Value Chain Study on Maize

Department of Agriculture and Marketing Cooperatives

Ministry of Agriculture and Forests

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ABBREVIATIONS

AEZ	Agro Ecological Zone
AMC	Agriculture Machinery Centre
ARDC	Agriculture Research and Development Centre
AWP	Army Welfare Project
BAFRA	Bhutan Agriculture and Food Regulatory Authority
BCD	Bhutan Centennial Distillery
BDBL	Bhutan Development Bank Limited
CIMMYT	International Maize and Wheat Improvement Centre
CoP	Cost of Production
DAMC	Department of Agricultural Marketing & Cooperatives
DCSI	Department for Cottage and Small Industries
DoA	Department of Agriculture
DRDP	Decentralised Rural Development Project
FAO	Food and Agriculture Organisation
FCBL	Food Corporation of Bhutan Limited
FMCL	Farm Machinery Corporation Limited
FYP	Five-Year Plan
MAGIP	Market Access & Growth Intensification Project
masl	Meters above sea level
MoAF	Ministry of Agriculture and Forestry
MoEA	Ministry of Economic Affairs
MT	Metric ton (= 1000kg)
NPHC	National Post Harvest Centre
NPPC	National Plant Protection Centre
NSC	National Seed Centre
Nu	Bhutanese Ngultrum
PPD	Policy and Planning Division
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resource
SAARC	South Asian Association for Regional Cooperation
SWOT	Strength, Weakness, Opportunity and Threats
IT	Information Technology

NMP	National Maize Program
PPP	Public Private Partnership
OGOP	One Gewog One Product
NKRA	National Key Result Area
CFM	Centenary Farmer's Market
FYM	Farm Yard Manure
RNR RDC	Renewable Natural Resource Research Development Centre
CARLEP	Commercial Agriculture and Resilient Livelihoods Enhancement Programme
QPM	Quality Protein Maize
OGTP	One Geog Three Products
GLS	Gray Leaf Spot
TLB	Turcicum Leaf Blight
CBSP	Community Based Seed Production Groups
CA	Commission Agents
EOs	Extension Officers
VC	Value Chain
UNDP	United Nations Development Programme
CORRB	Council for Renewable Natural Resource Research of Bhutan
IFAD	International Food and Agriculture Development
RAMCO	Regional Agriculture and Marketing Cooperatives
OPV	Open Pollinated Variety
BNB	Bhutan National Bank
BoB	Bank of Bhutan

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1. INTRODUCTION

1.1 Background

Maize or corn literally means "that one sustains life". With its high carbohydrates, fat, protein, and some of vitamins and minerals, it is nutritious for human consumption. Maize is now being termed as nutricereal. The presence of a mixture of carotenoids (β-carotene, cryptoxanthins and β-zeacarotene having Pro Vit A activity) provides maize a specific place among cereals. The presence of high quality protein (QPM) in some varieties of maize is attraction, catching the eyes of scientists, planners, policy makers and extension workers to tackle the problem of protein malnutrition prevalent in the world. Hence, the urgent need is to exploit the potential of maize for the promotion of the health of our population especially the vulnerable segment of the society. It is possible only when maize will be utilized in a more diversified ways by converting them into a variety of products by adopting various processes like grinding, alkali processing, boiling, cooking, fermentation etc. Besides its uses as normal nutritional purposes, maize is also used in industrial applications and this opens opportunity for the maize to become a profitable crop for the country.

Maize is a versatile crop grown in all the twenty districts of Bhutan from an elevation of about 150 m to above 3000 m in both dry and wet land. However, the extent of cultivation varies among the Dzongkhags. In the country it ranks the highest among cereals in terms of area and production. It is the staple food of the people of the six eastern districts where high slopes limits rice farming which is practised on terraces supported with irrigation facilities. Food security is thus closely linked to maize, although it is often seen as a poor cousin to rice.

Since the 10 FYP maize has been given the status of commodity program to enhance the contribution of maize to the household food security. Maize Commodity Development Program is part of the Cereal Development Program. In addition, the 10 FYP identified maize and maize products as One Geog Three Products (OGTP) under the OGTP Program. In the 11 FYP, the maize commodity program focused on increasing production and productivity through different interventions. The 12th FYP focus is to enhance maize production through commercialization and reduce import of maize through domestic production, improve product diversification through value addition for income generation and to enhance and ensure household food security for the communities dependent on maize.

1.2 Objectives

The main objective of the maize value chain is to further strengthen the production and marketing of maize and its value added products through identification of constraints and new opportunities. The specific objectives are:

a) Value chain mapping that depicts the chain actors and their functions & inter relationships,
b) Identify the challenges and constraints of the existing value chains and provide recommendations and interventions to mitigate them.

1.3 Analytical framework for value chain analysis

The basis of value chain analysis uses the following framework (Figure 1.) to identify the functions, actors, activities service providers and business environment.

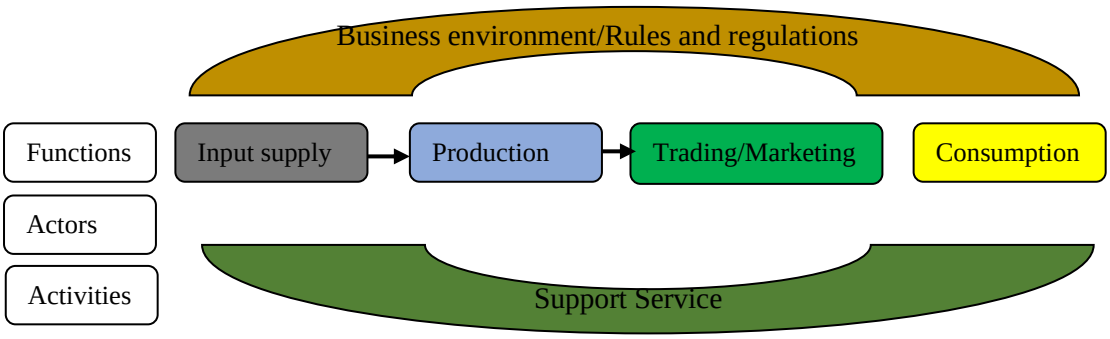

Figure 1: Analytical Framework for Value Chain Analysis

This framework is used to:

a) Identify all the functions required to produce and finally reaching the products to the consumers;
b) Identify the value chain actors involved in performing the functions;
c) List out the activities that the value chain actors are engaged in.

Some of the potential and existing value chain actors are farmers, Karma Feeds, Army Welfare Project, Schools with boarding facilities, traders, retailers and whole sellers and other support service providers.

Once the functions of value chain actors are identified, this framework is used for identification and analysis:

a) The business environment looking at those laws, rules and regulations influencing the value chain. The relevant laws like Food Act of Bhutan, Seed Act of Bhutan, Pesticide Act of Bhutan, Food and Nutrition Security Policy, Subsidy policy, 12 FYP with specific focus on commodity programs.
b) The service providers like research (RDC), marketing services (DAMC), policy supporters (DoA, PPD), Dzongkhag and Gewog extension services, financial institutions like BDBL, BOB, BNB, Priority Lending Schemes etc.

1.4 Methodology

The following methodology was used to collect data and gather information relevant to this study.

Review of Secondary Information: The secondary information was collected from project documents, reports and statistics of RNR, RDC Wengkhar, Department of Agriculture, DAMC, other government and non-government agencies and internet data. The publications of the International Maize Value Chains, the data of FAO on various aspects of maize, and earlier publications of Bhutan Maize Programme were reviewed that provided an important basis for the review of past experiences and practices. The list of publications and websites visited for understanding the maize value chain and marketing systems and support service structures are provided in the reference cited.

Primary information: Primary data were collected (1) through observation from people, places and practices (i.e. watching people, production and marketing practices, storage

conditions and other market infrastructure). On the other hand, observation data is collected through (2) asking questions to actors and supporters in the maize value chain.

Focus group discussions were also organized to get collective view of the participants on what they do, issues on the existing practices and how these can be improved (better market linkage).

Meetings, informal interactions and interviews were conducted with the professionals of support providing agencies, business entrepreneurs, and farmers for in-depth understanding on selected issues for production, marketing, trading, processing, customs, as well as constraints/opportunities and potential interventions to remove the constraints and to take advantage of the opportunities.

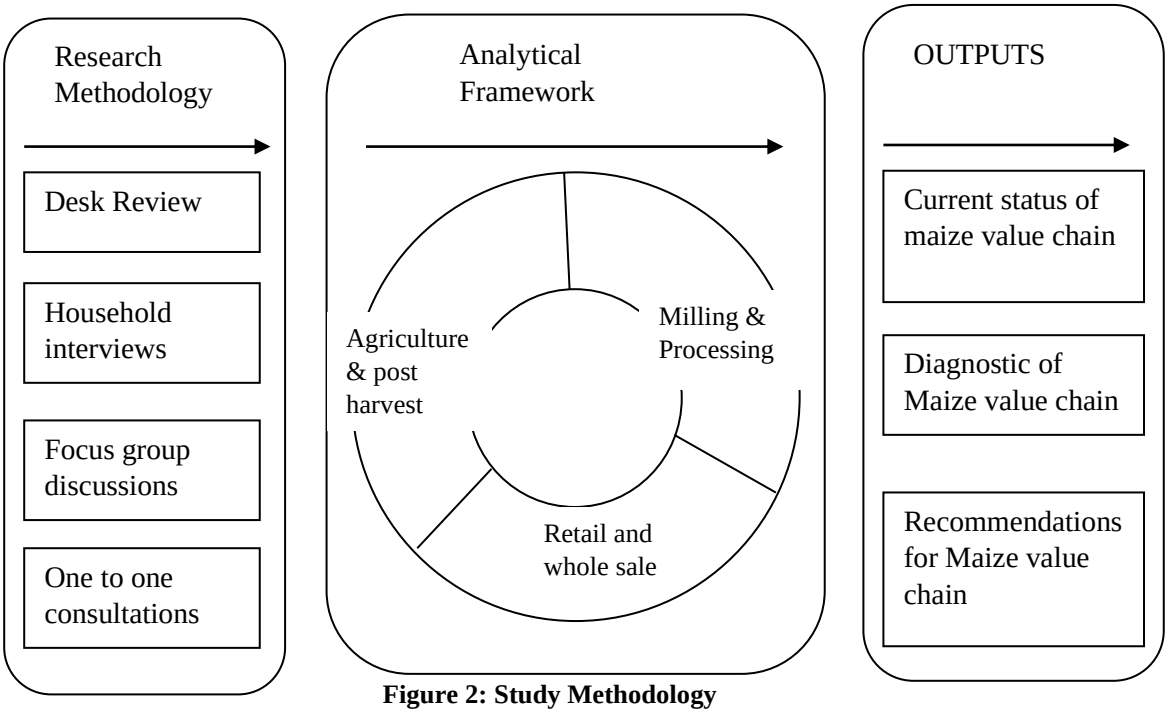

Figure 2: Study Methodology

Q**uestionnaire data:** Field visits were carried out in 4 Dzongkhags and in the Gewogs identified by the client (DAMC). Data and information were collected through questionnaires related to the value chain actors (producers/groups, middlemen, wholesalers, retailers) and support providers. The different sets of questions and checklists were prepared for the different group of actors/stakeholders and interviews/interactions held at following level:

a) Maize growers
b) Middlemen
c) Traders
d) Retailers/ local vendors
e) Support Service providers/VC promoters

1.5 Study area

The main geographical focus of the survey as guided by the client organization (DAMC) are Mongar, Trashigang and Samdrup Jongkhar and Tsirang (representing the maize growing Dzongkhags of high, mid and low altitudes). In total, 330 farm households were surveyed along with the physical observation of maize stores, collection centres and market sheds.

Apart from the farmers, local vegetable vendors, middlemen, traders in the specific Dzongkhags and other relevant stakeholders providing support in the maize subsector were also interviewed.

Tables below provide details of the survey area and socio-economic characteristics of farmers.

Table 1: Producers and areas of cultivation

	Monggar	T/gang	S/jongkhar	Tsirang
No. of farmers interviewed	71	79	59	62
Average farm size (acres)	1.025	1.31	0.38	1.29

Table 2: Respondent characteristics

	Monggar	T/gang	S/jongkhar	Tsirang
Level of education				
a) Less than class 10	11%	13%	9%	24%
b) No education	89%	87%	91%	76%
Male	42.25%	43.04%	45.76%	43.55%
Female	57.75%	56.96%	54.24%	56.45%

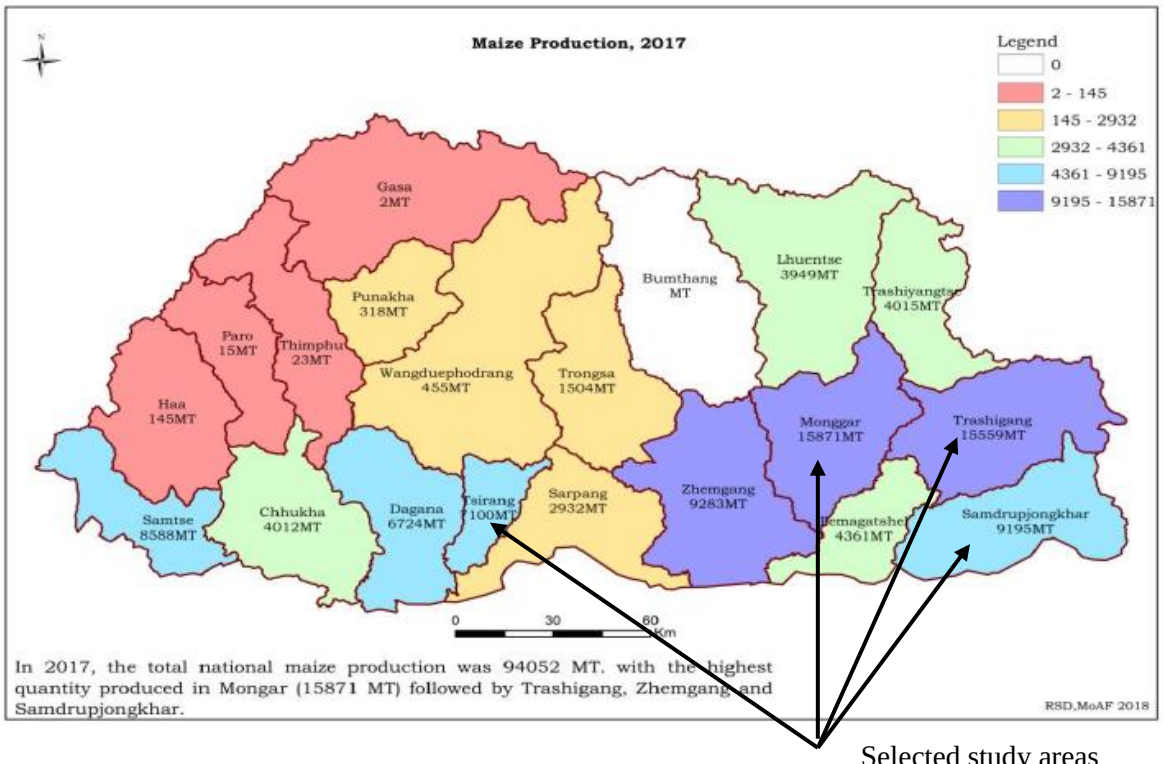

Figure 3: Selected Study Areas

1.6 Gender representation

As per the findings from the survey, about 56.35% are female who are involved in the production of maize and its products as well as selling maize products in the nearby markets especially at the road sides, while male represents only 43.65%. So overall it is the female who takes major decisions in the maize value chain process. It is witnessed that females are the ones who takes major contribution in processing of ara, tengma and kharang especially processed manually while it is the males who are involved in processing through machines.

