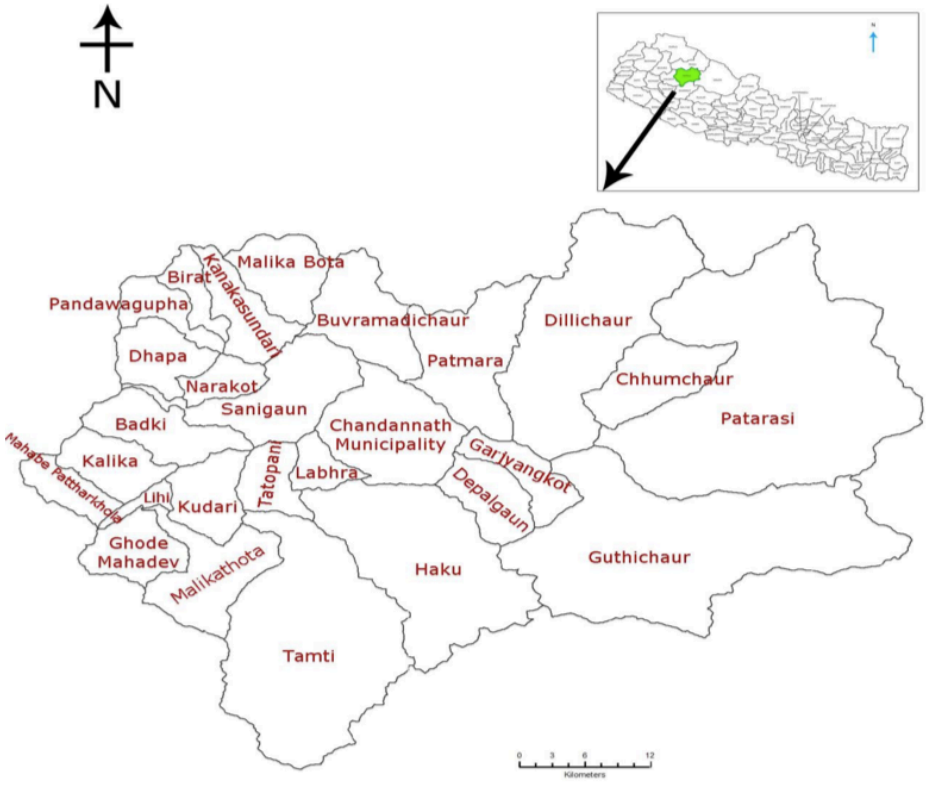

Figure 6. Map of Jumla district

(Source: (MoAD, n.d.))

3.3 Sampling procedure and selection of respondent

The list of producers was obtained from the respective District Agriculture Development Office (DADO) of each districts. With discussion with the agriculture officer and a local key informant, 30 apple growers were selected from each districts for the primary data collection with the apple producers. Careful attention was paid to make the selection more inclusive of producers from various wealth categories, farm size and different ethnic groups.

Similarly, 5 collectors (traders) in Jumla, 2 wholesalers in Nepalgunj, 5 retailers in Nepalgunj, 15 consumers in Jumla and Nepalgunj were selected randomly for the interview to study Jumla apple value chain. On the other hand, 3 wholesalers and 5 retailers in Pokhara and 15 consumers from Jomsom (Mustang) and Pokhara were selected randomly for interview to study and compare the Mustang apple value chain.

3.4 Sources of information and technique of data collection:

The primary sources of information were all the actors of the value chain like input suppliers, apple producers, collectors, wholesaler, retailers, consumers, service providers and key informants. The primary data was collected through household survey, Focus Group Discussion (FGD), key informants' interview and field observation during the field survey.

Secondary information was collected from the reports of the District Agriculture Development Office (DADO) of Jumla and Mustang district, High Value Agriculture Project in Hill and Mountain Areas (HVAP), Nepal Agriculture Research Council (NARC), Ministry of Agriculture and Cooperatives (MoAC), Central Bureau of Statistics (CBS) SNV Nepal and USAID Nepal.

3.4.1 Field Survey

Field survey was conducted during the month of December 2017 and January 2018 in the two districts, Jumla and Mustang. Information related to the cost of apple production, marketing system, marketing channel, contribution of apple to household income and issues related to production and marketing were obtained from the survey. Similarly, traders and consumers were surveyed for the marketing aspect as well as quality of the produce. Key informant interview was conducted with the agriculture officers of the respective districts for the information about the production and marketing situation of apples.

3.5 Data analysis:

Data collected through the field survey was coded and entered in an Excel sheet for analysis. Data analysis was done by using Microsoft Office Excel. The analysis of apple production economics was done through value chain mapping and analysis of production cost, gross margin, factors affecting gross margin, marketing margin, producers' share, benefit cost ratio.

3.5.1 Socio- demographic and farm characteristics analysis

It deals with descriptive analysis of the study area, population and apple production system. For this analysis, descriptive statistical tools such as frequencies, percentages, means, standard

deviations and standard errors were used. Different variables such as family size, gender, occupation, land holding were analyzed.

3.5.2 Economic analysis

Cost of production

Since cost of production for apple is the initial orchard establishment fixed cost summed with variable cost of orchard management of each year, only the variable cost items were considered in this research for the cost of production. The variable costs were the cost of labour, manures, fertilizers (bio/chemical), pesticides and farm equipment. Since most of the farmers in Nepal do not have any type of record keeping for their costs and income from their farm, it was very difficult to split the cost of each variable costs. Moreover, they apply their own farm yard manure as organic manure to the farm and they themselves are their labour. Nearly no any farmer keeps a record of this kind of cost in their farm.

Thus, the cost of labour was calculated by multiplying the man-day spent in the farm for inter-cultivation in orchard, fetching and applying the manure, fertilizer and pesticides, training and pruning of apple tree and harvesting and marketing (wherever applicable) with the current basic wage per day of the country (Rs 395 per man-day). The cost of fertilizers from farmers' own farm yard pit and the cost of production of organic pesticides as well as the chemical fertilizers and pesticides bought from the market (for non-organic growers) was considered as the cost of fertilizers and insect/pesticides respectively for each district. Cost of farm equipment was the price paid for the different tools and equipment bought in the same year.

Gross margin analysis

Gross margin is the difference between the gross return and the variable cost of any business. It is a quick and easy method to analyze a farm business since it offers a direct means to compare the technical efficiency of the business (Upton, 1964). Here, only the variable cost was taken in account to calculate the gross margin. Gross margin can be calculated by following formula:

Gross margin = Gross return – Total variable cost

Where,

Gross return = Quantity of product sold (Kg) * Unit price of product (Rs/Kg)

Total variable cost = sum of cost of all variable inputs.

Benefit cost analysis

Benefit cost analysis is the benefit or return of a farm business relative to its cost. Benefit cost ratio is the ratio of total revenue and total cost. In our study, the total revenue means income and total cost means variable cost (Luitel, 2017). It was calculated by using following formula:

B/C ratio = Gross income/ Total cost

If B/C ratio is greater than 1, then the farm business is considered to be profitable.

If B/C ratio is less than 1, then the farm business is considered to be unprofitable.

If B/C ratio is equal to 1, then the farm business can neither be considered profitable nor unprofitable.

Marketing margin, producer's share and marketing efficiency

The difference between the farm gate price received by the producer and the price paid by the consumers is known as marketing margin. It is also known as price spread. It can be calculated by subtracting farm gate price with price paid by the consumer at retail market (Amgai, Dutta, Regmi, & Dangol, 2015).

