Value Chain and Market Analysis of Renewable Natural Resources Products Report

Enhancing Sustainability and Climate Resilience of Forest and Agriculture Landscape and Community Livelihoods in Bhutan

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Abbreviations

AC	Acre
AMC	Agriculture Machinery Center
BAFRA	Bhutan Agriculture Food and Regulatory Authority
BCCI	Bhutan Chamber of Commerce and Industry
BIL	Bhutan Insurance Limited
DRC	Department of Revenue and Customs
EA	Extension Agent
EFS	Electric Fencing System
FCB	Food Corporation of Bhutan
FGD	Focus Group Discussion
FNPP	FAO-Netherlands Partnership Programme
GEF	Global Environment Facility
GNHC	Gross National Happiness Commission
KG	Kilogram
LCMP	Land Cover Mapping Project
LDCF	Least Developed Countries Fund
LG	Local Government
MoAF	Ministry of Agriculture and Forests
MASL	Mean Above Sea Level
MoEA	Ministry of Economic Affairs
MPU	Milk Processing Unit
MT	Metric Ton
NLC	National Land Commission
NPPC	National Plant Protection Center
NPK	Nitrogen Phosphate and Potassium
NSSC	National Soil Service Center
NSC	National Seed Center
NU	Ngultrum
PPD	Policy and Planning Division
PPG	Project Preparation Grant
Rs	Rupee
RICB	Royal Insurance Corporation of Bhutan
RSPN	Royal Society for Protection of Nature
RSTA	Road Safety and Transport Authority
RNR	Renewal Natural Resources
SAARC	South Asian Association of Regional Cooperation
SLOT	Shari Lothuen Omgi Tshogpa
SPAL	Soil Plant Protection Center
SSR	Seed Replacement Ration
SSP	Single Superphosphate
STAR	System for Transparent Allocation of Resources
ToR	Terms of Reference
UNDP	United Nations Development Programme
VC	Value Chain

Executive Summary

Alongside gradual reduction and utilization of limited natural resources and increasing pressure related to quality of environmental management and governance, the government have sought to implement and develop mechanisms to overcome emerging environmental challenges with a view to better promoting the emergence of the most sustainable form of development in the country. It is against this backdrop the government has successfully completed the Global Environment Facility's (GEF) National Portfolio Formulation Exercise setting the country's priorities along thematic areas of i) climate change, ii) biological diversity, and iii) land degradation. In accordance with the procedures, Bhutan has secured a project preparation grant (PPG) from the GEF System for Transparent Allocation of Resources (STAR) allocation, to formulate a full-size project on ***"Enhancing sustainability and resilience of forest and agriculture landscape and community livelihoods in Bhutan."*** The overall objective of this project is to operationalize an integrated landscape-based approach for management of forest and agricultural systems, strengthening biological corridors in adjunct with protected areas, and building climate resilience of community livelihoods.

Value Chains and Market Analysis of Renewal Natural Resource Products is one study among other studies, and its findings will be used as a vital component to the formulation and design of the RCEC project.

The specific purpose of the study is to carry out value chain and market analysis of Renewable Natural Resource (RNR) commodities that can be produced from sustainable and climate-resilient livelihood practices. It identifies and prioritizes renewable natural resources commodities that can be produced from sustainable and climate-resilient livelihood practices while examining opportunities, constraints and challenges, and recommends measures to strengthen the existing value chains. The study also assesses the present market conditions in terms of size, demand and supply gaps, price, imports and exports, and distribution networks in addition to making observations on the distinct roles of men, women and youth groups. Finally, the study identifies and prioritizes business development and extension services needed for promoting the production and marketing of renewable natural resources as important links along the value chain.

The study identified five commodities namely potato, maize, ginger, cardamom and dairy products. Product selection has been based on criterion of i) productive capacity, ii) number of beneficiaries and size of *dzongkhags* and *gewogs* falling under a particular landscape boundary, iii) sustainable livelihood options, iv) degree of vulnerability to climatic conditions, v) product resilience to climatic conditions, vi) scalability potentials, and vii) fair gewographical distribution of commodities representing all three landscapes.

Dairy products (milk, butter and cheese) has been chosen in Bjee *gewog* under Haa *dzongkhag* as part of Landscape I considering only negligible parts of Sombhakha and Sama *gewogs* falls under the landscape boundary, and Tsento is the only *gewog* in Paro as compared to three *gewogs* in Haa. Bjee *gewog* also exhibits productive capacity and scalability for expansion with livelihood benefits of the community. Keeping the criterion in mind, under Landscape II, Wangdue and Sarpang *dzongkhags* has been chosen by identifying potato value chain in

Phobjikha *gewog* and ginger value chain in Athang *gewog*. Under Sarpang *dzongkhag* Cardamom value chain has been identified in Jigmecholing *gewog*.

Out of the total 23 *gewogs* under Landscape II, 11 *gewogs* fall under Wangdue *dzongkhag*, with 75% of area coverage in Athang and 55% of area coverage in Phobjikha falling within the landscape. Productive capacity, livelihood option and poverty alleviation, market value and export earnings, road access, income generation, climate resilient, traditional knowledge, gender roles were some of the reasons cited for commodity selection. Similarly, cardamom under Jigmecholing *gewog* was chosen because attributes to climate resilient, 55% area coverage under landscape as compared to just 5% in Doban, productive capacity, cash income and poverty alleviation, road access, market value and future potential to upscale production. Under Landscape III, maize commodity value chain has been chosen under Saleng *gewog* in Monggar *dzongkhag* attributing mainly to livelihood options, comparative resilience, productive capacity and scalability potential.

Potato Value Chain

Potato is an important cash crop that has benefitted farmers across the country with Phobjikha valley identified as one of the pronounced production area. The crop provides sustainable livelihoods in the *gewog* with productive capacity not only for self-consumption but benefitting export earnings with the crop sold to India mainly via the auction yards. Income derived from the sale proceeds has empowered families with increased literacy and enrollment, standard of living, health and hygiene through improved housing and running water supply, purchase of farm machines and locomotives for personal transport and farming tractors. However, the value chain does not prevail without constraints ranging with a single player (mainly the farmer) performing all functions along the chain starting from production functions to markets, losses to crop damage from wildlife, pests and diseases, post-harvest losses from storage and transport. Processing at a commercial scale is absent but with research on variety selection presents future potential with youth business groups venturing into locally produced potato chips. Recently a youth group has initiated potato cultivation with new varieties piloting in Paro and successfully started processing potato chips gaining increasing brand recognition as Happy Chips.

Dominant markets for table and seed potatoes are concentrated at the Food Corporation of Bhutan auction yard in P/Ling, but long and arduous journey with thoughtless loading and unloading succumbs to physical product damage. Collection and assembly of produce to the nearest road head from farmers' field incurs high transaction costs resulting from scattered and small quantities of harvest. Market information that determines the profitability of the potato sales is often based on inaccurate word-of-mouth news relayed by friends and neighbors.

Some of the key recommendations for the potato value chain are as follows;

- Strengthen existing integrated pest management to combat pests and diseases to reduce crop losses and innovate measures to combat wildlife crop damage in addition to electric fencing and field guarding;
- Increase both table and seed potato production through more support for irrigation

and soil fertility management, farm mechanization, climate resilient practices with institutional capacity developed at *dzongkhags* and *gewog* levels for potential climate risk mitigation mechanisms by promoting climate resilient methods;

- Build awareness of farmers, cooperatives, and government officers of risks and opportunities in market linkages and value chain for enhanced climate-resilient production and marketing;
- Improved market knowledge and market related infrastructure such as collection centers, improvised grading machines and storage warehousing, and improved packaging materials;
- Enhance market access with environment friendly and improved road quality withstanding monsoon roadblocks;
- Develop payment for environmental services and community based agro/eco-tourism in the locality for additional rural income for farmers;

Maize Value Chain

Saleng *gewog* in Monggar *dzongkhag* has potential to increase maize production through improved farm management practices. Currently, the crop suffers 15-20% post-harvest losses from inadequate shelling, storage and packing materials. Wildlife damage and climatic damages resulting from prolonged dry weather, invasion of weeds, windstorms, cloud burst, etc. have contributed to 50% reduction in production. Strong winds or windstorms have been cited as a negative factor, with impacts on both the crop stem and the quality of cob kernels. Occurrence of unexpected windstorms and hailstones has also proven disastrous to quality. Further, farmers have indicated that changing and more unpredictable precipitation patterns in the region have limited their ability to produce reliable quantities of maize.

Processing is prevalent but constrained by rudimentary milling equipment inhibiting the quality and quantity of processed products with only 30,000 kg of *Kharang* and 20,000 kg for *Tengma* in 2015. Packaging is limited to basic plastic wrapping lacking proper grading, product labels and brands. Distribution is under developed with the product passing hands through relatives and friends sold through retail outlets in urban towns with a percentage sold on the roadside to travelers plying the east-west highway.

Potential exist with increasing demand for maize as an important ingredient to feed making and product diversification venturing into enhanced quality of *Tengma* and *Kharang* employing modern packaging materials with product labels, brands and certification.

Some of the key recommendations for the maize value chain are as follows;

- Address wildlife crop damage through innovative measures to ward off wildlife from farmers' field.
- Negotiate crop insurance schemes with providers like RICB and BIL;
- Increase production and productivity through improved sustainable land management practices and sowing high yielding varieties with awareness on seed replacement with fresh seeds that are disease free and resilient to climatic changes;

- Improved marketing infrastructure through development of post-harvest storage, packaging, processing and sales facilities;
- Employ labor saving devices through basic farm mechanization with the usage of small size power tillers;
- Strengthen existing farmer groups and association to derive associated benefit along the value chain;

Cardamom Value Chain

Cardamom is a high value cash crop witnessing increasing production with untapped markets in the neighboring towns of India. Like in most cardamom growing areas, farmers in Jigmecholing *gewog* are suffering from poor planting materials for propagation with production inadequacy especially in terms of soil fertility management, maintaining overhead tree shade preventing the plant from direct sun radiation, and poor quality as a result of traditional methods of drying using the *Bhattie*. A *Bhattie* is a traditional flattened pan with shallow depth circular in shape used for drying cardamom over wood flames. The cardamom value chain suffers from inadequate drying and storage facilities resulting to the quality deterioration and weight losses. The value chain is under developed in terms of specialized functions with more than 50% of the trade flowing out through informal channels. For instance, farmers sell the harvest to local traders at the farm who in turn sell to Indian traders for onward delivery to wholesale retailers in the neighboring Indian towns.

Some of the key recommendations for the cardamom value chain are as follows;

- Increase production and yield through the distribution of quality planting saplings and explore expansion of cultivation area using State Reserve Forest land;
- Explore community forestry integrated with cardamom as an undergrowth cultivation;
- Employ sustainable land management practices and integrated pest management to reduce crop losses to low yield and crop damage
- Develop research agenda on improved drying technologies, storage facilities, diversifying market intermediaries;
- Training of farmers on quality grades, labels and brand building of Bhutanese cardamom;
- Developing value chain players such as transporters, local traders, auction markets, etc.

Ginger Value Chain

Ginger value chain has been studied in Athang *gewog* taking into consideration livelihood options and poverty alleviation benefits of the community growers. Production is predominantly at a backyard scale and in scattered locations with acreage ranging from 0.25 to 0.5 acres. Crop destruction is not spared from wildlife damage such as rodents, porcupine, deer and other wild animals. Distance to markets require transporting on human backs, power tillers and truck loads to either the local market or the weekend market in Thimphu.

A major problem encountering farmers is the un-economics of selling in small quantities resulting from transport charges and labor lost from travelling to and fro to market places. However, selling in bulk quantities often exceeds market demand and forces prices to drop with the competition from Indian ginger. Storage of ginger is limited in pits dug inside the ground yielding to spoilage and deterioration. Currently, there is no processing of ginger in the area but prospects for processing is promising with simple value addition.

Some of the key recommendations for the ginger value chain are as follows;

- Increase production area through expansion of cultivation using State Reserve Forest land;
- Address production inadequacy of rhizome rotting through improved management;
- Develop on-site processing of ginger pickle, ginger powder, ginger tea sachets through farmer groups or private investors;
- Branding and grading of ginger from Athang as organic with proper packaging, weights and standards for fresh sales;
- Explore supply contracts to deliver to Bhutan Agro-industries Ltd. and other processors;

Dairy Value Chain

Dairy farming in Bjee *gewog* in Haa *dzongkhag* is carried out by farmers as members of the Yangthang, Talung and Chundu Om Tshogpa. Production is at a small scale with an average production size of 3-4 milking cows. Cattle breed is a mix of both indigenous like *Thrabam, Jatsa-Jatsam*, yaks and improved breeds like Brown Swiss and Jerseys. Production is under capacity by the lack of fodder grasslands during winter months and cost of commercial feeding incurring high transportation charges. Grazing in the wild is subject to labor availability with a permanent family member attending to cattle rearing year round. In the case of yaks, family labor or hired is considered a fulltime job. Production is driven by farmers who do not necessarily view the dairy activity as a commercial venture but rather as part of an integrated farming system to generate a little income subject to availability of labor and other cattle associated resources.

There are challenges of milk collection from the farmer's yard to the milk processing unit (MPU) center with farmers having to carry milk for long distances under harsh weather conditions of either heavy rainfall or hot weather. Certain gaps in the value chain observed are processing technology limited to traditional bamboo or wooden pistons with hand churning although the MPU in Yangthang maintain equipment like the milk churner, cream separator and butter mixer. Unreliable supply and inadequate packaging and transport are also some of the impeding factors towards growth of the industry.

Some of the key recommendations for the dairy value chain are as follows;

- Breed improvement from Jatsa-Jatsam, Thrabham to Jersey Cross and Brown Swiss through artificial inseminations, distribution of breeding bulls and other improved

veterinary services;

- Value addition with product diversification to processing into ice cream, yogurt in addition to butter and cheese with possible partnerships with entrepreneurs like youth groups or established business houses;
- Technical support to improve packaging of butter and cheese (*datsi*) and cold storage facilities for both storage and transport freezer vans;
- Pasture development for fodder development and hay making for lean winter months;
- Distribution and training on new processing equipment;
- Policy support on grazing pasture rights either through lease or ownership;

I. Background, Objectives and Methodology

As part of the Royal Government of Bhutan's initiatives to reduce climate change vulnerabilities and to improve the sustainability of local livelihoods and biodiversity of the country, a study on value chains and market analysis on prioritized Renewal Natural Resources (RNR) products is carried out in project target areas. The findings of the study along with other studies is used as core inputs for the larger formulation and design of the UNDP/GEF/LDCF project, particularly in relation to the development of climate resilient livelihood options for local communities in the project landscape.

The project Landscape covering *dzongkhags* and *gewogs* falling within each landscape are described as below;

Landscape I constitutes Jigme Khesar Strict Nature Reserve (JKSNR) and Biological Corridor 1 covering 758 square kilometers falling in Bjee, Sombay and Sama *gewogs* in Haa and Tsento *gewog* in Paro. The total population living inside Landscape I is estimated at 1,500 people.

Landscape II constitutes Jigme Singye Wangchuck National Park (JSWNP) and Biological Corridor 2 and Biological Corridor 8 covering 2,844 square kilometers falling in 7 *dzongkhags* and 23 *gewogs* distributed in Punakha, Sarpang, Thimphu, Trongsa, Tsirang, Wangduephodrang and Zhemgang *dzongkhags*. Wangduephodrang constitutes 11 *gewogs* of the total 23, Trongsa constitutes 4, Punakha, Sarpang and Tsirang constitute 2 each and 1 *gewog* each falls in Thimphu and Zhemgang *dzongkhags*. The total population living inside the protected landscape II is estimated at 10,000 people.

Landscape III constitutes Phrumsengla National Park (PNP) and Biological Corridor 4 covering 1,406 square kilometers in area covering five *dzongkhags* and 11 *gewogs* distributed among Bumthang, Lhuentse, Mongar, Zhemgang, and Trongsa. Bumthang and Lhuentse constitute 3 *gewogs* each, Monggar and Zhemgang constitutes 2 *gewogs* each and finally Trongsa constituting 1 *gewog*.

1.1 Objectives, Scope and Limitation

The primary objective of the study is to identify commodity value chains and a related market analysis within the renewable natural resource sector that can be produced from sustainable and climate-resilient livelihood practices in the target project areas. This would mean identifying at least one commodity value chain within Landscape 1, Landscape 2 and Landscape 3.

The scope of the study is as follows;

- Within the project landscapes, to identify and prioritize renewable natural resource commodities that can be produced from sustainable and climate-resilient livelihood practices (e.g. reduced / efficient water use, integrated soil and water conservation on farmlands, community based natural resource management, and agroforestry);

- To develop value chain maps for these commodities considering the distinct roles of men and women;

- To examine opportunities, constraints and challenges, and recommend measures to strengthen the existing value chains for identified renewable natural resources commodities in the target project areas;

- To assess the present market conditions such as in terms of size, key players (including the distinct roles of men and women and their capacity building requirements), demand-supply gap, pricing trends, imports and exports, and distribution networks;

- To identify and prioritize business development and extension services needed for promoting the production and marketing of renewable natural resources commodities, including linkages with other potential initiatives such as ABS (access to genetic resources and benefit-sharing) schemes and organic farming enterprises.

1.2 Rationale, Methodology and Approach

i. Rationale

The rational of the study are discussed below;

The choice of commodities has been carried out keeping in the mind the scope and objective of study in terms of climate-resilience and environmentally sustainable livelihoods. However, while zooming into a select commodity group, final choice has been influenced by landscape demarcations in terms of cadastral coverage, population and number of beneficiaries, number of *gewogs* and *dzongkhags* falling under each landscape type, productive capacity within landscapes and fair distribution of commodity choice across all three landscapes. Within this set of criterion employed, considerations were also examined in terms of scalability, climate-resilience of the commodity, availability of markets and market value and abled farm labor availability.

This has resulted to identifying milk and milk products from Bjee in Haa dzongkhag under Landscape I; potato (Phobjikha), ginger (Athang) and cardamom (Sampheling) under Wangdue and Sarpang *dzongkhag* under Landscape II; and maize in Saleng gewog in Mongar *dzongkhag* under Landscape III. Table 1 also highlights salient features of justifying the choice of commodities.

The study has been carried out employing the following methods and approaches;

ii. Review of Related Literature

Related literature to value chain studies have been studied identifying potentials and opportunities for productive capacity, processing potential, distribution networks and market

value. In the past, the Ministry of Agriculture and Forests under partnership between United Nations Food and Agriculture Organization and the Government of the Netherlands (FNPP) project carried out several commodity value chain studies starting with rice, maize, chilies, potatoes, mushroom and dairy products. Other studies on market opportunities in terms of market size, demand and supply gaps, customer preferences and choices were also reviewed. Recent production and sales data were studied, while examining the commodity value chain examining processes starting farm to table. To estimate market demands, import and export figures were analyzed using Bhutan Trade Statistics data. (For list of literature reviewed refer Annexure 2).

iii. Consultations with Key Stakeholders both in the Center and Districts

Primary information has been collected through Focus Group Discussions (FGDs) and Key Informants Interview (KIIs) while one-to-one consultations were engaged with key informants in the *dzongkhags* as identified by *gewogs* corresponding to commodities. FGD discussion participants are provided in Annexure 3.

Consultations with key stakeholders were as follows;

- Farmer groups and key informants such as village elders and progressive farmers
- Government officials
- Local Government officials
- Food Corporation of Bhutan
- Sersang Agriculture Exports Company
- Department of Trade, Ministry of Economic Affairs
- Member of Parliaments for BBIN, trade compacts and other issues
- Department of Agriculture Marketing and Cooperatives, MoAF.
- Bhutan Agro-Industries Ltd.

Secondary data sources have been derived mostly from the compilations of past years' data of Bhutan Trade Statistics, Agriculture Statistics, Livestock Statistics, Bhutan Agriculture Food and Regulatory Authority database and Food Corporation of Bhutan reports.

iv. Field Visits to Target Project Areas by Landscape and Commodity Type

Field visits and commodity selection were undertaken corresponding to Landscape 1, Landscape 2 and Landscape 3, bearing in mind the following set of criterion;

1. Percentage cadastral area and associated beneficiary count of the *dzongkhag* and *gewog* falling under the specified landscape type.
2. Productive capacity of the commodity using past data and first-hand consultation with *dzongkhag* and extension officials.
3. Livelihood benefits, poverty alleviation potential and the degree of vulnerability.
4. Commodity resilient to extreme climatic conditions, e.g. drought/heat tolerance.
5. Role of women and men, and youth groups covering socially inclusive.

6. Markets, infrastructure and distance to markets.
7. Available of transportation facilities and road networks.

In addition to the above criteria the following observations were made while selecting the commodities under the respective landscapes;

1. Study inclusion of at least one commodity within each landscape as part of equal distribution of commodity value chain studies across the three landscape types.
2. Fair gewographical distribution / representation across all three landscape types.
3. Commodity selection in addition to productive capacity is determined by choice distribution between agriculture and livestock products.
4. Number of *dzongkhags* and *gewogs* falling under the project landscape.
5. Percentage of *gewogs* and percentage population falling under the landscape. For example, Athang 75%, Jigmecholing 55% compared to Doban 5%.
6. Availability of information and personnel of the *dzongkhags* and *gewog* officials.

Landscape I	Bjee in Haa	i) Milk and milk products
Landscape II	Athang, Wangdue	ii) Ginger
	Phobjikha, Wangdue	iii) Potato
	Jigmecholing, Sarpang	iv) Cardamom
Landscape III	Saleng, Monggar	v) Maize

Table 1 presents selected commodities corresponding to *gewogs* falling inside landscape types.

Table 1. Tabular representation of commodities by landscape.

Landscape Type	*Dzongkhag*	Commodities	Salient features of commodity choice
Landscape I	Bjee, Haa	Milk and milk products	Productive capacity, larger area under the landscape compared to Sombay and Sama *gewog* with 75% of Bjee under Landscape I compared to 45% for Sombay, 5% for Sama, and 25% for Tsento, milk and milk products are a vital source of income and livelihood, scalability to larger markets and higher market value, active role of women in the value chain and beneficiary number.
Landscape II	Athang (Wangdue) Phobjikha (Wangdue)	Ginger Potato	Out of the total 23 *gewogs* under the landscape, 11 *gewogs* correspond to Wangdue *dzongkhag*, with 75% of area coverage of Athang and 55% of area coverage of Phobjikha falling within the landscape, leader in productive capacity for potatoes, livelihood option and poverty alleviation benefits, market value and export earnings, good road access, substantial income generation leading to improved livelihoods, climate resilient, long tested traditional knowledge and production experience, equal distribution of gender roles and responsibilities.

	Jigmecholing, Sarpang	Cardamom	Climate resilient, 55% area coverage under landscape as compared to just 5% in Doban, productive capacity, cash income and poverty alleviation, road access, market value and future potential.
Landscape III	Saleng, Monggar	Maize	Gewographical distribution, climate resilient, productive capacity, livelihood option, income earnings, 40% of area under landscape and population beneficiaries.

Table 2. presents meetings with other stakeholders during the consultation process.

Table 2. Other consultation stakeholders.