2. OVERVIEW OF MAIZE IN BHUTAN

2.1 History of Maize

A frequent traveller to the Far East between 1631 and 1668 J.P. Tavernier makes specific reference to the abundance of corn and other crops in the country (Olschak 1979). Although, this was the only written report of maize in the early literature on Bhutan, one may infer that maize cultivation was well established in the 17th century. In 1774, Bogle also noted the presence of Indian corn planted in patches with wheat and barley. From his report, we can speculate that the introduction of the Andean crops, maize and chili to Bhutan may have preceded the potato (Markham 1979). While travelling from Chukha after crossing Punugga in 1783, Captain Samuel Turner and his team "saw the Patchieu, as it comes round the mountains to the north-west, forming a junction with the Tehintchieu, which runs-on to receive the river Hatchieu, near Kepta. Turner (1800) reported that as they approached Nomnoo, they observed that husbands were busy in the fields, the reapers were cutting down the corn with sickles, which others collected in handfuls, and bound up with a wisp of straw". On reaching Thimphu, Turner referred to maize again, stating: "The banks of the river are lined with willows, and the surrounding mountains have some timber trees, intermixed with the fir and pine, as well as a great variety of flowering shrubs; whilst a number of single houses, and some monasteries, having orchards and hanging fields of corn about them, ornament the finely romantic views, with which we were delighted from every-part of this valley" (Turner 1800). The frequent references to maize in the 18th century strengthen the theory that maize had already made its mark in Bhutanese cuisine by this early time[1].

2.2 Cultural and socioeconomic importance of maize

Maize is a major food crop in Bhutan and one of the major components of dru-na-gu (the nine basic crops). It is cultivated across the country and it ranks first among the food crops in terms of area cultivated and production volume. Over 70% of households cultivate maize, mainly for subsistence and this cereal play a critical role in household food security. Maize is consumed mainly in the form of kharang (grits), tengma (roasted and pounded maize), and ashommungnang (a local term for popcorn). It is also brewed into bangchang and ara (local drinks), which are indispensable for religious rituals and traditional chores. Maize grits are also consumed mixed with rice. Fresh, immature cobs are eaten boiled or roasted. Corn flour and other residues are excellent feed for cattle. The husk is used as a raw material to make mats. Young green maize stalks are used as fodder for cattle. Green stover (thinnings, leaf strippings, plant tops) is an excellent source of food for cattle during the critical winter months when feed is in short supply. Maize flour has a special use as a burnt offering to appease spirits (sur) and as a substitute for wheat and barley flour for making torma (a ritual figure). As of 2014, five varieties of maize were released in Bhutan (CoRRB 2014).Trends in maize cultivation include the availability of a surplus for sale; semi-mechanized processing of tengma; and the adoption of modern technologies (FNPP 2006). With the planting of Yangtsipa, an improved maize variety derived from Suwan-1, which was introduced through CIMMYT's former regional maize program in Thailand, there has been a real improvement in maize yields (CIMMYT 2008). In 2012, maize production was at 73,024 tonnes. The highest production was reported from Mongar, Trashigang, and Sarpang with 10420, 9113, and 6890 tonnes, respectively. Monger, Samtse, and Sarpang have the largest areas under

[1] The history of the introduction and adoption of important food crops in Bhutan-Rice, maize, potato and chili, National Biodiversity center, Ministry of Agriculture and Forests, 2015

maize cultivation: 3432, 2700, and 2666 ha, respectively (MoAF 2014). In 2015, the maize production has slightly increased to 73,715 tonnes (MoAF 2015). The highest production was reported from Mongar, Dagana, and Trashigang with 14767, 7655, and 7071 tonnes, respectively. Monger, Dagana, and Samdrupjongkhar have the largest areas under maize cultivation: 3437, 2599, and 2211 ha, respectively.

2.3 Maize production systems in Bhutan

Maize cultivation ranges from less than 300masl to nearly up to 2800masl. The maize production environment in the country is broadly categorized into three zones based on the altitude. The three production zones are Sub-tropical maize production zone I (<1200masl) or low altitudes; Sub-tropical maize production zone II (1200-1800masl) or mid altitudes; and the Highland maize production zone (>1800masl). Depending on the agro-ecological zone(s), there is a wide variety of production systems which include various crop rotation, intercropping, relay cropping, and mixed cropping systems. Maize is intercropped and also grown in rotation (and relay) most commonly with legumes, potatoes and other crops. Intensification and diversification in maize farming are viewed as fundamental strategies to increase production and to secure rural household food security. The most prominent production systems are[2]:

Maize - Maize: Maize double cropping is widespread in the six eastern Dzongkhags where maize is the staple food. It is practiced in the rain-fed dry land and is most prevalent at the altitude range of 600-1500 masl. The main crop is planted in February and harvested in July/August, while the second crop is sown in August/September and harvested in November/December. It is estimated that 15% of the area under maize is under this maize-maize sequential cropping.

Maize - Rice: Another important system under which maize is cultivated is in the irrigated wetlands. Rotations are common in the low altitude sub-tropical humid areas. Maize is cultivated as a spring crop in February and harvested in June prior to rice cultivation. In the maize-rice rotation, farmers in maize production Zone I usually cultivate maize to supplement the household food requirement in the lean months of July and August.

Maize – Barley: Planting of barley immediately after the harvest of maize is carried out in the Maize Production Zone II and highland maize production Zone III. Immediately after the harvest of maize in July-August, the fields are ploughed and barley is sown by late August/early September. The barley establishes itself with the residual moisture and nutrients from the maize field. The moisture requirement of barley is met from the winter frost. The local barley variety is sown winter and is harvested in March just before planting maize.

Maize – Legumes: Planting of different legumes in rotation with maize is an established practice in the dry lands and humid sub-tropical agro-ecological zones. A variety of legumes-namely Rajma Beans or Kidney Beans (Phaseolus vulgaris), Soybeans (Glycin max) Urd beans (Vignamungo), Peas (Pisumsativum), Groundnut (Arachis hypogea) and Cowpea (Vignaunguiculata) – are mono-cropped in rotation with maize. The cultivation ranges from approximately 200 to 2700 masl. The maize is sown during February/March and harvested in July/August. After the maize has been harvested, legumes are sown in August and harvested by late October to November. These legumes are normally sold in the local markets as cash

[2] Based on Katwal, T.B, 2013

crops and fetches very good prices. The crop residue of the legumes is fed to the cattle as fodder. The additional advantages of legumes come from their nitrogen fixing ability and also as cover crops which reduce soil erosion.

Potato and Maize Intercropping: This is the most established kind of multiple cropping practiced by Bhutanese farmers in the maize production Zone II and highland maize production Zone III. This system has to some extent displaced the traditional maize-beans intercropping. The maize-potato intercropping practice is most popular in the altitude range of 1200-2400 masl and constitutes 35% of the total potato area in the country. In this system, potato (which is the main crop) is planted in February in ridges, and maize is planted into the furrows between the two ridges in March. The potato crop is harvested in July and the land is passed on to the maize crop, which is harvested by September. Some of the other common intercropping practices are maize-beans, maize–soybean, maize vegetables, maize-millet, maize-ginger and maize–tuber crops (tapioca, yam).

In general, the main crop is planted in February and harvested in August while the second crop is sown in early September and harvested in December. It is estimated that second Crop of maize covers about 15% of the total area under maize[3].

Agro ecological zones	Altitude range	Planting/sowing	Harvest	Recommended varieties
Highland maize production zone	>1,800	March	October	Traditional
Subtropical Mid altitude zone (main crop maize)	1,200 to 1,800	March	October	Yangtsepa, Khangma Ashom 1 and 2
Subtropical low altitude zone (main crop maize)	<1,200	February	October	Yangtsepa, Khangma Ashom 1 and 2

Table 3: Maize growing seasons

Cropping calendar

Mostly in the six eastern Dzongkhags, there is practice of double cropping in a year where maize is being harvested twice. While in other areas, mostly it is a one-time crop in a year.

Agro ecological zones	Altitude (m)	Dzongkhags	Cultivation Season	Harvest Season
Highland maize production zone	Above 1800	T/yangtse, Lhuntse, Trongsa, Haa, Paro, Thimphu, Bumthang	Feb March	June September
Subtropical Mid altitude zone (main crop maize)	1200-1800	T/gang, Monngar, Zhemgang, Tsirang, Punakha, Wangdiphodrang	February September	August December
Subtropical low altitude zone (main crop maize)	Below 1200	S/Jongkhar, P/gatshel, Sarpang, Samtse, Chukha	Feb Aug/Sept	Jul/Aug Nov/Dec

Table 4: Maize cropping calender

[3] RNRRC1996-97

3. MAIZE PRODUCTION IN ASIA AND SAARC REGION

3.1 Maize production in Asia

The following figure shows the maize production of different countries in the region.

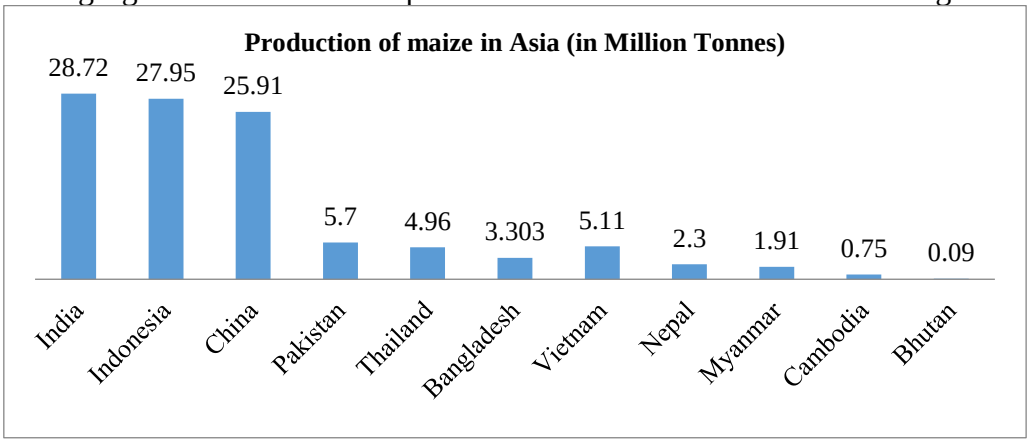

Figure 4: Maize production in Asia 2017 (Source: www.statista.com)

Among the countries in Asia and the SAARC region, India is the largest maize producer with production of 28.72 million tonnes in 2017 followed by Indonesia with 27.95 million tonnes and China with 25.91 million tonnes. India exported over 500,000 metric tonnes of maize in 2018. Similarly, Indonesia exported 100,000 metric tonnes and China 20,000 metric tonnes in the same year. Other neighbouring nations in the region also produce a good quantity of maize around 3.03 million metric tonnes by Bangladesh, 5.7 million metric tonnes by Pakistan and 2.3 million metric tonnes by Nepal (FAO, 2017).

3.2 Maize production in SAARC region

The following table shows the production of maize among the SAARC countries.

	Cultivation area (Million Hectare)	Production (Million tonne)	Productivity (tone/hec)
Bangladesh	0.33	2.45	6.9
Nepal	0.891	2.23	2.5
India	8.9	21.77	2.5
Pakistan	1.144	4.92	4.3
Sri Lanka	0.059	0.021	3.4
Bhutan	0.26	0.085	3.5

Table 5: Comparison of Maize production in SAARC region (Source: SAARC Agriculture Center, 2017)

Among the SAARC countries, the highest cultivated area is India with the total cultivation of 8.9 million hectares with the production of 21.77 million tonnes of maize with the productivity of 2.5 tonnes per hectare in 2017. It is followed by Pakistan with the cultivation area of 1.144 million hectares with the annual production of 4.92 million tonnes and the productivity of 4.3 tonnes per hectare. Comparatively, Bhutan's cultivation area is only 0.26 million hectares with the production of 0.085 million tonnes but the productivity is 3.5 tonnes per hectare which is better than India, Nepal and Sri Lanka. Though Bhutan is the lowest in

all the parameters that are compared, maize is one of the major food crops in Bhutan and ranks first in terms of area cultivated and production volume in the country.

4. MAIZE PRODUCTION IN BHUTAN

4.1 Maize growing Dzongkhags

Over 70% of households cultivate maize, predominantly for subsistence with only the surplus being sold. The maize is particularly important in the Eastern Districts of Bhutan, where about 45% of maize production originates. The remaining production is spread almost evenly among the warmer districts in the rest of the country (East-Central, West-Central and Western regions). Maize plays a critical role in household food security and is consumed in the form of: Kharang (grits) and Tengma (roasted and pounded maize); Ashom Mungnang (local term for popcorn); boiled and roasted cob; and in the processed form as Ara (local alcohol).

The following table shows Dzongkhag wise maize production in terms of area of cultivation, yield and production in the country.

Dzongkhag	Harvested Area (acre)	Production (MT)	Yield (kgs/acre)
Chuka	3,115	4,012	1,288
Dagana	6,754	6,724	996
Gasa	1	2	1,538
Haa	166	145	878
Lhuntse	2,641	3,949	1,495
Monggar	11,503	15,874	1,380
Paro	24	15	615
Pemagatshel	3,964	4,361	1,100
Punakha	162	318	1,966
Samdrupjongkhar	8,221	9,195	1,118
Samtse	5,195	8,588	1,653
Sarpang	4,008	2,932	732
Thimphu	8	23	2,986
Trashigang	6,997	15,559	2,224
Trashiyangtse	2,165	4,015	1,854
Trongsa	825	1,504	1,822
Tsirang	2,545	7,100	2,790
Wangdue	285	455	1,596
Zhemgang	7,464	9,283	1,244
Total	**66,042**	**94,052**	**1424.12**

Table 6: Dzongkhag wise maize harvested, production and yield
(Source: Agriculture statistics 2017)

4.2 Maize production trend

National maize production is growing at a slower rate than maize imports, resulting in an increasingly negative trade balance (figure 6). This negative trade balance reached Nu 344 million in 2017, coupled with a declined self sufficiency rate of 78% in 2017, down from 90% in 2010.