Marketing margin = Retail price (Pr) – Farm gate price (Pf)

The ratio of farm gate price received by the Producers to retail price paid by the consumers expressed in percentage is known as producer's share. Considering the retail price to be Pr and the farm gate price to be Pf, the producer's share (Ps) was calculated as:

$$Ps = Pf/Pf * 100$$

Productivity and resource use efficiency in apple production

Cobb-Douglas production function was used to estimate the productivity and apple production function of the producers from the surveyed site. Though more developed functional forms than the Cobb-Douglas could be used to model the frontier agricultural production technology, the functional form has a limited effect on empirical efficiency measurement (Idiong, 2007; Kopp & Smith, 1980). The Cobb-Douglas form has a theoretical fitness to agriculture and has computational management. So, it is widely used in many empirical studies, mostly dealing

with the study about developing country agriculture (Idiong, 2007; Sarker, Majumder, Sayem, & Farid, 2018; Xu & Jeffrey, 1998). The specified Cobb-Douglas production function was;

$Y = \alpha X_1^{b1} X_2^{b2} \ldots\ldots\ldots X_n^{bn}$

Where Y was the dependent variable and X_1 to X_n were the explanatory ones. Similarly, b_1 to b_n were the factors of respective production parameters. This function was then converted to logarithmic form in order to solve by least square method as follows;

$LogY = Log\alpha + b_1 Log\ X_1 + \ldots\ldots + b_n LogX_n$

Where,

Y = Gross return (Rs/Ropani)

X1 = labour cost (Rs/Ropani)

X2 = Fertilizer cost (Rs/Ropani)

X3 = Plant protection cost (Rs/Ropani)

X4 = Cost of buying farm equipments (Rs/Ropani)

α, $b_{(1-4)}$ = coefficient

Contribution of apple in household economy

The total farm income from apple was calculated and was compared with the total income of the household. The income from apple was expressed in share of the total household income to analyze the contribution of apple in household economy.

3.6 Value chain of apple

Value chain shows the major actors and activities involved from production to the marketing and consumption in a sequential manner. Value addition in apple occurs in each step of the chain. From the study, the information on major actors and their activities along the marketing channel followed was collected and the value chain was mapped along with the analysis of price spread at each step.

3.7 Indexing

From the qualitative data, indexing was done. Indexing was done for the analysis of producer's perception on the production and marketing problems of apple. Farmers perception about the problems were ranked by using five-point scale of problem, that is from highly problematic to highly non problematic. 1 represented for the highly problematic issue, 3 for neutral to the issue and 5 for highly non problematic issue. Then the priority ranking was done and a reasonable decision was made.

Following formula was used to find the index for intensity of various problems**.**

$$I_{prob} = \sum \frac{Si\ fi}{N},$$

Where,

I_{prob} = index of problem

$\sum$ = Summation

S_i = Scale value at i^{th} intensity

f_i = Frequency of i^{th} response

N = Total number of observation

3.8 Materials used

Semi-structured questionnaires for producer and trader were used to collect the primary data. The analysis of thus collected data was done using Microsoft® Excel for Mac, Version 15.26 (160910) with the formulas for averages, standard error of mean and regression analysis function.

4. RESULTS AND DISCUSSION

4.1 Family size and gender of respondents

Most of the respondents were the household heads during the survey. The gender of the household head plays an important role in household decision-making (Devkota, Rauniyar, & Parker, 1999). 56.67% of the respondents in Mustang district were male whereas 63.33% were male in Jumla district.

Similarly, the average family size of the respondents was found to be 5.13 for Mustang and 5.83 for Jumla with a standard deviation of 1,55 and 1.68 respectively. The average household size of Mustang and Jumla district according to National Population and Housing Census (NPHC) in 2011 was 4.01 and 5.64 respectively (CBS, 2014c).

Table 4. Gender distribution of the respondents by survey district

Gender/District	Mustang	Jumla
Male	17 (56.67)	19 (63.33)
Female	13 (43.33)	11 (36.67)
Total	30	30

(Source: Field Survey 2017/18)

4.2 Ethnicity of respondents

With respect to ethnicity, 80% of the respondents in Mustang district were Janajati and remaining 20% were Dalit. In Jumla district, majority of the respondents were Chhetri (63.33%) followed by Brahmin and Dalit (13.33 % each) and 10% Janajati. The ethnic composition of the sampled households is shown in table 5.

Table 5 Ethnic composition of the sampled HH

Ethnicity	Mustang		Jumla	
	Number of HH	Frequency (%)	Number of HH	Frequency (%)
Brahmin	0	0	4	13.33
Chhetri	0	0	19	63.33
Janajati	24	80	3	10
Dalit	6	20	4	13,33

(Source: Field Survey 2017/18)

4.3 Analysis of contribution of apple in household economy

Table 6 Contribution of apple in household income (Rs '000')

Source of income	Mustang (Mean ± SEM)	Share (%)	Jumla (Mean ± SEM	Share (%)
Apple farm	272.58 ± 26.42	68.27	148.62 ± 13.98	44.8
Except apple farm	126.67 ± 19.58	31.73	183.13 ± 21.47	55.2
Total	399.25 ± 29.54	100	331.75 ± 30.65	100

(Source: Field Survey 2017/18)

The household members of economically active group of the respondent family were found to be engaged in different kind of farm and off farm activities to support their needs. People were found to be engaged in other crop cultivation, business, off-farm labor and services other than growing apple to generate remuneration in both the districts. The respondent family from Mustang district was found to generate 68.27% of their total income from apple farm whereas families from Jumla district were generating 44.8% of their total annual income from apple

cultivation. This revealed the significance of apple farming for the rural farmers and the significance of investment in further improvement of the farming and marketing technique of apples.

4.4 Cost of production of apple

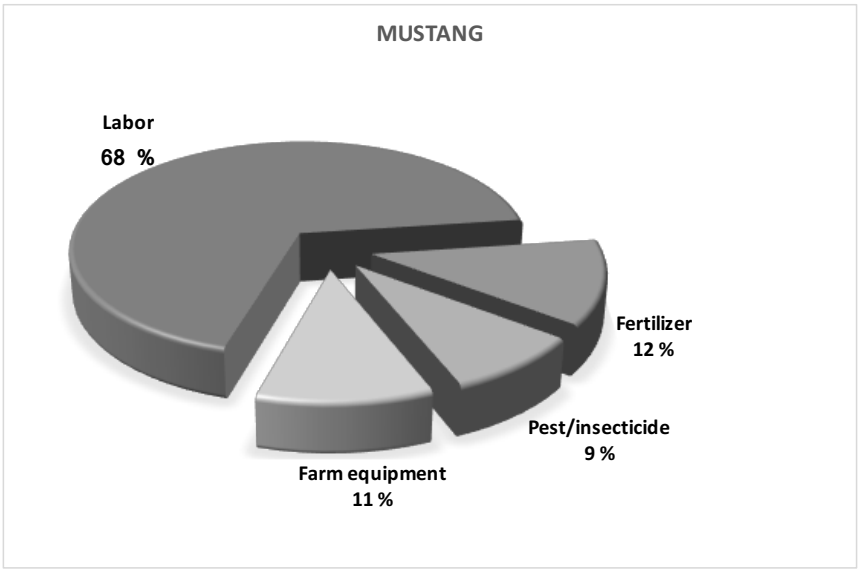

Figure 7. Cost of production of apple per ropani in Mustang district

(Source: Field survey 2017/2018)

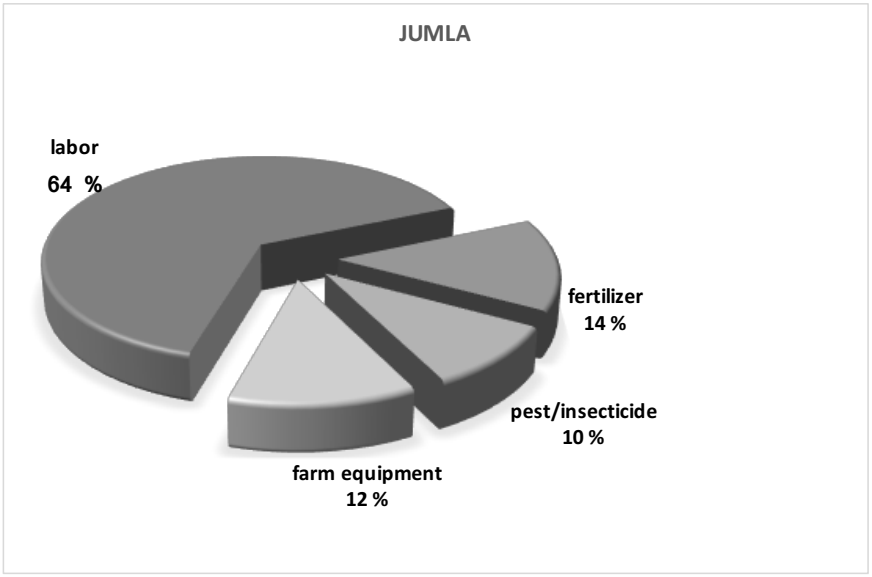

Figure 8. Cost of production of apple per ropani in Jumla district

(Source: Field survey 2017/2018)

As discussed in section 2.5.2, for calculating the cost of production of apple, the variable costs incurred in the orchard in the year 2017 were considered. Share of each variable costs in cost of production per ropani of apple are shown for Mustang and Jumla district in figure 6 and 7 respectively. The labour cost was the highest among all variable cost in both the districts (68% for Mustang and 64% for Jumla). Cost of fertilizer followed the cost of labour cost in both districts with the share of 12% in Mustang and 14% in Jumla. The share of cost of plant protection and farm equipment for Mustang district was 9% and 11% respectively. The share of cost of plant protection and farm equipment was 10% and 12% respectively in Jumla district.