Other Stakeholders	Stations	Key Informants
Gelephu	FCB Auction Yard, Depot manager	Higher management, depot staff,
Food Corporation of Bhutan	Head Office, auction yard, infrastructure facilities	Marketing agent in variety of RNR products
Sersang Agriculture Marketing	P/Ling Office	General Manager
Regional Revenue and Customs, RSTA, BAFRA	P/Ling border gate	Trade facilitation
Bhutan Exporters Association	P/Ling	General Secretary
Bhutan Agro-Industries	Wangchu Taba, Thimphu	Selected fruits and vegetables
Government Agencies	MoAF, MoEA, RSTA, GNHC,	BAFRA, DoA, DoL, DoFPS, PPD, NPHC, AMC, DRC, DAMC, NSSC, FCB, Extension Services, Private Suppliers, NPPC.

v. Analysis and Report Writing

Information collected through field visits and consultations with other players in the value chain have been analyzed and narrated into a report format.

II. Overview of the Value Chain System

2.1 Definition of Value Chain

A value chain is defined as a sequence of related activities or functions from provision of specific inputs for a particular product to primary production, transformation and marketing, up to the final sale of a particular product to the consumer. It also includes the set of operators performing different functions, viz; producers, processors, traders and distributors of a particular product linked by a series of business transactions through which the product passes from primary producers to end-consumers. Thus, value chain actors, responsible for transmission of materials, information and/or services, share an interest in the end product because changes in the end-market affect all players in the chain.

It can also be understood as the relationship established between different important players involved with the aim of adding value and sharing associated risks in each stage of the product flow starting from the production stage till it is consumed. In general, it involves input suppliers, producers, traders, distributors, processors and end consumers. Partners within the value chain work together to identify objectives they are best at while willing to share risks and profits, and invest time, energy and resources to make the effort work successfully.

2.2 Definition of Value Chain Mapping

Value chain mapping is a central element of value chain analysis. It is used to show the flow of transactions from sourcing of raw materials and inputs, to production, processing, marketing and final sale. The maps can also illustrate costs, value addition at each stage, secondary services important to each stage, critical constraints, and the relative clout of players along a value chain.

2.3 Value Chain System

Understanding the value chain of commodities is important in order to plan and execute programme interventions allowing one to contribute to overall economic development of the country. It is useful to understand the relationship between producers, processors, transporters and traders. Farmers are the main producers whether it is rice, maize, ginger, cardamom or dairy products and often production operation is traditional in nature with little or no commercial orientation.

With increasing trade, farmers now face increasing challenges on how to respond to market reactions with several players in the value chain as compared to direct marketing decades ago. Today markets have become more diverse, fragmented, with niche products, and as a result farmers are finding a need to orient to market dynamics.

III. Potato Value Chain System Dynamics

3.1 Importance of Potato Commodity

Potato is Bhutan's most important cash crop with pronounced production in Wangdue, Trashigang, Haa, Bumthang, Chukha, Monggar, Trashigang and Trashiyangtse. Almost 85% of households in Bhutan grow potatoes either for export markets or for their own home consumption (Roder, Nidup & Chettri, et al., 2008). It is one of the most widely cultivated crop next to rice maintaining a superior standing in productivity, nutritional and dietary value with adaptability qualities to the changing environmental conditions accompanied by good management practices. The crop by its versatile characteristics thrives well in Bhutan's agro-climatic conditions ranging from high alpine elevations of 4,500 masl to the sub-tropical plains of 300 masl. In Phobjikha, potato is grown at an altitude of 3,000-3,300 masl intercropped with turnip and harvested once a year.

Potato has been chosen as one of the commodities of study considering the following advantages and prevailing conditions;

- productive capacity and future growth potential
- food security and poverty alleviation
- beneficiary number estimated at 2,347 people
- cash earnings and rural income generation
- climate resilient compared to other crops
- equitable and socioeconomic development
- environment friendly - intercropping with maize, mulching with crop residues, planting in heaps

3.2 Potato Production Systems and Climatic Change

Over the past many decades' potato varieties and management practices have been improved with the start of institutions like the Department of Agriculture in 1961 with projects such as the Rural Development Project in Bumthang (1974-83), CIP Country Program (1981-87), and the earnest Bhutan National Potato Program (BNPP) (1983-95).

Potato production in Phobjikha *gewog* like in other production areas, involves five main farm activities starting with i) input selection, ii) soil preparation and planting, iii) weeding, while maintaining soil fertility, iv) crop protection (wildlife, pests and disease) and v) harvesting.

Input selection – farmers in Phobjikha use seeds from the last harvest and apply farmyard manure mixed with commercial fertilizers to enrich the soil. Fertilizers are procured from the nearest local supplier or otherwise procured from either Bajo town, markets in Thimphu or directly from P/Ling suppliers during the return journey. Purchase price of urea, SSP, NPK and Suphala from Bajo town ranges from Nu. 895 to Nu. 1,690 per 50 kg bag. Insecticides are also applied with purchases made at Nu. 127 for a 100gm concentrate packet that has to be mixed in specified liquid proportions prior to spraying. There are not many traders or private enterprises engaged in importing, wholesaling or retailing inputs (like seed, fertilizer,

pesticides, etc.) to the potato growers except the government owned farm shops, and supplies made by National Seed Center and National Plant Protection Center. One-stop farm shops have been a recent government initiative started in 2014-15 and the main channel for the sale and distribution of agricultural inputs. One-stop farm shops are identified and appointed by the *dzongkhags* and are responsible for the distribution of seeds, saplings, fertilizers, agricultural tools and small machineries. The cost of transportation for the supply of inputs is subsidized by the government with free delivery to *dzongkhag* outlets.

Occasionally, fresh seeds are purchased from the National Seed Center in Paro but most farmers use previous harvest selected seed stock. Some farmers trade or sell seed stock to farmers residing in lower elevations in exchange for cereals (mainly rice) and chilies; a trade system largely based on personal relationships. With the national average at a low 5-7% farmers using certified seeds of improved varieties, the seed replacement ration (SSR) stands at 10% (Nidup & Tshering, 2007). Between 2014-15, the National Seed Center in Paro has supplied 172,637 kg of potato seeds to the farmers. Nidup & Tshering et al., 2007 has reported yield gains across varieties registered at 5,177 kg per acre of Desiree, 5,290 kg for Kufri Jyoti and 5,804 for Yusikaap variety. According to Agriculture Statistics 2014, potato yield in Wangdue is recorded at 6,393 kgs per acre against the national average yield of 3,455 kgs per acre. About 60% of farmers in Phobjikha grow *Desiree* followed by *Kusikaap* as second preferred variety. Choice of variety has been based on historical preference, profitability, yield, taste and shelf life.

Soil Preparation and Planting Methods – preparing the soil is a labor-intensive task requiring nurturing the soil with additional nutrients through application of farm manure and commercial fertilizers and in some cases spreading leave mold collected from the forests. As compared to the past, the use of tractors (like Kubota power tillers and Indian tractors) are mostly driven by men to plough the field. Detail soil preparation of fine soil formation, ridge making, heap plantation, drain making, removing of weeds, etc. are carried out by both men and women. Men carry out most of the laborious digging work while women are effective in sowing seeds. Some reported that both men and women farmers depending on the availability, place tubers in the furrow created by the plough / tractor resulting in lines following the contours. Picking or harvesting of potatoes is dominantly carried out by women folks. Application of farmyard manure is also observed as a task done by women. However, men do the application of commercial fertilizers and driving tractors while tilling the soil. Large-scale cultivation is limited due to small land parcels, rugged terrain and steep slopes.

Crop Protection – crop damage from wild animals such as wild boars, pygmy hogs, sambar deer, barking deer, porcupine, sloth bears, and domestic animals continues to be a serious problem among the Phobjikha potato farmers. According to Agriculture Statistics 2014, at a national level, 72 acres of land corresponding to 244 metric tons of potatoes have been lost to wildlife damage. This values at an estimate of Nu. 5 million in terms of monetary losses. Ura K., 2009 reported that potato farmers on an average guarded their fields 100 days and 96 nights resulting to huge opportunity cost of labor and time. As a result, managing conflicts between wildlife and producers has become an important subject of discussion in the country's conservation efforts for the past decade or more. On an average 21% rain-fed agriculture land and 8% of irrigated land are left fallow because of either water scarcity or

wildlife damage. Farmers in Phobjikha encounter these challenges on a daily basis and dedicate a large part of their time protecting the crop.

Potato farmers in the *gewog* are not spared from pest and diseases. Potato blights, tuber moths, weed invasion by wild plants such as Artemisia, *Persicaria runcinate*, *Galium apartine* and *Digitaria ciliaries* is a common sight. Plant protection measures through the use of chemicals like Mancozeb, Cypermethrin, Linear Alkybenzene, Sulfonate Sodium Salt, Cocamido Propyl Betane, Sodium Lauryl Ether Sulfate are sprayed on regular intervals with support from the Extension Agent.

Men carry out spraying of insecticides and fungicides while both men and women engage in guarding potato fields against wildlife in addition to the wooden fencing shielding from easy animal entry. No *gewog* level data is available but Wangdue *dzongkhag* is the third highest in terms of pesticide usage after Thimphu and Paro (Annual report 2014-2015, NPPC).

Harvesting - harvesting is noticed when the tubers reach maturity when the haulm turns yellow, loses moisture and become dry. Harvesting occurs between late June till August and is carried out with the use of small tractors, hand implements such as rake or a spade. Harvest is collected and stored in makeshift sheds to cure before transported to markets. As can be noticed from Table 3, total potato production and yield has increased over the last three years attributing to good management practices. Wangduephodrang ranks the highest in both productive capacity and yield in the last three years with pronounced production in the *gewogs* of Phobjikha, Gangtey, Sephu and Dangchu. Both men and women share equal responsibility with women seen picking and men later loading sacks and carrying the load to nearest collection points.

Table 3. Potato production and yield for the last three years, 2012-2014.

Dzongkhag	**Production (MT)**			**Yield (kg/ac)**		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Bumthang	3,608	4,005	6,019	4,665	6,439	7,200
Chukha	4,162	5,378	6,061	3,370	6,583	6,601
Dagana	217	171	159	995	1,065	1,329
Gasa	225	189	187	2,446	3,000	2,814
Haa	2,639	2,491	1,873	3,926	4,488	4,480
Lhuntse	891	1,106	1,183	2,932	3,243	3,501
Monggar	3,516	5,170	4,975	2,146	2,387	2,432
Paro	3,649	2,678	3,601	4,533	3,884	4,777
Pemagyatshel	1,947	1,185	1,375	3,250	2,036	2,412
Punakha	87	186	118	1,956	2,447	1,663
Samdrupjongkhar	1,437	2,047	1,364	2,099	1,829	1,900
Samtse	119	108	220	1,280	1,333	1,985
Sarpang	77	93	93	794	627	773
Thimphu	1,425	1,058	1,297	4,240	4,445	6,419
Trashigang	8,331	6,400	5,356	3,693	3,329	2,981
Trashiyangtse	1,593	3,055	2,107	3,784	4,004	3,547
Trongsa	670	507	377	3,401	3,900	3,342

Tsirang	320	261	240	1,131	439	997
Wangduephodrang	**7,822**	**14,165**	**16,820**	**4,889**	**6,338**	**6,393**
Zhemgang	265	137	187	1,308	1,540	1,536
TOTAL	**45,012**	**52,403**	**55,626**	**58,850**	**65,369**	**69,096**

Source: Compiled Agriculture Statistics, 2012, 12, 14.

As cited earlier, the most pronounced potato varieties grown in Phobjikha are the red skinned *Desiree* (60%) *followed by Yusikaap* and *Kufri Jyoti.* All three varieties have adapted well to the favorable ecological climactic conditions of the area with consumers developing a preference of potatoes from high altitude climatic conditions.

Climate Change Impacts on Potato – potato plants are quite vulnerable to both excess water and drought, particularly during planting and early vegetative stages. In addition, plants are susceptible to low temperatures (unexpected frost in the middle of the growing season). Poor plant growth will affect tuber development and, consequently, affect yield and quality of the crop. Technically, there is risk for a decrease in productivity of potatoes due to climate change with most vegetative stages vulnerable to climate extremes while reproductive stages and tuber development are more resilient to climate change. Extended rainy seasons can enhance plant development but will impact stolon and tuber filing, which will in turn, reduce yields. For this case study, there is no sufficient data available to present findings on the impacts of climate change on potato growers in Phobjikha *gewog* or for that matter in the entire country.

3.3 Post Harvest Practices and Labor Distribution by Gender

Curing and cleaning – tubers are unearthed through use of small farm tractors and manually by human labor. There is no distinction between men and women in unearthing and picking the tuber but rather depend on the availability of labor irrespective of gender. Tubers are left on the earth surface to cure and allowing the skin to toughen while excess earth drops off upon drying. Past studies (Nidup & Tshering, et al., 2007), reports that less than 10% of farmers' practice curing and cleaning before storage resulting to increase risks of deterioration during storage. Minimal grading is done as it is time consuming, and efforts to bring a mechanical grader to the farmers' field may not be practical as quantities produced by farmers are not large enough to meet the additional cost. Equal labor is contributed from both men and women for curing and cleaning.

Storage - storage infrastructure is inadequate with farmers using makeshift huts to store their valuable harvest for the duration of four to five months for purposes of seed, home consumption and for sale. In Phobjikha, most commonly noticed stonewall enclosures were used in the historical past. Other conventional storage facilities are either on the ground floor of their dwelling place or in the attic allowing the fast blowing wind to dry. Storage facilities varies with altitude differences but lack adequate housing amenities resulting to weight loss, damage from rodents and insects, natural deterioration or soft rot, decay and sprouting, and moth damage especially in mid lower altitudes. Cold storage facilities with temperature-controlled warehouses are absent forcing the entire harvest to sell at the auction in one season.

It is crucial that the storage area is dark, well ventilated and under controlled temperature conditions but most farmers do not have access to any kind of purpose-built stand-alone storehouse. The current facility lacks adequate ventilation adjustable temperature and darkness. Many growers pile up the potato tubers on the humid ground, which leads to a lot of post-harvest losses from crop spoilage and damage from pests like insects, rodents, fungi growth and others.

Packing – most common packaging material used is the 50kg and 100kg jute/plastic netted bags as part of the standardization efforts of the then Ministry of Agriculture and Forests. These bags are now increasingly used by the farmers but it has been observed that supplies from FCB and other sources are not readily available. Problems persist on physical damage owning to the tender texture and high moisture content of the crop from stacking on each other, poor handling, bruising, cutting, use of iron hooks.

Labor Distribution and Gender - both men and women get equally involved in packing while observations reveal men stitching of the seams once a sack is filled. Carrying potato from the center field to peripheral collection points are done mostly by men, while filling the sack with potato is carried out by women. Mostly men drive the tractors during soil preparation and while transporting to nearest storage areas.

3.4 Transportation and Markets

Speaking of all potato growers, transportation is southwards carrying the fresh produce to auction markets of S/Jongkhar, P/Ling, Samtse and small quantities through Gelephu. Like elsewhere in the country, in Phobjikha there are no organized transportation systems with farmers building personal relationships with truck owners to benefit discounted transportation rates. Potatoes are packed in 50kg bags and loaded onto the trucks averaging about 10-12 hours on the road before reaching the auction market of P/Ling. Transport charges are levied on a per bag load count, as a result farmer still continue to pack more than 50kgs to gain savings from transport charges. This is attributed to the absence of weighing infrastructure in the growing areas and the cumbersome nature of manual weighing each truckload in terms of unitary bags. Accompanying the consignment is mostly men who travel with the truck but there are instances when the women households are compelled to take on that responsibility. In some cases, the truck owners perform the role of a middleman whereby the farmer do not accompany the consignment but rather puts trust on the truck-owner who performs the sales functions at the auction yard for a minimal fee.

Estimates of transportation rates from destination to auction yards are provided under Table 4.

Table 4. Transportation charges from destination to markets by travel distance.

Production Area	Auction Market	Rate in Nu. for 50kg bag	Approximate Distance (Km)
Phobjikha, Wangdue	P/Ling	60	287
Sephu, Wangdue	P/Ling	75	312
Chhokhor, Bumthang	P/Ling	75	453

Ura, Bumthang	P/Ling	70	488
Chhapcha, Chukha	P/Ling	45	116
Naja, Paro	P/Ling	70	165
Dremestse, Monggar	S/Jongkhar	60	232
Zobel, P/Gyaltshel	S/Jongkhar	45	
Thrimshing, Trashigang	S/Jongkhar	50	
Khaling, Trashigang	S/Jongkhar	45	125

Source: Author's KIIS and FGDs, 2016.

However, transportation does not go without problems. During summer months, road blocks are frequent from landslides and soil erosion resulting to product quality deterioration with long extended hours on the road. Further as noticed from Table 4, access to to markets have to endure long hours of travel due to narrow and mountainous roads. Upon arrival at the auction yards, long queue stretches resulting from auction capacity both in terms of infrastructure, human resource and systems, despite ongoing improvements.

3.5 Auction Markets and Indian Traders

Produce from all growing areas flow southwards to the auction markets of Food Corporation of Bhutan (FCB) in S/Jongkhar, Samtse, Gelephu and P/Ling. Phobjikha farmers take their produce in trucks to the P/Ling auction yard. Indian traders who are the main buyers at the auction, resells to major towns of West Bengal. According to FCB figures, in 2015, 22,597 metric tons of potatoes have been auctioned fetching a total sales value of Nu. 374 million. This has fallen down from the previous year export earnings that fetched Nu. 688.79 million corresponding to 26,849 metric tons of export as seen from Table 4. Indian traders come from Jalpaiguri (Alipudaur, Banarhat, Birpara, Madarihat, Dhupgiri, Kalchini) and Cooch Bihar (Falakata, Cooch Bihar) districts.

At the time of writing, Kuensel June 24, 2016 reports that on an average about 8 truckloads of potato arrives in the auction market of S/Jongkhar each carrying about 9 metric tons with price for red *Desiree* at Nu. 20 per kg compared to Nu. 16 last year and Nu. 16 for the white variety compared to Nu. 12 per kg.

Table 5. Export and import of potatoes from 2010-2014.

	Import		**Export**	
Year	**Qty (MT)**	**Value(Nu.in Million)**	**Qty (MT)**	**Value(Nu.in Million)**
2015	NA	NA	22,597.24	373.99
2014	5,271.87	80.50	26,849.47	688.79
2013	5,283.82	57.08	21,871.25	360.13
2012	5,372.75	62.17	19,059.17	309.35
2011	6,420.48	76.69	24,484.99	250.74
2010	4,018.99	27.29	18,745.18	197.51

Source: Bhutan Trade Statistics and FCB.

Auction yards serve as a nodal point between the Bhutanese farmers and the Indian traders where the commodities are transacted. FCB convenes auctioning of all the produce that

reaches its auction yards. With the overarching aim to facilitate fair and free trade, FCB ensures that the auction prices are competitive based on the ongoing market prices in the Indian market. In response to recognition of the inability of traditional rural farmers to market their produce, FCB established regulated auction yards since 1982 providing services to oversee the auctioning. This move has considerably improved the bargaining power of the farmer, enabling improved commodity rates. For providing such infrastructure facilities and associated services, the FCB generates 6% service charge by levying 3% from the producer and 3% from the buyer. FCB provides auctioning services for potato and assorted vegetables with facilities located in Phuentsholing, Samdrupjongkhar, Gelephu and Samtse.

3.6 Weekend Markets

Small quantities are also sold in local markets during the weekends. Consumers are mostly residents of the place with few expatriate (mainly Indian teachers and PHPA employees) consumers. The prospect for marketing potato produced in Bhutan seems good, as the requirement of the domestic market is increasing annually due to the increase in consumption levels (SDC, 2008). The per capita annual consumption of potato in Bhutan is estimated to be 40 kg/person, which is expected to increase to 60kg/person by 2020 (Nidup & Tshering, et al., 2007). This level of consumption is much higher than the average annual consumption in Asia (24 kg/person) and encouraging demand prospects. Prices in the weekend markets on an average are Nu. 28 per kg for local varieties and Nu. 25 per kg for imported. Phobjikha farmers rarely sell to weekend markets but rather transport large consignments to the auction markets and return buy rice stock and other essentials enough to last the entire season.

3.7 Processing

Processing in the country is minimal and limited to backyard potato chips frying for purposes of food vendor sales in local markets. Of recent, initiatives have emerged from young entrepreneurs coming up with potato chips brand like Happy Chips in Thimphu and Hifi Enterprise in S/Jongkhar. Small quantities are home consumed in the form of local dishes (*kewa datsi* being the most popular) and French fries served in restaurants.

In Phobjikha no significant efforts have translated to any kind of value addition leading to good processing outcomes with farmers more keen on the traditional practice of selling fresh to the auction yard. This is perhaps driven by lack of cold storage facilities, uncertain about processing outcomes and its benefits and a bulk cash reward from the sale of the consignment during the season.

3.8 Potato Value Chain Map

The value chain in potato is fairly short and performed largely by the farmers starting with procurement of inputs, production, packaging, transport and sales. Inputs like quality seeds, fertilizers, plant protection chemicals, farm implements and tools are one way or the other managed by the farmers though the government make efforts to supply them at subsidized prices. The involvement of private entrepreneurs (seed and fertilizer agencies), registered

transport companies and agro-trade houses are almost absent. The main actors (input suppliers, producers, middlemen and traders) and the functions performed are described in the following paragraphs.

Producers or Farmers – farmers are the main producers across the country employing traditional methods of cultivation. They are the main agents involved in transforming the product from the farm to the ultimate consumer optimizing utilization of resources along the entire value chain.

Inputs – as described in the above sections, a majority of farmers use best grade previous year seeds as sowing seed stock. However, low seed replacement ratio has been one of the causes of low productivity, as most farmers cannot afford to replace fresh seeds annually. Other inputs required are farm tools and equipment, irrigation support, fertilizers (both farmyard manure and commercial fertilizers). Value chain enablers in this chain-link are government institutions like the Agriculture Machinery Center for farm tools and machines, National Plant Protection Center for pest and disease control, Soil and Plant Laboratory for soil testing and government extension agents providing technical support and advice.

Production – this is carried out by the farmers and involves good management practices along the entire production cycle in terms of soil preparation, crop protection and harvesting. A great deal of value addition is incurred starting with the sowing of the seed tuber till harvest is made. Producers spend significant efforts to ensure high crop yield through improved seeds and increased soil fertility, prevention of pest and disease damage, maintain or expand production area and other farm management and care. Specifically, crop losses from blights and rots and wildlife crop invasion require more innovative strategies.