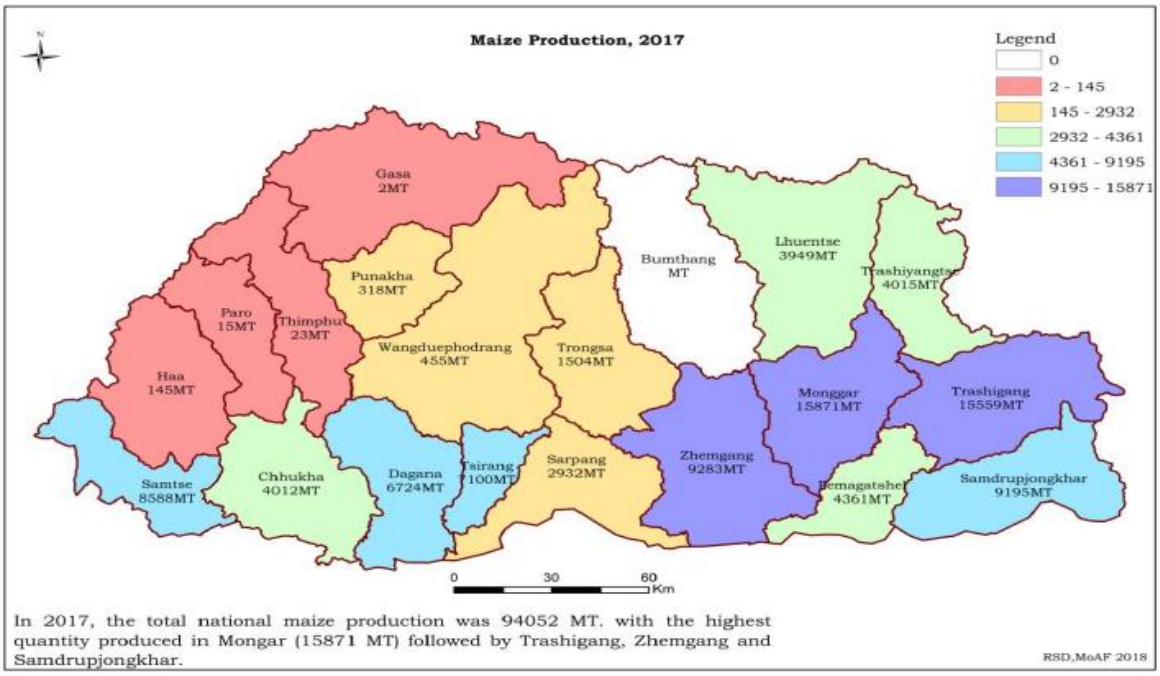

Fig 5: Dzongkhag wise maize production 2017

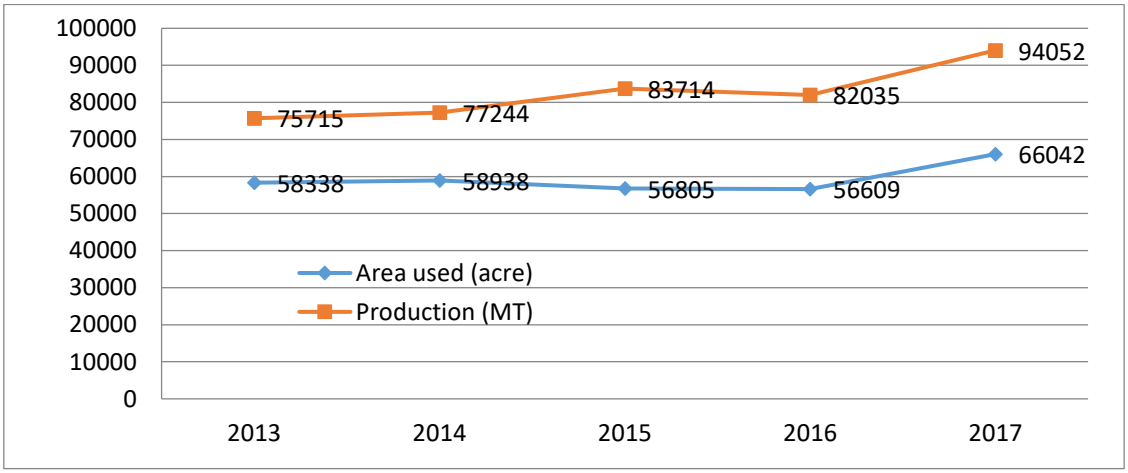

Figure 6: Trend in production and area of maize (Source: RNR statistics 2017)

4.3 Maize import

In terms of maize production needed for local consumption, Bhutan may in fact be self-sufficient. However, large amounts of maize are imported as raw material for producing alcohol (Army Welfare Project), and livestock feed (Karma Feeds).

The outbreak of two fungal diseases, Gray Leaf Spot (GLS) and Turcicum Leaf Blight (TLB), almost wiped out the maize crop in 2006-2007 and led to a drastic decline in the production, especially in areas above 1500 masl. In response, the MoAF collaborated with the CIMMYT to introduce, evaluate, and eventually release two GLS-tolerant varieties (Chaskharpa & Shafangma Ashom) in 2012.

A massive seed replacement campaign with support of the World Bank-funded Decentralised Rural Development Project (DRDP) was instrumental in rapid seed multiplication through Community Based Seed Production Groups (CBSP). With rapid seed increase through the

CBSP groups, a 75% seed replacement of the affected farmers with the two GLS tolerant varieties had been accomplished by the 2013 planting season (Katwal, T.B.; Wangchuk, D., 2013). The disease was finally contained and overall productivity improved steadily, reaching an estimated 94,052 metric tonnes in 2017. Since the area used for maize production is decreasing rather than increasing, it is currently estimated at around 60,000 – 70,000 acres, productivity gains are attributable to improved average yields (2.3MT/ha in 2010 and 3.5MT/ha in 2016), higher than those of neighbouring countries (e.g. Nepal 2.6MT/ha, India, 2.9MT/ha)[4].

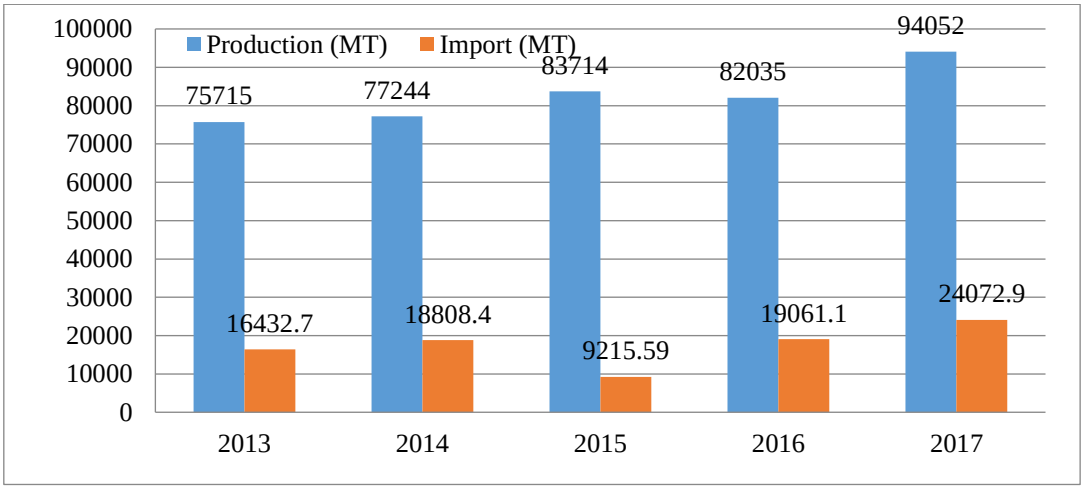

Figure 7: Production and import of maize for the past 5 years (Source: RNR Statistics 2017)

As per the annual production of maize, the total production in 2017 in the country was 94,052MT where about 45% of the production comes from the East. Mongar has the highest production of 15,871 MT followed by Trashigang with 15,559MT, then Zhemgang and Samdrupjongkhar with 9,283 MT and 9,195 MT respectively[5]. Corresponding to production, there is also an increase in import of maize of about 24,072.9 MT worth Nu. 343.72 million in 2017. This excludes maize seeds or corns being imported which is about 12.8MT worth Nu. 0.32 million in 2017 and 53.35MT worth Nu. 4.44 million in 2016 respectively.

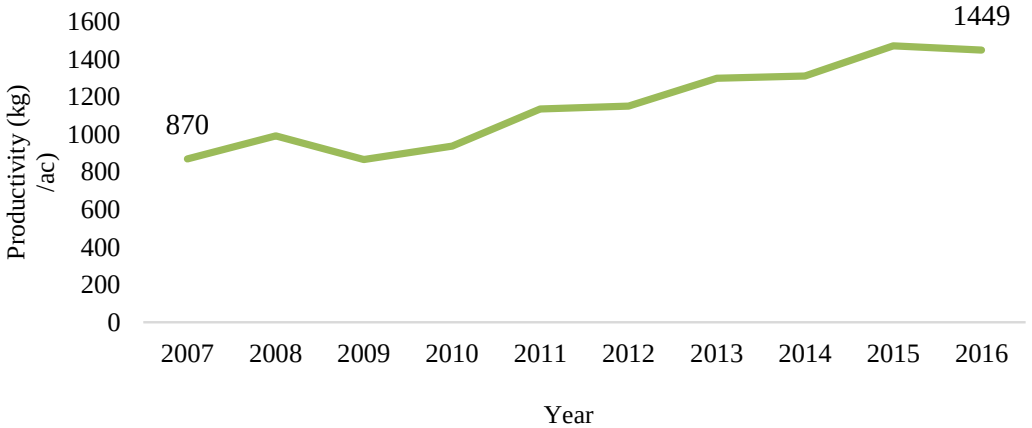

Figure 8: Trend in productivity of maize from 2007-2016

[4] https://data.worldbank.org/indicator/ag.yld.crel.kg
[5] Agriculture Statistics, 2017

4.4 Maize productivity

There was 33 % increase in maize production and 66% increase in productivity but 20 % of area under maize cultivation is reduced in last 10 years (figure 8). It has potential to go commercial to meet the internal demand through the use of hybrid seeds. The maize based enterprises such as Bhutan Centennial Distillery (BCD) in Gelephu imports maize at Nu.11.5 to Nu.12 per kg from India, and Karma Feed in Phuntsholing also imports maize from India at similar rates.

4.5 Maize utilization

As per the Agriculture Statistics, the utilization of maize in 2017 was about 1,124 MT which was sold for Nu. 22.48 million as shown in the table below.

Crop utilization (maize 2017)			
Qty. Sold (MT)	Mean Unit price (Nu/kg)	Median Unit Price (Nu./kg)	Amount Earned (million Nu.)
1,124	20	17	22.48

Table 76: Maize utilization

5. MAIZE PRODUCTION PROCESSES

The maize produced in Bhutan go through five basic operations– 1) selection of seeds, 2) land preparation and sowing of seeds, 3) fertilization/weeding/loosening of soil, 4) plant protection-guarding to protect from wild animal damages and application of pesticide if needed, and 5) harvesting and Cob Shelling. The functions and inputs applied in the production process are shown in the figure below.

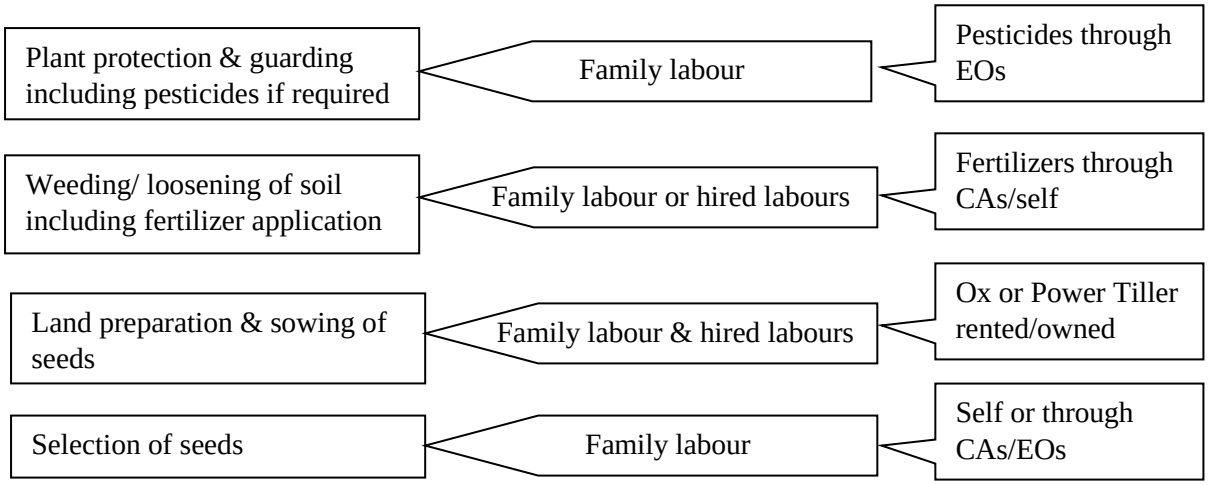

Figure 9: Production process, functions and inputs

5.1 Selection of Seeds

The survey results show that about 29% of the farmers use seeds saved from the previous season crop while 71% uses improved seeds provided by NSC and supplied through either CAs or brought through some other arrangements.

5.2 Land Preparation

Depending on the terrain, farm size and access to resources, maize growers use power tillers and bullocks for tilling their land. As indicated in Table 7 below, majority of the farmers use bullocks for land preparation. Power tillers are not much used in the Eastern region of the country. All production systems are highly labour intensive as most of the work is done manually. Small plots, sloping land and the widely used maize intercropping system limit the opportunities for mechanized production. 89% of the growers, who used bullocks for land preparation said that they undertake their work on a labour and bullock sharing basis.

Method		Percentage of respondents (N=271)
Power tillers	Hired	4%
	Owned	7%
Bullocks	Sharing	89%

Table 8: Different methods of land preparation adopted by the farmers

5.3 Fertiliser application

The farm yard manure (FYM) is mainly used to meet the nutrient requirements for the production of maize. The use of inorganic fertilisers is not very common in Eastern Bhutan. The field survey showed that 42.06% of the respondents do not use any fertilisers, 42.44% use only Urea, 10.70% use farm yard manure and 4.80% with other fertilizers (Table 8). The rate of fertilizer application is not uniform; farmers use it arbitrarily depending upon their own judgment and the availability of fertilisers.

Fertilizers used	Percentage of respondents (N=271)
None	42.06%
Urea	42.44%
Farm Yard Manure	10.70%
Other fertilizers	4.80%

Table 9: Use of chemical fertilisers on maize crop

5.4 Crop protection

Crop damaged by wild animals and natural disasters is a serious problem for maize growers especially in Eastern Bhutan. As per Agriculture Statistics 2017, about 5,151 MT of maize is lost to wild animals annually. The loss reported in Samdrupjongkhar is 2,144 MT followed by Tsirang with 499 MT, Mongar 453 MT and Trashigang 334 MT. While the actual yield loss may not be significant - except for individual farmers - the economic opportunity loss due to guarding the field is considerable. The wild animal crop damage adds significantly to the total cost of maize production as growers have to guard the crop for 4-5 months (on the average of 140 to 50 nights) in a year. Further the maize crops are severely damaged by windstorms losing annually an estimated of 2-3 truck loads.

5.5 Harvesting

The maize crop sown for grain is harvested when the grains are nearly dry and do not contain more than 20 per cent moisture. The appearance of the plant may be misleading, particularly in the case of high yielding hybrids and composites whose grains are dry, while the stalk and leaves may be still green. Ears are removed from the standing crop. Harvested ears are dried

in the sun before shelling. In the case of the late-sown crop, farmers prefer to harvest the whole plants and pile them, and the ears are removed later. Maize stalks are used as cattle feed or fuel. In fact, no part of the maize plant, even the cobs from which the grains have been removed, is left unused.