Table 7 shows the details of the cost of production of apple per ropani in each district. The total cost of production of apple per ropani in Mustang was Rs 24530 with 1670 SEM and Rs 7690 in Jumla with 720 SEM. The cost of production of apple per Kg in Mustang and Jumla district were Rs 47.24 per Kg with SEM ± 2.63 and Rs 19.53 per Kg with SEM 1.26 respectively.

Table 7. Cost of production of apple (per Ropani) in Mustang and Jumla district

Variable cost	Mustang (Mean ± SEM) (in Rs '000'/ropani)	Jumla (Mean ± SEM) (in Rs '000'/ropani)
Labour	16.79 ± 1.38	4.93 ± 0.48
Fertilizer	3.03 ± 0.18	1.09 ± 0.11
Plant protection	2.12 ± 0.11	0.74 ± 0.09
Farm equipment	2.6 ± 0.22	0.92 ± 0.12
Total cost of apple production per ropani	24.53 ± 1.67	7.69 ± 0.72
Cost of apple production per Kg (Rs/Kg)	47.24 ± 2.63	19.53 ± 1.26

(Source: Field survey 2017/2018)

4.5 Gross margin of apple production

Table 8 shows the gross margin of apple production per Ropani in Mustang and Jumla district as surveyed in 2017/18. The gross margin of Mustang district (Rs 20860 per Ropani with SEM 2110) was found to be higher than that of Jumla district (Rs 10260 per Ropani with SEM 1500). This might be due to the better market and facilitation of apple production in Mustang than in Jumla district. Jumla was connected with the road transportation from April 2007 (Gurung, 2016) but it was black topped very recently. Still, there are various part very unsafe to travel. Moreover, the roads are blocked for prolonged period during the monsoon season in various regions of the 232 Km highway due to landslides. Along the consumer survey for their preferences, it was found that the quality of apples from Mustang was better than that of Jumla.

Table 8. Gross margin of apple production (per Ropani) in Mustang and Jumla district

	Mustang (Mean ± SEM) (in Rs '000' per Ropani)	Jumla (Mean ± SEM) (in Rs '000' per Ropani)
Gross margin (Rs/ropani)	20.86 ± 2.11	10.26 ± 1.5

(Source: Field survey 2017/2018)

4.6 Benefit-cost analysis of apple production

Due to the harsh topography of both the districts, cultivating high value cash crop would best utilize the resources of these marginal mountainous regions. This is why, different government and non-government organizations were found to be investing and working to develop the apple cultivation sector during the field survey. The cost of cultivation of fruits was less than the cost of cultivation of other crops and the benefit-cost ratio was higher in case of fruits than the cereals or vegetables in the highlands of Nepal (Bhandari & Aryal, 2014/15).

Since benefit-cost ratio provides the overall profitability of the business, apple cultivation was found highly profitable enterprise in both the districts. The B/C ratio of Mustang and Jumla district was found to be 1.98 and 2.44 respectively.

AP & MDD (2017) have found B/C ratio of apple orchard from 1.11 at the fifth year of apple orchard establishment to maximum 2.29 at the ninth year of orchard establishment with a decreasing B/C ratio afterwards in case of Mustang district. Similarly, the B/C ratio of apple orchards in Jumla district were minimum 1.13 at fifth year after plantation and the maximum of 1.93 in the seventh year of orchard establishment and decreasing afterwards as the returns of the fruits from the old tree decreases (AP & MDD, 2017).

Table 9. B/C ratio of apple production in Mustang and Jumla district

District	B/C ratio
Mustang	1.98
Jumla	2.44

(Source: Field survey 2017/2018)

4.7 Marketing system of apple in Mustang and Jumla.

The marketing channel of apple produced in Jumla district is shown in figure 9. Jumla apples were mostly collected by traders who can be a larger farmer themselves in Jumla or just a trader known to be local or village trader. The trader then transported the apple to the wholesaler in Surkhet district or to Nepalgunj in the Terai (lowland of Nepal). The wholesalers sold the apples to the retailers of respective district and the bicycle vendors who sell fruits and vegetables door to door in the settlements and at the roadside of the market. The consumers get their Jumli apple from these retailers and the bicycle vendors.

The District Cooperative Union and Organic multipurpose cooperative made contract with the farmers prior to the harvesting season and collected the apple from the big and small producers and marketed the collection to the wholesalers based in Kathmandu, Surkhet and Nepalgunj. These wholesalers sold the apples to the retailers and bicycle vendors of the respective districts which finally was sold to the consumers.

The apple producers in Jumla also sold some of their produce in the market of the district headquarter Khalanga and at the airport gate of the Jumla airport.

Some of the produce from Jumla was supplied to the registered and unregistered processing industries of Jumla bazar. After processing the apple to dried apple, apple juice and apple alcohol, it was supplied to the retail shops in Jumla bazar and then sold to the consumers, mostly tourists from 'Jumla Kosheli Ghar'.

The Mustang apples were very popular for its quality in regards to the size, color, taste and its crispy nature among people. Mustang district is very popular destination for internal and international tourists. During the harvesting season, farmers, themselves sold their apple in the Jomsom bazar. Figure 10 shows the different marketing channels of apple produced in Mustang.

Individual large contractors used to make contract with the farmer prior to harvesting time. These contractors then sold the apples to the wholesalers in Beni (Myagdi district), Baglung, Pokhara, Chitwan and Kathmandu. The retailer shops and the bicycle vendors bought the apples from the wholesalers and sold to the consumers.

Some of the apple harvests were collected by the Marpha Horticultural Farm, Marpha and processed into various apple products, mainly alcoholic beverage called "Brandy" and dried apple slices. These products were primarily sold from the retail shop (Marpha Sasto Pasal) in Jomsom and Marpha to the tourists and few from the retail shops (supermarket) of Pokhara and Kathmandu district.

The presence of more numbers of middlemen in the marketing channel of apple in both the districts hindered the vertical linkage between producers and the other market actors as found by Luitel (2017) in value chain analysis of coffee in central Nepal. Niroja, Mamoru, and Muto (2015) found that cooperative marketing increased the bargaining power of farmers and also reduced the transportation cost and commission costs during marketing of vegetables in Chitwan district. Applying this knowledge in the apple value chain of Mustang and Jumla could benefit the famers to consumers of apple by increasing the farmer's share and reducing the cost of apple for the consumers.

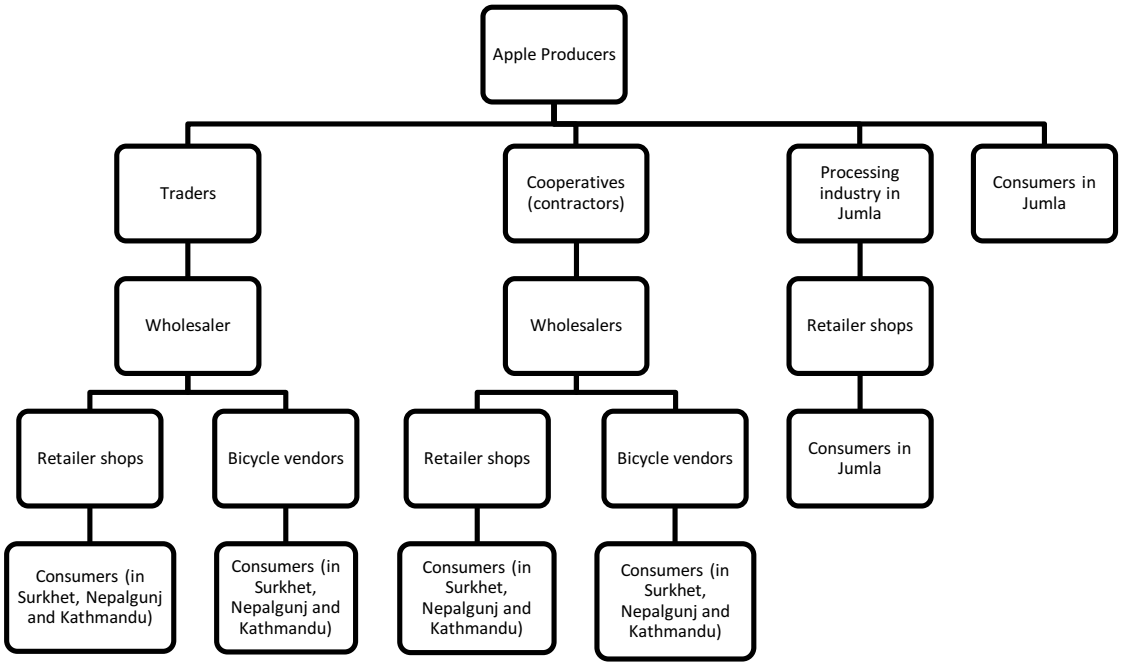

Figure 9. Marketing channels of apple produced in Jumla

(Source: Field survey 2017/2018)