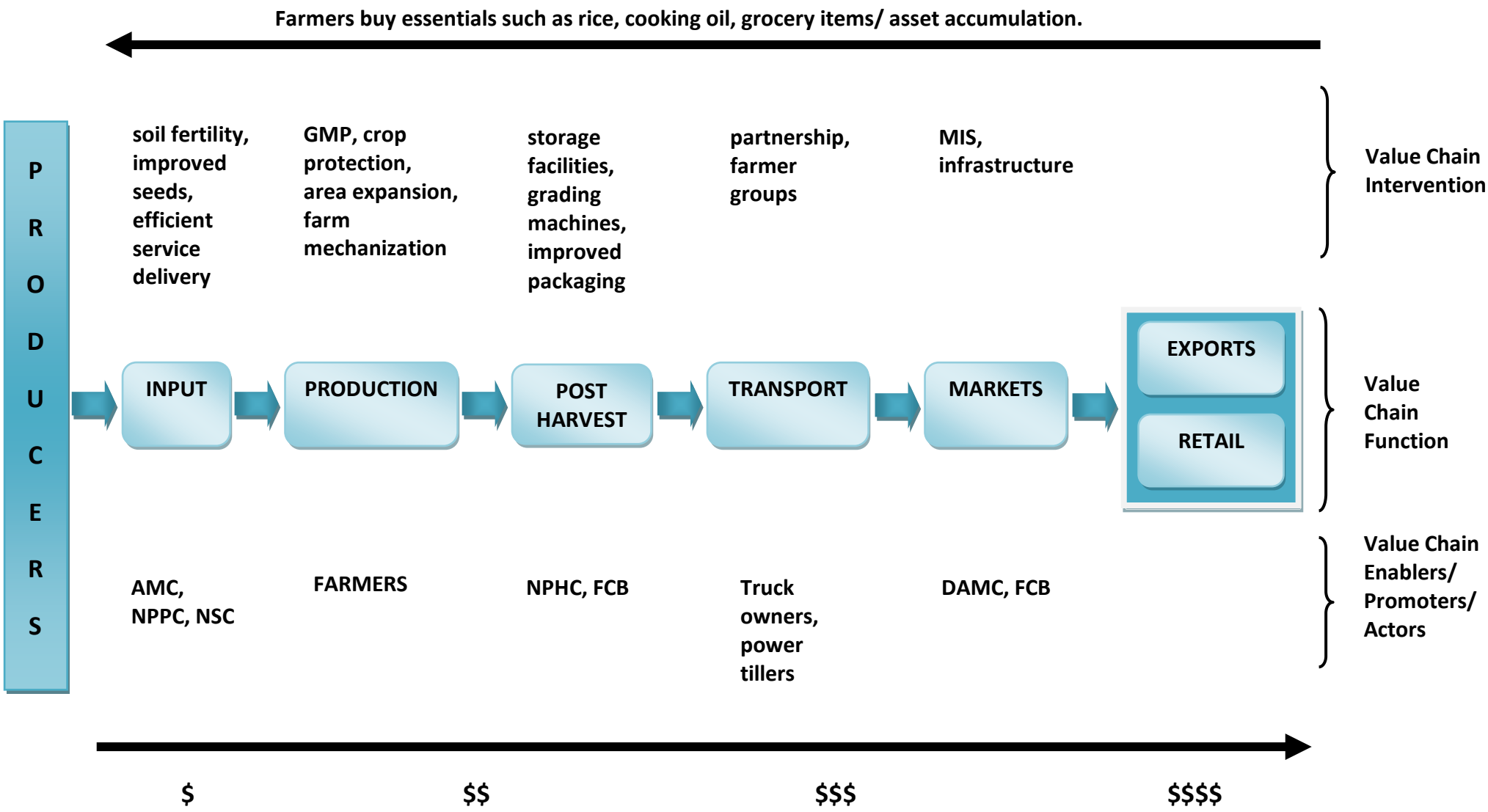
Post-Harvest – this involves drying and dusting off loose earth from the tuber, grading and storage. Interventions are required to build well-aerated warehouses to reduce storage losses from crop deterioration from weather related destruction. Efforts from institutions like the National Post Harvest Center and the Agriculture Machinery Center need to be scaled up to build adequate storage and grading facilities and innovating packaging sacks from the existing plastic material. Improvement of FCB auction yard through more ventilation and temperature control while storing produce may warrant quality standards assuming costs are kept within competitive pricing.

Transport – as explained under the production systems, private truck operators carry out transportation functions. Possible value addition can be achieved through long-term partnerships between producer groups and transport agencies to allow economies of scale and secured business for a win-win outcome. This will allow reliability on the part of players, price transparency and improved payment methods and possible outsourcing of functions to interested transport agencies to auction the consignment.

Markets – markets are dominated by i) auction yards and ii) retail sales. Farmers from 13 *dzongkhags* sell their potatoes through the auction yards of P/Ling, S/Jongkhar, Gelephu and Samtse. With the auction yards established in the early 1980s, 65% of potatoes are marketed by FCB through the auctioning system. In 2015 alone, 22,597 metric tons of potatoes were exported corresponding to Nu. 374 million. Auction volumes peak in the months of September, October and November. Phobjikha farmers bring their 85% of their

consignment to the P/Ling auction yard. Retail sales are through weekend markets, schools, monastic and military institutions either through direct marketing, middlemen and vegetable vendors. Imported potatoes from India flood the domestic market starting January till May with local potatoes available only starting June till early December. Red varieties are preferred over the white and command a higher price. Studies from (Nidup & Tshering, et al., 2007) report that retail prices are lower in the months of February till May (imported from India) and peak high during months of June till November (fresh local produce).

Figure 1. Potato Value Chain Map



3.9 Gaps, Challenges and Opportunities

Gaps and Challenges

Lack of Storage Facilities – with the ongoing national cadastral survey and evacuation of private property built on government land has affected potato farmers in Phobjikha with storage facilities, which have to be dismantled under government order. This has proven difficult for them to find storage space in proximity of the farm. Similarly, storage facilities for potatoes across the country are confined to makeshift shacks or temporary enclosures or in the basement of the house. Storage space in ground floors and attics are prone to spoilage and pest and disease attacks reducing quality and incurring losses.

Input Usage – distribution of inputs such as seeds, fertilizers, plant protection chemicals and farm machineries though subsidized by the government are often not readily available. There are narratives where farmers after walking for hours to the sales outlet only to realize inputs are out of stock or orders are due to arrive causing untimely delays in agronomic management at the field level. The mountainous terrain with widely varying agro-climatic zones and remote scattered habitation also make input delivery very challenging and costly.

Low Seed Replacement Ratio – most farmers use their own seeds trying to safe cost from buying fresh seeds resulting to low replacement rates. In the past, only 5-7% of farmers use certified seeds of improved varieties resulting to a seed replacement ratio of a lowly 10%. Experts view this as a contributing factor to low yield as compared to other countries. Past reports (Nidup & Tshering et al., 2007) reports only 18% of farmers sourced seeds from the National Seed Center leaving 78% of the farmers using their own seed stock.

Limited Scope for Expansion – with small land parcels intermixed with multiple owners disallows convenient access of tractors or other farm machines in farm plots surrounded by other owners. It is termed as '*buuzhi*' a preferred land in the olden times as it can be protected from domestic animal destruction but now a lesser preference and often inconvenient for mechanization.

Conservation Conflicts with Livelihoods – in Phobjikha the nature reserves of the black neck cranes and the RAMSAR wetland heritage site of valley restricts farmers from developing the area with improved infrastructure of electricity gridlines, improved warehouses for storage and other infrastructure construction. Despite government incentives on electric fencing of farmer's fields to ward off wild animals and monetary compensation on crop depredation, conflicts between nature conservation and livelihoods remains an unresolved public policy debate.

Declining Farm Labor – with increasing enrollment in schools, army and monastic studies the availability of farm labor is survived by the old village folks. Rural to urban migration, farm labor opting to work as contractual laborers in construction sites, odd employment as night guards and the like are posing serious challenges on production and farm management. Some may argue that it has not affected production and yield in the past years but with everything remaining constant, a continuous decline in farm labor is bound to impact production negatively overtime.

Diseases and Pest Infestation - potato tuber month is a common phenomenon contributing to 95% of the crop damage (Annual Report 2014-15, NPPC). Farmers are now trained to identify early detection of the disease and apply fungicides to reduce damage that was once very severe.

Wildlife Crop Damage – concentrated efforts on conservation versus optimizing production remains to continue as a perpetual debate. With crop damage on the rise and initiatives taken to minimize damage not being effective battles both producers and policy makers on what next best steps to embrace. Feasible technologies like snares, electric fencing, repellents, organized guarding and chasing have helped but at a huge cost to the farmers and the government. In Phobjikha, dominant wildlife pests are wild boar, deer, birds, insects and rodents. According to Agriculture Statistics, at a national level, 476 acres of land corresponding to 1,069 metric tons of potatoes were lost to wildlife damage. In Wangduephodrang alone, 72 acres of land has been destroyed accumulating to 244 metric tons of potatoes. Again in Wangdue on an average 58-hours daytime and 59 night-hours are spent by farmers guarding their fields. A perception survey conducted by Ura, K. et al, states that 53.1% of the total 303 respondents reported that potato is highly vulnerable to wildlife damage amounting to 822 kilogram of losses from an acre of cultivation.

Post-Harvest Losses – incurring from storage and transport damages, crop deterioration resulting from poor storage facilities, natural damages from unexpected weather conditions during harvest time. Data on actual losses are not available but certainly deserves attention as part of future research agenda.

Limited Market Information and Market – price of potato sold in the auction market is passed on through word-of-mouth that are not always reliable and real time. At a certain time period, a sudden peak in the price at the auction yard triggers most farmers to rush their consignment to the auction market resulting to a temporary over supply. The sudden increase in supply cannot be effectively auctioned without longer waiting time in queue before the consignment is unloaded in the bay area[1]. There are narratives where farmers in the past incurring extra costs from hotel rentals and meals while waiting three to four days prior to completion of business transaction.

Soil Fertility and Use of Fertilizers – it has been observed that maintaining soil fertility through the use of commercial fertilizers affect soil vitality and its natural constituents with farmers complaining about hardness of soil and large clumps while ploughing. Key stakeholders at the National Plant Protection Center estimated that about 70% of the nitrogen fertilizers used in Bhutan are applied to potato.

Lack of Grading and Packaging Materials – grading and sorting is intentionally not done resulting from uniform pricings downstream as compared to costs involved in this activity versus little margin derived from the value addition. Few key stakeholders mention that auction yard price offer on graded potato does not meet the actual cost involved in carrying

[1] Knowing this, it has been rumored that buyers at the auction are deliberately not willing to buy immediately forcing price to drop with farmers burdened from rental costs for additional holding transport charges, accommodation and meal expenses.

out this function. However, clinical trials would be worth pursuing to test the market with improved grades and determine if upstream activities are worthy of the additional investment.

Value Addition Almost Absent – aside from basic bagging in jute / plastic bags and transporting to the auction yards, there remains to be no value addition along the supply chain. It is directly sold from the field to the concentrated auction markets across the country, in this case P/Ling auction yard.

Bhutanese Farmers Are Price Takers – all farmers across the country bring fresh produce to the auction markets where price is determined by Indian traders who attend the auction at the FCB auction depots.

Climate Change, *Biodiversity and Environmental Sustainability* – there is little reliable data (both historical or present) to surmise that climatic changes have affected potato cultivation in the country. As discussed in earlier sections of the report, the crop continues to be susceptible to fungal, bacterial and viral diseases with late blights and tuber moths by the far the most prevalent but adequate crop protection measures are in place through insecticides and pesticide sprays. Heavy monsoon rainfall downpour risks roadblocks resulting from landslides and other soil erosion hazards disrupting timely delivery of goods to the auction markets. Continues and excessive rainfall can wash away fertile top soil especially with cultivation on the slopes but there are no proven data or research findings of any kind to make any deductions.

Opportunities

Markets and Demand for Seed Potato – the demand for seed potato in the country exceeds 4,000 metric tons, which is ten times higher than the average five-year total production by the National Seed Center recorded at 389 metric tons (MoAF, 2009). For example, the demand for potato seed in West Bengal and Assam is recorded at 585,000 metric tons and 151,893 metric tons respectively confirming huge potentials to satisfy the Indian markets. Government institutions like the National Seed Center clearly has prospects to expand business through their existing registered seed growers focusing on producing high quality seed potato for wider distribution at affordable rates to farmers. According to Bhutan Trade Statistics 2014, the country imported 5,272 metric tons of potato (combined seed and table) with an outflow of INR 80 million.

Value Addition through Processing – it is worth conducting an in-depth study to determine the viability, sustainability and expansion of small processing companies like Hifi and Happy Chips. Youth Business Cooperatives and partnerships among youth groups have recently emerged with the test product in the market encountering severe competition against established brands like Lays, Uncle Chips, Potato Crackers and Enjoy. Value addition prospects can be explored along the lines of potato chips, frozen products from potato such as converting into fortified potato powder, potato stripes and the like.

Agro-climatic Advantages – Bhutan's pristine natural environment supports excellent factors of production resulting to preference of Bhutanese potatoes in terms of taste and freshness by Indian consumers and processors. Since potatoes are harvested earlier in Bhutan than in

most parts of India, they fetch higher prices in nearby export markets. It has been noted through personal consultations that there is a preference for potatoes from Bhutan that have a distinct fresh flavor over lowland Indian potatoes.

Increase in Yield and Production Levels – with the overall improved management and distribution of inputs like farm machines, freshly replaced seeds, plant protection initiatives both from pests and wildlife exhibits potentials to increase yield and production substantially. The Ministry of Agriculture and Forests continues to provide free extension services through the Extension Agents in addition to subsidized delivery of inputs through commission agents.

Income Generation and Employment – potato has served and will continue to serve as the main source of income for producers in the rural areas with Nu. 373 million in 2015. In addition to sales made in auction markets, potato seeds are sold to the National Seed Center at Nu. 1,700 for a bag weighing 100 kilograms for the red variety while the white variety fetches Nu. 1,600 per bag.

With economic benefits derived from the sale proceeds, farmers purchase rice and other edibles stocking up for the entire season. This has resulted to more fortune among farmers allowing them to increase their awareness through television, gaining access to basic education thereby empowering them to participate in the decision making process at the grass-root level. Income derived has allowed children to attend school, improved health and homes, purchase of home appliances and in successful cases purchase of utility vehicles including trucks and jeeps. The crop has huge potential to provide substantial employment and equitable income earnings in rural areas during the production stage and can provide opportunities for the youth employment in the processing stage.

3.10 Strategic Axis for Future Growth

Strategies	Action	Lead Agency
Reduce Production and Post-Harvest Losses.	• Continue crop protection methods through use of both local and commercial methods. • Resolve/reduce wildlife crop damage • Promote curing and proper cleaning and handling after harvest. • Develop adequate storage facilities and stacking infrastructure. • Farmers training on handling and safe storage methods.	NSSC, NPPC, NPHC, AMC, DAMC, FCB, DoFPS.
Improve soil fertility and productivity and other good management practices to stabilize production.	• Land management and soil fertility improvement through continuous prevention of soil erosion and top soil run off with SLM interventions like hedge row plantations, contour bunds and dryland terracing on steep slopes. • Crop protection services through integrated approach of FYM, commercial sprays, wildlife damage control.	NPPC, NSC, NSSC,

Resolve public policy conflicts. Example, Nature Conservation Laws and related policies and guidelines, National Cadastral Survey and the like.	• Public and citizen dialogue to resolve policy conflict with livelihoods taking the Phobjikha farmers as an example. • Reduce wildlife crop damage through innovative interventions. • Revisit Forest and Nature Conservation Laws, Rules and Guidelines and other environmental protection legislatures.	NLC, RSPN, MoAF, LGs, Dzongkhag Administration.
Payment for environmental Services and Agro/eco-tourism.	• Explore the development of alternate community revenue through PES models. • Develop community based agro-tourism models for livelihood creation and rural income generation.	
Develop innovative storage infrastructure both in production areas and in downstream market area.	• Research agenda for developing such infrastructure across the country starting with areas falling under Landscape I.	GNHC, MoAF,
Marketing Information System	• FCB in collaboration with DAMC should relay real time market information to producers to avoid over supply at the auction depot creating temporary glut either by improving the existing Interactive Voice Response or introducing SMS, or radio announcements.	FCB, DAMC,
Explore Processing Options	• Possible linkages with young entrepreneurs such as the Happy Group. • Government support establishment of enterprises using potato as an input for further value addition and quality and standard packing and processing of products. • Explore processing into fortified potato powder, potato stripes, potato chips, others.	AMC, NPPC, DAMC, Other interested private parties from the business community.
Increase Seed Potato Production and Distribution for both domestic and exports.	• Expand operations of Registered Seed Growers of NSC to expand exports. • Disseminate benefits of seed replacement amongst farmers and potato growers. • Increase effective demand of seed potato with farmers through trails and education. • Estimate seed potato demand in India	NSC, RSG, FCB, DOA.
Improved collection and assembly centers.	• Build environment friendly roads connecting farmer's field to the main road for efficient collection and assembly of farm produce. • Build related infrastructure such as	

	warehouse keeping in mind the surrounding befitting the environment landscape.	
Mechanization to address labor shortages.	• Small tractors and others machines to substitute manual farm labor in the production cycle.	

IV. Maize Value Chain System Dynamics

4.1 Importance of Maize Commodity

Maize is Bhutan's second largest cereal commodity in terms of total production, acreage, and the number of farm holdings. The subsector elaborates in terms of its coverage and contribution to food security especially in the eastern *dzongkhags* of the country. Maize is also the single most important crop in terms of number of farmers engaged in cultivation with 90% of production consumed at home as a staple. Maize is a versatile crop with high resilience to change in climatic conditions and dominantly grown in the eastern *dzongkhags*. Cultivation is mainly in dry lands and *tseri* land except for recent trials in wetlands. The vast majority of maize growing farmers are small-scale producers. For example, per capita availability of agricultural land in Bhutan is one of the lowest in the world constrained by the lack of arable land (5.4 per cent of total land area in the country is fit for cultivation), along with inadequate technology, poor road access and high transaction costs (Tobgay & McCullough, 2008). It has also been reported by the recent Land Cover Mapping Project (LCMP 2015) that only 2.93% of the area is fit for agriculture cultivation.

Maize has been chosen as a commodity of study citing the following reasons;

- Gewographical distribution across the landscapes
- Climatic resilient as compared to others
- Livelihood option and poverty alleviation
- Percentage area coverage under the landscape
- Population beneficiaries of 2,362 compared to 1,682 in Tsamang *gewog*
- Accessibility to markets and road network

4.2 Production, Post-Harvest and Climatic Change

At a national level, maize production has increased over the years from 75,029 metric tons in 2012 to to 79,257 metric tons in 2014. Farmers from Saleng *gewog* like most farmers in eastern Bhutan grow maize as a staple crop with small volumes for sale in the form of *Tengma* and *Kharang*. These farmers are characterized by small land ownership (usually less than 2 acres) and low utilization of yield enhancing technologies such as hybrid seeds and chemical fertilizers. According to the Extension Agent, at an aggregate level, less than 50% of the farmers use high yielding seed varieties and only 45% of the farmers apply chemical fertilizers. Women are involved in maize production at different stages, including 60% of the maize processing and family labor is the major source of farm labor. Men continue to contribute labor in soil preparation in terms of ploughing and guarding the crops against wildlife destruction. In 2015, production of maize in Saleng *gewog* was recorded at 566 metric tons with yield at 870 kg per acre in dry land slopes (interview with EAs).

The rapid assessment conducted during the Focus Group Discussion suggests post-harvest losses of 15% to 30% with losses concentrated at the farm level. Losses were found to be driven primarily by the timing of harvesting, shelling methods, and the type of storage

devises. On-farm storage structures, such as bamboo baskets, recycled sacks and plastic bags expose maize susceptible to different types of damages, including weevil and rodent attacks causing substantial losses. Moreover, harvesting and crop management practices are sub-optimal in the sense that there are losses resulting from improper handling and farm management.

As conventional knowledge dictates maize requires soil types with proper levels of humidity during early vegetative stages allowing breaking of seed dormancy, seed germination, elongation, and other early developmental stages are particularly vulnerable to climate impacts. In particular, extended dry periods are a serious problem for early maize plants. For example, literature tells maize varieties with an average of 100-120 days to maturation require at least 600 to 700 mm of rain for their vegetative stages. If drought is associated with high temperatures, plants do not survive for very long. On the other hand, it is important to note that prolonged water constraints would affect all of the phenological stages of maize, both vegetative and reproductive phases. In the reproductive phase, when physiological maturity is reached rain and high humidity at this stage present fungi to develop and accelerate rotting of the corn.

Farmers in Saleng *gewog* through the KIIs indicate that maize production have experienced weather and climate related disruption in the past. The most significant events recalled include the increasingly irregular distribution of precipitation across the country in recent years, with episodes of scarce rainfall in some years alternating with extreme precipitation in other years leading to excess soil moisture, plant destruction, soil erosion and landslides. Based on information gathered through FGDs, farmers in Saleng *gewog* perceive that rains are increasingly delayed and unpredictable compared to conditions in the past, which has created problems in planting decisions. For example, May month is previously the benchmark for the onset of the rainy season; however, farmers now indicate that rains begin in June. Farmers have indicated that changing and more unpredictable precipitation patterns in the region have limited their ability to produce reliable quantities of maize. As a result of these two extreme weather conditions, maize harvest has been affected through direct damage to crop growth and the production cycle. Farmers through FGD and KIIs raised concerns on possible trial experiment of hybrid drought tolerant varieties in the future. On the contrary, some farmers also expressed that there is only moderate potential for decreased productivity of maize due to changes in precipitation and temperature, particularly during early vegetative stages of germination as well as emergence and seedling growth. However, maize shows remarkable adaptability in later developmental stages.

Strong winds or windstorms have often been cited as a negative factor, with impacts on both the crop stem and the quality of cob kernels. Occurrence of unexpected windstorms and hailstones has also proven disastrous to harvest quantities and quality. Overall, key stakeholders consider rising average temperatures from untimely rains has been a major threat affecting the productivity. With climatic changes impacting on the yield of maize triggers indirect effects on livelihoods through reduced consumption of the staple and lesser income earnings from sales of processed maize products. This in turn could reduce all elements of household food security (access, availability, and utilization), which would negatively affect nutrition security for households, particularly for children.

4.3 Marketing, Processing, Storage and Packaging

An estimate of marketable surplus ranges from 15-30% of total production. Selling is done directly by the farmers themselves either on the roadside or through informal distributors. Monggar is the leading *dzongkhag* in maize production contributing to 20% of total production as seen from Table 6.

Table 6. Production and yield of maize in selected *dzongkhags* 2012-2014.

Dzongkhag	**Production (MT)**			**Yield (kg/ac)**		
	2012	**2013**	**2014**	**2012**	**2013**	**2014**
Bumthang	0	0	0	0	0	0
Chukha	2,329	2,713	2,571	746	850	857
Dagana	6,870	7,655	7,390	1,048	1,192	1,173
Gasa	0	0	0	0	0	0
Haa	347	329	255	834	997	850
Lhuentse	3,228	5,032	3,976	1,382	1,779	1,750
Monggar	**10,420**	**14,767**	**15,416**	**1,229**	**1,739**	**1,500**
Paro	46	53	79	846	946	1,350
Pemagyatshel	5,903	6,113	6,750	1,163	1,317	1,500
Punakha	208	230	328	559	1,000	1,420
Samdrupjongkhar	6,361	6,818	7,010	1,350	1,248	1,348
Samtse	6,393	4,046	6,572	958	720	1,145
Sarpang	6,890	5,687	3,793	1,046	1,357	986
Thimphu	0	0	4	0	0	833
Trashigang	9,113	7,071	8,417	1,570	1,306	1,581
Trashiyangtse	2,325	3,046	3,138	1,437	1,710	1,743
Trongsa	990	1,730	1,660	1,035	1,345	1,400
Tsirang	5,745	5,150	5,090	1,061	961	1,018
Wangduephodrang	430	330	316	1,165	971	1,054
Zhemgang	5,419	4,937	4,478	1,098	1,346	1,245
TOTAL	**75,029**	**77,720**	**79,257**	**20,539**	**22,797**	**24,767**

Source: Compiled Agriculture Statistics 2012, 2013, 2014.