Figure 10: Maize damaged by windstorm in different areas

5.6 Postharvest Handling

Post harvest handling includes different activities (cob shelling, sorting, packing, storing, carrying to the road heads, transportation, loading and unloading). This is mainly carried out by the growers themselves. After harvesting, maize is collected in baskets and carried to a separate store or is piled up in other areas. Most of the growers use the ground floor of their dwelling house as a store. However some have built separate sheds.

Most farmers store maize on wooden planks or bamboo mats prior to con shelling. Then once the con shelling is completed, most of them hang the maize over the ceiling for drying or storing purpose which is exposed to pests and other diseases. Thus there are serious losses in the post harvest stage for the maize.

Literature suggests that post-harvest losses amounts to approximately 20% of total production. A UNDP report mentions 15% to 30% post-harvest losses, predominantly arising at the farm level. Losses were found to occur mainly due to the timing of harvesting, shelling methods, and the type of storage devices used. On-farm storage structures, such as bamboo baskets, recycled sacks, and plastic bags expose the maize and increase the crop's susceptibility to different types of damages, including weevil and rodent attacks causing substantial losses[6].

5.7 Constraints

The production and productivity of maize is constrained by damage of maize by wild animals, limited access to market due to lack of market information as well as prices offered were too low for them, labour shortage, scarcity of water, seed supply and damages by windstorms etc. The major constraint is the marketing because of the underdeveloped value chain due to lack of combined efforts from the value chain actors to address the bottlenecks to link the products to the market. Table 10 presents the list of problems highlighted by maize

[6]UNDP Bhutan, 2016

growers during the field survey. According to their views, damages by wild animals is a major problem followed by limited access to market and labour shortage.

Major problems	Percentage of respondents (N=271)
Crop damage by wild animals	27.00%
Limited access to market	16.61%
Labour shortage	11.44%
No water	9.23%
Damaged by windstorm	8.86%
Seed supply constraint	8.86%
No tools or machineries	5.54%
Crop attacked by pest and insects	4.80%
Limited land	2.96%

Table 10: Major problems faced in maize sector

Wild animal and windstorm damages

Maize producers consistently cited wild animal problems as one of the most important constraints to maize production. This survey revealed that 27% (the highest % of the HHs) of the HHs loss maize to wild animals. Similar situation is reported in Agriculture Statistic 2016 where 40% (second highest) of the household reported loss of maize to wild animals.

As per the conservative estimate, 5,151 MT of maize are lost annually to wild animals and similarly in Agriculture Statistics 2016 reports that 3892 MT of maize are loss from 4390 acres of cultivated areas.

So, in order to guard the crop from wild animals, each household on an average spends about 1-4 months of night in a year. The findings are similar as per the Agriculture Statistics 2016 which reported farmers spending 47 days and 58 nights on overall crop guarding in a year.

As per the existing survey result, about 27% of the HHs faces problems with the wild animals damaging the crop.

Underdeveloped value chain and limited market access

The links in the value chain (production, post harvest processing and management, marketing, and business development services) are underdeveloped. This leads to an inefficient flow of information along the chain. Though maize comes second in terms of staple food next to rice, there is not a single registered buyer involved in trading maize from road head collection centre or villages to the bigger market centres such as CFM and other industrial supplies. The flow of information along the market chain is very poor. Sometimes there is a huge glut of maize in the store while at other times there is not enough. The farmers do not have a reliable system for accessing information on transport and prices in various markets.

The underdeveloped value chain has limited access to maize and its products. The survey results show that marketing is the second most important constraint in the maize production with 16.61% of the HHs reporting limited access to market.

Labour shortage

Most of these constraints are inter-linked. Small plots and sloping topography limit the options for mechanization and result in high labour costs. The high labour requirement is further amplified by the requirement for guarding fields against wildlife crop depredation. Small land holdings and low availability of inputs and services result in low productivity. The lack of group enterprise, pest and disease problems and lack of appropriate storage lead to high post harvest losses.

Lack of group enterprise

Most of the maize growers in the Eastern Bhutan cultivate in less than one hectare of land. Thus, the quantity produced is very small at the individual farmer level. At Gewog or village level, there is a substantial number of growers, but farmers are not organized in a group or co-operatives. So, even for a few kgs of maize or tengma they travel long distances to the nearest market. They generally are not aware of business principles and hence do not calculate the travel and accommodation costs incurred while going to the marketplace. Furthermore, most of the maize growers seem to be individualistic and seek short-term solutions based only on their individual needs as opposed to developing initiatives that promote groups and cooperatives that can create competitiveness with a number of fellow producers joining the market chain in the medium or long term.

Lack of seed assure seed supply

Seed is crucial input for maize production. The survey results show that 8.86% of the HHs are constrained by lack of assured seed supply. The situation is worse with the lack of appropriate structures and space for the storage of seeds. It is crucial that the storage area is well ventilated and under optimum conditions. Most of the farmers in Bhutan do not have access to any kind of purpose-built stand-alone store for maize. They use their existing residence, especially the ceiling of the roof and other floors of their houses for storage that lacks proper conditions for storage. This has led to attack by pests and insects.

Others

The lack of irrigation water, tools and machineries and insect damage were other constraints identified that limits the maize production.

6. MAIZE PROCESSING

Processing of maize can be divided into two segments: (a) the small scale artisanal and home based production of tengma, kharang, and ara; and (b) the large scale industrial type of processing which are described below:

6.1 Artisanal Processing

6.1.1 Tengma

Tengma (beaten corn) is produced by roasting dried maize kernels over fire in a wide flat pan and pounding or flattening them by a crushing machine or hand beaten. Some producers flavour their product with Sichuan pepper and sell the tengma for a slightly higher price. Average price at the Centenary Farmers Market for tengma is around Nu. 250 per kg.

6.1.2 Kharang

Kharang (maize grits) is produced through milling and is consumed as a rice substitute, predominantly in the eastern Dzongkhags. It is cooked like rice and used as a staple food. With less sugar content compared to rice, nowadays increasing number of households is including kharang in their daily diet. The average unit price for kharang is around Nu. 30 per kg.

Both, tengma and kharang are usually packed in small plastic bags weighing one kilogram. With plastic bags imported from India, the packaging is limited to simple sealing. No labels or brand names are visible, and there is no product description on the outside of the plastic cover.

6.1.3 Ara (Local brew)

Ara (local brew) in a sizable quantity of maize is typically used as an ingredient for making ara. In 2016, a total of 5,711 MT (7% of local production) of maize were converted to alcohol (MoAF-DoA, 2016). As a family tradition, most households possess the skills and experience to brew ara. Alcohol is part and parcel of the social and spiritual ritualistic affairs in Bhutanese culture, and is often home brewed from various grains like rice, wheat, barley and maize. The brewing of local spirits is mainly done by women. A litre of good quality ara is sold at Nu. 50, while it is also sold by the glass at Nu.15-20 per glass.

6.1.4 Cattle feed

Cattle Feed is the product of crop residues like low-grade maize kernels, milling dust, grain flour, and remaining old stocks of maize are fed to cattle. Maize foliage is also used as cattle fodder. No quantifiable volume of maize has been supplied as raw material to commercial feed mills, although attempts to quantify the volumes have been made in the past. According to a study by a food processing expert (Singh, U., 2014), the understanding and knowledge of maize processing in Bhutan is still underdeveloped. Experts from the Agriculture Machinery Centre (AMC) and Post-Harvest Centre have very limited knowledge of the processing technologies of maize. Even the machines provided by them for production of tengma and kharang are very crude. In fact, the machines used for rice milling are also used for maize processing. The crude machines with crude processing methods produce poor quality maize products. Even this quality is not uniform across the country. The quality of maize products varies from place to place, from processor to processor, and from processing method to processing method, e.g. boiling, soaking, roasting etc. The soaking of maize grains for a long duration invites fungal attack, which may lead to aflatoxin contamination in the products. Furthermore, improper techniques lead to low recovery of tengma and kharang, thereby increasing the cost of these products. As such, standardization of the processing technologies is essential. Food grade machines specific to maize processing should also be made available to food processors.

The same study (Singh, U., 2014) highlights the need to employ well trained staff for processing and value addition of the maize crop at relevant institutions like the NPHC. In order to improve the quality of maize products, a dry milling machine would be necessary. Various products which result from dry milling include large grits (30-40%), small grits (20%), corn meal (12%), flour (10%), and animal feed including germ (17-20%). The grits that are the main product of the dry milling process can be used as food at the household level in different forms.

6.2 Industrial Processing

Industrial processing of maize in Bhutan is dominated by (i) Karma Feeds, which produces cattle, poultry, pig and fish feed, and (ii) AWP/BCD, which produces alcohol (whisky, rum). Both companies rely mainly on imported maize from India.

7. MARKET ANALYSIS

The market analysis was carried out to find out the supply and demand situation for maize in the country. The analysis is based on secondary data complemented by the primary data collected from the survey and presents a comprehensive picture of the current maize situation in the country specifically the domestic demand and supply situation.

7.1 Demand

As per the value chain and market analysis of Renewable Natural Resources Products Report 2016, 90 % of the production is consumed at home as staple food. This is further supplemented by the Agriculture Statistics 2016 which reports that of the 82,035 MT of maize produced, sold and used in other purposes (Tengma, Kharang, Alcohol and roasted maize) accounts 10,400 MT. This means 71,635 MT (87%) is used for home consumption.

The major consumers among the enterprises are that of Bhutan Centennial Distillery (BCD) in Gelephu which requires about 70-80 MT daily with the specification of 63% starch content and 12% moisture, maize should be free from foreign materials and dust. Majority of the maize are imported from Burdhwan, Bihar, India at Nu. 11.5- Nu.12 per kg while those from the domestic supply are charged at Nu. 15 per kg[7]. The annual requirement of maize is about 26,400 MT and without the availability of domestic production, about 13,200 MT was imported annually. Similarly, for the Karma Feed, the annual requirement of maize is about 1500 MT, out of which about 15-16 MT were imported from Gulubag, Kalyanganj of West Bengal and Assam, India. So, the annual requirement of the BCD and Karma Feeds comes to 27,900 MT of maize (26,400 MT and 1500 MT respectively).

On the other hand, the National Seed Centre requires 70-80 MT of maize for seed annually. In the 12 FYP, the Department of Agriculture aims to bring 58,044 acres under maize cultivation in order to address self sufficiency of food. This will require 870 MT of maize for seed purpose. Based on this analysis, Bhutan will require 100,405MT of maize annually. The details of the demand are as shown in the table below.

Internal demand of maize	**Qty (MT)**
Home Consumption	71,635
Seed (NSC and Farmers own seed)	870
BCD	26,400
Karma Feeds	1,500
Annual Demand	**100,405**

Table 11: Internal Demand of Maize

[7]Assessment of Maize Demand of Bhutan Centennial Distillery, DAMC, 2017 and field interviews

The annual production target of the 12 FYP is estimated at 96,535 MT and this leaves an annual shortage of 3,870 MT. So, even if we exclude the major industrial consumers like the BCD and Karma Feeds, Bhutan will still require 78,567 MT of maize annually. The details of the use of maize are shown in the table below.

Different uses of maize	**Qty (MT)**
Home Consumption	71,635
Seed (NSC and Farmers own seed)	870
Alcohol production	5,711
Tengma production	351
Kharang production	555
Consumption Annual Needs	**78,567**

Table 12: Internal Demand excluding major industrial needs

The school feeding programme intends to substitute 10% of the rice fed in the school. The kharang required to substitute rice is estimated at 684 MT annually[8] that will require 1267 MT of maize.

Therefore, from the above data, it is clear that there is huge demand beyond the scope of the production potential of the Bhutanese farmers. ***An estimated 107,734 MT of maize is required annually*** to meet 78,567 MT for self consumption, 1267 MT for school feeding and additional 27,900 to meet the industrial requirement.

7.2 Supply sources

7.2.1 Imports

India is the largest maize producer with production of 28.72 million tonnes in 2017 followed by Indonesia with 27.95 million tonnes and China with 25.91 million tonnes. India exported over 500,000 metric tonnes of maize in 2018. Similarly, Indonesia exports 100,000 metric tonnes and China 20,000 metric tonnes in the same year. Other neighbouring nations in the region also produce a good quantity of maize around 3.03; 5.7 and 2.3 million metric tonnes respectively in Bangladesh, Pakistan and Nepal (FAO, 2017).

7.2.2 Domestic

Bhutan produced on an average of 82,552 MT of maize grains annually between 2013 and 2017[9]. The following table shows the annual production of maize in the past 5 years.

Crops	**2013**	**2014**	**2015**	**2016**	**2017**
Maize	75,715	77,244	83,714	82,035	94,052

Table 13: Maize production in metric tonnes (MT)

At the end of the 12FYP, Department of Agriculture estimates an ***annual production of 96,535 MT***.

[8] Personal communication with Anjal of School Agriculture programme

[9] RNR Statistics 2017

7.3 Demand and Supply Analysis

The Agriculture Statistics 2016 reports that 71,635 MT of maize is used for home consumption and 7,487 MT for other purposes (such as seeds, Tengma, Kharang, alcohol and roasted maize). In addition school feeding programme requires 1267 MT. This leaves 16,146 MT annually for potential sale. This quantity will meet only 58% of the requirement of BCD and Karma Feeds.

Therefore the domestic ***supply is clearly not able to meet the demand***. Even in the best case scenario based on the projected production at the end of 12 FYP, the production will not be able to meet even the present requirements of BCD and Karma Feeds. The following table shows the demand and supply situation of maize in the country.

Demand	Qty (MT)	Supply	Qty (MT)	Gap (MT)	Remarks
Demand including BCD and Farma Feeds	107,734	Production based 12 FYP	96,535	11,199	Deficit
Demand excluding BCD and Karma Feeds	80,734	Production based 12 FYP	96,535	-15,801	Surplus

Table 14: Internal Demand and supply scenario

8. ECONOMIC ANALYSIS

8.1 Price dynamics

The price of an agricultural commodity tends to increase during the planting period and decreases during the harvesting period. The case is otherwise with maize. Following are the various products of maize with the prices in the market:

a) The fresh pounded maize called as "Ocha" (when the crop is not fully matured) fetches good price especially at the start of harvest season and then the price stabilizes. The fresh pounded maize fetches as high as Nu.600 per kg in the Thimphu Centennial Farmer's Market (CFM) and those matured crop founded maize fetches Nu.250 per kg. On the other hand, Kharang fetches about Nu.100 per kg. Within the locality, tengma is sold at Nu.100 to Nu.150 per kg at the road sides in the maize producing gewogs.
b) Maize grains fetch Nu. 25 to Nu. 30 per kg in the villages. The same maize grains if traded with the traders, it fetches Nu.16 per kg or Nu. 15 per kg to the industrial use and Nu. 12 to Nu.14 per kg when sold to FCB.
c) The distilled processed brew (Ara) is mainly for domestic consumption and it is also sold at Nu. 25 to Nu.50 per litre in the villages based on the demands from the neighbours. Similarly, it is sold in the urban areas at Nu. 80-100 per litre but selling of local alcohol is not legalized.
d) Nowadays, selling of roasted maize along the road side has become a usual business for the rural as well as urban people due to higher recovery. One piece of roasted maize fetches Nu. 30 to Nu.50 per piece when sold at the road sides in their locality but if the third party sells, it fetches Nu.50 to Nu.70 per piece based on the size of the maize. They keep the margin of Nu.10 per piece.

e) The OGOP shop in Thimphu sells three products-kharang, tengma and cookies. The kharang is sold at Nu. 100 per kg, tengma at Nu. 120 per kg and cookies at Nu.95 per packet. The OGOP shop gets it supplies mainly from Zhemgang, Monggar and Trashigang through contacts with the villages or with the middleman.
f) The general grocery shops in Thimphu such as City Mart, 8 Eleven and others usually buy from the Centennial Farmer's Market and sell to the customers. They buy kharang at Nu. 60-70 per kg and tengma at Nu.130 per kg from the CFM. The shops in turn sell kharang at Nu. 105 per kg and tengma at Nu. 220 per kg keeping margin of Nu. 90 per kg of tengma and Nu. 35 per kg of kharang.