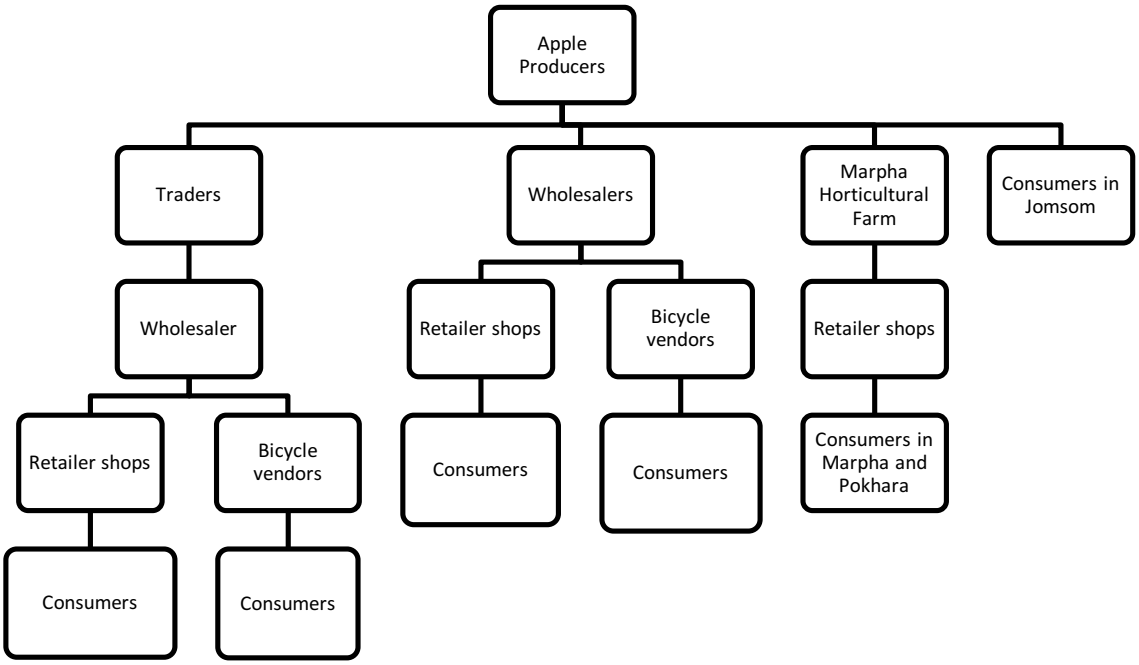

Figure 10. Marketing channels of apple produced in Mustang.

(Source: Field survey 2017/2018)

4.8 Marketing margin and producer's share

Price of the apples at farm gate of Mustang was Rs 84.67 per Kg of apple. The transportation cost of apples from Jomsom to Pokhara was Rs 7.50 per Kg. The wholesale price of apple in Pokhara was Rs 140 per Kg and the retailers sold the apple at Rs 180 per kg.

Similarly, the price of apple at the farm gate of Jumla district was Rs 43 per Kg of apple. The cost of transportation of apple per Kg from Jumla to Nepalgunj by road was Rs 9 per Kg. The wholesale price of the Jumli apples in Nepalgunj was Rs 100 per Kg. The retailers sold the apples to the consumers at Rs 150 per Kg of apple.

Thus, the marketing margin for Mustang apple and Jumla apple was Rs 95.33 per Kg and Rs 107 per Kg respectively. The producer from Mustang obtained 47.03% of the price paid for the apple whereas only 28.67% was the Jumli producer's share. The higher producer's share in Mustang district envisaged the better marketing efficiency than that of the Jumla district.

Table 10. Marketing margin and producer's share in fresh apple from Mustang and Jumla.

District	Farm gate price (Rs/Kg)	Marketing margin (Rs/Kg)	Retail price (Rs/Kg)	Producer's share (%)
Mustang	84.67	95.33	180	47.03
Jumla	43	107	150	28.67

(Source: Field survey 2017/2018)

Arndt, Jensen, Robinson, and Tarp (2000) had found that lowering the marketing margin increased the welfare of both producer and consumer by raising the price of former and decreasing the price for latter. Increasing the market efficiency, specially in Jumla district, could attract more producers to market their products and have more economic gains.

4.9 Productivity and resource use efficiency in apple production

The surveyed data for the cost of variable costs and income from the apple was analyzed through regression analysis as per the protocol of Cobb-Douglas production function. The coefficients and the estimated values of the surveyed parameters are shown in table 11 and 12 for Mustang and Jumla district respectively.

Table 11. Coefficient and parameter estimates of regression model for gross return of apple production in Mustang district

Independent variables	Coefficients		t stat	p value
	b	Std. error		
Constant	3,82	1.02	3.75	0,0009**
Log labor cost (X_1)	0.03	0.13	0.23	0.8222
Log Fertilizer cost (X_2)	0.34	0.22	1.52	0.1408
Log Plant protection cost (X_3)	0.70	0.23	3.06	0.0053**
Log Farm equipment (X_4)	-0.19	0.09	-2.14	0.0424*

(Source: Field survey 2017/2018)

Dependent variable = gross income from apple,

R = 0.84, R^2 = 0.71, Adjusted R^2 = 0.66 and standard error of estimate = 0.21,

Durbin-Watson test = 0.9829 and f stat = 15.16

Note: * and ** refer to the significance at 0.05 and 0.01 level of significance

The coefficient of variable plant protection was 0.7 and was highly significant in 99% level of confidence. This implied that increasing the expense for plant protection to control the

prevalent apple disease and insect pest in apple orchard of Mustang district would increase the production and give higher income for the apple farmers in Mustang. Similarly, the regression coefficient for farm equipment bought in Mustang was (-0.19) and was significant at 5% level. It implied that every 10% more sum spent on farm equipment would decrease the level of return by 1.9%. The non-significant coefficients of labour and fertilizer suggested that there is excessive use of labor and fertilizer in the apple orchards. The econometric model thus obtained from the analysis to explain the production use efficiency in Mustang district was:

$$LogY = 3.82 + 0.03X_1 + 0.34X_2 + 0.7X_3 + (-0.19)X_4$$

Table 12. Coefficient and parameter estimates of regression model for gross return of apple production in Jumla district

Independent variables	coefficients		t stat	p value
	b	Std. error		
Constant	4,04	1,16	3,49	0,0018**
Log labor cost (X_1)	0.86	0.22	3.98	0.0005**
Log Fertilizer cost (X_2)	-0.62	0.27	-2.33	0.0285*
Log Plant protection cost (X_3)	0.37	0.18	2.00	0.0565
Log Farm equipment (X_4)	0.04	0.07	0.68	0.5025

(Source: Field survey 2017/2018)

Dependent variable = gross income from apple,

$R = 0.78$, $R^2 = 0.61$, Adjusted $R^2 = 0.54$ and standard error of estimate = 0.31,

Durbin-Watson test = 1.43997 and f stat = 9.64

Note: * and ** refer to the significance at 0.05 and 0.01 level of significance

In Jumla district, the coefficient of variable labor was 0.86 and was highly significant at 1% level. Investing in labor by 10% to manage the orchard would increase the farm production and ultimately the total return would increase by 8.6%. The significant value of coefficient of fertilizer cost in negative (-0.62) at 5% level of significance suggested that increasing the investment in fertilizer by 10% further would decrease the total return by 6.2%. This might be due to the excessive addition of the fertilizer in the orchard which would increase the expense but not the production. The coefficient of plant protection and farm equipment for orchard in Jumla was not significant. This also suggested that excessive money is being spent in plant protection and farm equipment in the apple orchard of Jumla. The econometric model to explain the production function efficiency for Jumla apple growers was:

$$LogY = 4.04 + 0.86X_1 + (-0.62)X_2 + 0.37X_3 + 0.04X_4$$

4.9.1 Description of variables

Gross return (Y)

It was the amount of money per ropani received by the farmer by selling apple at farm gate price. It was calculated by yield of apple per ropani multiplying with the farm gate price of the farmer.