Maize is processed into few traditional product types are described in the following topics;

Tengma or beaten corn – this is produced after dried maize kernels are fire roasted over a wide flat pan and pounded flat by a crushing machine. In the past, pounding was done manually using deep hollow wooden containers curved out of large tree trunks with pounding force of wooden poles beaten down by hand power. *Tengma* types are flavored with Sichuan pepper and slightly priced higher for the value addition cost. Prices at the Centenary Farmers Market for new *Tengma* or *Gayzasip* is Nu. 350-550 per kilogram while old stock from last season can be purchased at Nu. 100- 200 per kilogram. In 2015, 20,000 kgs of *Tengma* was processed from Saleng *gewog*. KIIs and FGDs cited women generally do the roasting and grinding with the use of basic machines but again this division of labor is also determined by availability of able labor in the household of irrespective of gender roles.

Kharang or maize grits – is another processed product consumed as a rice substitute dominantly in the eastern *dzongkhags*. *Kharang* is basically milling maize kernels into small grit size and cooked like rice as a staple. With less sugar content compared to rice, increasing number of households are including *Kharang* in their daily diet. *Kharang* at the Centenary Farmers Market is Nu. 80 per kilogram. In 2015, 30,000 kg of *Kharang* was processed from the *gewog*.

Ara or local brew – a sizable quantity is consumed as an ingredient for making *Ara* or a local brew. As a family tradition, most households possess the skills and experience to brew *Ara*. Alcohol is part and parcel of the social spiritual-ritualistic affairs in Bhutanese culture and home brewed from various other grains like rice, wheat, barley and maize. Largely the brewing of local spirit is carried out by the women. A liter of good quality *Ara* is sold at Nu. 50 while it is also sold by the glass at Nu. 15-20.

Cattle Feed – crop residues constituting low-grade maize kernels and other solid residue, milling dust, grain flour and remaining old stocks of maize are fed to the cattle as a close feed substitute. Maize foliage is also used as cattle fodder. No quantifiable volume of maize has been supplied as raw materials to commercial feed mills although an attempt in the past has been made between Karma Group of Companies and farmers.

Technology – most farmers in Saleng *gewog* use traditional methods of shelling, such as hand shelling while few use basic shelling machines to remove the kernel from the cob and flatten the roasted corn. Natural drying is done in the sun and wind. Frying pans and traditional wooden stoves are used to roast the corn before it is beaten into maize grits (*Kharang*) and *Tengma*. Most farmers procure the machines from the Agriculture Machinery Center in Paro while some purchase from India and China through trading companies.

Storage of Maize - traditional facilities for maize storage used are bamboo baskets, plastic bags and sacks, wooden structures, plastic water tank containers and overhead hanging on the ceiling. Silos distributed in the past by the government are observed in other growing areas.

4.4 Packaging, Distribution and Markets

Tengma and *Kharang* packaging is manually packed in small plastic bags weighing one kilogram. With plastic bags imported from India, packaging is limited to simple sealing by melting the plastic flaps over a flicker flame to glue against each other. No labels or brand names are visible or any product description on the outside of the plastic cover. *Ara* is stored in traditional bamboo wares, jerry cans and recycled Coke and Pepsi bottles. According to key stakeholder interviews, about 60% of the *Tengma* and *Kharang* are sold on the roadside shops while 40% of it is distributed to other *dzongkhags* like Paro, Thimphu, Wangduephodrang and Bumthang through a network of friends and relatives. New harvest *Tengma* is sold at Nu. 300 per kilogram outside Monggar, while to distributors it is sold at Nu. 150 kg.

Attempts in the past were made to sell *Kharang* grits to schools as part of the school feeding support of the World Food Program but unreliable and inconsistent quality were some of

the impeding factors that stalled continuity in the partnership. Timely delivery and price negotiations were another concern that led to the fallout in business continuity. In the past, maize grains were also supplied to intermediate buyers like the Food Corporation of Bhutan and Karma Feeds. Similar reasons of high transaction costs, unreliable supply volumes and delivery inconsistencies emerged as some of the bottlenecks for viable collaborations between the processors and farmers. There are no formal markets for *Ara* as it is supposedly brewed for home consumption but demand for the spirit appears apparent not only for human consumption but as an important ingredient while performing cultural rituals and wine offerings that has to be made to local deities.

Currently, no professional effort has been geared towards product development tapping market segments through effective sales and timely delivery. As discussed above, packing and distribution is left to the initiatives of the farmer with little know-how resorting to rudimentary plastic wraps and word of mouth selling from roadside sheds.

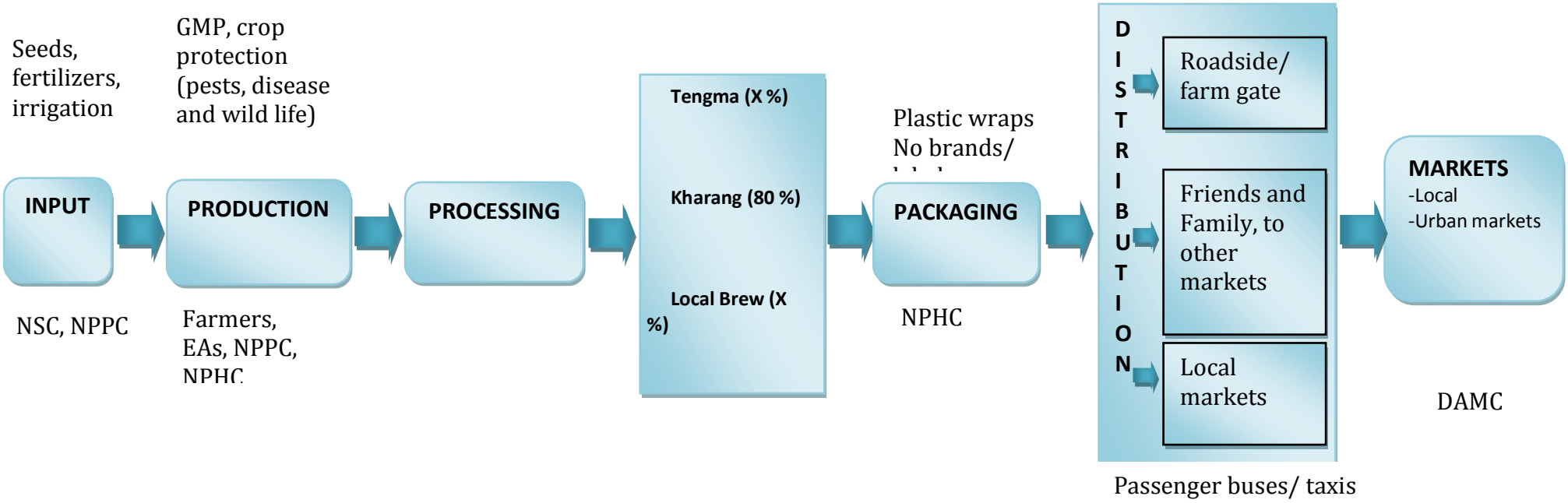
4.5 Maize Value Chain

The maize value chain is fairly simple with traditional farmers who are subsistence in nature grow the crop in small parcels of land dominated mostly in the eastern *dzongkhags* as illustrated by the production figures under Table 6. Inputs to improve soil nutrients are available from the farm using farmyard manure stored from the tethering of cattle and other domestic animals. Suphala and urea are two major commercial fertilizers commonly used. Inputs are either procured from suppliers in the nearest local market or supplied by newly opened one-stop farm shops. As described earlier, processing is fairly basic at a backyard scale producing *Tengma*, *Kharang*, *Ara* and cattle feed. Markets are both local and in other *dzongkhags* sent through the passenger buses plying the east west high way.

Currently, value addition is limited to few traditional products namely *Tengma, Kharang* and *Ara* with limited professional know-how to capitalize on the growing market needs and wants. Functions along the value chain are not developed as institutional or specialized players but continuing at a personal level as part of a favor or help to a neighbor or friend. For example, processed products (*Tengma* and *Kharang*) are transported to other *dzongkhags* in public transport buses with unattractive packaging in the absence of brands or labels. Product development has not received any improvement attributes of changing market demands in terms of taste, color nor texture. Nor does there exist any knowledge in terms of attractive packaging in terms of size, weights, type, etc.

Huge potential exists to add value and develop different products using maize as a main ingredient. For details refer opportunity section below.

Figure 2. Maize Value Chain Map



4.6 Gaps, Challenges and Opportunities

Gaps and Challenges

Fragmented Supply - given the small size of supply from individual farmers, operating a warehouse of 2,500 metric ton capacity will require aggregation of maize from about 5,000 smallholders. Aggregation through cooperative marketing provides a scale advantage both to the producers and traders. However, the amount of grain aggregated and traded through cooperatives is limited, largely due to underdeveloped cooperative structures swamped by management and financial constraints.

Lack of Proper Sales Outlet – sales outlet is limited to makeshift structures along the roadside of the national highway without proper storage facilities. Further, with the road widening project and the 50-meter buffer space along the road is going to pose problems with no retail outlets when the temporary roadside structures are dismantled.

Low Productivity – resulting from low levels of input supply, poor soil fertility, inefficient input supply mechanisms and limited access to input and output markets. Droughts and natural calamities are also some of the factors contributing to low productivity and reduced production.

Inadequate storage – though silos have been distributed with support from government projects, storage is still predominantly done by hanging while some pile the maize grains in corners of their dwelling places mostly in the attic or in the lower floors of the house.

Wildlife Damage – wildlife crop damage remains a major challenge. In the case of Saleng *gewog* the crop is damaged by monkeys, wild pigs, deer, porcupine, bear and birds. According to Agriculture Statistics 2014, in Monggar *dzongkhag* 695 acres of maize were lost to wildlife corresponding to 584 metric tons. In Saleng *gewog* about 50% is damaged by wildlife. At a national level, past surveys (Ura, K et al.) reports out of 354 respondents an alarming high 84.2% confirmed the maize crop highly vulnerable to wildlife damage. This has been estimated at 356-kilogram loss of crop harvest from an acre of cultivated land.

Climate-related damage - windstorms and hailstorms destroying large portions of the cultivation just before harvest time are a major challenge. Natural calamities like excessive rainfall; hailstorm, cloud burst, landslides and soil erosion have affected 17 households in Monggar accordingly to Agriculture Statistics 2014. In Saleng about 10-20% are lost incurred from climate related damages.

Inadequate Processing and Marketing – processing is limited to basic machines requiring intensive labor particularly while removing the kernel from the cob and roasting. Markets are limited small quantities sold on the roadside outlet and urban retail stores.

Climate Change, Biodiversity and Environmental Sustainability - excessive rainfall and gusty wind results in fertile top soil getting eroded with maize cultivation situated largely on steep mountainous slopes. Similarly, socioeconomic vulnerability exists from wind storms together with heavy rainfall causing crop damage and harvest losses.

Opportunity

Demand as Input in Feed Mills – there is also latent feed demand from shifting to grain-fed poultry and other livestock and capturing latent livestock demand. Currently all maize requirements for Karma Feeds are procured from India. The company has input requirements to manufacture feed for cattle, poultry and pigs.

Value Addition – currently produced *Tengma* and *Kharang* requires further value addition in terms of quality and packaging. Improved packaging with attractive brands and labels into variety of weights serves potential for increased demand. Value addition can be done in terms of adding different flavors or producing fried crispy chew sizes. Similarly, like in the case of potato, corn can also be converted into powder form and later after fortification supplied to institutions (schools/monasteries, armed forces) as part of the institutional feeding program. This will require adequate know-how, technology and business acumen.

Increase Acreage – currently about 100 acres of wetland has been put to meaningful use by cultivating spring maize. This can be escalated to larger areas increasing production and deriving additional benefits of food security and income from value added products sold.

Formation of Cooperative – group efforts can address myriad of issues from product development, value addition, brands, pricing and markets. This effort however, may require professional support along the entire value chain.

4.7 Strategic Axis for Future Growth

Strategy	Action	Lead Agency
Promote Adoption of Improved Technologies for Production and Processing.	• Continue to develop viable technologies for highland and subtropical maize production. • Improve technology to existing processing facilities. • Venture into converting corn into fortified corn powder in addition to existing *Kharang* and *Tengma*.	AMC, NPHC, DAMC,
Crop Insurance Against Natural Calamities.	• Explore schemes with Insurance Companies like RICB and BIL. • Continue Land Management Campaign (SLMP) in terms of contours, bunds, hedgerows, wind-guard tree plantations. • Research on new improved varieties in terms of crop height, yield, resistant to droughts or excessive rainfall.	MoAF, NSSC
Increase Production	• Through improved varieties for double cropping, maize cultivation in wetland fields during off-season, timely supply of inputs, adequate support for fencing and guarding fields from animal destruction, etc.	NSC, NPPC, AMC
Introduce Labor Saving Technology.	• Past studies (MoAF, 2007) revealed that about 40% of farmers in the survey area reported no access to improved seeds, fertilizers, and labor saving technology.	AMC

Reduce Post Harvest Losses.	• Attempts must be made to reduce 20% percent post-harvest losses with improve storage facilities to prevent deterioration, damage from rodents and other insects, excessive dehydration,	NPHC
Improve Processing and Marketing of Processed Products.	• Improved marketing, processing and packaging with the help of DAMC, AMC, NPHC and private interest groups.	DAMC
Strengthen Farmer Groups and Association.	• Improve functioning of Farmer Groups and Cooperatives through training on book keeping, cost-benefits, economics of scale, bargaining power, improved packaging and branding, labels, pricing and other aspects of doing smart business.	DAMC
Develop Research Agenda	• Conduct research studies on production quantities and available volume for sales. • Do a market analysis on volume, quality, price, delivery mechanisms, etc. as supplier to feed mills. • Research of setting up feed mills on site by either cooperatives, private investors, etc.	PPD, DoA, FCB, DAMC
Develop Farmer Cooperative and New Products	• Build farmer groups and cooperatives to achieve economies of scale, new product(s) development, branding pricing and markets. • Initiate either PPP models or inject technical assistance in terms of professional support to build the entire value chain capitalizing on the distinctive features of organic, social enterprise, etc.	

V. Cardamom Value Chain System Dynamics

5.1 Cardamom Commodity

Cardamom is considered a high value crop and grown in the southern belts of Bhutan with pronounced cultivation in the *dzongkhags* of Samtse, Sarpang, Samdrupjongkhar, Dagana, Haa and Chukha. The buds of the plant are used as a flavoring ingredient in cuisines and served as a spice condiment in curries and tea. Cardamom is generally reproduced through vegetative propagation. This method gives out the production relatively earlier than by seed /seedlings. Thus, cardamom cultivation begins with the management of seed materials and other inputs associated with it. Narratives tell that the crop was first introduced in Bhutan via Sikkim in the early 1970s with first cultivation reports in Sibsoo in Samtse and Kalikhola in Sarpang *dzongkhag*. For a period of two decades after its introduction in Bhutan, its cultivation expanded to other areas with production reaching 1,781 metric tons out of 8,683 acres as per Agriculture Statistics 2014 records.

5.2 Production System and Climate Change

Cardamom is a perennial, shade-loving crop found at an altitude between 600–2,000 masl. It requires a high level of humidity (>90%) and soil moisture (>70%) and, therefore, grows best in areas with annual rainfall of 2,000–4,000 mm and ambient air temperature of 10–22 degrees Celsius (Sharma 2013; Sharma et al. 2000). Ideal sites are areas with gentle slope as slopes aid a stronger root system and protect rhizomes against lifting up from the ground (Dorji, S 2010). The cultivated species has 12 local cultivars suitable for cultivation at different elevations and adapted to local environmental extremes such as water deficit and frost.

The plant flowers during the months of April and May and requires timely weeding at least in two intervals corresponding to one at the on-set of monsoons and the other just before the harvesting. It grows well in loamy soil with overhead shade to protect direct sunlight in summer months and frost damages during winter. Cardamom is propagated asexually through suckers obtained from healthy clumps. Two suckers are planted per hill at a spacing of 4-5 feet with the help of farm implements. The suckers are taken from the mother clump during the month of June-July and planted immediately benefitting from the monsoon rains. Suckers for propagation are chosen from at least a three-year old plantation (Dorji, S 1997). Cardamom is the least labor-intensive agro-forestry crop. The maximum requirement of labor peaks during weeding and harvesting when capsules mature. Weed slashing is done twice annually and there is no practice of irrigation for the large cardamom plant.

Total gestation period ranges from two or three years after planting but with full fruit bearing begins on the fourth year. According to Agriculture Statistics 2014, national average yield of the crop is recorded at 205 kgs per acre and cultivated over an area of 8,684 acres. Sustained yields are normally expected up to the 15th year from planting. However, constant replanting by replacing the old and degenerated clumps every year in the plantation estate along with optimum shade and nutrition may keep them productive for many additional

years [2]. The quality of produce depends on input quality, shading practice, altitude, temperature, rainfall etc. Generally, the cardamom capsule buds with high oil content, strong aroma, large capsule size and a characteristic rich maroon color is considered good quality.

Cardamom is grown in the following *dzongkhags* with Samtse having the highest cultivation area of 4,619 acres producing 1,154 metric tons as shown under Table 7. According to Agriculture Statistics 2014, in Jigmecholing *gewog* 225 acres of cultivation has yielded 14 metric tons of cardamom and in Chhudzom *gewog* 447 acres are cultivated corresponding to 31 metric tons.

Table 7. Major production pockets by *dzongkhags.*

Dzongkhag	Cultivated Area (acres)	Production (MT)	Yield (kg/acre)
Chhukha	1,505	256	170
Dagana	754	124	164
Haa	611	93	153
S/Jongkhar	166	023	140
Samtse	**4,619**	**1,154**	250
Sarpang	698	91	130
Tsirang	199	25	125
Others	132	15	170
TOTAL	8,684	1,781	162.75

Source: Agriculture Statistics, 2014.

During the FGDs and KIIs farmers reported that lack or poor agro-meteorology and climate data and scarce access to information have limited production and productivity. Weather data that is needed on a weekly/monthly or on seasonal basis for the agriculture and forestry sectors are not available readily. The data gap affects the implementation of early warning systems based on hydro-meteorological data, as weather forecasting is not adequately developed in the country though continuous efforts are initiated.

5.3 Production Comparison in the Region

Input Supply Situation - the quality of produce depends on the input usage and the methods adopted in its cultivation, processing, packing, storing, transportation etc. Therefore, great care and nurturing is required along the entire cultivation period. For example, application of insecticides is lowest in Sarpang with 67.50kg/liter as compared to Paro 1,545kg/liter, similarly, application of herbicide is lowest at 45kg per liter as compared to 3,555kg per liter in Wangdue. (NPPC data report, 2013-14).

[2] www.agrihortico.com

Labor Intensive – labor constitutes a large percentage of the cost of cultivation and cost of suckers for propagation. Clearing the area, soil preparation, providing shade by maintaining overhead growth, harvesting, drying and curing are some of the labor-intensive farm activities. Area near the plant clumps are cleared regularly while tree shades are maintained over by a canopy. FGDs cited area clearance and soil preparation are carried out mostly by men as a historical practice while harvesting and drying in done jointly depending on labor convenience in the households. FGDs also reported that selling and market price negotiation is done predominantly by men as being the head of the household.

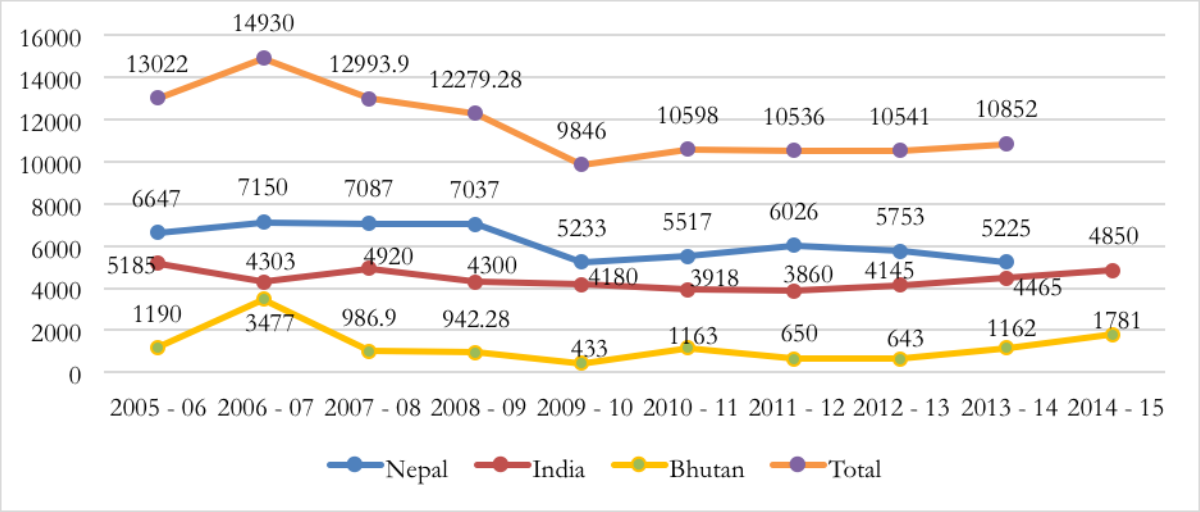
Plantation and Maintenance - cardamom is a shade loving tropical herb that requires appropriate rainfall grown best under loamy soil conditions. Plantation is done with the commencement of monsoon but just before heavy rains. For new plantation, overgrown plants are removed and destroyed first and land is cleared of all weeds. There are possible options to incorporate agroforestry such as the tea estates where tall shade trees of timber value are planted with cardamom cultivated as part of the undergrowth.

Post-Harvest Practices - a very significant post-harvest practice for cardamom is drying and curing. Drying determines the quality translating to the market price the crop will fetch. Curing is carried out in a traditional kiln called *Bhatti*. This system is not only time consuming but inefficient in terms of fuel wood usage and results to non-uniform drying. This activity is mostly carried out by the men as it requires greater physical strength while collecting fire wood is contributed mostly by women and children.

Local Production Compared to Other Countries in the Region - with trade closely integrated in the region through free trade areas and preferential trade agreements, it is important to review the cardamom production from a regional perspective that includes India, Nepal and Bhutan. Under Figure 3, one observes a decline in production in the Sub-Himalayan region starting 2007 and stabilizing at 10,000 metric tons between 2010-2015. It is also worth noting whereby India the leading cardamom producer is now only second to Nepal. Further, in 2014, Nepal accounted for about 48% of the production with India at 41% and Bhutan at 11%. Cardamom production in Bhutan shows significant fluctuation in the past decade, though there is a slight increase in the recent years.