The following table shows the price changes in each of the actors in the market for the specific products:

Products	**Village** (Nu/kg)	**CFM** (Nu/kg)	**Profit Margin**	**Retail shops** (Nu/kg)	**Profit Margin**	**Total Margin** (Nu/kg)
Tengma	100	130	30	220	90	**120**
Kharang	40	70	30	105	35	**65**

Table 15: Maize produce price dynamics across different actors in the chain

8. 2 Production costs

8.2.1 Maize grains

The production cost of maize varies between area to area and farmer to farmer depending upon the weather conditions, soil type, the level of farmers' cultivation knowledge etc. It largely depends on the agro-ecological zone as well as on the production system adopted. Various surveys results show that a kg of maize costs Nu. 9-15, the following table shows the comparison of cost of production of maize grains.

Basis of Cost of Production (CoP)	**CoP/Kg**
Socio-economic impact assessment of maize commodity[10]	12.00
Cost of Production of Agricultural and Horticultural commodities in Bhutan[11]	15.58
ICRR, Decentralized Rural Development Project[12]	9.80
Hybrid maize	9.30
Yangtsepa (normal OPV variety since the 90s)	11.90
Present survey assessment	19.90

Table 16: Cost of production comparison

Cost of production of maize grains from the survey

The production costs of maize grains based on the survey findings comes very high. Using the same format used by the ARDC Wengkhar and applicable rates of the sample of the Dzongkhags, the cost of production of maize grains are as detailed in the following table. The average cost of production of maize per kg comes to Nu. 19.90 with the average gross margin of Nu. 1.10 per kg. The high cost of production is mainly due to highly intensive labour

[10]MoAF-PPD, 2018
[11]MoAF-DoA, 2017
[12]World Bank, 2015

engagement for the production of maize. For example, 2 acres of land in Monggar involves 12 people for 71 days from initial weeding until cob shelling which is exclusive of family member's engagement throughout the production process. It is also due to high wage rate which normally ranges from Nu.300 to 500 in all he districts under study.

Sl. No.	Dzongkhags	Per kg cost of production (Nu)	Selling rate/kg	Gross Margin (Nu)
1	Tsirang	19.00	20	1.00
2	T/Gang	19.50	20	0.50
3	S/Jongkhar	19.10	20	0.90
4	Mongar	22.00	20	2.00
	Average	**19.90**	**20**	**1.10**

Table 17: Cost of production and gross margin of maize grains

8.2.2 Maize seeds

In terms of maize seed, the cost of production is the same as grain with Nu.19.90 per kg but the gross margin comes to Nu.3.10 per kg since the selling price is Nu.23 per kg as shown in the table below.

During the survey, it was noted that most maize growers do not keep a record of labour inputs used for production. They generally use FYM prepared by themselves and do not keep a record of the number of baskets of FYM used in the farm. Similarly, there is a general trend of providing food and drinks beside their daily wage to the farm labourers. Hence, it is difficult to calculate the exact cost of labour inputs. Furthermore, many growers guard the crop to protect from wild animals for about 2-3 months. Regardless of the size of land, whether it is only one Langdo (one third of an acre) or 5 Langdo, the cost involved in guarding the crop is the same. This makes it difficult to get the right figure.

Sl. No.	Dzongkhags	Per kg cost of production (Nu)	Selling rate/kg	Gross Margin (Nu)
1	Tsirang	19.00	23	4.00
2	T/Gang	19.50	23	3.50
3	S/Jongkhar	19.10	23	2.90
4	Mongar	22.00	23	1.00
	Average	**19.90**	**23**	**3.10**

Table 18: Cost of production and gross margin of maize sold for seed.

8.2.3 Tengma

The cost of production was calculated based on the consultation with key informant in some of the villages. The following table shows the details of cost of production calculation without using machines but purely based on man-days with the improved version of processing tengma as shown in the table 19 below.

It is found that Tengma is sold at Nu. 150 per kg at retail shops and Nu.100 per kg at wholesale prices in the nearby areas of the villages. However, tengma is sold at Nu. 250 per kg in CFM at Thimphu based on the RNR Statistics 2017 and the results of the interview with the vendors.

Inputs	Qty	Unit	Rate (Nu)	Amount (Nu)
Maize	300	kg	20	6,000
Labour				
● Roasting & pounding	3	persons	500	1,500
● Cleaning	1	persons	500	500
● Packing	2	persons	500	1,000
Packing material	142	pieces	1.25	177.5
Fuel	1	litre	65	65
Machines				0
Roaster	1	no	200	200
Power tiller	1	no.	1000	1,000
Total cost				10,442.5
Yield	142		150	21,300
Cost per unit				74
Gross Margin per unit				76

Table 19: Cost of production and gross margin of tengma

8.2.4 Kharang

The cost of production of kharang is based on the survey results of the sample Dzongkhags and Gewogs. The details of the cost of production of kharang for the 12 gewogs covered by the survey is presented in the following table:

Sl. No.	Gewogs	Milling charge/ Kg (Nu.)	Maize Cost (Nu)	Labour cost (Nu)	Plastic cost (Nu)	Total (Nu)
1	Bartsham	1.38	34.48	2.30	1.25	39
2	Chali	1.6	33.33	2.78	1.25	39
3	Monggar	1.25	38.46	3.85	1.25	45
4	Dewathang	1.28	35.09	2.34	1.25	40
5	Drametse	1.28	35.71	2.38	1.25	41
6	Gosarling	0.86	40.00	2.33	1.25	44
7	Kanglung	1.45	40.00	2.67	1.25	45
8	Mendrelgang	2	39.22	1.96	1.25	44
9	Pemathang	1.42	31.75	1.59	1.25	36
10	Phuntshothang	1.29	40.00	2.00	1.25	45
11	Radhi	1.44	37.74	2.52	1.25	43
12	Tsholingkhar	1.34	39.22	1.96	1.25	44
	Average	**1.38**	**37.08**	**2.39**	**1.25**	**42.10**

Table 20: Cost of production of one kg of kharang

The cost of production of maize grain to produce 1 kg of Kharang is approximately Nu. 37 and the final cost of the kharang is Nu. 80. Therefore a value of Nu. 43 per kg is added to the maize by processing into kharang. The added value is shared among the farmers in the form of payment for their efforts, the plastic bag sellers, the transporters and the vendors in Thimphu.

The average selling rate at Thimphu Centenary Farmers's Market is Nu. 80 per kg. The small pick-up truck can carry 800 kgs of Kharang and cost Nu. 6500 from Monggar to Thimphu as

transportation charge. This means Nu. 8 per kg of kharang is charged as transportation cost. The total cost of kharang if brought from Mongar to Thimphu comes to Nu. 50 per kg. The Gross Margin comes to Nu. 30 per kg. So, 59,060 kgs of kharang produced by the farmers from the sample Dzongkhags is worth Nu. 4,724,800, if all the kharang is brought to Thimphu.

8.2.5 Comparison of cost of production and gross margin of maize products

The following table shows the comparison of cost of production and gross margins of various maize products:

Sl. No.	Products	Cost of production (Nu. Per kg)	Selling price (Nu per kg)	Gross margin (Nu per kg)
1	Kharang	42	80	28
2	Tengma	74	100	76
3	Maize seed	19.9	23	3.1
4	Maize grains	19.1	20	1.1

Table 21: Comparison of cost of production of various products

8.2.6 Value addition among the value chain actors

The table below shows that the value addition favours more other actors like input suppliers and vendors which normally is the case. On the other hand if main inputs (for example maize grains for kharang and tengma) are sourced from their own supply, farmers stand to benefit more. However what this information does is that value chain can create economies and employment opportunities beyond the farmers.

Sl. No.	Products	Value (Nu per kg)				
		Inputs	Labour	Transporters	Vendors	Total
1	Kharang	38.33	2.39	8	31.28	80
	% share	48	3	10	39	100
2	Tengma	52.41	21.13	8	68.46	150
	% share	35	14	5	46	100
3	Maize seed	1.41	16.36	0	2.23	20
	% share	7	82	0	11	100
4	Maize grains	1.41	16.36	0	5.23	23
	% share	6	71	0	23	100

Table 22: Value shared among the actors in the chain

9. VALUE CHAIN ANALYSIS

9.1 Introduction to value chain

A Value Chain is a sequence of related business activities (functions), from the provision of specific inputs to a particular product for primary production, processing, sales and distribution to final consumption. From an institutional perspective, a value chain can be defined as the organisational arrangements linking and coordinating the producers, processors, traders, and distributors who perform these functions.

Value chain (VC) analysis is a method for accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users. VC analysis typically involves identifying and mapping the relationships of four types of features: (i) the activities performed during each stage of processing/product flow; (ii) the value of inputs, processing time, outputs and a final value added; (iii) the spatial relationships, such as distance and logistics, of the activities; and (iv) the structure of economic agents, such as input suppliers, the producer, and the wholesaler (FIAS, 2007). According to Richter (2005) a value chain systematically takes all steps of a production process into perspective, it analyses the links and information flows, it reveals strengths and weaknesses, even losses in the process, the boundaries between the national and the international chain, the buyer's requirements, international standards, it allows international benchmarking, etc'. A value chain analysis helps strengthen production relationships to find solutions to the so-called critical success factors, which determine if a product meets the requirements with regard to quality, price, dependability, volume, design and speed of delivery and consequently improves competitiveness.

Value chains generally include three or more of the following: producers, processors, distributors, brokers, wholesalers, retailers and consumers. The partners within the value chain work together to identify objectives, they are willing to share risks and benefits, and invest time, energy and resources to make the relationship work. A value chain is therefore regarded as an actor oriented approach and considered very effective in tracing product flows, showing the value adding stages, identifying key actors and the relationships with other actors in the chain (Schmitz, 2005).

One of the dimensions of a value chain is its flow, which is also called its input-output structure. In this sense, a chain is a set of products and services linked together in a sequence of value-adding economic activities. In other words, a value chain is a series of participants along the entire marketing spectrum who collaborate to satisfy market demands for specific products or services to their joint and collective mutual benefit. The participants in the case of a maize value chain would be:

a) Seed and associated input suppliers
b) Growers
c) Processors/transporters
d) Bulk buyers
e) Retailers

The advantages of being a participant in a value chain would be:

a) Reduction in the cost of doing business
b) Increase in bargaining power
c) Improved access to advanced technology, information and capital
d) Transport and logistics
e) Formation of alliances
f) "Trueness to promise" that strengthen backward and forward linkages
g) Inventory management including the quality of the inventory storage

The key objective of value chain analysis is to find the most pressing bottlenecks first and address them in a systematic manner. These bottlenecks can be either issues related to functions, actors, linkages among them or even external factors such as policy and infrastructure. In addition, the isolation of the value added by each link in the chain can give useful clues to the areas where remediation is most needed, and where the most benefit is likely to follow from further focus of resources directed to improvement.

9.2 Value chain map

Value chain mapping means drawing a visual representation of the chain, which involves various linkages among the maize growers, inputs and logistical service providers, transporters, traders and retailers. The value chain map depicts the flow of maize in the market, activities carried out at each stage of the value chain, the structure of actors and the support involved in the value adding process (Figure 11). The map shows general trend that prevails in the Eastern region of Bhutan. A more detailed location specific map for each sub-channel can be developed and functions at each level of the value chain can be mapped. For example, maize from Chali Gewog in Monggar may not follow the same routes as that of maize from Radhi or Kanglung Gewogs in Trashigang.

The farmers in and around Chali enjoy a different competitive advantages because of their proximity and easy access to transport and other necessary business services. They also have better access to market information because of their proximity to Mongar town and national highway. Since the production of maize in Chali is much higher than in Kilikhar, the farmers of Chali are more interested in dealing with bulk quantities of tengma. Accordingly, the map presented here is a generic one. There is a need to provide more details such as identifying the number of producers, proportion of maize produce and seeds sold, local demand, quantity passing through different channels, transportation system, etc.

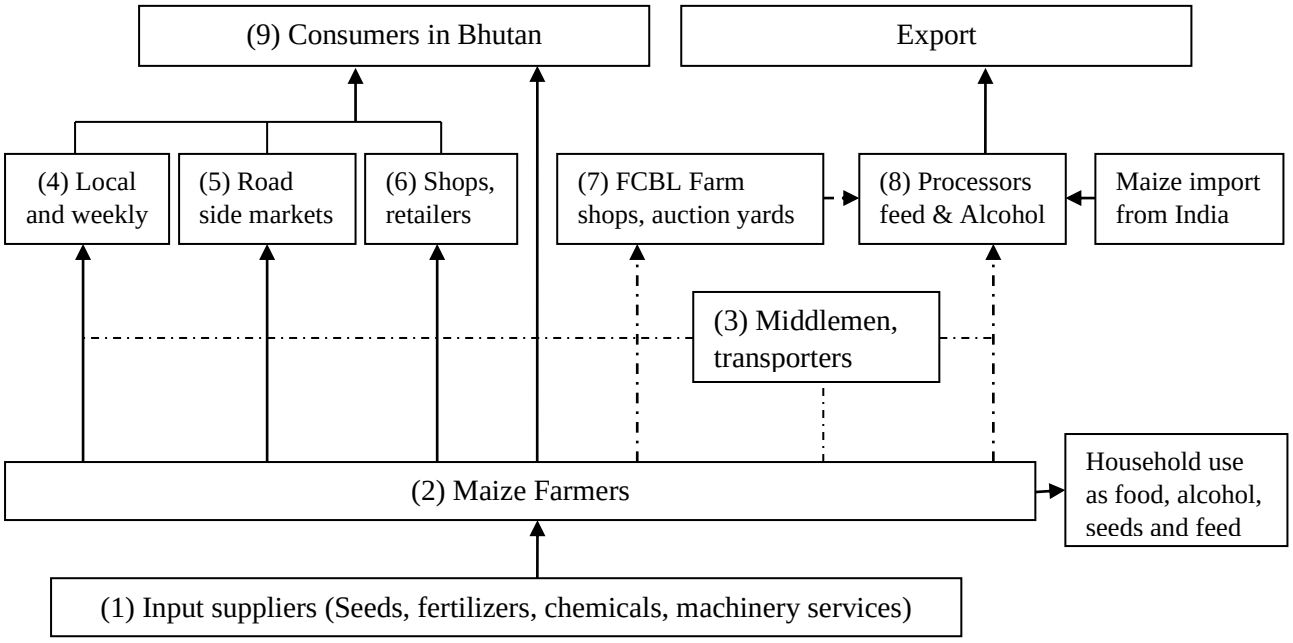

Fig 11: Maize Value Chain Map

As depicted in the map, many maize growers in Bhutan act as integrated value chain operators and perform two or more functions. They often arrange farm inputs (FYM, seeds etc) on their own, grow maize, harvest, produce maize products and pack them, and then take to the road head and transport them to the nearest marketplace for sale. The involvement of logistical service providers, middlemen and traders in linking growers with the market is very low. The maize growers have a lot of dependency on government services - right from inputs supply to product management. They have grown to expect direct support services and subsidies from government agencies.