Labor cost (X_1)

It was the product of national per day wage and the total human labor spent on the apple orchard of 1 ropani. The direct cost for hired labor and the opportunity cost for the family labor spent on the orchard was calculated as the labor cost. It included the labor for manuring, irrigating, training, pruning of trees, applying plant protection in the orchard, harvesting of apples and other activities requiring human labor.

Fertilizer cost (X_2)

The cost of fertilizer was calculated from the direct expenditure on the chemical fertilizers and imputed cost of own farm yard manure applied per ropani.

Plant protection cost (X_3)

The plant protection cost was calculated from the direct expenditure on the chemical and organic pesticides and the imputed cost for preparation of homemade organic pesticides.

Farm equipment cost (X_4)

The cost of farm equipment was calculated from the direct expenditure on different farm equipment purchased in the year between the last two consecutive harvesting of apple.

4.10 Problems related to apple production

Upon the survey for the farmer's perception to problems related to apple production, the problem of disease, insect and pest infestation in the apple orchard was the most problematic issue for farmers from both the districts. The index value of disease insect and pest was 1.47 and 1.5 for Mustang and Jumla respectively. Lack of loan facility, lack of technical knowledge, lack of irrigation and lack of good quality planting material were the other top ranked constraints for the apple producer in Mustang district. Similarly, lack of irrigation, lack of loan facility, lack of technical know-how and lack of good planting material was the order of problems in perception of Jumla's farmers. Farmers from both the districts were not acquainted with the crop insurance of their apple orchard. Table 13 shows the index value and ranking of problem according to the perception of farmers from the respective districts.

Table 13. Farmers' perception on intensity of problem to apple production

Production problem	Mustang		Jumla	
	Index value	Rank	Index value	Rank
Disease/insect and pest	1.47	I	1.5	I
Planting material	4.57	V	4.07	V
Irrigation	4.43	IV	2.8	II
Technical knowledge	4.37	III	4.27	IV
Loan facility	2	II	3.6	III
Crop insurance	0	N/A	0	N/A

(Source: Field survey 2017/2018)

4.11 Price spread of apples in the value chain

The price spread of apples in the value chain along the different actors of Mustang and Jumla are shown in the figures 11 and 12 respectively. The farmers in Mustang were getting an average of NRs 84.67 per kg of apple and Jumli farmers were getting NRs 43 per kg of apple. The producer's share in Mustang and Jumla were 47.03% and 28.66% respectively.

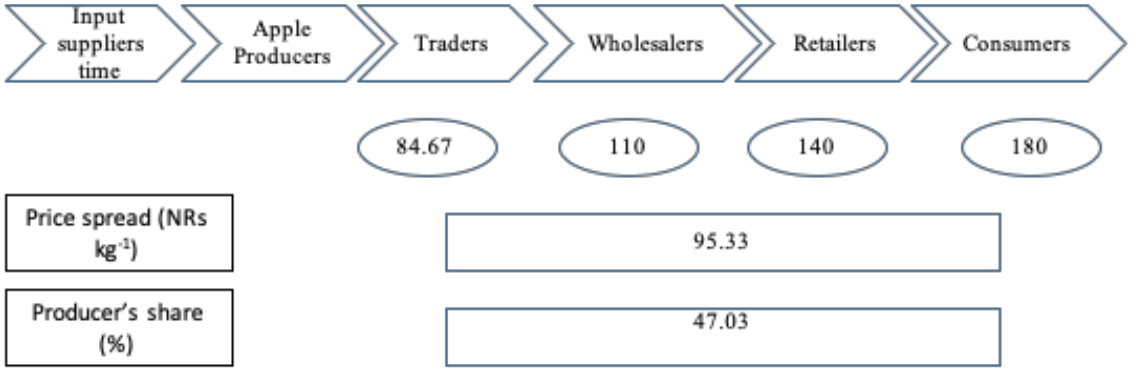

Figure 11. Price spread of Mustang apple along the value chain

(Source: Field survey 2017/2018)

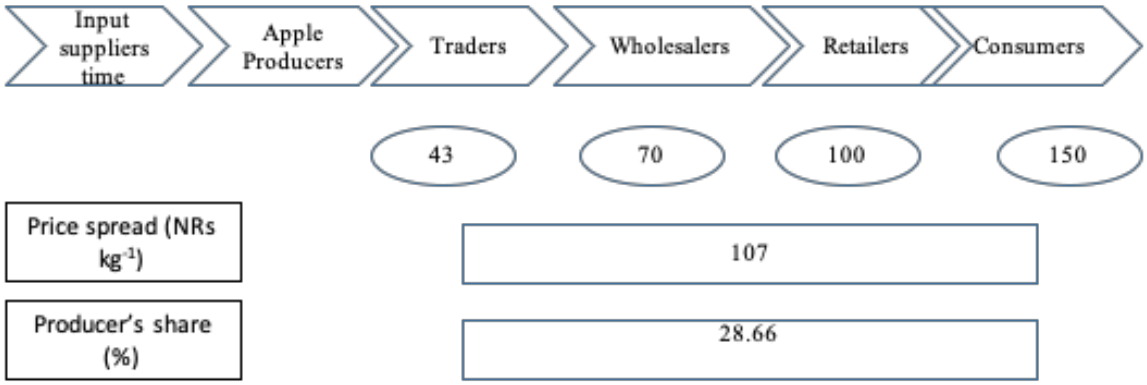

Figure 12. Price spread of Jumla apple along the value chain

(Source: Field survey 2017/2018)

4.12 Value chain of apple

The activities related to bring the apples produced by farmers in their farms to the hands of the consumers in a hierarchical chain is the value chain of apple. due to the involvement of different actors in the chain, the value chain can be different and its efficiency may differ

among each other. This value chain focuses on the identification of the actors involved and the institutions providing the enabling environment. Thus, it also helps in identifying the opportunities and constraints in each level of the value chain and recommending possible strategy to overcome the constraints and utilize the opportunity.

4.12.1 Value chain mapping

Figure 13 and 14 illustrates the value chain map of apple from Mustang and Jumla district. It shows the various actors involved in the value chain and their relationship. On the left, the corresponding functions of the actors are mentioned. Similarly, the support institutions enabling environment for the value chain operation are mentioned to the right of the figure