As per the statistics reported in the three countries, the yield of large cardamom averaged about 400 kg/ha in India and Bhutan, whereas the yield in Nepal was about 450-500 kg/ha. In India, main production centers are the Sub-Himalayan ranges across Sikkim and Darjeeling in West Bengal, though in recent years' production has spread to other north eastern states including Arunachal Pradesh, Nagaland, Manipur, etc. In Nepal, Ilam, Panchthar, Terhathum, Dhankuta and Taplejung are the notable districts for cardamom production.

Figure 3. Production in Bhutan compared to countries in the SAARC Region.



Source: Department of Agriculture Statistics, RNR Statistics, Spices Board of India, 2015, Ministry of Agriculture and Development, Nepal.

5.4 Processing, Packing and Storage Methods

Processing is limited to sun drying, curing and thereafter storing in dry open places or packed in recycled airtight sacks. Packing and storage is still rudimentary with the use of recycled plastic/jute bags and stored in corners of homes lacking adequate aeration and preservation conditions with some harvest kept over a year in home corners loosing aromatic flavor with possible discoloration. A properly dried cardamom preserving the aromatic flavor and color is an important determinant of market value in terms of quality and grades. Right drying determines the market price of the crop.

Curing is an important processing step carried out in a kiln, or locally improvised *Bhatti*, a traditional method of drying by placing a flat circular pan over fire. This curing system using smoke results in poor quality capsules both in color and moisture content due to non-uniform heat distribution. Capsules are either over dried or unevenly dried resulting to quality deterioration and lower competitiveness against the produce from neighboring countries. The *Bhatti* system of drying has been reported as inefficient requiring long hours (5-6 days to dry 300-400 kg) in energy utilization and requires large quantities of fuel wood. Mehta & Rabgyal 2015 estimated that 25-30 back-loads (375-450 kg) of firewood are needed per *Bhatti*. Therefore, to maintain quality in terms of proper drying and curing, improved drying system such as gasifiers, or other innovative technology need to be explored. Removing of the capsule tail is still carried out manually with the feet when the capsule is still hot but this proves less efficient lacking neat and complete detachment with fiber ends jutting out.

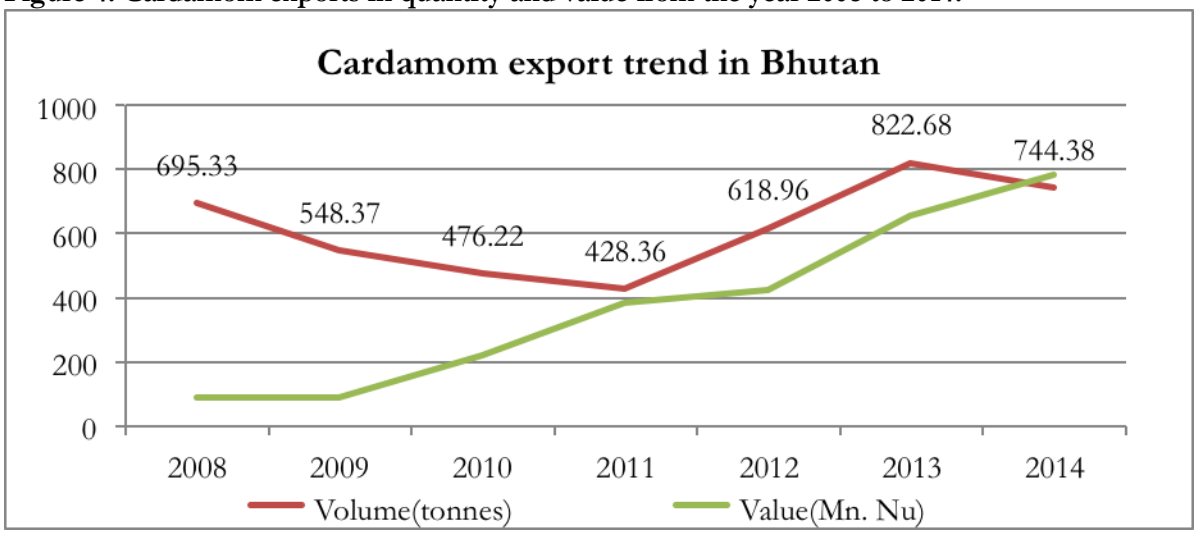
5.5 Distribution, Markets and Price

From field consultations, about 40% of the harvest are sold to India and Bangladesh under formal trading channels. The remaining 60% flows to India through informal marketing channels in the form of cross-border trading in repetitive frequency of small vehicles plying back and forth. Market intelligence indicates increasing demand from Bangladesh encouraging exporters to earn convertible currency. Siliguri a town in West Bengal state of India is the trading hub for cardamoms in the region.

The traders serve three key market channels namely the retail sale of cardamom in India, sale of cardamom to big processors in India in bulk quantities and sale to exporters. Total volume of large cardamom coming to the market is 10,000 metric tons. Of this, about 10% is exported to middle east, Pakistan, about 30% goes for processing, whereas the rest is sold for retail sale in major consumption hubs in India including, Delhi, Lucknow, Hyderabad. Delhi is the main hub from where large cardamom is distributed throughout the country. Lucknow and Hyderabad are main consumption centers because of high Muslim population who use this spice in their traditional dishes such as Biryani etc.

Cardamom exports have peaked in 2013 with close to 833 metric tons. Exports in 2008 was recorded at 695 metric tons and dipped to 428 metric tons in 2011. In 2014 exports bounced back to 744 metric tons as shown under Figure 4. Despite domestic consumption being low, the corresponding export quantities recorded seems significant compared to production data indicating informal transactions as another trade channel. It is commonly sold in quantities of 40 kg units called '*mon*' at the rate of Nu. 52,000 per '*mon*' with variations depending on market dynamics.

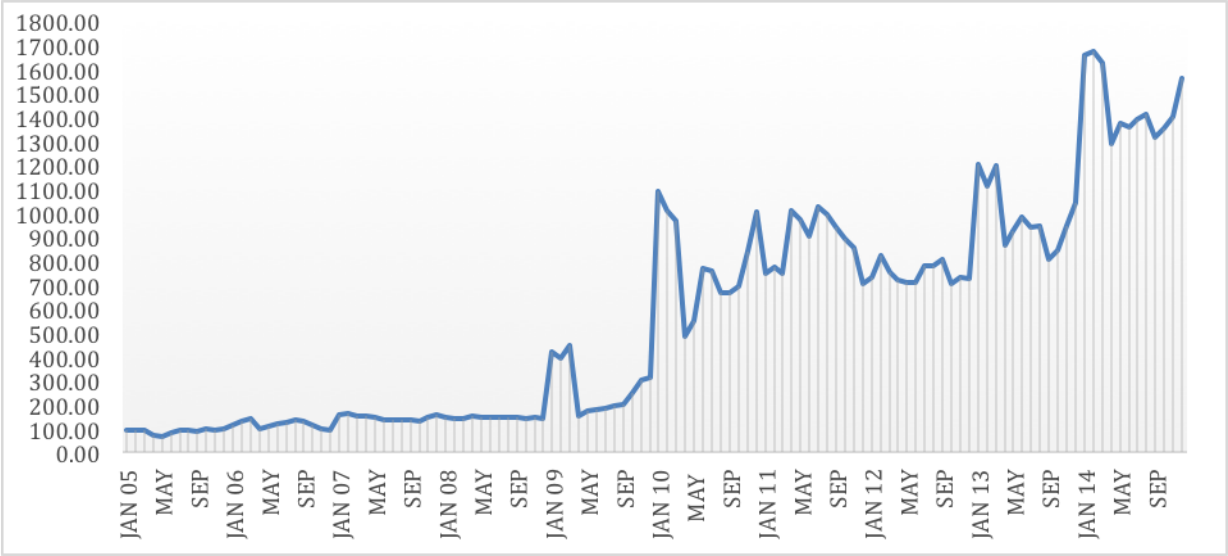
Figure 4. Cardamom exports in quantity and value from the year 2008 to 2014.



Source: Compiled data of different years from Department of Agriculture, Bhutan. *Courtesy of Horticulture Division, Department of Agriculture, MoAF.*

Cardamom price in Siliguri are likely to influence the price in Bhutan because Siliguri being the main market hub for Bhutanese cardamom. Figure 5 shows the details of the prices of large cardamom in the Siliguri market based on data collected by the Indian Spices Board. Between 2005-2010 prices of large cardamom were in the range of Rs.150-200 per kg. With a slight reduction is supply due to low production beyond 2010 onwards the prices average Rs. 1,000 per kg. In 2015, the price has reached a high record of Rs. 1,500 per kg encouraging farmers to restart growing cardamom.

Figure 5. Cardamom price trends in Siliguri market, India between 2005-2014.



Source: Spices Board Database (www.indianspices.com); credit also to Mehta &Rabgyal for compilation works.

5.6 Cardamom Value Chain

Traders or middlemen contractors make forward contracts with cardamom farmers by handing out cash advances ahead of the harvesting season. Farmers for need of money to pay for children's education, purchase of household items, payment amortization of overdue bank loans, etc. oblige to forward contracts against unfavorable conditions in terms of pricing deals and other options to sell to the highest bidder.

The middlemen or contractors collect the produce at farm gate or at the nearest road-head, and transport it across the border to wholesale-retailers in India and Bangladesh. Bhutanese middlemen or contractors receive cash advances from Indian dealers on the promise of an assurance of the demand volumes kept reserved ahead of the season. Some Indian dealers further export it to the Middle East countries fetching higher value. Other Indian traders purchase the produce from local contractors in Bhutan and sell in the Siliguri wholesale market including Cooch Behar, Kolkata, Amritsar and Guwahati. Some of these traders sell to the Organized Processors like Everest Masala. Selected group of wholesalers in India export the produce to Pakistan and the United Arab Emirates. This is a fairly concentrated market with the involvement of a few big players in the industry.

Prices prevailing through the cardamom value chain are summarized in Table 8 below. Though data for each level in the value chain is not available, the table classifies the price break up broadly.

Table 8. Market price of Bhutanese cardamom in the value chain.

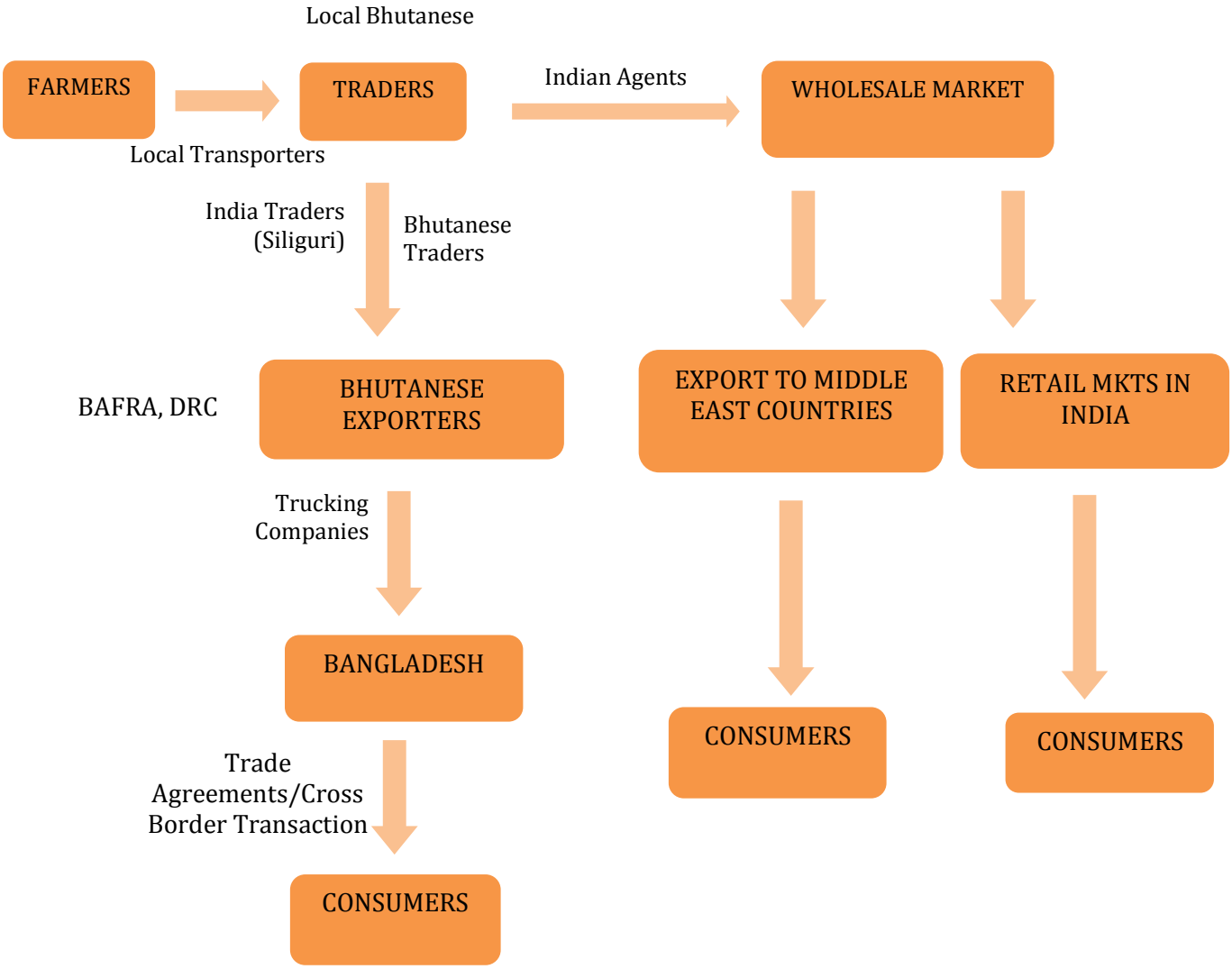
Actor	Purchasing Price	Selling Price	Gross Margins	Activities Undertaken
Farmers	400 kg	Nu. 1,000-1,200/kg	Nu. 600-800 / kg	Production, drying, marketing
Local Traders / Contractors	Nu. 1,000-1,200/ kg	Nu. 1,200-1,400/kg	Nu. 200-250 / kg	Collecting, packaging and transportation
Traders in border towns of P/Ling, S/Jongkhar	Nu. 1,200-1,400/kg	Nu. 1,300-1,500/kg	Nu. 100-200 / kg	Collecting, storing for off-season and selling to exporters in P/Ling and Siliguri.

Source: Mehta & Rabgyal, 2015.

Dried cardamom capsules are purchased from farmers by local traders who in turn sell it to Indian traders. The consignment changes hand whereby the local Indian traders further sells it onto another set of traders outbound for the wholesaler-retailer market in the Siliguri, India. Field information suggests farmers' cost of production is Nu. 400/kg wherein his labor constitutes more than 60% of the total cost. The same produce is sold to the trader for Nu. 1,000-1,200/kg with a gross margin at Nu. 600/kg. Local traders make a gross margin ranging Nu. 200-250/kg and traders in border towns who export to India and Bangladesh believe to be between Nu. 100-200/kg (Mehta & Rabgyal et al.,).

In comparison, in the north-east region of India in 2012, margins reported by local traders, wholesalers and retailers were Rs.73/kg, Rs.163/kg and Rs.244/kg respectively, whereas in 2008 for Nepalese farmers, traders, wholesalers and exporters the figures stood at NPR 11/kg, NPR 8/kg, NPR 2/kg and NPR 12/kg respectively (Ingocha and Pothula 2013). It is clear that with the demand and supply gap, the margins have increased significantly at all levels in the chain.

Figure 6. Cardamom Value Chain Map



5.7 Gaps, Challenges and Opportunities

Gaps and Challenges

Post-Harvest Losses - farmers continue to use traditional kilns called *Bhatties* for drying the cardamom, which have adverse impacts on the quality of produce which includes loss of color but susceptible to charring or burnt produce resulting from uncontrolled heat resulting to non-uniform drying and some instances burnt capsules. Additionally, traditional curing units use large quantities of fuel wood for heating that has been painstakingly collected from the forests. As much as 1,200 kg of fuel wood is required for heating 400 kg of capsules which further releases 2,196 kg of carbon dioxide in the air (MoAF, 2007).

Limited Research Focus on Cardamom – as compared to rice, maize, chilies, mandarin oranges, cardamom receives little research support both in terms of budget and subject. For example, research topics on identification of local varieties, development of improved varieties, develop location / variety specific package of practices, climate resilient variety development, market research, etc. are largely missing. Furthermore, there is severe gap in the research related to address issues of climate change, deforestation, value addition and markets. Lack of research automatically translates to lack of extension support to farmers in terms of production, disease management and, input and output markets. This may result to gaps in supplying quality planting materials. In all, institutional and technical support towards cardamom is only responsive to recent high market price and has not reached levels of focus received by rice, maize, apples, potatoes and citrus.

Supply of Poor Planting Materials – supply of adequate quality and quantity of planting materials remains another pressing issue resulting from leaf blight and wilt caused by fungi (*Collectotrichum* and *Fusarium* Spp.) infections and sporadic incidences virus infection. According to the key informants, between 2014-15, the National Seed Center supplied about 191,165 planting materials including seedlings supplied from registered growers corresponding to total new plantings. The discrepancy arises from planting material entering in the country through informal trade channels across the border. Thus, questioning standards of safety, quality and certification. It was also noted that propagation materials were not necessarily done from healthy clumps but rather from plants exposed to direct sunlight.

Limited Scientific Knowledge - farmers are not aware of the scientific practices on how to attend to cardamom cultivation as a field crop. Farmers widely use various varieties of trees for shading that are not appropriate for cardamom production. As per the Spices Board, the crop needs 30-50% shading.

Under Developed Marketing and Marketing Information System - several challenges arise while marketing cardamom. First, the trade is largely through informal channels roughly at 50% or more. Such data goes unrecorded not able to document for future reference both in terms of sales and revenue earnings. There is no proper market information system-recording price at which the Bhutanese cardamoms are sold and farmers are totally dependent on word of mouth.

Lack of Adequate Grading and Sorting – cardamom is sold as a single mix without grading, sorting, packaging and branding. There is no initiative on cost leadership or product differentiation of cardamom from Bhutan as compared from India and Nepal. This approach does not support premium pricing for specific quality attributes (organic or otherwise) of Bhutanese cardamom resulting from its pristine environment.

No Developed Value Chain and Negligible Value Addition – cardamom is sold as fresh produce from the farm through business intermediaries and reaches the consumer. It is through the Siliguri market in India that the fresh produce is distributed to other states of India and other countries. Aside from cleaning, drying and curing the product is still sold fresh to traders with no value addition in terms of new product development using cardamom as an ingredient.

Climate Change and Biodiversity - As the land use remain mainly agricultural, events of landslides affect agriculture-based livelihood activities and also contribute greatly to agricultural crop losses. The high value crops like cardamom are more vulnerable to excessive rainfall risks with damage of pods, defoliation and damage to shade trees. Slash and burn methods while clearing the area are likely to increase erosion, decrease biodiversity and degrade soil fertility. Increasing deforestation and other land use changes on steep slopes can expose the mountain agriculture to climate change impacts. Further, drying of cardamom through use of firewood continues to put pressure on deforestation and loss of forest cover (see above sections for figures). Farmers often advance further up hillsides, clearing forested areas to expand land under cultivation thereby causing further negative impact on biodiversity and forest cover.

Opportunities

To Increase Cultivation Area on Government Land – with cardamom plantations requiring large tracts of land it is worth pursuing partnerships with the Department of Forest and Park Services to utilize State reserve forestland. The use of land for large cardamom as a field crop and as a plantation in forests can be optimized arguing along the lines of food security, farmer incomes and foreign exchange earnings. For example, the MoAF has awarded large tracts of land for Hazelnut and Coffee; similar models can be explored in terms of contract farming, FDI investments or Joint Ventures.

Increased Income - with increasing demand and prices rising each year, opportunity to increase rural income and standard of living is likely to happen allowing people to purchase luxury goods. It has been observed that most farmers in Doban *gewog* in Sarpang own brand new utility vehicles like the Bolero jeep.

Potential to More Earnings of Indian Rupees – with every year additional farmers are engaging in cardamom cultivation and export earnings are bound to rise with India being the main buyer adding to earnings of Indian rupees. Of course, the earnings would result to multifold benefits of livelihoods and standard of living of the farmers and other players in the value chain. Other opportunities could arise in terms generating employment at the farm level with enterprise development surrounding the cardamom commodity.

Value Addition – using cardamom as a major ingredient, attempts can be made to enhance its value through new product development. For example, cardamom powder packed in different weights and containers suiting the desired client. Likewise, fresh cardamom pods packed in attractive packaging materials of plastic, tin, glass and the like. Again like the other products, this can be done with the help of a PPP model or in collaboration with a farmer cooperative supported by professional technical assistance.

5.8 Strategic Axis for Future Growth

Strategy	Action	Lead Agency
Accelerate the supply of improved quality planting material.	• NSC to spearhead procuring and supplying quality grade planting materials.	NSC, RSG,
Explore possible area expansion for cardamom cultivation.	• Explore leasing SRF to private investors along the models of Hazelnut and Coffee plantations. • Upscale existing schemes.	PPD, DoFPS, NLC.
Innovate fuel-efficient drying and curing methods replacing the *Bhatties*.	• Consider solar drying or electric drying systems to reduce pressure on cutting down fuel-wood and increase efficiency. • Feasibility studies in terms of technology, adaptability, practicability, affordability on drying techniques. Tray drying using simple enclosed barn driers can be easily researched and implemented.	AMC, PPD, NPHC
Develop strong research agenda and improve extension support.	• A program focusing on cardamom crop needs, technology transfer, initiate introduction of improved planting materials. • Area development integrating cardamom cultivation with agroforestry providing overhead shade and timber resources. • Study the informal trade constituting 50% of the harvest across the border and recommend way forwards. • Research study on proper drying and storage through improved technology and management. • Conduct market study in Siliguri, India and Bangladesh.	DoA, PPD, NPHC, AMC, DoFPS,
Diversify markets	• Explore linkages with Food Corporation of Bhutan. FCB can potentially develop linkages with agencies such as North Eastern Regional Agricultural Marketing Corporation in India assisting farmers in selling and distribution of agricultural produce from North East Region to enable farmers to get a higher price.	DAMC, FCB
Invest in Marketing and Quality Standards, and accreditation.	• Establish a brand name for Bhutanese cardamom like how Nepal has established Everest Big Cardamom to differentiate large cardamom originating from Nepal. • Encourage grading and sorting by size and quality. • Certification and accreditation and quality seal.	DAMC, BAFRA
Investigate value addition through packaging, labels,	• Fresh cardamom processed into ground powder for various usage with curry ingredient being the major one. This will require special packing materials such as	

brands suiting market segments.	polypropylene as polythene bags cannot be used as the flavor components will diffuse through it. It will also require adequate sealing with flaps folded and machined sowed. • Convert to cardamom pods of different sizes and weights as a spice to flavor foods and drinks derived from its aromatic fragrance. • Small cardamom sachet/bottled/ either as fresh or processed keeping targeting market segments. • Explore PPP models in collaboration with farmer groups or cooperatives.	