In addition to technical inputs, training and market information and infrastructure (e.g. farm roads and road-head collection centres) development, they also expect support for transportation, good prices and market guarantees for their maize and its produce from the Government agencies.

According to the Agricultural Statistics 2017, farmers retain around 2% of the total maize production as seeds, use 7% for brewing alcohol, sell 3% to various market outlets, and loss 5% due to wild animal damages. Then the unaccounted 83% are apparently for home use (e.g. consumption purposes) or cattle feed.

The maize value chain in Bhutan is comprised of several key actors, namely the: (i) input suppliers; (ii) farmers; (iii) middlemen and transporters; (iv) local markets; (v) road side markets; (vi) retail shops; (vii) FCBL; (viii) processors; and (ix) consumers. A simplified value chain map is depicted above. Bold lines indicate functioning market linkages, whilst the dotted lines indicate occasional, but mainly defunct market linkages. The FCBL, for example, has not been engaged in maize marketing in the last few years, although it offers a guaranteed buy-back price of Nu.15/kg.

9.3 Value chain actors

The success or failure of a value chain intervention depends principally on the partnerships that are built between actors and support providers that participate in a particular chain (Lundy et al, 2004). The VC approach therefore requires that the VC operators are clearly identified and existing relations understood. This information enables the VC supporters involved in the design and implementation of strategy to increase competitiveness and to promote the fair distribution of income among the VC actors.

The maize value chain in Bhutan is very short as most of the functions are performed by maize growers themselves. The involvement of private entrepreneurs (seed and fertilizer agencies), registered transport companies and agro-trade houses is nearly absent or it is at a subtle level. The main actors (inputs suppliers, producers, middlemen and traders) and the functions performed by them are described in the following sections.

9.3.1 National Seed Centre (NSC)

National Seed Centre is a sole supplier of inputs for the maize crop. NSC deals with the supply of seeds and fertilizers. During the cropping season, NSC supplied 79,792 MT of seeds to the farmers. Of the 79,792 MT, 69,488 MT were improved open pollinated varieties (OPV) consisting of Yangtsepa, Chaskharpa and Shaphangma and 10,304 MT hybrid imported from India. The hybrid varieties are normally imported from India based on the advice and recommendation of the National Maize Programme managed by the ARDC Wengkhar.

During the same cropping season, the NSC supplied 188 MT of suphala, 573 MT of urea and 22 MT of SSP to the 6 eastern Dzongkhags where maize is the predominant crop. The following table 23 shows the details of fertilizer supplied to the six Dzongkhags where maize is grown.

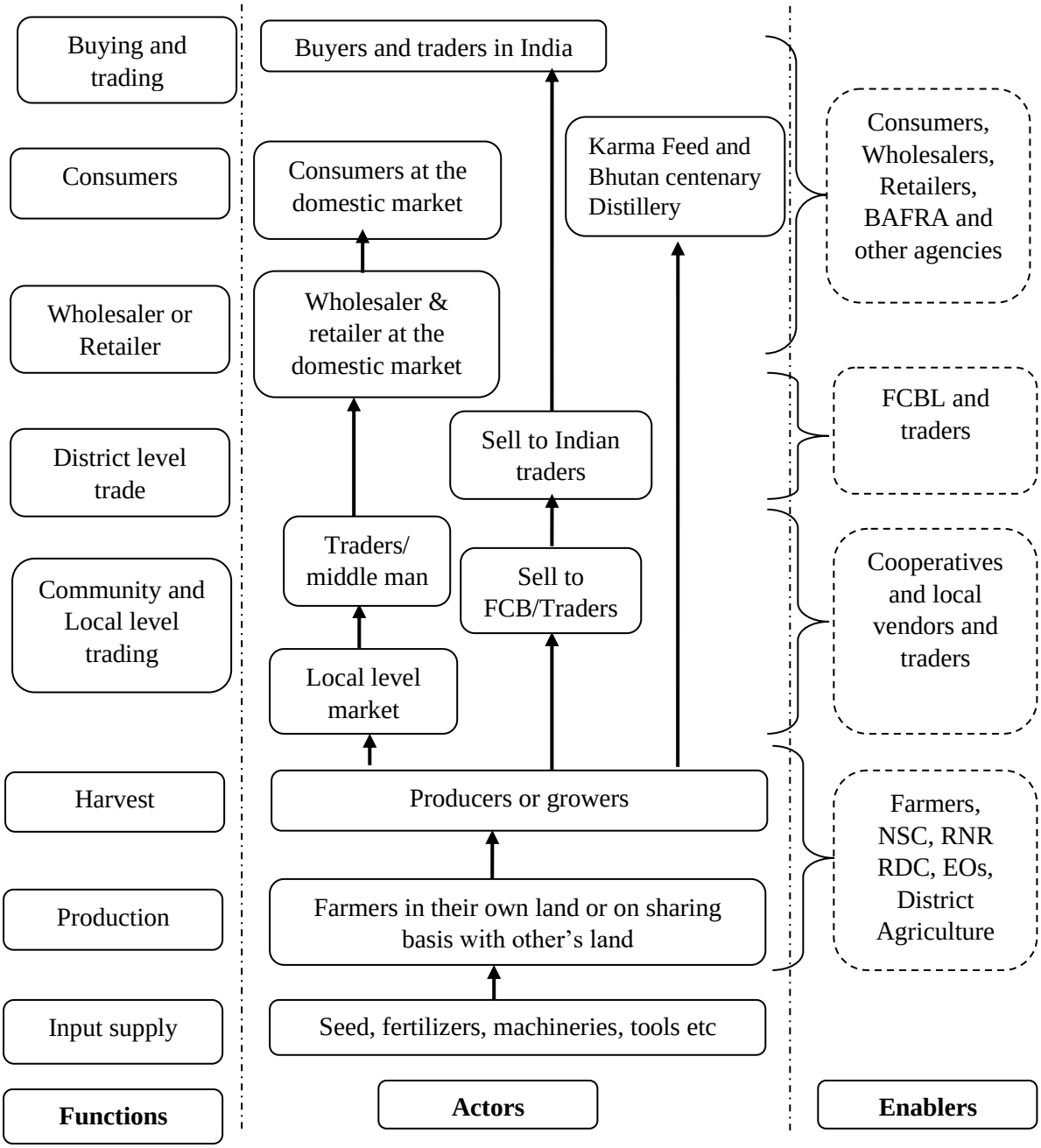

Figure 12: Value chain operators and their functions

Sl.No.	Dzongkhag	Suphala (Kgs)	Urea (Kgs)	SSP (Kgs)
1	Lhuntse	100	110,385	200
2	Mongar	44,840	149,075	250
3	P/gatshel	40	75	
4	S/jongkhar	0	0	
5	T/gang	107,150	170,445	21,600
6	T/yangtse	36,150	143.175	
		188,280	**573,155**	**22,050**

Table 23: Fertilizers supplied to the six maize Dzongkhags

The survey result shows that the sample Dzongkhags purchased close to 12 MT of urea for maize production worth Nu.264,000 at Nu.22 per kg. The urea was mainly purchased from the CAs in their respective areas. Of the total households 271 interviewed 115 households (42%) used urea.

CBSP concept has played an important role in increasing quality maize seed production and ensuring seed security, enhancing the socio-economic condition and food security. The category of farmers with food self-sufficiency of 6-9 months has increased by 34.9%. The annual maize production of the CBSP within the last six years (2011-2016) has increased by 45.4% (37.4MT in 2011 to 139.2MT in 2016). The increase in production is related to use of improved varieties and adoption of quality seed production. The study found that growing a single variety of maize in a community has resulted in quality seed production. Farmers were provided with training on quality seed production, seed selection, pest and disease management, and were supported with some free input supplies. The mobilization of the community into groups has brought unity within the community. The mobilization of the community into a group has also seen a change in marketing. Unlike before, today the buyers come to farmers' door-step to buy the seed and the price has increased annually. The unity was mostly in terms of decision making. Some drawbacks of CBSP were on loss of traditional varieties, increasing wage rate and labour shortage[13].

9.3.2 Commission Agents (CA)

The system of Commission Agents (CA) was introduced in 1989 and is the main channel for the sale and distribution of agricultural inputs. Commission Agents 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 most inputs to the farm is subsidized by the government. The CAs receives 10% of the value of inputs distributed to the farmers as commission from the government.

9.3.3 Maize Growers

Maize growers are generally small holder farmers with an average landholding of only 1.028 acre per household. As per the field survey conducted in the four Dzongkhags, maize is grown in almost 87% of the agricultural land. The proportion of land holding is presented in Table below. Almost all the maize are grown in the kamzhing (dry land) type of land.

Land holdings	**N=271**
	Land under maize cultivation
<1 acre	66%
1-2 acre	23%
2-3 acre	9%
>3 acre	2%
Average land	**1.028 acre**

Table 24: Land holdings of maize growers in 4 Dzongkhags

Farmers are engaged in the production of maize both for grains and seeds, processing, transporting and selling. The farmers process maize grains into kharang (maize grids), Tengma (Flattened maize) and Ara (Alcohol). Farmers also transport their products to the

[13] Wangmo, P. et al., 2018

roadside shops to sell their products especially along the lateral national highways. For example under Monggar Dzongkhag, out of the 15 gewogs only three gewogs (Monggar, Chali and Saleng) are actively engage in the maize commercial activities.

Box 1: Maize Grower working as an integrated VC Operator
Mr. Tashi, Chaskhar, Mongar
Interviewed on 18th September, 2019

I grow maize in almost all of my land and I generally keep my own maize seeds but some years ago I also exchanged my seed with other growers. I intercrop my maize with other crops. Ploughing and land preparation work is done by using a pair of bullocks. All of my family members help in planting, weeding and harvesting. I use farm yard manure as well as some quantity of chemical fertilizers.

After harvesting the maize, I hang it over the ceiling for storage. My annual harvest is about 300 tones, out of which 700kg is used for production of Kharang, 200kg for production of Tengma and 500kg for Ara. The annual seed supply of about 30kg is kept as provision for seed in the following year. Then the surplus quantities of kharang, Tengma and ara are sold in the nearby markets which fetched Nu. 40,000 in 2018.

I already sold 1000 packets of kharang in the locality at Nu. 30 per packet, earned about Nu. 30,000 from the sale of maize product. The proceeds from the sale are used for purchasing of grocery items from the market.

Maize growers are the major actors who perform most of the value chain functions right from arrangement of farm inputs to post harvest handling and marketing. Only a few growers are involved in the production process, while the majority act as integrated VC operators and perform multiple tasks. The different functions carried out by farmers are briefly described in the box above.

9.3.4 Processing Agents

Bhutan imports most processed maize products like pop corns and other maize ingredient processed foods from India, Thailand and other countries in the region. Very small quantities of homemade are available except tengma and kharang. There are no maize processing units in Bhutan but now with the assistance from National Post Harvest Center (NPHC), few youths have come up with the cookies made from maize in Mongar which is under trial at the moment.

The only processing agents are those mills which process tengma and kharang in the villages. They take a commission of Nu. 1.3 to Nu. 5 per kg of kharang and tengma. However, if they have to process higher quantities, then the charges are minimizing accordingly

9.3.5 Transporters

In most of the growing areas, maize growers themselves bring down their maize products to the road side market sheds or to the nearest district vegetable markets for sale. They carry maize products on their back or in some cases in taxis/private cars. Sometimes, they sell to

middle man or traders who come at household level to collect the maize products specially tengma.

Along the national highway, the public transport services (buses) were the only transporter of maize products. With the opening of farm roads across the country, small pickup trucks are used to collect and transport the maize products-mainly tengma-from the villages and distribute to the markets. For example a small pickup truck carries around 800 kgs of tengma packed in plastic bags and charges Nu. 6,500 from Monggar to Thimphu.

9.3.6 Local vendors

There are only very few local vendors who purchase maize products especially tengma and kharang from the local growers and then transport to the market. In most cases, the farmers themselves have to bring the produce to the nearby markets and even to some extent to the capital city-Thimphu.

Local vendors have served the interests of farmers by purchasing produce from the farmers who do not have time to carry out small purchases from local markets or from scattered farms for sale to large traders.

9.3.7 Vegetable vendors/retailers

In most cases, the growers bring their produce to the designated market places (mainly the Sunday Market) and sell it by themselves. Only in town areas, local vegetable vendors buy maize produce from the growers at the farm gate and sell to domestic consumers through their grocery stores/stalls. The profit margin from the sale of maize produce is not lucrative in comparison to the sale of other products due to smaller scale produce. Accordingly, they were able to earn few hundreds to more than Nu.100,000 in a year.

The common maize produce is ***tengma*** which are available in the Centenary Farmer's Market in Thimphu and many of the popular grocery shops such as 8 Eleven, Shop No. 7, My Mart, Chuniding Food and many other grocery shops. However ***kharang*** is not as common as ***tengma*** and those ***kharang*** available at the Centenary Market is mainly from Tsirang.

9.4 Service providers

9.4.1 Gewog Extension Officers (EOs)

There are 205 Gewogs in the whole country, with RNR EOs (also called Extension Workers or Extension Agents) in every Gewog. These EOs are supposed to provide updated information, promotional seed and pesticides on a cash-and-carry basis, technological awareness and training to the farmers. However, they are overloaded with different tasks, look after number of agricultural crops and most of them lack exposure and knowledge of modern maize production technologies. Moreover, some EOs are supposed to look after large Gewogs with far flung villages and households making it difficult for a single person to cater to the needs of the most farms.

9.4.2 Dzongkhag Agriculture Office

All the Dzongkhags have a well elaborated Agriculture Development Plan, which aims to contribute to national development. The Dzongkhag Agriculture Offices have a vast network of Extension Officers in each Gewog. Agricultural development interventions focus on crops that simultaneously satisfy all of the following four criteria: i) production potential; ii) proven market demand and/or were prioritized in the Five-Year Plans iii) proven production technologies available within RNR-RDCs in Bhutan and iv) farmers' interest in cultivating.