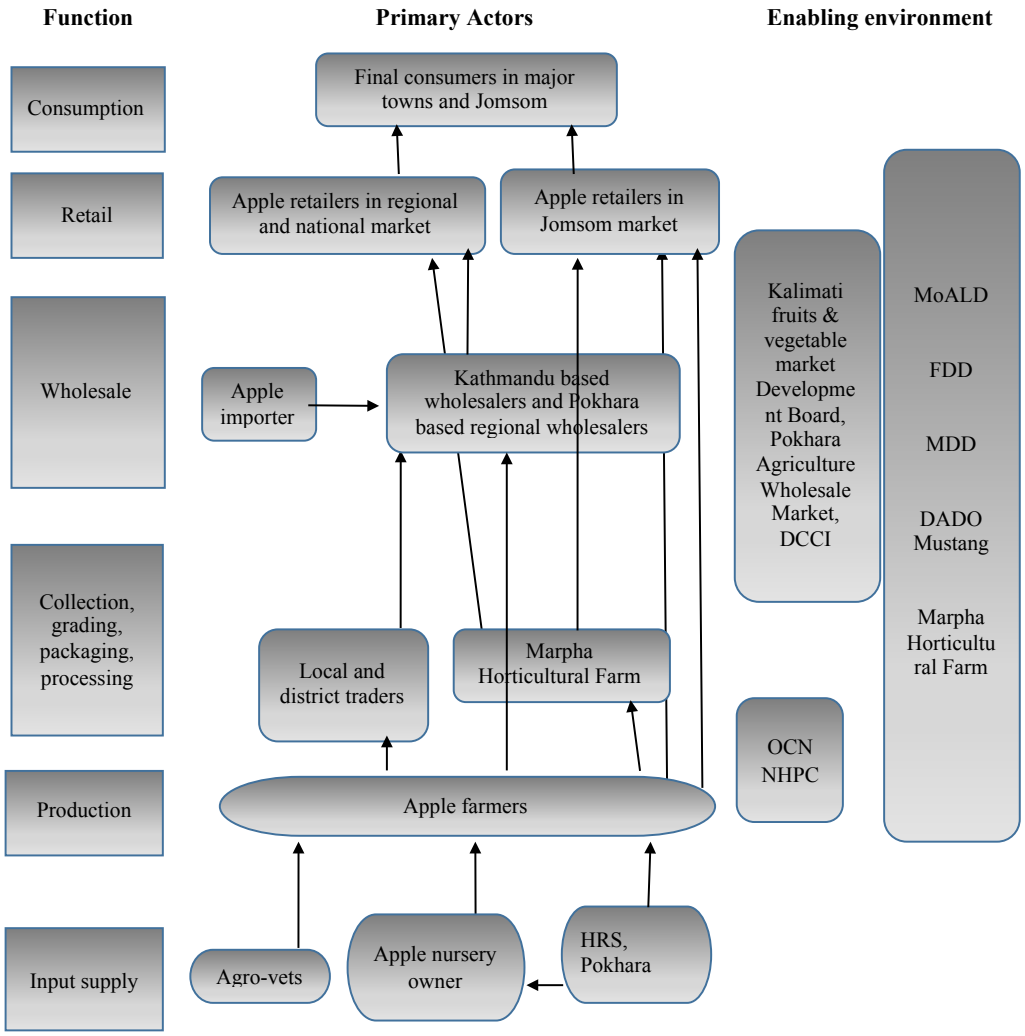

Figure 13. Value chain map of Mustang district

(Source: Field survey 2017/2018)

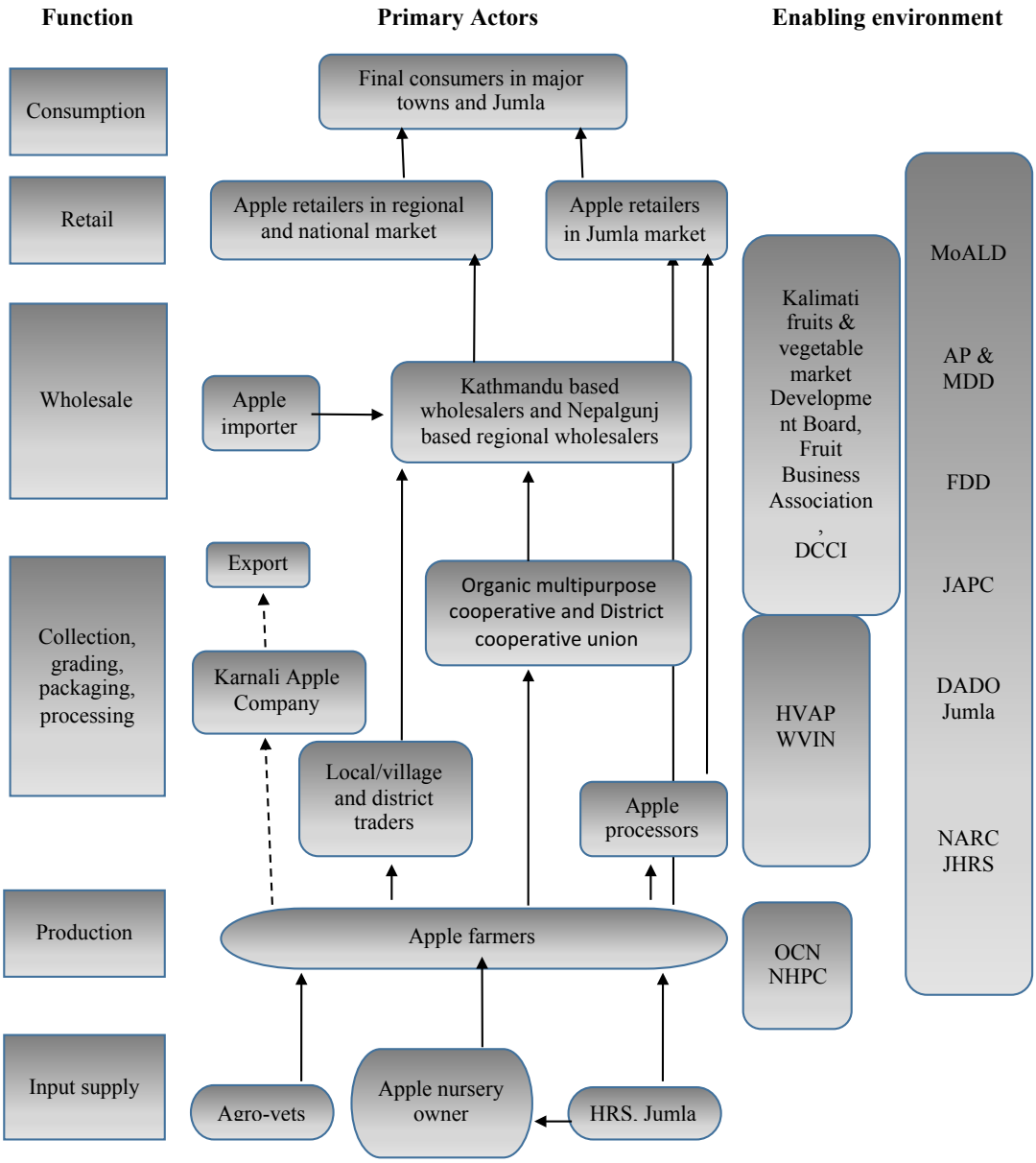

Figure 14. Value chain map of Jumla district

(Source: Field survey 2017/18)

The value chain maps of apple produced in Mustang and Jumla districts are described below

Input suppliers

There were 5 registered apple nurseries and 1 agro-vet in Mustang district. The apple saplings for the farmers in Mustang district were supplied by these apple nurseries. DADO Mustang distributed the saplings produced by Marpha Horticultural Farm to the farmers. The agro-vet

in Mustang supplied the chemical/bio-fertilizers, pesticide and insecticide as well as some organic pesticides to the apple producers. The farm equipment like training and pruning equipment was also supplied by the agro-vet to the farmers.

Similarly, there were 33 apple nurseries in Jumla registered to DADO Jumla and many more un-registered nurseries as per the information from Senior Agriculture Development Officer Mr. Bharat Prasad Kandel from Jumla. There were 6 agro-vets in Jumla district and were supplying organic pesticide, insecticide, bio-fertilizer and farm equipment to the apple farmers.

The Horticulture Research Station, Pokhara and HRS, Rajikot were supplying the farmers with the technology needed for apple producers of the respective districts in Mustang and Jumla.

The apple nursery owners from both the districts were out of the access from the improved and new varieties of apple.

Apple producers

The farmers with apple orchard and producing fresh apples were the apple producer in the value chain. In both the districts, the Delicious varieties: Red, Royal and Golden Delicious were the popular varieties. In addition to this, Chocolate, Jonathan, Macintosh and Richared varieties of apple were also being produced in both the districts. Few farmers in Mustang district were found to be introducing Fuji apple varieties in their orchard.

In Mustang district, DADO Mustang was in lead role to transfer the technology to the farmers on cultivation practice of apple. Similarly, OCN was helping few large farmers in certifying the organic apples.

In Jumla, different organizations were found to continuously increase the capacity of apple producers. Farmers were getting trainings and attending workshops organized by DADO Jumla and SNV Nepal. Hira Bahadur Bohora, a leading farmer from Patarashi-4, Jumla said that he got the knowledge that optimum training and pruning of apple trees leads to better production of apple in terms of quality and quantity. He also said that still there are lots of farmers who think reducing the branches of apple tree by pruning reduces the apple production. Similarly, OCN was providing technical assistance in case of producing organic apples.

Farmers from both the districts complained on the same disease and insect/pest as one of the major problems for apple production. The disease like Powdery Mildew, Scab, Crown gall and pink diseases were the identified diseases in both the districts. Similarly, Wooly aphids, San Jose scale, stem and root borer, tent and slug caterpillar were the major insects infesting the apple orchard in both the district.