VI. Ginger Value Chain System Dynamics

6.1 Ginger Commodity

Ginger rhizome is a cash crop concentrated mostly in the southern *dzongkhags* and with scattered production seen in some parts of western Bhutan like in Athang *gewog* in Wangdue *dzongkhag* and in some parts of lower Haa. The crop thrives best in warm and humid climate such as the favorable southern *dzongkhags* experiencing sub-tropical climate like Chukha, Sarpang, Samtse, Tsirang, S/Jongkhar and some parts of Wangdue as can be seen from Table 9. Samtse has the highest production recorded at 1,616 metric tons in 2013 followed by S/Jongkhar.

Table 9. Ginger production in selected *dzongkhags* of Bhutan.

Dzongkhag	**Cultivated Area (acres)**	**Production (metric tons)**	**Yield (MT/acre)**
Chhukha	647	767	1
Samtse	622	1,616	2.6
S/Jongkhar	491	1,182	2.4
Sarpang	307	523	1.7
Tsirang	244	548	2.2
Wangdue	4	6	1.5

Source: Agriculture Statistics, 2014.

Table 10 below present area of cultivation corresponding to production and yield starting 2005-2013.

Table 10. Production records since 2005-2013.

Year	**Area (ha)**	**Production ('000 metric tons)**	**Yield (in metric tons/ha)**
2005	985	6.9	7.0
2006	1,790	7.6	4.2
2007	2,063	9.9	4.7
2008	1,800	7.6	4.2
2009	1,033	3.8	3.6
2010	877	4.0	4.6
2011	1,446	4.6	3.2
2012	803	5.0	6.2
2013	948	3.4	3.6

Source: Compiled Renewal Natural Resource Statistics records.

6.2 Production System and Potential

Ginger cultivation is largely traditional in practice with farmers employing inputs that are locally available in terms of rhizome as seed, farmyard manure and human labour. The crop grows well in warm and humid climate and is cultivated in sub-tropical areas under both rain fed and irrigated conditions. Moderate moisture is necessary during the initial sowing period for rhizomes to sprout but not desirable to have high moisture throughout the season. Implements like plough, spade, sickle, etc. for cultivation is still a standard practice. Ginger crop is largely rain fed and cultivated in marginal and gradient land therefore organic manure and dry leave compost is used to maintain soil fertility. The use of improved seed is also very rare as most farmers are using locally available seed varieties. Major part of the cost constitutes the seed estimated at about 50% of total production cost. Usually, seed are being produced by farmers who preserve quality stocks for next season plantation. From the key informant interviews, farmers keep 20% to 25% of their production for purposes of rhizome seed.

Ginger cultivation is common in most of the *chiwogs* of Athang *gewog*. The crop is ready for harvest in eight to ten months for use as green ginger. Rhizomes are then lifted either with a digging fork or spade and cleaned thereon for markets. Rhizomes which are to be used as seeds for propagation are preserved carefully either in pits under shade or covering with layers of leaves on the ground.

Production of the spice crop is at very backyard level with most farmers growing less than half an acre or few decimals. Current total production is estimated one truckload of ginger combining from the *gewog*, this would be estimated at 8,000 kilograms. Given the road conditions are improved and the bridge construction completed in the *gewog*, farmers are willing to increase production provided appropriate marketing support is available. Empty plots of land unutilized in the *gewog* are alternate source of increasing production acreage. According to Agriculture Statistics, the total cultivation area in the country is recorded at 2,651 acres with an average yield of 2,800 kg per acre. The seed rate is 1,500-1,800 per acre.

6.3 Processing Methods

Processing of fresh ginger into any other product type is absent except for negligible quantities as homemade pickles. Trials are made to dry ginger into powder by the National Post Harvest Center and Bio-Bhutan.

Three practical value addition potentials that exist are processing fresh ginger into dried ginger powder, ginger tea sachets and ginger pickles. Possible interventions can be explored through PPP models, contract farming, farmer groups and cooperatives. Processing can be considered using several options like i) processing at the farm (powder, pickles) through different models of investment (farmer groups, outside investments, partnerships, etc.), ii) explore possible supply contracts with agro-processing companies (BAIL, Druk Fruit Products Limited). Processing of ginger pickle mixed with other ingredients like chilies, *amla (Phylanthus emblica)*, radish, etc. as a cooperative on site has bright prospects.

6.4 Distribution and Markets

India is the major market for ginger from Bhutan as the domestic consumption is low. According to Bhutan Agriculture Statistics 2014, about 2,638 metric tons of ginger has been exported, valued at Nu. 126 million. As per key informants, about 80% of the ginger production in Bhutan is sold to India. Farmers sell to local contractors (some Indian also participate) and then transported in truckloads to India crossing the border check posts. Minimal quantities are also auctioned via the auction markets. Small quantities are sold in the weekend markets.

Indian traders across the borders towns of Bhutan directly buy the ginger from the farmers from the nearest road head. For example, farmers in Logchina *gewog* in Chukha and some farmers from Samtse (Tendu and Bara *gewogs*) carry ginger down to the Indian border areas following traditional routes and sell it to the Indian traders. Unlike Cardamom, no local agents or private businessmen engage as intermediaries between farmers and Indian traders compelling farmers to carry the produce down to the road head disallowing economies of scale with each farmer having to carry small amounts individually. Other growing *dzongkhags* such as Wangdue, Tsirang and Sarpang first sell small volumes in the local market and then try to sell to larger weekend markets of Thimphu and Gelephu. The price of ginger in weekend markets ranges from Nu. 120-160 per kilogram. For example, in Centenary Farmers Market in Thimphu, price for a kilogram of ginger is recorded at Nu. 160/kg, while in Gelephu, it is Nu. 120/kg.

Transportation of consignment ranges from human back, horses, power tillers and small trucks. Despite government initiatives through the supply of plastic crates, traditional packing materials like jute/plastic bags are more convenient and dominantly used given the rugged terrain and road conditions. Transportation through long distances to markets results damages from bruises and broken parts of the rhizome, weight loss through product perspiration and rotten parts enhanced with heat and pressure built up on the journey. Key stakeholders in Athang *gewog* reported that about 10% of the consignment deteriorates in quality on the road forcing to sell at a discounted price. Further, with storage losses from spoilage and weight loss, farmers are forced to bulk sell them after harvest at wholesale to local vendors in the Wangdue weekend market. Transport to Thimphu Centenary Farmers Market also encounter the same problem of having to sell at low prices.

6.5 Ginger Value Chain

Ginger production in Athang *gewog* like other parts of the country is undertaken by smallholder farmers with average plantations area estimated between 0.25 to 0.5 acre. According to Agriculture Statistic 2014, the highest production recorded is in S/Jongkhar at 1,182 metric tons followed by Samtse at 1,616 metric tons. Production in Wangdue is very low but the crop has huge poverty alleviation potentials benefiting a highly marginalized community. Production entails dedicated hard work not just on good farm management in terms of crop yield but the need to guard the crop from wildlife destruction. It has been reported that wild animals like the porcupine, deer, monkey, wild birds and pigs as the major

cause of crop damage. Ginger rot has been a concern despite continued efforts by the government.

Inputs in terms of maintaining soil fertility are either farmyard manure from cattle and in some areas application of leaf mold collected from the forest. Commercial fertilizers are applied depending on the affordability of price and cost of transport and procurement.

Upon harvest, ginger is sun dried allowing loose soil to fall off the rhizome and later stored in pits dug in the ground and located beside the dwelling place of the farmer.

Labor activities along the value chain has no distinctive gender roles and responsibilities. All activities along the value chain are performed either by men or women driven mostly by labor availability rather than any perceived division of labor in terms of expertise, suiting specific tasks or the like.

The movement of fresh ginger from the farm to market undergoes several players in the value chain as illustrated below;

Scenario I – Farmer sells directly to markets (local or major weekend markets). This is carried out by either men or women by FGDs suggest the activity is predominantly negotiated by the men.

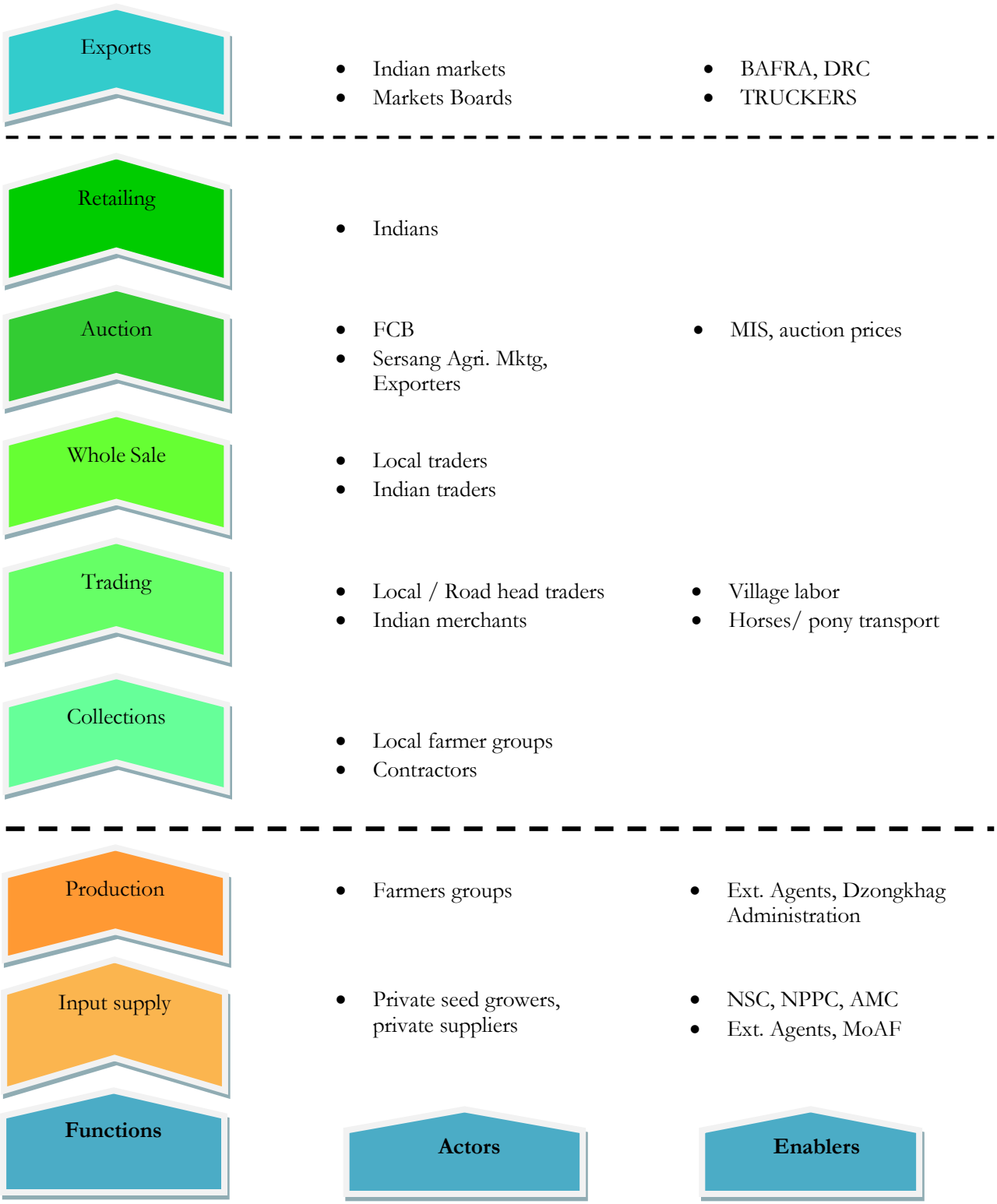
Scenario II - Farmer sells to directly to Indian traders (commission agent) in the border areas. Gender roles are similar as described in Scenario I.

Scenario IV - Farmer sells through auction markets. Small quantities find auction yards as sales outlets is carried out mostly by men.

Indian traders or commission agents have an important role in the value chain and act as intermediaries between the farmers and Indian wholesalers. Wholesalers further perform onward sales to retailers in the larger markets of India directly to consumers through retail outlets. Likewise, wholesalers have a significant role to play by linking the farmers and traders with exporters. Sometimes the wholesalers take up dual responsibility of the exporters as well. Exporters are the last component of the value chain delivering consignments to the larger markets. The most prominent markets are in the Indian border towns nearing P/Ling and Gelephu where traders buy ginger both from farmers and local traders and sell it to the wholesale market in India.

In summary, the product travels from the farm traded by the local contractors who sell it to the wholesalers and small retailers. Some are auctioned off in FCB auction depots while a large percentage is exported to India as depicted by the value chain map. The price of locally grown ginger is Nu. 150-180 per kg. Total exports recorded under the Bhutan Trade Statistics in 2014 is 123 metric tons.

Figure 7. Ginger Value Chain Map



6.6 Gaps, Challenges and Opportunities

Gaps and Challenges

Lack of Access and Associated Infrastructure – access in terms of roads and bridges are not adequate in ginger growing areas. For example, in Athang *gewog* the first access is a power tiller track that would take about two hours to reach the main highway. Then another three hours to reach the Thimphu weekend market. It also lacks a motor bridge requiring people to transship consignments on people backs crossing the suspension bridge. Similar situation is the same in other production areas of the country. A case in example is in Logchina *gewog* in Chukha; Tendu and Bara in Samtse where people carry it to the nearest road head on human backs and ponies prior to selling to the Indian trader. This results to high cost and commodity damage.

Rhizome Rotting – rhizome rotting poses the biggest challenge for ginger production in the country. This has been reported referring mainly due to lack of proper drainage, deficient in management skills and poor planting material that are infected with disease and pests. Most farmers are not applying any fungicides or other plant protection chemical treatment.

Insufficient Technical Knowledge on Plant Protection Measures - although there is high infestation of rhizome rot disease in most of the ginger producing districts, there is little adequate knowledge on appropriate plant protection measures. Pesticides found at local level are seen not effective to control rhizome rot disease.

Inadequate Knowledge on Quality Seed Supplier - seed is the major input component in ginger cultivation as it incurs around 50% of the cost of production. Most of the farmers are using local varieties and traditionally grown seeds. During this study, most of the farmers were asking about quality seed (with attributes on high productivity, disease free and fibreless) suppliers and their location

Traditional and Non-scientific Farming Practices - ginger cultivation continues to be an age-old tradition and rain fed with conventional practices. Employing traditional ways of farming implies sub-optimal production and lower returns compared to producers using advanced techniques. Farmers are not aware of the available package of practices that can ensure higher and sustainable yield. Issues on size of rhizome seed, sowing and harvesting techniques continue in the absence of improved best practices, lagging behind to adopt the research findings.

Auction Markets far from Production Sites - in the case of Gelephu, auction facilities are located 40-50 km from the ginger farms serving as a major impediment while transporting ginger long distances. With inconveniences to transport arrangements, farmers sell at farm gate to local contractors or carry to nearest road-head and sell in bulk to the traders. Small quantities are sold in the auction yard to Indian bidders who trade in bigger markets of Cooch Behar, Siliguri, Malda, depending on the volume and quality. Likewise, in P/Ling, small quantities of the produce are sold through the auction yard while larger portions are sold to retailers directly in Jaigaon, India. The Indian traders trade it to larger markets of northeast India.

The situation is same for ginger production areas in Logchina and Athang *gewogs*. With production just gaining momentum, ginger from Athang can reach only as far as the Thimphu Centenary Farmers Market although focus is more on processing at farm in terms of value addition.

Large Volumes Sold via Informal Channels – at a national level unrecorded volumes in significant quantities are sold as part of the informal trade with farmers selling in local weekend markets over a two to three-month period. Sales are made at the convenience of the farming by taking the produce in small batches to the market while bringing home essential commodities with the cash returns after the sales have been made.

Limited Varietal and Market Research on Ginger – there is limited scientific information on the cause of rhizome rot and on quality of inputs to be used. This handicaps technical knowhow of the extension agents for optimal ginger production. Quality of inputs and planting material has a direct impact on the quality of production and productivity and therefore, it cannot be compromised with. For example, in Sikkim, advanced research, increased awareness, motivation among farmers and extension services together contributed to production gaining momentum from 2010 to 2012 (Uma et al., 2014).

Poor Planting Materials - owing to limited supply of certified seeds and the convenience of use, farmers use their own mother rhizomes as planting material for ginger. The issue here is that they reuse residues from previous crops, which have not been evaluated for disease or other infections. It is proven difficult to differentiate an infected rhizome from a healthy variant at the time of sowing. Since ginger plant can survive even if its parent plant is uprooted, the risk of infected rhizome assumes a bigger threat. Moreover, farmers break the rhizome into pieces before sowing to be able to cover more area heightening the chances of crop rot. Frequent disease outbreaks, in fact, are the reason why many farmers in the past have stopped growing ginger altogether.

Lack of Adequate Grading and Standards – farmers still do not engage in grading and standardization of their produce and sell in mix grades of both size, color and shape. This is attributed to the non-sophisticated nature of the local market where price is the primary determinant followed by mix quality.

Considerable Post Harvest Losses – ginger is stored in the dug pits inside the ground losing to weight loss and deterioration. To ease the process of post harvesting for farmers, best practices in India and Nepal engage in washing the produce in warm water, sun drying the crop, scraping the skin with bamboo splinters or wooden splice instead of metallic knives to avoid damage, soaking tender ginger in 30% salt water and so on (Spices Board India 2009). For yielding a healthy organic produce, mechanical, thermal or biological methods are primary techniques of processing. Farmers in India are sensitive to the importance of ginger quality and are willing to improve post-harvest activities. However, the question of viability arises considering production system in the country is different from the two mentioned. In the Athang context, farmers training on improved methods of post-harvest best practices and processing techniques must be initiated.

Opportunities

Increased Farm Income – like cardamom, ginger too has potential to increase farm income provided marketing is done effectively in terms of markets, price and timely delivery. Currently, ginger is imported from India is sold at Nu. 160 per kilogram in the Thimphu weekend market. Group marketing initiatives can help reduce overheads and bring in economics of scale making it a viable business for farmers to earn cash income. Value addition into pickles, tea, powder, etc. can fetch larger margins if executed properly.

Processing at The Farm – processing into ginger powder or as ingredients for pickles raises potential to set up small processing machines in production areas. With value addition like a good processing technology, attractive packaging (bottles and plastics), branding and labeling can lead to success stories especially as part of a community initiative.

Regulate Supply in the Market – given proper storage facilities, supply of ginger in the market need to be regulated based on demands determined by the weekly markets. Currently farmers upon harvest, glut the market with supply exceeding demand and triggering prices to spiral downwards.

Organic Ginger differentiation through Premium Quality and Brands – ginger grown in the country can be differentiated through brands and standards in terms of natural growth history in pristine environments of Bhutan, minimal use of chemical fertilizers, high quality rhizome, proper packaging and other quality parameters.

6.7 Strategic Axis for Future Growth

Strategy	Action	Lead Agency
Explore Processing Options	• Through Farmer Groups/Cooperatives. • Training of farmers on processing methods and management into produce of ground ginger, tea and curry sachets and the like. • Partnership with private investors like Bio-Bhutan, Happy Chips, Hifi, others.	DAMC, NPHC, AMC
Improve Productivity and Production Quantities	• Explore varieties that are resistant to pests, diseases and rotting. • Farmers training on improved management practices. • Distribution of improved planting materials.	NPPC, NSSC, DoA,
To study different methods of rhizome rot management practices.	• Undertake research trials • Consider planting the rhizome in rocky soil or under shade.	RNR RCs, NPPC, PPD, DoA,
Increase yield	• Distribute improved planting materials, increased application of FYM and mulching whereby soil is covered with green leaves at the time of planting.	NSC
Reduce Post Harvest	• Training on post-harvest practices such as cleaning,	NPHC

Losses	drying, sorting, grading at the farm level. • Technology to substitute manual labor for processes of sorting, cleaning, and grading can be made possible.	
Product Differentiation	• Quality segregation into A, B and C grade in terms of color, size, texture and general appearance. • Proper packaging in aerated plastic bags in retail quantities of 500gram, 1kilogram or as desired by retail outlet.	DAMC, BAFRA
Increase Product Shelf Life	• Improvised cool storage infrastructure at the farm replacing the existing pit storage facility.	NPHC, AMC
Farmer Groups and Cooperatives	• Strengthen and expand mandate of existing vegetable farmer groups/cooperatives. • Institute new farmer groups especially for ginger.	DAMC
Increase Efficiency in Distribution and Markets	• Study markets and invite new bidders from India to auction yard. • Study market dynamics of i) informal trade across the border, ii) retail in weekend markets, iii) auction markets and provide best alternate or a combination of alternatives. • Explore retail chain supply models with urban retailers such as Lhatshog, E-Eleven, Sheryang in the case of Thimphu and other retailers in different *dzongkhags*.	FCB, DAMC

VII. Dairy Value Chain

7.1 Overview of Dairy Sub-Sector

Dairy sub-sector in Bjee *gewog* continues to be a backyard activity with milking herd sizes ranging from 3-6 cows dominated mostly with indigenous breed of *Jatsam* and *Trabhams,* although concerted efforts are made by the Department of Livestock to increase the supply of improved breeds like Brown Swiss and Jersey through genetic improvements.

Table 11 presents a breakdown of breed varieties in Bjee *gewog*;

Table 11. Breed Varieties in Bjee gewog.

Breed Variety	Number of Cattle
Jatsa-Jatsam	138
Jersey Cross	419
Nublang-Thrabam	622
Yaks	3,982

Source: Livestock Statistics, 2013.

Only 50% of the households in Bjee *gewog* have improved breeds according to records reflected in the Livestock Statistics 2013. The diary sub-sector plays an important role in the Bhutanese farming systems with the cattle utilized for ploughing, farm manure and as source of protein meat. In the alpine belt cattle byproducts such as fur is woven into yarn to weave tents, jackets, blankets, carpets and other novelty items. Dairy and cattle rearing is treasured as a financial resource to bail out families during distress periods. For purpose of this case study, we are going to examine dairy products focusing on the value chain of milk, butter and cheese using Bjee *gewog* in Haa as an example.

The dairy sub-sector includes production, processing and marketing of milk and milk products. A typical Bhutanese dairy farmer produces modest amount of surplus milk and milk products for sale in the local market. There are basically two marketing systems in the country: (i) the informal system where the farmer sells the surplus to neighbors and in the local market, either as milk or in the form of butter or freshly churned local cheese *datsi*, and (ii) the formal system in which the milk is collected at the milk processing unit (MPU), an organized group initiative that further processes into butter and *datsi* at a relatively large scale. The earnings from butter and cheese are used to purchase household requirements, e.g. clothing, grain, tea, sugar, salt and other food essentials.

7.2 Dairy Production System

According to Livestock Statistics 2013, milk production in Bjee *gewog* was recorded at 114,535 kgs, butter at 3,591 kgs and 6,891 kgs for cheese (*datsi*). Dairy production in the *gewog* can be categorized into traditional and improved. The traditional system includes subsistence, pastoralist and some agro-pastoralist. The improved production system includes peri-urban dairying systems. Production is largely subsistence and highly dispersed.

Domestic milk production at a national level is targeted to replace imports, which currently constitute 70 percent of annual consumption. The national strategy is to promote community-based organizations of production, processing and marketing to overcome these constraints and therefore farmers who own milking cows are expected to play a key role in helping to achieve this target.