The Dzongkhag and Gewog extensions are crucial service providers in the maize value chain development and facilitation. They are responsible for production, planning, technical backstopping and organising input supplies through the commission agents. They are mandated to contribute to the National Level Production targets through annual performance agreements. Assuring the quality seeds have been their main challenge. The Dzongkhag and Gewog extension can play a vital role in assisting DAMC to organize collection and distribution of the surplus maize to the markets (for example the BCD and Karma Feeds though there is still need to find out workable solutions to the price between them).

9.4.3 Food Corporation of Bhutan (FCB)

The Food Corporation of Bhutan (FCB) was established initially as a government agency under the Royal Charter issued on the 16 August 1974. It was established with the aim to have a centralized procurement and distribution system for supply of essential food across the country. FCB had diversified its business by engaging in trading of fast moving consumer goods (FMCG) at later part of 1997 to enhance revenue generation for supporting and sustaining the increasing social obligation and responsibilities. FCBL has three regional offices at Gelephu, Sumdrup Jongkhar and Thimphu, 23 depots, 5 retail outlets and 173 farm shops catering business and services to relevant clients across the country.

FCBL also started collecting maize with coordination and facilitation by RAMCO from 70 Gewogs of six eastern Dzongkhags in 2015 based on the surplus supply of maize. The total quantity of maize collected and marketed was 73.350 MT against the target expected of 72.808 MT. There was rejection of 5.684 MT of maize due to inferior quality or infested by diseases and damaged. The total quantity of surplus maize which local traders have market was estimated at 119 MT.

9.4.4 RNR, RDC, Wengkhar

In order to enhance maize productivity and contribute to food self sufficiency, the National Maize Program at RNR RDC Wengkhar, explored the potentials of Hybrid Maize as a spring crop mainly as pre rice in fallow paddy fields. A total of five hybrid maize varieties were introduced from Pioneer Seeds, Hyderabad with supports of the Decentralized Rural Development Project, World Bank.

Introduced and evaluated in eight different locations in Chukha, Samtse, Sarpang and Mongar, covered some 88 acres with 90 households. Then the assessments were conducted at various areas. Out of the five varieties, two namely P 3441 and P 3377 showed good performance across all locations. These two varieties on average yielded 1.8 tons/acre (about 64 % higher than the existing varieties in farmer). Apart from higher productivity, farmers

preferred the hybrid varieties due to its uniform cob bearing ability, good grain color, good husk cover and less lodging.

The National Maize Programme is housed in the Agriculture Research and Development Centre at Wengkhar. Over the year the NMP has released 6 varieties as follows:

	Variety	Year of Release	Yield Potential (t/ac)	Recommended AEZ	
				Altitude (masl)	Cropping suitability
1	Yangtsepa	1992	1.2-1.6	Upto 1800	Main Single
2	KhangmaAshom 1	1999	1.5-2.0	Upto 1800	Main Single
3	KhangmaAshom 2	1999	1.6-2.0	Upto 1800	Main Single
4	Chaskarpa	2012	1.6-1.9	1200-2100	Main Single/GLS Tolerant
5	Shaphangma Ashom (QPM)	2012	1.6-1.9	1200-2100	Main Single/GLS Tolerant
6	Bhur Ashom	2015	1.5-1.8	600-2100	Early Variety/Double cropping

Table 25: **Maize variety released (Source: National Maize Program, ARDC Wengkhar)**

In 2014, spring maize program was initiated through the promotion of hybrid maize. Since then the demand for hybrid seed has gradually increased over the years due to higher productivity. However, the supply of free seeds every year raises the issue of sustainability and thus a 50:50 cost sharing of seeds has been started. Moreover, purchase of hybrid seed every year from India is a concern for the quality of the seeds. To ensure self reliance and sustainability of seed supply, the evaluation of climate resilient hybrid seed has been initiated since the last four years. The following table shows the details of support for the spring maize program.

Year	Season	Variety	Seed supply (MT)	Area covered (Acres)
2014	Spring (Feb-Jun)	Hybrid (5 varieties)	1.25	83.33
		Yangtsepa	3.15	210
2015	Spring season	Hybrid (P3377 & P3441)	61	4066.67
		Yangtsepa	14	933.33
2016	Spring season	Hybrid (P3441)	11	733.33
		Yangtsepa	19	1266.67
2017	Spring Season	Hybrid(P3441)	13	805.6
2018	Spring Season	Hybrid (P3502)	15	1000

Table 26: Spring maize seed supplied (Source: National Maize Program, ARDC Wengkhar)

In August 2018, participatory varietal selection was conducted to identify and select five best lines and five promising hybrid lines were ready to be deployed for seed production. In the coming years, one selected line from spring 2017 and 2018 climate resilient hybrid lines were released and deployed. ARDC Wengkhar based on its mandate as the National Maize Program Manager advises the NCS on the import of hybrid seeds from India. ARDC also provide backstop support to the maize growing areas of the country through the Dzongkhag Administrations.

9.4.5 Commercial Agriculture and Resilient Livelihoods Enhancement Programme (CARLEP)

The Commercial Agriculture and Resilient Livelihoods Enhancement Programme (CARLEP) aims to facilitate the transformation of a subsistence-based rural agricultural economy into a sustainable value chain and market driven productive sector by promoting climate smart approaches in agriculture and strengthening capacities of communities and local institutions. It builds on prior IFAD interventions focused on increased agricultural production and makes a basic shift in approach towards marketing and climate resilient farming practices. The office is also involved in developing capacity of the farmers as well as distribution of seeds.

The Programme is scheduled for seven years from 2015 to 2022. The programme area includes selected Gewogs in six eastern Dzongkhags (Lhuentse, Mongar, Pemagatshel, Samdrupjongkhar, Trashiyangtse and Trashigang). The programme will benefit 28,000 smallholder households of which 5,000 households will directly benefit from vegetable and dairy value chains.

9.4.6 Renewable Natural Resource Research Development Centre (RNR-RDC)

RNRRC has been collaborating with various national and international development organizations in order to achieve the dual objectives of contributing to poverty reduction and increasing horticultural production. It is expected to deliver the following outputs:

a) Informal and formal seed system to optimize seed quality available to producer and for export
b) Production technologies adopted to optimize yield and quality, increase production, reduce labour cost and preserve production base
c) Post harvest and marketing support to reduce storing losses and increase value addition
d) Production area is expanded

9.4.7 Agricultural Machinery Centre (AMC)

The AMC is responsible for farm mechanization through the procurement and supply of farm machines and equipment such as power-tillers, tractors, planters, reapers, threshers, weeders, etc. AMC is also responsible for conducting R&D of small tools and implements and imparts training to farmers on the use and maintenance of farm machines and equipment. However, the marketing and supply of small tools and implements have been privatized and private entrepreneurs/shopkeepers, (such as Sherab Enterprise) deal with farm implements. The big machines like tractors and power-tillers which come to AMC through Japanese grants are subsidized, but their numbers are limited and create a huge difference in demand and supply.

9.4.8 National Plant Protection Centre (NPPC)

More than a thousand farmers were provided capacity development training along with the extension officers on good storage practices in 2017. NPPC has procured maize drier, Sheller and super bags designed especially for grain storage to provide to the farmers.

People still follow primitive methods to store maize leaving it prone to pests and diseases, so NPPC were exploring ways to attain food self sufficiency. One of the areas is improper

storage facilities which leads to destruction by pests and fungi. So NPPC is also exploring ways to tackle the problem.

9.4.9 National Post Harvest Centre (NPHC)

Post-harvest loss continues to be one of the main constraints in maize production Zone I and II. Sometimes post harvest loss goes up to 20 to 40% due to the poor drying methods and storage of maize[14]. At present there is no research focus on post-harvest problems except for the improved storage equipment (silos) promoted by NPHC. The main maize harvest season coincides with the monsoon season and post-harvest damages through incidences of ear rots are a major issue. Minimizing post-harvest losses will entail selection of varieties with good husk cover, good quality keeping and less susceptible to damage by pest while storing. Finally, good storage facility at the household level will be vital. Since, tengma making is becoming popular and earns good cash income from it. Most of the farmers are venturing into it. Therefore, research on new product development and product diversification by NPHC will be important to diversify the uses of maize.

The National Maize Program in collaboration with NPHC and AMC will improve the maize processing by introducing improved processing technologies and equipment. The main focus will be on improving the quality of Kharang and Tengma through improved milling facilities to enhance the quality. Once the milling is improved a number of different products can be developed from maize that can help diversify the food basket.

9.4.10 Department of Agriculture Marketing and Cooperatives (DAMC)

Though there are substantial marketable maize surplus in the country (4,949 MT), it has not been able to market all the available quantities. The highly scattered nature of production where the marketable quantity does not come from a single place was identified as one of the challenges. Department of Agriculture Marketing and Cooperatives (DAMC) can create collection points to facilitate on bulking the small quantities for marketing the surplus maize in 12 FYP. DAMC has the mandate to support marketing infrastructures for collection centres to facilitate collection and bulking of vegetables.

DAMC will continue and upscale support for marketing maize products through improved processing and packaging in collaboration with National Post Harvest Centre (NPHC).

9.4.11 Bhutan Agriculture and Food Regulatory Authority (BAFRA)

As the implementer of Seed Act and Rules, Regulations and Food Act, Rules and Regulations, BAFRA has a great role to play in the maize value chain development. BAFRA being the custodian of Seed Acts, Rules and Regulations, it has to ensure quality of seeds supplied to the farmers, so that the production is improved substantially. It also has to ensure quality of processed products especially Tengma and Kharang at the moment.

[14] Commercial Agriculture and Resilient Livelihoods Enhancement Programme, Working paper, 2014

9.5 Business environment

9.5.1 Food Act and Food Rules and Regulations

The food business is governed by the Food Act and Food Rules and Regulations that safeguards food safety and hygiene. The value chain actors will have to be aware of the Act and Rules and regulations. The BAFRA, who is the implementer of this Act and Rules and Regulations must create and educate all the actors involved in this value chain. This is especially important for those who are engaged in processing and packaging the food.

NPHC should be fully aware of this Act and Rules and Regulation when developing the products and training the entrepreneurs who will be engaged in the food business.

9.5.2 The Seed Act and Rules and Regulations

Input suppliers especially those dealing with seed supplies - NSC and CAs - should be aware and educated on these Rules and Regulations. This is critical since there is huge demand on hybrid seeds which is in short supply at the moment.

9.5.3 RNR Marketing Policy

The overall guiding principles for RNR marketing policy provides a good basis to support the value chain development and marketing support to RNR products wherein maize can also fit into it. Further the following policy objectives are highly relevant in terms of following:

a) Policy objective 5.2: Enhance RNR product value addition
b) Policy objective 5.5: Enhance RNR commodity marketing

9.5.4 The 12 FYP of the Department of Agriculture

The 12 FYP has maize value chain development under the value chain development as one out of the three crop identified under output 1.1. This indicates that the DoA gives top priority to maize value chain development in addition to the maize production plan. The value chain development is linked to the two NKRAs – NKRA 8: Water, food and nutrition security ensured and NKRA 2: Economic Diversity and Productivity Enhanced. Maize is also prioritised among the six commodities focused for the plan. By the end of the 12 FYP, the DoA aims to produce 96,535 MT of maize annually.

10. SWOT ANALYSIS

Strength, Weakness, Opportunities and Threat (SWOT) is a powerful tool used in developing strategies for intervention. The tool provides a framework for understanding controllable and non-controllable factors that the interventions should address for the entire value-chain. The critical issues of the SWOT are generally categorized into the following four broad categories as presented in the table below:

S - What are the subsectors internal Strengths?
W - What are the subsectors internal Weaknesses?
O - What external Opportunities might move the subsector forward?
T - What external Threats might hold the subsector back?

The typical assessments of subsector's strengths and weaknesses as well as the opportunities and threats specific to each of the interventions consist of the following:

a) Production system and delivery of products in the value chain
b) Quality of business service provisions
c) Competitive advantages of the value chain members
d) Market access, infrastructure, management information and financial systems
e) Policy environment.

When designing the interventions, the focus is generally given on the exploitation of strengths rather than simply addressing on the weaknesses. In other words, the interventions are not only about addressing the constraints, but also nurturing the strength of the subsector. Similarly the opportunities and threats - the external trends that influence the subsector are also analysed. The external opportunities and threats are usually categorised into political, economic, social, ecological, demographic and legal forces.

These external forces include such circumstances as changing business trends, increased competition, changing regulations, and so on. They can either help the subsector move forward (opportunities) or hold the subsector back (threats) - but opportunities that are ignored can become threats, and threats that are dealt appropriately can be turned into opportunities. Any non-controllable factors are generally dealt through advocacy and networking to bring about changes in the policy framework.

a) Internal factors influencing the maize

STRENGTHS	**WEAKNESSES**
Production:	***Production:***
• Years of experience in cultivation by the farmers; • Grows well in all marginal and sloppy lands; • Reasonable adaptability to diverse climatic conditions • Attractiveness for commercial returns and business prospects; • Versatile use as staple food -kharang, tengma and ara and animal feed; • Suited to many cropping systems - mixed cropping with any other cereals or vegetables	• Mostly grown for family consumption and not for commercial; • Limited availability of maize products and no varieties; • Inadequate adoption of modern techniques of production and crop management; • Small land holdings, scattered farms and low productivity; • Use of traditional methods for harvesting and storage techniques;
Marketing:	***Marketing:***
● Good demand for tengma and kharang in urban centres (Dzongkhag markets and Thimphu FCM and grocery shops) as well as maize grains for industrial production; ● Opportunity to improve markets through network of farm roads; ● Emergence of value actors (local vendors who also act as transporters) interested in maize and maize product marketing	• Lack of reliable market information; • Farmers performing multiple roles of value chain actors thus hindering development of specialized skills required in the value chain; • Mismatch between the prices offered in the market and the farmers' expectations; • Dependent on few local people who acts as marketing channel;
	Enabling environment: • Insufficient focus to develop

Enabling environment: ● Support from the Government (12 FYP, RNR Marketing Strategy); ● Good support from RDC to promote maize production and easily accessible extension services for technical backstopping; • Government support to substitute rice with 10% kharang in the school feeding programme	infrastructure such as proper storage and product development; • Insufficient support to creating awareness and knowledge on maize marketing and product development

b) External factors influencing the maize

OPPORTUNITIES	**THREAT**
Production: • Opportunity to increase productivity with the acceptance of hybrid seeds by the farmers; • Large scale industrial demands and further scope for enhancing the supply; • Present maize products are limited to kharang and tengma. Some 10 products have been developed NPHC those can be tested with the value actors (processors and sellers) ***Marketing:*** • Opportunity to establish value chain to collect and process excess maize from the scattered rural production centre • Link the surplus maize producers with the school feeding programme. • Test out the products developed by NPHC to diversify the products and develop products for the market ***Enabling Environment:*** • Government support for commercialization, food & nutrition, input supply, post harvest, crop protection and marketing; • High potential for reducing poverty and employment creation through value chain development	***Production:*** ● Limited access and supply of quality hybrid maize seeds. ● Maize crop is prone to wild animal attacks ● Unpredictable occurrence of windstorm, pest and insects ● Shortage of labour due to rural urban migration Easy availability and access to rice in shops replacing kharang as staple food in the villages ***Marketing:*** • Fluctuating price in the market; • Availability of cheap maize grains from across border; • Easily and cheaply available maize products in the market imported from other countries etc; ***Enabling environment:*** • Changes in the policy decisions from the government

The identified strengths, weaknesses, opportunities and threats indicate that commercial cultivation of broom grass is economically viable and socially compatible. However, there are some practical hurdles for its smooth progress. The market based solutions to identified weakness and threats, and to tap the existing opportunities can be a point of improvement for developing strategies for value chain streamline.