Apple processors

The harvesting season (August and September) of apple in all the apple producing districts of Nepal was the same and there was a greater supply of apples in the market at that time. The price of apple at that time was also less as stated by the most farmers surveyed. Both the districts did not have good storage facilities for the fresh apples produce and all the apples had to go to market after the harvest. It is therefore very necessary for processing of apple and transform it to storable form. The diversified products form apple in both the districts were dried apple slices (Syauko sukuti), apple ciders, jam and jelly of apple and apple brandy (a high alcoholic beverage). These diversified products were being prepared mainly by RK apple distillery in Jumla and Marpha Horticultural Farm in Mustang. There were few other local farmers involved in production of home made similar products. In Jumla, there was one governmental processing center called as Jumla Apple Processing Center (JAPC), running under Ministry of Agriculture and Livestock Development (MoALD). Here farmer could bring all their ingredients and use the machinery or equipment for processing their apple into desired forms like dried apple slices or apple jam/jelly. Most of these products were consumed in Jumla district from the retail gift shops of the respective districts as the production was very less.

Marketing actors of the value chain

The major marketing actors in the value chain of apple in Mustang and Jumla district were:

- Traders
- Wholesalers
- Retailers
- Consumers

Traders

The suppliers of the Mustang and Jumla apple were the local and district level traders. In both the districts, few large farmers used to collect the apples from the surrounding farmers and trade it to the wholesalers from Pokhara, Kathmandu and Nepalgunj.

In Jumla district, there were few cooperatives collecting the apples form various farmers and trading respectively to the wholesalers.

Wholesalers

Kalimati Fruits and Vegetable Market based wholesalers imported apples from India and China and bought the apples from Jumla and Mustang also. They supplied the apples to regional wholesalers all over the country as per their demand.

Balkhu Fruit Wholesale Market was a jointly owned wholesale market by GoN and public. It also imported apples from India and China and supplied them to the market.

Majority of retailers like department store, retail fruit and vegetable shop, bicycle vendors in Kathmandu valley buy apples from Kalimati and Balkhu fruit and vegetable market.

Pokhara Agriculture Wholesale Market collected Mustang apples from the traders and supplied them to the wholesalers and retailers based on Pokhara, Chitwan and Kathmandu.

Retailers

The department stores, retail fruits and vegetable shops, and the peddlers who sold the fruits and vegetables in their bicycle were the retailers of apple in Nepal.

Consumers

These were the final consumers of apple and apple products from the producing districts to the people and institutions all over the nation.

Enabling environment in Mustang and Jumla

District Agriculture Development Office (DADO) (Mustang/Jumla)

The DADO of both the districts were mainly responsible for the status of the agriculture development in the respective districts. Both the institutions were actively involved to provide technical and physical assistance to the apple farmers. Since they were the similar institution under the GoN, they had similar roles as stated below"

- Provision of subsidized saplings to the poor and needy farmers to establish the orchard.
- Provision of training on cultivation practice and orchard management to the farmers.
- Provision of grafting training and nursery management to the registered nurseries.
- Provision of subsidies to buy farm equipment to farmers and transport subsidy to traders as per the rule of GoN and need of the traders in the respective district.
- Providing assistance to District Development Committee in formulating agriculture related plans and policies.

District Chambers of Commerce and Industry (DCCI)

DCCI in Jumla was found to be more active than DCCI of Mustang. Mostly, it was the organization of the shop keepers and traders of the respective district. The respective DCCI were operating a souvenir shop to sell the diversified apple products like dried apple slices, jam, jelly and apple alcoholic beverages just near to the airport of respective districts.

Mr. Govinda Bahadur Shahi, the president of Jumla Chamber of Commerce and Industry said that they have been facilitating the traders to conduct apple business with the wholesalers in Kathmandu and Narayanghad.

Nepal Agricultural Research Council (NARC)

It was established in 1991 as an autonomous organization under "Nepal Agricultural Research Council Act-1991". It conducted research in agriculture to develop scientific farming and uplift the economic level of the people (NARC, n.d.).

The Horticulture Research Station under NARC in Rajikot, Jumla had conducted several researches for apple producers and traders. It also conducted on farm trials for technology development and technology transfer. It had conducted researches on orchard management and cushioning material for transport of apples to the market.

High Value Agriculture Project in Hill and Mountain Areas (HVAP)

It was the project jointly implemented by MoALD, SNV Netherlands Development Organization, Agro-Enterprise Centre (AEC), DADO/DLSO/DFO and local NGOs in the respective district. It supported in capacity building of DADO Jumla, various trainings for apple nursery owners and the apple producers.

World Vision International Nepal (WVIN)

World Vision International Nepal was supporting in the organic certification of the apple orchards, capacity building of Local Agricultural Resource Farmers (LARFs) and local value chain development.

Nepal Horticulture Promotion Centre (NHPC)

NHPC was a national level NGO with its program in several districts. It was conducting programs for capacity building of apple producers

Organic Certification Nepal (OCN)

Organic Certification Nepal was the most popular organic certifying agency in Nepal. There were not any government organic certifying bodies in Nepal. Amidst few other private organic certifying bodies, OCN was popularly used by farmers for organic certifying their apple. OCN also helped in facilitation and provide training in the organic certifying process as well as growing apples organically.

Ministry of Agriculture and Livestock Development (MOALD)

It was the central body of GoN responsible for the agriculture development of Nepal. It had several departments, directorates and projects related to development of apple farming in Nepal. Some of the relevant ones were:

Department of Agriculture (DoA)

It was the lead government organization for the development of agriculture in Nepal. Its broad objective was to achieve food security and alleviate poverty through transformation of agriculture in Nepal (DoA, n.d.). The implementing bodies of DoA were the Regional Directorates (RD) and the DADOs. These offices were mainly responsible for the extension services and transfer of technology to the farmers.

Fruit Development Directorate (FDD)

Fruit Development Directorate (FDD) was the central technical body under DoA for the development of fruits, coffee, tea and ornamental crops in Nepal. It had its broad objective to increase the level of income of farmers by increasing the production and productivity through research and dissemination of improved technology.

Agribusiness Promotion and Marketing Development Directorate (AP & MDD)

It was the major government body responsible for agribusiness promotion and marketing of agricultural produce within the country through various wholesale and retail markets.

Kalimati Fruits and Vegetable Market Development Board

Kalimati Fruits and Vegetable Market was the terminal wholesale market in Nepal. It facilitated the trade and marketing of various fruits and vegetables, including apple from Jumla and Mustang. It was regulating the prices of the commodity in value chain as much as possible.

Pokhara Agriculture Wholesale Market

It was the wholesale market owned by GoN in Pokhara. It was facilitating the trade of apple from Mustang to Kathmandu, Pokhara and Narayanghad.

4.12.2 Constraints and opportunities of apple value chain

Input supply

Quality of saplings: The quality of saplings from the private apple nursery owner was not monitored by any government organization before selling. Some of the nursery owners were found to be unaware of the varieties they were raising in Jumla. The nursery owners in both the districts were in access to only the old traditional varieties of apple and were unaware of the need of the pollinizer for the varieties they were producing.

Fertilizer, pesticide and farm equipment supply: The permitted bio-fertilizer and bio-pesticides were not adequate in both the districts. Farmers from both the districts complained about the timely delivery of the fertilizers and equipment through the agro-vets.

Production

Poor orchard management was found in most of the farmer's orchard in both the districts. They did not have adequate knowledge on training and pruning of trees and fruit thinning. This had led to poor quality of the fruits. Irrigation was a major problem in most of the orchards of Jumla district though comparatively better irrigation was found in Mustang district.

Harvest and post-harvest

Most of the farmers were found to harvest the fruits by shaking the tree leading to deterioration of the fruits with bruises. Grading of fruits according to the fruit variety was not in practice as most of the farmers had various varieties of apple in same orchard

Packaging material: Several researches had been conducted to analyze the effect of packaging material during marketing of apple by Paudyal (2017); Subedi and Giri (2017). The level of extension of these researches were found to be poorly done. It had led to decreased consumer preference in the market.

Storage: The storage facility of apple was not adequate in both the districts for farmers and traders. The indigenous way of storing apple in ground floor or cellar storage with very small capacity was in practice which led to high post-harvest loss of fruits.

Technology development and research

The indigenous knowledge of bio-pesticide was not documented properly. The locally available bio-pesticide was a good opportunity for the producers to minimize cost of inputs.

Similarly, research in introducing new apple varieties was with very slow progress and most of the farmers and nursery owners were still using old varieties of Delicious apples.

Research on increasing the quality of compost manure and farm yard manure was also an opportunity for reducing the price of inputs to the farmer.