The main characteristic of milk and dairy sector is the importance of the informal sector. Milk is either processed for home consumption or sold to consumers or consumed by the family of the producer. Traditional dairy farming is subsistence with farmers milking indigenous cattle and few improved mixed breeds. Small surpluses are sold in the local market or sometimes exchanged for labor hours. Annual milk production from the indigenous breed fluctuates widely from year to year depending on the amount and distribution of rainfall for natural fodder and on the occurrence and severity of disease outbreaks. According to the Livestock Census 2013, the amount of milk produced was recorded at 30,920 metric tons and out of which 78.56% has been processed into 1,322 metric tons of butter and 2,382 metric *datsi*. Livestock Census 2015 shows increase in milk production by 22%, butter by 19% and *datsi* by 31% respectively as shown in Table 12.

Table 12. Production records of milk, butter and *datsi*, 2013, 2015.

Quantities	2013			2015		
	Milk	Butter	Datsi	Milk	Butter	Datsi
MT	30,920	1,322	2,382	39,844	1,630	3,471
% Increase				22%	19%	31%

Source: Livestock Census 2013 and 2015.

Production of milk in Bjee *gewog* is summarized through the Farmer Groups as illustrated under Table 13;

Table 13. Production of milk in Bjee *gewog*, July 2014-June 2015.

Production Area	Number of Members	Milking Cows	Average daily milk collection (Liters)	Annual milk collection (Liters)	Price	Income Earned (Nu.)
Yangthang Gonor Gongphel Detsen	34	51	142	28,687	35/liter	467,712
Talung Om Tshodrel Detsen	40	30	166	3,504	35/liter	248,994
Chundu Tshongdrel Detsen	16	59	330	86,289	35/liter	1,562,000
Tokey-Geysa Tshongdrel Detsen	18	24	112	10,032	35/liter	NA
TOTAL	108	164	751	128,512		2,278,706

Source: District Livestock Officer, Haa Dzongkhag, 2016.

Milk production in Bjee *gewog* like is the situation in most *dzongkhags* is widely dispersed and confined to small quantities. The markets for milk and milk products are similarly scattered, although there is a high concentration of consumption of fresh milk and related dairy products (butter and *datsi*) in and around the capital city of Thimphu. The average dairy activity in the *gewog* constitutes about three heads of milking cattle; therefore, production continues to witness a backyard scale. Further, dairy is still considered a "secondary" profession after agriculture, even for farmers with 5-10 heads of milking cattle. Part of the reason is that by culture and tradition, cereals are considered as the main staple and given importance compared to dairy.

Liquid milk only had informal supply structure and in fact constituted a small portion of the total market. However, with the development of the collective farmer groups and enterprises as mentioned above, the market for milk began to expand and surplus milk made its way to the urban towns. For example, the Yangthang Om Tshogpa sold 89,514 liters of milk earning Nu. 723,604 and 6,247 kg of cheese and earned Nu. 2,082,479 between July 2014 and June 2015. Similarly, butter earnings recorded Nu. 1,313,460 by selling 3,648 kg of butter in the same period.

7.3 Processing Methods

Traditionally the sub-sector has been dominated by the yak herding communities who collect milk from farms and process them into butter, *datsi*, hard cheese *chogu* and *talep* or soft cheese. According to Livestock Statistics 2013, 35,340 kgs of milk and 1,538 kgs of butter were processed. Likewise, 3,560 kgs of cheese (*datsi*) and 42 kgs of chugo or hard cheese were processed.

In recent years, milk-processing centers in Bjee in Haa, Bathpalathang and Tamshing in Bumthang, Sha Gogona and other MPUs have ventured processing milk into butter, *datsi* and Gouda cheese with technical assistance from developmental partners such as GTZ, Swiss Development Assistance and the Government of India project support. Haa *dzongkhag* has two MPUs with one in Yangthang under Bjee *gewog* and the other at Tshelungkhar under Uesu *gewog*.

Milk produced by farmers in Bjee *gewog* is at subsistence level and consumed by family in the form of fresh milk or processed into butter and *datsi*. Little forgone consumption is delivered to the MPU for onward sale either as fresh milk or processed products. For butter making, milk is collected over a period of three to four days to accumulate sufficient milk volume for churning and the time taken for the milk to become sour. The method of butter churning may take between two to three hours, depending on factors like temperature, fat content and acidity of the milk and the amount of milk in the container. The time taken to churn butter and cheese together with the time involved in taking it to the market entails considerable labor hours and travel time. The buttermilk remaining after the butter gets separated from the whole milk is used to produce a cottage-type cheese called *Datsi* by heating the buttermilk and separating the coagulated fat and protein from the whey.

Processing of butter and *datsi* at farm level is the traditional way to extend the shelf life of the milk and practiced by all the farmers considering the long distance of travel to markets. Butter traditionally processed is fermented called *Ma.* Depending on the quantity of milk available, milk is stored from one to three days before churning. The most widespread churner is the piston type bamboo churner (some areas use tree trunk hollowed out into a cylindrical shape). Depending on the temperature and churning techniques, half an hour to one hour is required to get a kilogram of butter. Once the small butter grain has been formed, the buttermilk is drained into a separate container. Butter and cheese are traditionally packed by the kilogram in rhododendron leaves amongst farmers in the high altitude areas and banana leaves in temperate and sub-tropical areas. Now days, special non-stick wrapping paper and plastics are used as improved substitutes.

Churning with improved technology is now carried out by both men and women as compared to the traditional piston churner where it is the women's role as seen dominant. Largely *datsi* ball making and butter size into shapes is still a women's job but there are also instances driven by labor availability where men also perform the task.

The Yangthang MPU that serves Bjee farmers are benefitted from the semi-automated processing equipment such as milk churner, cream separator, boiler containers, molding machines and other testing equipment.

Some of the MPUs falling under the project landscape area are as follows;

Landscape I	Shari Lothuen Omgi Tshogpa (SLOT) in Paro
	Yangthang Om Tshogpa MPU in Haa
	Tshelungkhar Om Tshogpa MPU in Haa
Landscape II	Sha Gogona in Wangduephodrang
	Beteni MPU in Tsirang
Landscape III	Bathpalathang private milk processing unit, Bumthang
	Chumey Gonor Gongphel Chithuen Tshogpa, Bumthang
	Tamshing Gonor Tshogpa, Bumthang
	Ngatsang, Themnangbe and Chaskhar in Mongar

Farmers in these areas supply fresh milk to the MPUs with payments collected on a regular interval. In some cases, commercial cattle feed is bartered in exchange for cash payments. Although there are number of milk producer groups, there are no full-fledged milk producer cooperatives in the understanding of the western definition. Milk price in Bhutan vary depending on the area of production caused by the variation in the cost of labor as the main input. Provided the quality of the milk is ensured through modern testing methods of the lactometer, national farm gate prices currently range from Nu. 25-30 per liter.

7.4 Collection, Distribution and Markets

Milk collection is done mainly through a network of farmer groups and association, some of which have milk-processing facilities such as the MPUs. Individual farmers upon becoming a member of the local farmer's group or *Om Tshogpa* supply milk on a regular basis to the MPU. When milk is delivered to the milk-processing unit, a simple organoleptic test is carried out and the quality of milk is measured using the lactometer. The milk is then weighed, filtered and run over a surface (ripple) cooler and placed in tall aluminum containers. Some of the MPUs are also equipped with small chilling tanks. Farmers through their dairy associations manage the processing unit with transparent bookkeeping. While in the initial stages costs are partly met by the government, a gradual exchange of responsibilities is implemented, with the farmers covering all costs once volumes reach a prescribed level. The effectiveness of milk collection is affected by the availability of adequate and suitable transport, road conditions and the operation of the cooling machines at the collection centers. These functions are performed by either men or women with no distinctive segregation of roles and responsibilities between the gender types.

The principal problems in the collection systems include the small limited volumes (1-5 liters) supplied by group members, the pronounced seasonality of supplies due to limited fresh fodder, dispersed and relatively low-income from retail sales, high ambient temperatures and inefficient transportation networks. The main limiting factor is the time taken for the milk to reach the consumer or the processing unit. The dairy development and distribution system in Bhutan is dominated by a relatively underdeveloped traditional livestock sub-sector. As mentioned earlier, the country has basically two systems of marketing milk and milk products, informal and formal.

Milk is sold from the MPU at Nu. 46 per liter while butter is sold at Nu. 370 per kg and cheese (*datsi*) is sold at Nu. Nu. 480 per packet contained 8 balls of *datsi* with average weight of 150 grams. The informal distribution system, which is the more dominant of the two and the most widely practiced in the traditional production system, involves direct sales from farmers to final consumers or indirect sales through market intermediaries like the retail outlets in urban areas. The formal distribution system, which usually serves the peri-urban clientele, involves organized milk collection, processing and distribution. Even in this case, vertical relations between milk producers and processors are not regulated by contracts (except when farmer groups or associations are involved) but are mediated by milk collectors; this situation makes quality management rather difficult to monitor.

The informal channel is allegedly inefficient because of redundant activities by the numerous middlemen in the dairy market. However, such observations have not been adequately studied; hence the merits and demerits of the alternative dairy marketing systems remain unclear. The informal sector dominates the Bhutanese dairy sector with milk processed (or simply sterilized for liquid consumption). The fact that only a small proportion of the milk produced in Bhutan is distributed by commercial enterprises implies that nearly all traditionally produced dairy products are sold through traditional, informal distribution channels. To date, where a few cattle owners produce excess above their own requirements, sales tend to be organized privately by farmer-producers. When the surplus increases beyond

what can be sold locally, farmer groups and associations purchase and process the excess milk and sell the products in urban towns under collective efforts.

Most traditional dairy products are marketed through inter-household sales and exchanges. The prices received from the sale of dairy products represent both the producer and retail (market) value of the product, with no intermediate marketing agents involved. This simple marketing channel has the lowest possible cost and, to a large extent, provides maximum returns to the farmer. Most of these traditional marketing systems can be found in all milk producing districts where mostly farmers themselves do the selling directly to neighbors or to consumers in nearby towns or on the highway side.

It is also common to sell the products at the place of production or at the farm gate among farmers with small herd sizes. This is the most informal system that consists of people coming to buy traditional dairy products directly from the farmer or from the roadside. The prices received on sale of the dairy products represent both the producer and retail market value of the product with no intermediate marketing agents involved. This simple distribution channel is of the lowest cost possible and does to a large extent provide maximum returns to the farmer under those particular situations. However, with production volumes still low, domestic demands are met by rising imports as shown in Table 14.

Table 14. Import of butter and cheese 2010-2014.

	Butter		Cheese	
Year	**Qty (MT)**	**Value(Nu.in Million)**	**Qty (MT)**	**Value(Nu.in Million)**
2014	238.99	61.14	1,170.72	396.55
2013	392.61	75.64	1,161.95	332.90
2012	382.87	71.45	1,107.12	296.75
2011	1,184.39	50.37	876.92	218.63
2010	351.09	49.72	943.85	171.27

Source: Bhutan Trade Statistics.

In summary, some of the constraints arising in the sub-sector involve inadequacy of market facilities, long distance to markets, inadequate transport and cold storage and the problems experienced at retail outlets. The gewographical location of livestock supply areas has an important bearing on the location of markets, method of marketing and processing. Major requirements contributing to the improvement of efficiency of marketing of dairy products are; (i) the establishment of milk collection centers, and public stockyard markets in the production area; (ii) the development of an accurate market information system on prices. (iii) utilization of a uniform terminology of grade standards for milk and (iv) the existence of adequate banking and credit facilities, and (v) vibrant market(s).

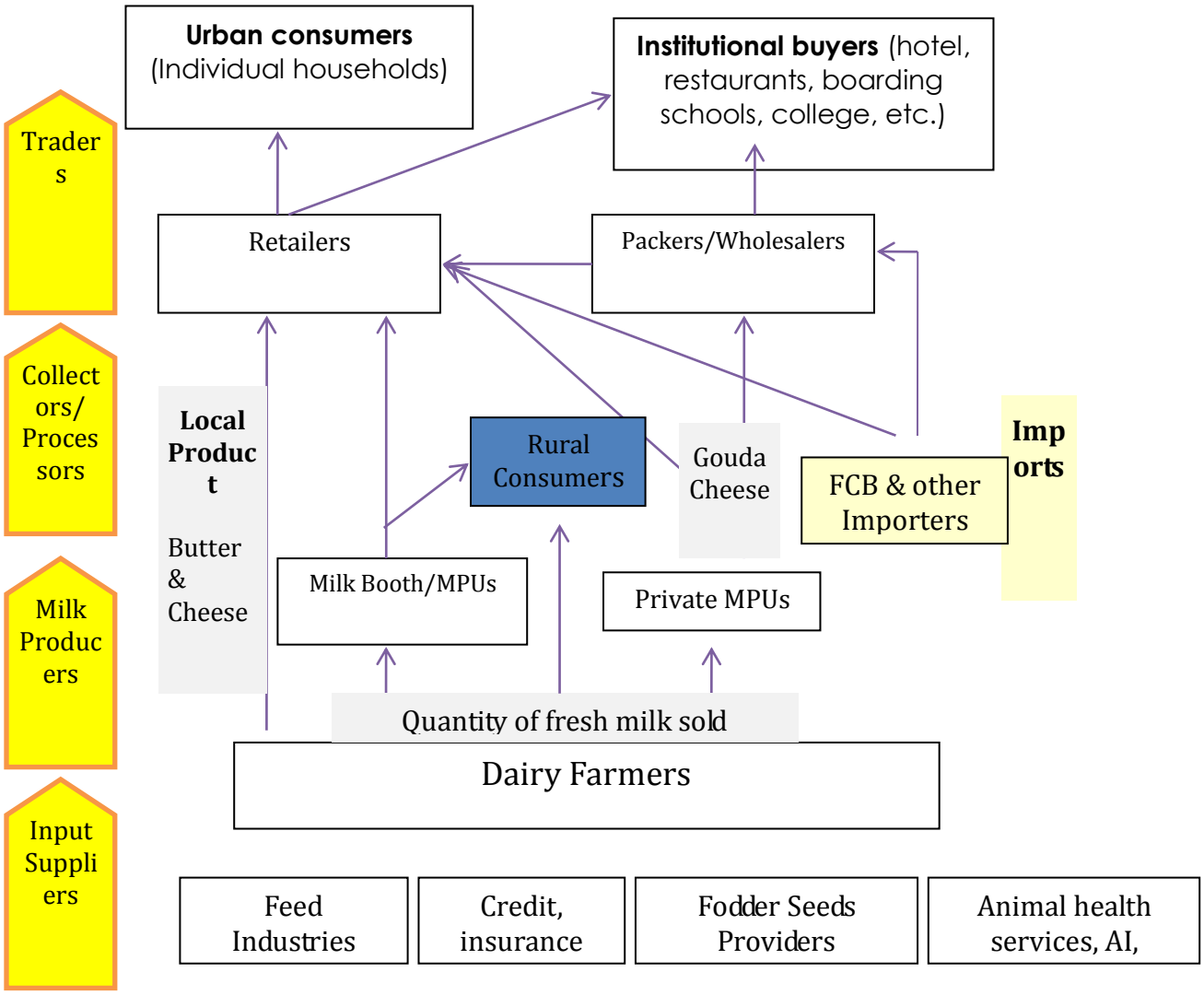
7.5 Diary Value Chain

Dairy value chain analysis is essential to an understanding of markets, their relationships, the participation of different actors, and the critical constraints that limit the growth of diary production and consequently the competitiveness of smallholder farmers. The opportunities

of the dairy sector are tremendous with urban markets growing each year and the demand side of milk is increasing. But on the supply side, production for the expected levels determined by the market remains a challenge. There are many reasons behind these constrains such as lack of improved breeds among the producers, poor management of the farm, high cost of commercial feeds and limited breed improvement support.

As described above, milk producers or farmers deliver their milk to the milk processing units regularly that in turn delivers it to urban markets after processing them into butter and *datsi*. The processors collect the milk in the early morning hours. Retail outlets in urban markets maintain close business linkages ensuring timely and consistent supply to meet market expectations. Consumers are mostly walk-in clients, institutional buyers such as schools, hotels and monasteries. Farmers procure their inputs from commercial suppliers like Karma Feeds, Food Corporation of Bhutan and direct import from Kolkata for items like packaging materials for butter and other cold storage containers. Government support continues in the areas of veterinary services (breed development, health services and AI), fodder development and the like. Bhutan Development Bank supports subsidized rural credit for farmers to procure improved breeds directly from neighboring towns across the India.

Figure 8. Milk Value Chain Map



Note: Adapted from past reports of Tobgay S., 2010, Derville &Tenzin 2007.

7.6 Gaps, Challenges and Opportunities

Gaps and Opportunities

Aging Population of Herders – herders especially in the alpine areas dominated by yaks is now left to the elderly folks posing a threat to continuity with younger generations attending schools and finding jobs in urban areas.

Low Cattle Feed and Fodder in Winter Months – meadow grass during winter months are less and commercial feeding is non-viable considering huge transportation cost incurred from long distance of procurement. Traditional knowledge or folk tales tell that heavy snowfall during

the winter months permits abundance in grassland growth. Others discuss surface controlled burning of terrace bunds and open grazing area brings about fast regeneration of meadow grass and scrub undergrowth. No specific studies have been undertaken on the expected impacts of climate change on grassland productivity.

Lengthy Processing Time with Basic Automation - processing is a time consuming activity especially with traditional piston style of butter churning. Technological improvements have been introduced with the pedal butter churners developed by Agriculture Machinery Centre in few *dzongkhags* like Paro, Haa, Wangdue and Chukha under the Wang Watershed Management Project. The churner combines the principle of the piston and spindle churners. It requires less muscle energy and reduced processing time. In addition, cream separators have also been introduced.

Dominantly Indigenous Breeds – this has resulted to low productivity with costs increasing from procuring commercial feeds, opportunity cost of labor, etc. eventually resulting to high cost of milk production and thus a limited profit margin.

Low Yield or Productivity – it has been reported that low productivity of the dairy activity is also due to infertility problem and long inter calving period. This can be attributed to inappropriate reproduction management such as not being able to accurately detect that the animal is on heat, delay in artificial insemination and insufficient or poor quality feeding.

Availability of Feed, Fodder and Area for Natural Grazing – there are major gaps in feed and fodder availability. In the progressive systems that are sedentary the farmers have now to find feed and fodder all year round. Procurement entails long distance of travel and high transportation cost and depending fully on it would endanger the sustainability of the dairy sector. With support of the Department of Livestock, farmers started developing pasture, planting more fodder trees and cultivating winter fodder.

Limited Access to Extension Services – access to veterinary extension support requires distant walking from the center to the farmer's house, limiting timely treatment and care in the case of artificial insemination.

Shortage of Manpower – with higher enrollment in schools, army and monastic studies, farm labor has been reduced to the elderly folks only. Further, the seemingly attractiveness of urban life has a major impact on cattle rearing and animal husbandry. The lack of herders often leads to a decrease in the performances, bringing down the economic interest of cattle rearing for the herd owners that tend to reduce the size of their herd. For example, cultivation of fodder and collecting fodder from the forests require additional labor. The entire dairy processing is a labor intensive activity putting pressure on limited farm labor.

Market and Marketing Related Gaps - some of the gaps arising involve inadequacy of market facilities, long distance to markets, inadequate transport and cold storage and the problems experienced at retail outlets. The deficit in the formal marketing chain is met by imports from liquid milk, milk powder and butter and cheese from India. In the case of local butter and *datsi*, most of it is sold in the weekend markets that operate starting Friday and last till Sunday evening. Of the major urban centers, the highest availability of local butter and cheese is in Thimphu, a situation helped by high demand and hence high prices although sale

of imported products are still high. Products are mainly supplied from near-by districts of Haa, Paro, Chukha, Wangduephodrang, Punakha and Bumthang with few popular retail outlets (HongKong Market, Youth Business Groups, Sheryang Grocery).

The gewographical location of livestock supply areas has an important bearing on the location of markets, method of marketing and processing. Major requirements contributing to the improvement of efficiency of marketing of dairy products are; (i) the establishment of milk collection centers, and public stockyard markets in the production area; (ii) the development of an accurate market information system on prices. (iii) utilization of a uniform terminology of grade standards for milk and (iv) the existence of adequate banking and credit facilities, and (v) vibrant market(s).

Distribution Hurdles - distribution of dairy products is not helped by problems in getting produce to the major urban markets because of poor communications associated with long distance to the markets. Distribution of dairy products has been promoted through marketing arrangement organized by farmer groups and cooperatives to collect farmer's milk and deposit to the processing units established under support from developmental partners and eventually sold through retail outlets located in urban areas. Nevertheless, these systems are presently collecting hardly one-fourth of total marketable milk. The operating costs of these organizations are high and many cooperatives for example SLOT in Paro have suspended operations mainly because of viability issues and Sha Gogona in Wangduephodrang and Choekhor and Tamshing in Bumthang recently resumed operations after partly addressing some of the constraints and problems.

Low Production Volumes - milk production per unit area is low and the producers face continued challenges while availing feed resources. Collection of milk for commercial processing is difficult due to the mobility of the producers resulting from cattle migration and the small volumes of milk surpluses. Milk production fluctuates with the seasonal availability of feed and fodder, and collecting enough milk for commercial processing is almost as difficult. Cattle in the mixed-farming system are kept primarily for draught power and to provide manure as fertilizer. Milk production is often of not primary importance. Private land ownership, prevalent in the mixed-farming system, allows for improved feed production in the form of fodder crop cultivation and planting of fodder trees. The quantity of surplus milk could justify the establishment of supporting infrastructure and collection and processing centers. Peri-urban dairy farmers rely mainly on purchased feed.

Poor Packaging and Reduced Shelf Life – milk, butter and cheese as the three primary products continue to be packed in plastic bottles and plastic bags. Despite refrigeration, shelf life is exceedingly less than the imported tetra pack substitutes. Mobility of the products through long distance is also hindered risking quality deterioration with poor packaging limiting sanitary and certification standards in terms of quality and safety.

Problems in Marketing Milk and Dairy Products

The mountainous terrain presents a major obstacle for marketing. Travel in the rural areas is difficult with many of the households scattered in different locations with some requiring long distance of travel. Poor roads, leading to breakdown of vehicles and difficulties in

collecting milk during the rainy seasons when more milk is available for collection, result in low milk intake and high collection costs. Inadequate milk collection vehicles and lack of spares for maintenance have compounded this problem.

Opportunities

Rising Demand for Milk and Milk Products - with both the increase of population and their income along with awareness of health benefits, demand for milk and milk products is increasing. This evidently suggests that there is great scope for promoting smallholder dairy farming as an integral part of present mixed crop-livestock farming systems. Its development can enhance farm employment and income and savings on the outflow of the Indian Rupees.

Potential for Commercialization – the potential to increase milk output is limited and depends on costs of production, collection, transport and processing. Mixed farmers and small dairy farmers in rural and peri-urban areas have slightly better control over their inputs in terms of procurement and private grasslands. There is thus a potential to increase milk production per cow, per farm and per unit area, which would reduce the cost per liter of the required supporting infrastructure (input supply, animal health services and marketing).