Knowledge on climate change adaptation of the farmers was minimal and introduction of varieties like late and early maturing trees could reduce the risk of farm failure.

Marketing

The road transportation in both the districts were improving as the black topping of the road was on progress during the time of survey. It could lead to better opportunity for marketing of the produce to farther districts and even export to other countries.

The price fixation of apples for the farmers was found to be done by the traders in both the districts and involvement of farmers was not found in the process. The cooperative marketing could be an option to provide good producer's share for the apple producers in both the districts.

More study on marketing channel was needed to reduce the number of steps in the marketing channel and increase producer's share along with decreasing the consumer's price. This could be an opportunity to the domestic apples for competing with the apples from India and China.

Organization and management

Different projects were in operation to enhance the apple value chain in Mustang and Jumla district. The better coordination between the actors of the value chains were prevalent during the project span. Several such cooperatives and other linkages were found to be inactive after the support period. Thus, ownership of the developed institutions by the locals and the permanent government body like DADO could be an opportunity to strengthen and continue the good management practice in the apple value chain of both the districts.

Regulatory policy

There was no organic certification system from the GoN. The popular organic certifying agency was OCN. The certification by individual was very expensive and group certification was comparatively cheaper. The growing consumer awareness about organic products is increasing the willingness to pay for organic products in urban and semi-urban area of Nepal (Rai & Adhikari, 2016). Thus, development of national accreditation system could increase the market for organic produce benefitting rural people

Value chain governance

Pricing of apple in the value chain was governed by the market actors rather than producers and was in favor of the large profit margin, high consumer price and low producer's share. The price fixation from the Kalimati fruit and vegetables market was not found to be effective in the market due to lack of market monitoring.

5. SUMMARY AND CONCLUSIONS

This section consists of the summary of the research and provides conclusion, policy recommendations and suggestion for further research based on the findings.

5.1 Summary

Apple was a promising enterprise to uplift the economy of mountainous rural farmers of Nepal by utilizing the even marginal resources too. The review of the government data and statistics showed that the area under apple cultivation is increasing year by year but the productivity has been very poor compared to the neighboring countries and the world. A total of 83,000 metric tons of fresh apple was imported to Nepal in fiscal year 2016/17 (MoALC, 2016/17) showing the high demand of apple and prospects of apple cultivation in Nepal.

A survey was conducted during December 2017 to January 2018 in two districts of Nepal Jumla and Mustang surveying 110 respondents as 60 from the apple growing community, 5 apple traders, 5 wholesalers, 10 retailers and 30 consumers to analyze the constraints and prospects of apple farming and marketing from the remote part of the country. The specific objectives of this study were to explore the actors in the value chain of apple, identify the resource use efficiency, analyze the contribution of apple in the household economy and identify the constraints and prospects of apple value chain in order to strengthen the value chain and make it sustainable.

The study revealed that the key actors of the apple value chain were **input suppliers**: apple nursery owner, agro-vets, **apple producers**: producing fresh apples, **traders/collectors**: trading apple from farmers to wholesalers, **processors**: Private and government owned processing facilities in the respective district, **wholesalers**: buying apples from traders and farmers and selling to retailers, **retailers**: retailer shops and bicycle vendors and the final **consumers** of the apple. The enabling environment providers in the value chain were DADO, NARC, DCCI, financial institutions, development and marketing institutions.

The respondent families in Mustang district were generating 68.27% of their total household income from apple farming which was higher than that of Jumla (44.8%). Thus apple farming was a significant source of income for household expenses in the apple growing districts. It

showed that improving the apple cultivation and marketing could help to increase the living standards of the apple growers.

The cost of apple production per kg in Mustang and Jumla was Rs 47.24 and Rs 19.53 respectively. The high cost of production in Mustang than that of Jumla was observed because of the use of excessive labor, fertilizer and plant protection measures in the apple orchard. Among the production factors, labor was the most cost demanding factor costing 68% and 64% of total production cost in Mustang and Jumla district respectively. It showed the labor intensive nature of the production system of apple in Nepal.

The labor cost in Jumla had a highly significant relation with the total income from apple whereas the labor cost in Mustang was not significant in generating the income from apple orchard. It implied that there was an excessive use of labor in the orchards of Mustang district than required.

Benefit cost ratios of apple farming in Mustang and Jumla were 1.98 and 2.44 respectively. It clearly indicated the highly profitable nature of apple farming in these districts. The marketing margins were Rs 95.33 and Rs 107 per kg in Mustang and Jumla respectively. The high marketing margin with less producer's share revealed the inefficiencies in the marketing channel. Decreasing the actors in the marketing channel to the possible least number and promotion of collective marketing could be the possible suggestion to increase the marketing efficiency.

The problem of insect/pest and diseases in apple production was in high prevalence in both the districts. Lack of irrigation, lack of technological know-how and lack of easy loan facility was few other problems for the apple farmers. Almost all of the respondents were unaware of the crop insurance for their apple orchards. Increasing marketing possibility and awareness of crop insurance could help the apple farmers reduce the risk of crop failure and increase income in the surveyed districts.

Similarly, the research and extension to introduce new and more promising varieties of apple in these districts also could benefit the farmers and the whole value chain.

Easy provision of organic certification, construction of government storage facilities for apple, development of apple processing industries would increase the opportunities for strengthening and enhancing the apple value chain of apple in future.

A personal suggestion from the experience through field survey would be to train and help farmers to record their costs and benefits through better book keeping of their farms. It could help to develop the farm to a commercial enterprise rather than a mere ordinary farm for livelihood. A better picture of the farm economics could be a value to the farmers, researchers and policy makers.

5.2 Conclusion

Mustang and Jumla are two potential districts for apple production due to their topography and climate. High share of the income from apple farming in total household income in both the districts revealed the significance of apple farming for the livelihood of the rural people of these districts. The development in the farming condition and marketing situation of apple in these districts could be a major means to achieve better economy and increased standard of living of the peasants from the remote mountainous part.

The key actors of the value chain of apple were found to be apple producers, local/district traders, wholesalers, retailers and consumers. The gross margin analysis and high B/C ratio signified the profitability of apple farming in both of these districts. However, the existence of the five links in the marketing channel, which was the most used marketing channel by the producers was causing the farmers to have less bargaining power in case of price fixation. The high share of income from apple was found to be taken by the marketing actors even when their role was for significantly shorter period of time as compared to the time of production by farmers.

Productivity of apple was found to be low as compared to the neighboring countries because of lack of management of insects/pests, poor planting materials, old varieties, lack of irrigation, lack of technical knowledge for orchard management and lack of easy loan services to expand the level of production. The major marketing problems were lack of storage facility, lack of good and low cost packaging material and a good and reliable transportation system.

The good governance of the value chain by fixing the minimum price for all stages of apple by the responsible authority could benefit the value chain. Development of governmental structure for organic certification system could help the farmers get more returns from their produce and make consumers assure on the quality of the produce. Organizational development of the marketing channels by formalizing the links could make the value chain

more strong. Furthermore, formulating a concrete plan and policy along with investment of government to develop the physical infrastructures required to facilitate the apple value chain can be profitable for the entire nation and an example to the whole world.

5.3 Suggested future research areas

- Research on plant protection of apple trees for the problematic diseases and pests like apple wooly aphid, borers etc.
- Research on post-harvest technology to reduce the post-harvest loss
- Research on need and effect of storage structures to regulate the supply of apples for prolonged time rather than a mere season.
- A detailed study on national value chain of apple

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APPENDICES

Appendix 1. Price of apple at different places for Mustang apple value chain

Price of apple at different places	Price (Rs)
Average retail price at Pokhara	180
Wholesalers price at Pokhara	140
Average per Kg price of traders	110
Transportation cost per Kg from Jomsom to Pokhara	7.50
Average farm gate price	84.67

Appendix 2. Price of apple at different places for Jumla apple value chain

Price of apple at different places	Price (Rs)
Average retail price at Nepalgunj	150
Wholesalers price at Nepalgunj	100
Average per Kg price of traders	70
Transportation cost per Kg from Jumla to Nepalgunj	9
Average farm gate price	43

Some glimpses of Field Survey

Photo 1. Survey with apple farmer from Jumla

Photo 2. Apple farmer from Jumla showing his indigenous technique of apple storage

Photo 3. View of Jumla bazar

Photo 4. Apple orchard in Mustang during the winter season

Photo 5. Survey with the apple farmer from Mustang

Photo 6. View of Nilgiri mountain from Thini village, Mustang