Potential for Value Addition – it has been suggested that Gouda cheese and other cheese types flavored with chili, turmeric, *Thingey*, garlic and cardamom may generate a demand. Similarly, *phelu, talep* and *chugo* can also accommodate greater innovation fetching a premium price. Possible tetra pack milk technology can be explored through partnerships with private investors and producer cooperatives. Products like ice cream, yogurt, whey etc. can be explored.

7.7 Strategic Axis for Future Growth

Strategy	Action	Lead Agency
Breed / Genetic Improvement	• Continue Artificial Insemination campaign. • Continue cross breeding program. • Improved and continuous animal health-care and associated veterinary services. • Distribution of Jersey bulls in remote inaccessible areas for AI services.	
Subsidy on Feed and Fodder Supply	• Government interventions on how to make commercial feed more affordable. • Prioritize feed and fodder development to increase the feed availability and reduce the feeding costs. • Explore providing transport subsidy • PPP with commercial feed manufacturers. • Establish commercial feed plants in different regions	
Develop milk collection schemes in	• Expand existing production and collection	

relation with milk processing factories to secure a market for the cooperatives' milk production.	facilities selling to milk processing factories through improve breeding stock and encourage best animal management practices. • The expansion of existing milk collection centers integrating new farmers in the cooperative societies. • The development of the dairy unions themselves, creating new milk collection centers.	
New product creation through value addition. Craft a proper marketing strategy for local dairy products, bringing customers to higher value products.	• Diversify and develop more product types beyond traditional butter, *datsi, phelu and talep*. • Packaging initiatives for milk, whey, yogurt, ice cream, etc. • Consider resizing of cheese to fit to the needs of high-end consumers in Thimphu. • Develop the number of points of sales to sell production not only from dedicated window shops but also from general stores.	
Retail Infrastructure Support and Product Innovation	• Continue to provide general stores with small cold storage devices. • Select independent retailers with high standard services (cleanliness, electricity, cold storage facility) and strategic location from where products could be commercialized. • Encourage the establishment of contracts. With a secure market the agents are likely to bring down their price; volume and risk limitation balancing the margin reduction. • Support product diversification to satisfy the growing urban demand. E.g. Flavored milk and yogurt, cream. • Sell butter and cheese per weight and well packaged.	
Build Veterinary Capacity	• HR planning at the central level • Redistribution and allocation of livestock extension support services based on demand in each *gewog* not limiting to one only. • Make available timely supply of veterinary medicine and equipment.	

VIII. Linkages and Partnerships

8.1 Contract Farming and External Investments

Backward and forward integration is when the value chain linkages are outsourced to specialized players in the industry. For example, contract farming is a classic example of backward integration where the vendor or distributor has control over production in the backend. Likewise, forward integration is when the farmer decides to perform all distribution and retail functions within the distribution channel selling directly to the consumers eliminating the middlemen.

In this study, integration along the value chain is limited with the producer/farmer carrying out most of the activities from farm gate till the point of sale. For example, in the case of potato, the farmer carries out functions of production including procuring of inputs and transportation to the auction markets. Therefore, the process involves all functions of input supply, production, grading, packing, transport and sales performed by a single player. Similarly, in the case of maize and ginger the farmer performs all the functions in the value chain including retailing. For dairy products, most farmers perform all functions including retail sales except for few producers who have connected with retail outlets in urban areas.

Cardamom is slightly different with local contractors engaging as intermediaries performing functions of middlemen by buying the produce at the farm gate and selling to the Indian buyers while handling transportation and other logistics. Local contractors work closely with the Indian buyers as loyal partner relationship built over past years. Cash advances are made along the chain with the Indian trader contracting the local middlemen and in turn the local middlemen contracting out to the farmer ahead of the planting season. This binds the chain and can be explained as an informal existence of forward integration.

A recent case study of backward integration though not covered under the commodities of the value chain study is the cultivation of hazelnuts by farmers in eastern Bhutan. The entrepreneur has contracted out the growing of the plant to the farmers assuring a buy back upon gestation to an agreed forward price. The same entrepreneur carries out in-house operations in terms of germinating and distributing hazel nut saplings located in Lingmithang, Monggar. Integration exists with the distributor in this case the entrepreneur having control over production. Investments have been made in setting up the company in terms of technology, infrastructure and human resource with 7,000 hazelnut plants already planted.

For the dairy value chain forward integration is developing to its initial stage with retailers in urban outlets agreeing to contractual arrangements of consignment delivery and payment schemes. Though not in Bjee *gewog* but in Bumthang farmers supply their milk to the MPUs in Tamshing, Chumey and Choekhor who either deliver to the cottage scale processors or process butter and *datsi* at part of the MPU activity. Backward integration is nonexistent with no investment from the downstream players leaving the farmer attend to the cattle and related dairy production as an entire upstream activity.

8.2 Public Private Partnerships

No formal public private partnership exists in the value chain commodities studied in the strict sense of its definition. However, the government as required by public policy continues to provide support to farmers through subsidized input distribution, free research and plant protection, extension services, marketing infrastructure such as the weekend and auction markets, market intelligence and technical backstopping from time to time. In the past, the Samtse Jersey and Bumthang Brown Swiss dairy farms run by the Ministry of Agriculture and Forest made attempts to privatize but somehow didn't materialize.

IX. Conclusions and Recommendations

9.1 Conclusions

Conclusions are structured based on the following broad spectrums of the value chain;

Production Stage

1. Production encounters challenges of small parcel landholdings and dependent on vagaries of weather and rainfall for irrigating crop fields situated far from the water source limiting to scattered micro value chain systems. Though production may be possible with efforts from the government through distribution of inputs and irrigation support, difficulties are persisting with inadequate farm labor and long distance to transport produce to market places.

2. In the case of the dairy value chain, indigenous breeds are more prevalent as compared to hybrid cattle breeds. Low availability of feed and fodder constitutes a pressing problem affecting productivity. Inadequate transport facilities required by high perishable dairy products covering long distance prior to reaching markets continue to pose business risks to farmers and cooperative groups.

3. The potential to increase milk output is limited and depends on costs of collection, transport and processing. Mixed farmers and intensive dairy farmers in rural and peri-urban areas have more control over their inputs, and improvements in inputs result in increased milk output. There is thus a potential to increase milk production per cow, per farm and per unit area, which would reduce the cost per liter of the required supporting infrastructure (input supply, animal health services and marketing).

4. Low seed replacement ratios across all four agriculture commodities were apparent with most farmers resorting to old seed stock preserved from the previous harvest. For example, cardamom and ginger presented poor planting materials while potato and maize continue to use old seed stock rather than getting fresh stock from the National Seed Center.

5. Extreme temperature rise threatens suitability of production at varying levels of vulnerability among the commodities examined with maize farmers reporting the most vulnerable. Likewise, depleting soil fertility reducing crop yields makes crops more vulnerable to climatic stress. Shortage of disease-free plantation materials (ginger and cardamom) has affected production. Other times, excessive rainfall and high-speed wind storms and cloud burst have resulted to crop damage.

6. However, there is no sufficient data available on the impacts of climate change on value chain commodities with short-term weather forecasts and seasonal predictions are poorly developed in the country with limited advice to farmers. For example, there is no data on impacts of delayed plantations on yield, or no specific data on production and yield of crops from climatic changes. As a result, long-term extreme and incremental climate-related impacts are insufficiently understood. This can be attributed to low capacity of the national weather service highlighting a broader issue of inadequate forecast capability (mainly because of the lack of basic forecasting infrastructure and field level information) and low accuracy of the existing short and medium-term meteorological data. Moreover, access to weather information appears to be restricted mostly to the population living in urban areas where television and the internet are available. However, attempts are made by the Hydrometric Department housed under the Ministry of Economic Affairs with projects supporting installation of infrastructure in all the *dzongkhags* to relay meteorological data to the center.

7. Wildlife crop damage across all five-commodity value chains were visible with elephants, wild boars, peacocks, porcupine, rodents, deer, monkeys and others invading farmers' field. This is apparent with increased labor hours spent by farmers (men and women and children) guarding the crop both during the day and at night. Despite government efforts through the fabricated electric fencing system (EFS)[3], crop and domestic animal loss compensation by the government the situation is still not under effective control. Wildlife damage occurs highest in landscape III for maize followed by landscape II corresponding to potatoes.

8. Crop damage is also prevalent from pests and diseases with weevil infestations, crop rotting, blights, wilting, armyworms, bud rots, fruit fly, etc. Similarly, crop damage from natural calamities like thunder rainstorms, high speed wind, extended dry months, insufficient irrigation has resulted to low production / productivity ultimately affecting food production and farmer's income. Natural calamity crop damage has been pronounced under landscape III with maize destruction recorded highest in Monggar *dzongkhag*.

9. Post-harvest loss is another component in the value chain farmers continue to battle. Losses are incurred from poor storage infrastructure yielding to crop spoilage and quality deterioration, weight losses and dehydration, destruction from rodents, insects, birds, etc. Post-harvest losses are also incurred from product bruises and damages from long hours in the journey. Perishable products like potato, cardamom and ginger requires un-

[3] EFS has been covered in 16 dzongkhags (Thimphu, Haa, Punakha, Trongsa, Sarpang, Bumtahng, Trashigang, Mongar, Lhuntse, Trashiyangtse, S/Jongkhar, P/Gyaltshel, Zhemgang, Dagana, Wangdi and Tsirang).

delayed transportation to markets and sold within a minimum time to escape quality deterioration and price value. Transporting farm produce from the field on human backs and ponies to the nearest farm road in the *gewog* and thereafter transporting to urban markets contribute to product damage and quality deterioration.

10. There are no distinct roles of men and women to specific functions along the value chain that requires targeted intervention and government support.

Processing Stage

11. Processing is almost absent or very rudimentary for ginger, cardamom and potatoes with the produce sold to buyers as fresh harvest. In the case of maize, processing is prevalent but limited to traditional products with no innovation to market needs and wants.

12. In the case of dairy products, processing is enhanced through the equipment installed in the milk processing units, although farmers still use traditional methods to churn butter and milk as done in the past. However, processing is still at a fresh product level with no enhanced shelf life initiatives in terms of tetra packing, vacuum packing and the likes of technology.

Value Addition and Value Chain

13. Value chains are under developed with the farmer carrying out multiple tasks of input supply, production, harvesting, grading, processing and selling. A single agent performs a multitude of functions along the entire value chain. There is lack of knowledge and experience on the importance of adequate packing, labeling and product branding. Perishable products like butter, *datsi*, potato, cardamom and ginger require skill and care in packing while transporting markets.

14. Maize value addition is limited to traditional products of *Tengma, Kharang* and *Ara* with limited know-how and acumen to capitalize emerging markets through product creation and innovation.

15. In the case of the four agriculture commodities only a supply chain exists with the producer performing most of the functions by bringing the produce to the markets. Except for cardamom where you have local traders connecting sales between the farmer and buyer for a commission for logistics and transport support.

Markets and Marketing

16. Access to markets are affected by long distance to markets, poor road infrastructure and high transaction cost.

17. Lack of adequate market knowledge determining accurate prices before transporting the consignment the market continues to be persistent problem.

9.2 Recommendations

In addition to listed commodity specific strategic axis for future growth in terms of interventions and lead agencies, the following are some general way forward to improve value chains and commodities;

1. At a national level which will benefit all landscapes and all five commodities, there is a need to build capacity to define research agenda to gather adequate data to substantiate interventions from climatic impacts on crops and livestock. For example, compiled meteorological data over past years needs to be compiled and analyzed to generate a climate advisory. This requires fulltime technically qualified people within the RNR sector to work closely with the Department of Hydromet Services of the Ministry of Economic Affairs. Therefore, the need to build technical capacity in terms of expertise, infrastructure, institutions, database management for pro-active planning and development of commodities along the value chain.

2. Appropriate mitigation methods to reduce crop depredation and cattle killings by wildlife need to be accelerated. For example, innovative biological interventions measures need to be designed to support the necessary integration, coordination and collaboration between stakeholders, adding value in terms of linking mainstreaming actions at the community level to wider policy perspectives and initiatives.

3. Reducing on-farm post-harvest losses will directly increase farmer income and improve value chain functions. Therefore, the government should stimulate on-farm storage structures that can prevent post-harvest losses, storage management practices (for example, optimal harvesting time, drying techniques, storage hygiene) need to be improved and should be disseminated through the extension system. Improvement of storage management practices should be one step in a wider intervention to develop and teach farmers about pre-harvest and harvest agronomic practices; disseminating technology for appropriate post-harvest drying, storing, and processing activities.

4. Defining the needs and implementing priorities of infrastructural development must be carried out to support the commodities listed. In the area of physical infrastructures, particular emphasis should be given to transportation and markets. Concerning institutional infrastructures, the development of adequate marketing sheds and other services required by the value chain and setting up collective farmers' bodies, responsible for marketing and for the interaction with other stakeholders in the chain, must be examined.

5. The future of maize, potato, cardamom and ginger value chains should demonstrate increased productivity from potentially lower acreage and a gradual realization of key latent demand with both ends of the value chain enabled by a stable, coordinated year-round market. It is therefore critical to grow productivity, commercial demand and increase crop rotation over time. From the supply side, greater productivity from input use, reduced losses and effective crop rotation to sustain productivity, while on the demand side, realization of latent demand such as domestic development of a feed and poultry industry.

6. While some good practice experiences exist, low adaptive capacity and reactive, short-term responses by households without adequate government support prevail. The government needs to devise appropriate adaptation measures that are of the utmost importance to counteract the negative effects of climate change in the face of increasing temperatures, higher variability of rainfall and recurrent extreme weather events keeping in mind the commodities of study.

7. Potato is a highly perishable produce and its quality deteriorates fast after harvest. This leads to a glut in the market during harvest season; hence low returns for farmers. Promotion of equitable market access may be achieved by improving rural transportation infrastructure and cold storage as well as cottage value addition facilities. There is need to educate and train farmers comprising of all actors along the potato value chain in order to enhance chain coordination, reduce transaction costs, increase market efficiencies and facilitate realization of economies of scale.

8. The government in partnership with the private sector, NGOs, CSOs must create an enabling environment to form public private partnerships (PPP) to develop value chains with different players providing specific functions. More importantly, greater value addition with new product innovation and design must be pursued with farmers as just one important stakeholder in the link. Other players must be identified in terms of viable business prospects choosing the right model. For example, a PPP vis-à-vis Foreign Direct Investment vis-à-vis private sector joint ventures.

Annexure 1. Terms of Reference

1) General Background

In order to reduce climate change vulnerabilities and improve the sustainability of local livelihoods and biodiversity of the country, the Royal Government of Bhutan has requested support from the Global Environment Facility through UNDP for a full-sized project titled "Enhancing Sustainability and Climate Resilience of Forest and Agricultural Landscapes and Community Livelihoods in Bhutan." The project aims to operationalize an integrated landscape-based approach to climate change adaptation and biodiversity conservation. It seeks to do so through: (a) improvement of institutional capacity at national, sub-national and local levels to manage forest and agricultural landscapes sustainably for enhanced climate resilience; (b) emplacement of governance system for biological corridors and operationalization of conservation management system in the pilot corridors; and (c) development of climate-resilient livelihood options for the local communities.

Based on the project identification form (PIF) document, which articulates the project concept and key components, the GEF has approved project preparation grant (PPG) to develop the Project Document and GEF CEO Endorsement Document. The PPG phase commenced in January 2016 and is scheduled to end in December 2016. In order to aid the project design and formulation of the Project Document, a series of sub-consulting assignments has been anticipated.

The objective of the assignment is to carry out value chain and market analysis of renewable natural resources commodities that can be produced from sustainable and climate-resilient livelihood practices. The findings of the assessment will be vital to the formulation and design of the UNDP/GEF/LDCF project, particularly in relation to development of climate-resilient livelihood options for the local communities.

2) Scope of Work and Key Tasks

Under the supervision of the UNDP Bhutan Country Office, Portfolio Manager for Climate Change and Disaster Risk Reduction and in close consultation with the PPG team, the consultant will carry out the following tasks:

3) Objective of the Study

- Identify and prioritize renewable natural resources commodities that can be produced from sustainable and climate-resilient livelihood practices (e.g. reduced/ efficient water use, integrated soil and water conservation on farmlands, community based natural resource management, and agroforestry) in the target project areas, and develop value chain maps for these commodities including fully considering the distinct roles of men and women;

- Examine opportunities, constraints and challenges, and recommend measures to strengthen the existing value chains for identified renewable natural resources commodities in the target project areas;

- Assess the present market conditions such as in terms of size, key players (including the distinct roles of men and women and their capacity building requirements), demand-supply gap, pricing trends, imports and exports, and distribution networks;

- Identify and prioritize business development and extension services needed for promoting the production and marketing of renewable natural resources commodities, including linkages with other potential initiatives such as ABS (access to genetic resources and benefit-sharing) schemes and organic farming enterprises.

4) Duration of the Assignment

The consultant will be employed for 30 working days spread over the period from the first week of April to end of May, 2016. He/ she will be expected to travel to the target project areas to consult local governments, local communities, extension agents, and other relevant local stakeholders.

Annexure 2. List of References

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Annexure 3. List of farmers consulted during the field consultations

Sl #	Name	Age	Gender	Village	Mobile No.
1.	Mr. Gyaltshen	59	Male	Samthang	17649770
2.	Mr. Sangay Dorji	60	Male	Thangna	77402503
3.	Mr. Phub Tshering	47	Male	Thangna	77452653
4.	Mrs. Buddha	58	Female	Samthang	77435684
5.	Mrs. Bokhum	59	Female	Hara Chu	77243877
6.	Mr. Tashi Dorji	48	Male	Thangna	77231919
7.	Mr. Daw Tshering	59	Male	Samthang	77448093
8.	Mr. Nim Tshering	49	Male	Thangna	77315537
9.	Mr. Pasang	48	Male	Samthang	77422762
10.	Mr. Wangchuk	65	Male	Phobjikha	77870515
11.	Mr. Pema	42	Male	Gangtey	17656514
12.	Mr. Wangchuk Dorji	48	Male	Gangtey	17854243
13.	Mr. Daw	72	Male	Phobjikha	17919109
14.	Mr. Tshering	70	Male	Gangtey	77310362
15.	Mr. Kumbu Dukpa	28	Male	Gangtey	17926292
16.	Mr. Phub Khandu	46	Male	Phobjikha	17869710
17.	Mrs. Nagee	62	Female	Phobjikha	17776658
18.	Mrs. Kali Bedha	60	Female	Phobjikha	No mobile
19.	Mrs. Lhamchu	56	Female	Phobjikha	No mobile
20.	Mrs. Sonam Wangmo	61	Female	Saling	No mobile
21.	Mrs. Ugyen Lhadon	44	Female	Saling	17335013
22.	Mrs. Ugyen Pemo	28	Female	Saling	16919910
23.	Mrs. Dorji Zangmo	44	Female	Saling	77633895
24.	Mrs. Kuenzangmo	63	Female	Saling	No mobile
25.	Mrs. Tshering Dema	35	Female	Saling	17361478
26.	Mrs. Sithar Lhamo	31	Female	Saling	17735199
27.	Mr. Samten Dorji	49	Male	Saling	17837151
28.	Mrs. Sonam Choden	35	Female	Saling	17808703
29.	Mr. Tshewang Dorji	49	Male	Saling	17595257
30.	Mrs. Muku Wangmo	43	Female	Saling	77259240
31.	Mrs. Tshewang Chenzome	39	Female	Saling	17597450
32.	Mrs. Yangzome	34	Female	Saling	17716319
33.	Mr. Gyalwang Phuntsho	38	Female	Saling	17647310
34.	Mr. Jagath Bdr. Tamang	48	Male	Jigmecholing	17842601
35.	Mr. Phurba Tamang	54	Male	Jigmecholing	No mobile
36.	Mrs. Phurba Dolma	25	Female	Jigmecholing	17657288
37.	Mr. Santa Kumar Tamang	28	Male	Jigmecholing	77277382
38.	Mr. Chandra Mon Tamang	58	Male	Jigmecholing	77610879
39.	Mrs. Mon Maya Tamang	58	Female	Jigmecholing	No mobile
40.	Mrs. Ambikha Gurayay	22	Female	Jigmecholing	17470741
41.	Mrs. Pabita Lami Chaney	67	Female	Jigmecholing	No mobile
42.	Mr. Phurba Tamang	53	Male	Jigmecholing	17843054

Annexure 4. Other stakeholders met

Sl. #	Name	Designation	*Gewog*	*Dzongkhag*
1.	Mr. Kinlay Dukpa	Extension Agent (Agri.)	Athang	Wangduephodrang
2.	Mrs. Sonam Yangden	Extension Agent (Agri.)	Saling	Monggar
3.	Mr. Kinlay Tshering	Asst. District Agriculture Officer	Agri. Sector, MoAF.	Wangduephodrang
4.	Mr. Loden Jimba	Senior Livestock Officer	Bji Gewog	Haa
5.		Dasho Dzongrab	MoHCA	Haa
6.	Mrs. Tara Pradhan	Extension Agent (Livestock)	Bjee	Haa
7.	Mr. Sonam Dorji	Input Supplier, One Stop Farm Shop		Monggar
8.	Mr. Ugyen Chhoedup	Regional Manager	Gelephu Regional Office	Sarpang
9.	Mr. Bhim Bdr. Pradhan	Senior Advisor	FCB, P/Ling.	Chukha
10.	Mr. Karma Nidup	Managing Director	FCB	
11.	Mr. Purna Bdr. Tamang	Complex Manager	FCB, P/Ling	Chukha
12.	Mr. Kinlay Dukpa	Auction Yard	FCB, P/Ling	Chukha
13.	Mr. Phub Gyaltshen	Auction Yard	FCB, P/Ling	Chukha
14.	Mr. Tshering Yeshey	Bhutan Exporters Association	P/Ling	Chukha
15.	Mr. Gongla	Bhutan Carbide Chemicals Limited	P/Ling	Chukha
16.	Mr. Singye Dukpa	Sersang Agriculture Marketing Limited	P/Ling	Chukha
17.	Mr. Wangda Dukpa	Program Director	National Seed Center	Paro
18.	Mr. Karma Dukpa	Post-Harvest Officer	National Post Harvest Center	Paro
19.	Mrs. Sonam Lhamo	Post-Harvest Officer	National Post Harvest Center	Paro
20.	Mr. Kuenga Norbu	Offtg. Program Director	Agriculture Machinery Center	Paro
21.	Mr. Sonam Tobgay	Senior Repair Technician	Agriculture Machinery Center	Paro
22.	Ms. Singye Dem	Focal Point Cardamom	Department of Agriculture	Thimphu
23.	Mr. Ganesh	Specialist	Department of	Thimphu

	Chhetri		Agriculture	
24.	Ms. Sangay Choden	Data Manager	DAMC	Thimphu
25.	Mr. Sonam Wangdi	Senior Marketing Officer	DAMC	Thimphu
26.	Mr. Meg Bdr. Tamang	Marketing Officer	DAMC	Thimphu
27.	Mrs. Yeshy Dema	Program Director	NPPC	Thimphu
28.	Mr. Chencho Dorji	Hydromet Officer	Department of Hydromet Services, MoEA.	Thimphu