11. STRATEGIC PATHWAYS

The following table provides a summary of challenges and possible pathways to address those challenges. It is a result of the literature review combined with observations and discussions held during a field visits.

Value chain functions	Constraints & challenges	Strategic pathways
Inputs		
Land	a) Small & fragmented land holdings hinder: • mechanization with larger equipment • make it difficult to produce higher volume needed for contract farming b) Not feasible to participate in commercial production	a) Intensification through multiple cropping in suitable agro-ecological zones can partly off-set land shortages; combine with improved soil and land management practices. b) Promote producer & marketing groups to share machinery and facilitate field operations and marketing. c) Identify and test small scale machinery for land preparation & weeding d) Explore and facilitate land consolidation options especially those left fallow e) Promote and scale up maize spring crop with hybrid technology in suitable areas (wetland cultivation).
Seeds	a) Lack of drought resistant varieties b) Limited availability of HYV and QPM seeds c) Poor seed replacement rates lead to declining yields	a) Support research to explore and develop varieties that are drought resistant and short duration b) Upscale the supply of HYV and quality protein maize (QPM) seeds c) Promote the seed replacement of improved varieties through rigorous awareness creation and demonstration through the extension services
Fertilizers	a) Poor soil nutrient management b) Indiscriminate use of herbicides and pesticides	a) Support farmers and farmers groups interested to use fertilizers with knowledge, skills and easy access to fertilizers b) Improve soil fertility management; soil test based use of fertilizers c) Promote the system of maize -legume rotations in conjunction with dairy d) Promote intercropping and mulching techniques with legumes to control weed and improve soil fertility
Labour	a) Lack of labour b) Labour costs too high c) Low productivity	a) For cultivation: increase mechanization of farming operations through combining fields of producer group members but also use/experiment with zero tillage options b) For post-harvest: introduce improved mechanized maize shellers c) For processing: introduce improved machinery for tengma, kharang, and other products d) Promote and scale up maize spring crop with hybrid technology in suitable areas (wetland cultivation).

		e) Increase farm mechanization with machinery suitable for smaller land holdings, including mechanical weeding options f) Increase harvested area through increasing cropping intensity where maize will be promoted in wetland as second crop in maize production Zone I. Under dry land condition (Zone II) maize double cropping will be promoted wherever feasible (drought resistant and short duration varieties)
Production		
Crop protection	Pests and diseases cause yield reductions	a) Invest in research to develop and promote disease tolerant varieties (e.g. tolerant to GLS and TLB) b) Promote IPM practices through research and demonstrations
Wild animal damages	Crop losses to wild animals	a) Electric fencing has proven to be effective against wild boar and deer b) Test thorny life fences to deter the wild animals entering the crop field
Post harvest management	a) High (20%) losses during harvest, post-harvest and storage operations b) Increasing evidence of aflatoxin and mycotoxins from fungal infections	a) Introduce and scale up improved on farm storage facilities such as the ambient storage technology developed by the NPHC b) Introduce improved drying methods to avoid fungal infections c) Train farmers on the use of storage structures and storage conditions required for safe storing
Processing	a) Poor processing technologies b) Poor packaging & labelling c) Limited maize based products for the local market	a) Improve processing equipment for tengma and kharang and standardize the process to ensure more consistent quality in texture and taste. b) Promote and assist farmer groups in improving their packaging and labelling for tengma and kharang c) Test artisanal tortillas and nachos production and marketing to diversify local maize products with young entrepreneurs
Marketing	a) Large scale industry cannot utilize local maize, because of: • Lack of constant supply • Insufficient quantities of supply • Too costly when compared to imports • Insufficient / inconsistent quality b) Locally processed maize products lack diversity	a) DAMC support to test the products developed by the NPHC with the entrepreneurs and local markets through awareness creation and promotion b) NPHC to develop / import and test improved maize processing techniques (e.g. pop-corn, nachos, etc.) and conduct a market research on these new products. If successful run business incubation for young entrepreneurs and provide investment support. c) DAMC and DoA to facilitate value chain to support the entrepreneurs interested to engage in the maize and maize business.
Farmer Groups & Cooperatives	a) As individuals small scale farmers alone cannot: • make use of economies of scale	a) Extension services (Dzongkhags and gewogs) to encourage the formation of farmer groups / cooperatives and provide training on effective management of such groups, but: • Only support formation of groups if there is

	• capture market opportunities • mechanize efficiently • receive intensive training	clear business case or a clear social or environmental benefit for all of the members. • Forming groups for training purposes (e.g. farmer field schools, lead farmer approach, etc.)
Services		
Advisory services	Farmers limited knowledge on improved varieties and crop management	a) Extension services to consistently update the farmers knowledge and skills through awareness creation, training and demonstration (through farmers field school) and regular and consistent monitoring.
Access to finance	Some farmer groups are neither registered with DAMC nor with DCSI, which deprives them of accessing certain financial services	a) DOA to continue to harmonize with MoAF subsidies and cost sharing mechanisms and publish them in print and online. b) AEOs to keep farmers updated on all relevant financial services; not only from MoAF but also through MoEA and banks in the form of online apps)
Vertical & Horizontal Linkages	a) Vertical linkages to industrial buyers non-existent b) Weak horizontal linkages between farmers (e.g. cooperatives)	a) DAMC and DoA to facilitate value chain development that provide opportunities for both vertical and horizontal linkages.
Research	a) Limited resources to conduct research b) Limited appropriate varieties c) Limited focus on product development to initiate development of improved processing technologies	a) MoAF to assure required resources (financial and human) to achieve the objectives of the government b) NMP to explore and expand varietal base for short duration, drought tolerant and double cropping system c) NMP to conduct research on minimizing labour requirements (zero tillage options and dense legume cover crops for weed suppression) d) NPHC to develop maize based products and recipes to diversify the maize products. e) DAMC to conduct market survey for the newly developed products

12. CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

a) Maize is largely cultivated in Bhutan representing 49% of the national food basket and 42% of the cultivated area. The Eastern region represents 45% of the total maize production. Maize can be consumed by the households but is also widely used as fodder/ feed for the livestock. Eighteen Dzongkhags are engaged in maize production covering 56,609 acres to produce 82,035 MT worth of Nu. 1,640.70 million in a year;

b) The surpluses of maize are scattered in remote villages and collection is expensive and challenging;

c) The BCD and Karma Feed have maize demand of about 30,360 MT annually at Nu. 15 per kg worth of Nu. 455.40 million, the average production cost is Nu. 20/kg. This is Nu.5 less from the cost of production. Therefore maize grains have no advantage in the

market to sell to BCD and Karma Feeds. This will be compounded by labour shortages and high production costs. For example labour costs (Monggar is Nu. 400 per day, Trashigang–Nu. 400 per day, S/Jongkhar - Nu. 300 per day, Tsirang – Nu. 250/ per day) can increase the cost of production;

d) Though some 10 maize products were identified through the TA **s**upport**, t**he maize product is limited to Tengma and kharang. The markets are still dominated by tengma and kharang. Ara though is a major product in the villages but is not sold in the open market. So there is large value addition potentials in maize products which can support maize value chain development and business;

e) Though research is crucial in any development activity but in the last 23 years, only 6 maize varieties were adapted and released. These were responses to critical situations. Research has not received priority in terms of assured funding. The fund sources are mainly from the area development projects. Though the fund requirement is not high (Nu. 189 million in 12 FYP), this has to be tied up with ADPs;

f) The past initiatives of NMP are highly appreciated especially for the introduction of hybrid seed. There is huge demand for hybrid seeds which is not able to meet by NSC. This is supported by the feedback from the extension agents for higher demand for maize hybrid seed;

g) Urea is the only widely used fertilizer and will continue to be in demand for maize production since most of them are not using any chemicals for the main production;

h) NSC is the only input supplier for maize production. Input supplier in the starting point of production and from value chain point of view such an actor should have economic motives to fully engage in the value chain;

i) The farm roads have created access to markets. The local vendors come to collect kharang and tengma from the villages at their door steps which is a positive development towards developing value chain.

12.2 Recommendations

a) There is demand for maize and its products (especially kharang and tengma) in the market and there is sufficient surplus in the maize growing areas in the villages. In addition to that construction of farm roads have somewhat created easy access to market with less time to reach their product to the markets. With the availability of farm roads, some farmers have purchased small pickup trucks to collect and reach the products to the market. Some of these pickup truck owners have taken the roles of local vendors. Therefore ***DAMC need to facilitate meetings between the producers (farmers), vendors and consumers to initiate and develop value chain to produce and develop demand based products***. Such meetings will help to analyse the needs and demands of the consumers for maize and its products, then to determine the prices at different levels of the value chain in a fair and transparent manner. In this way, there is a good opportunity to start building the foundation for value chain development since the government plans to substitute 10% (approx. 684 MT valued at Nu.54,720,0000 at Nu. 80 per kg of kharang) rice feed in the schools with kharang.

b) There is need to start the value chain with the (i) ***identification of key value chain actors (for example local vendors, pickup truck owners, maize mill operators, school feeding programme to supply kharang to the schools) who have the motivation to engage in long term marketing of maize and its products***. Similarly, from the survey it is learnt that there is huge demand for hybrid maize seed. (ii) ***So there is need to identify***

private entrepreneurs and encourage them with support (i.e. through policy guidance, market linkage and financial advice) to supply the seed. This has the potential to create a link to the market for maize and its products. It could also be the local pick-up operators who may be interested to be engaged in transportation of maize products to the larger markets or consumers;

c) In the past, many studies on value chains were conducted for various products but there is not a single value chain especially in cereals which are operational. ***Therefore, DAMC and DoA should hire or recruit an expert especially dedicated to the maize value chain development until the time when the value chain is fully developed and functional***;

d) There is existence of blame game for the surplus maize and not having sufficient volume of maize for marketing. So there is need (i) ***to confirm the existence of surplus maize production and ready market to absorb the surplus. DAMC should mobilise collection of surplus maize (by providing Government subsidies to meet at least the cost of production) and supply to school feeding programmes.*** This will build the confidence of the farmers to produce at the commercial level. At the initial stage, DAMC can carry out this function through extension system until the value chain actor is in place to take over in the longer term. Thus, there is need to (ii) ***establish strong and robust collaboration and coordination between the agriculture extensions and DAMC***. This is in the interest of both DAMC (whose main mandate is to support agriculture marketing) and DoA (which has one of the three focus areas in the 12 FYP)

e) The information on maize and its products are almost non-existent at the moment. ***So DAMC should make extra efforts to collect and share market information with all the relevant stakeholders of the value chain.*** This can be achieved through active facilitation and monitoring of the value chain activities and actors.

f) There is lack of product diversification which constraints to maize marketing. However, there are other products in the market from outside such as maize grits and polenta which can be substituted by using local tengma as the base material for value addition. The present recipes for maize foods are also limited. The packing of maize products are rudimentary (packed in transparent plastic bags). In the past, NHPC has developed about 10 products from maize but it could not be materialized at the larger scale, so (i) ***DoA should support NPHC with resources to conduct research in developing products and held accountable for the actions.*** (ii) ***NPHC should look not only on product diversification but also on developing recipes, increasing shelf life and proper packaging to meet the needs of the customers (size, price, improve packaging of the products etc.).*** Since marketing mandate is with DAMC, (iii) ***DAMC should test the products in the market, get feedback from the sellers and consumers and provide the findings to the NPHC for improvement or promote the potential products to the entrepreneurs.***

g) Post harvest losses concerns were raised in many of the literatures and NPHC is mandated to address this constraint. In the past NHPC has developed and up scaled the production and supply of improved varieties. So ***NPHC should continue to conduct research to improve the storage structures. In addition NPHC can engage with the extensions and farmers to educate them on the conditions required for the maize storage. For example there is need of education on sanitation of the grains and storage structures and environment like moisture content of the grains to be stored, temperature requirement and humidity of the stores.***

h) National Maize Program (NMP) based in RDC Wengkhar is mandated with the overall maize development of the country in addition to the research mandate. However, NMP is constrained with reliable and assured financial support. So (i) ***MoAF should provide required resources so that NMP and RDC can focus on their mandates***. (ii) ***NMP and RDC should prepare long term strategic plans to identify, develop and advise varieties to increase production, products development and value addition potentials of the varieties***.

i) In the absence of private entrepreneurs***, NSC should equip itself to ensure smooth flow of input supplies (seeds and fertilizers) to match the demands of the farmers*** so as to contribute to the maize development in the country.

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14. ANNEXURE

Annexure 1: List of stakeholders interviewed

a) Phub Dorji, ADAO, Monggar
b) Extension Supervisor, Chali Gewog
c) Chenga Tshering, Extension supervisor, Chaskhar Gewog
d) Dorji Tshering, Extension supervisor, Dremetsi Gewog
e) D.C Bhandari, DAO, Trashigang
f) Tshering Wangdi, Extension supervisor, Bartsam Gewog
g) Pema Wangchen, Extension supervisor, Radhi Gewog
h) Sonam Yangdon, Extension supervisor, Kanglung Gewog
i) Chorten Tshering, ADAO, Samdrup Jongkhar
j) Tenzin Dema, Extension supervisor, Phuntshothang Gewog
k) Tshering Norbu, Extension supervisor, Pemathang Gewog
l) Dorji Gyeltshen, DAO, Tsirang
m) Kinley Dorji, Extension supervisor, Mendrelgang Gewog
n) Sonam Jamtsho, Extension supervisor, Gosarling Gewog
o) Sonam Gyeltshen, Offtg. Programme Director, ADRC Wengkhar, sonamgyeltshen@moaf.gov,bt
p) Passang Wangomo, Maize Focal Officer, ADRC Wengkhar, passangwa@gmail.com
q) Sonam Dorji, Officiating Programme Director, NPHC snmdoji@gmail.com
r) Sujan Pradhan, Technical Officer, NHPC, sujanpradhan@moaf.gov.bt
s) Thinley Namgyel, Chief, Agriculture Production Division
t) Phutsho Wangmo, Key Informant, Thridangbi, Saleng, Monggar
u) Managing Director and Deputy Managing Director, AWP, Phuntsholing
v) Chencho Wangyal, Project Director, Karma Feed Unit, Karma Group
w) Chhimi Tshewang, Agriculture and Marketing Services Division, FCB
x) Retail shops: OGOP, City Mart, 8 Eleven and Shop No.7 in Thimphu
y) Retailers in Centenary Farmer's market, Thimphu

Annexure 2: List of Focus Group Discussions conducted

Monggar Dzongkhag a) Chali b) Chaskhar c) Dremtse	**Trashigang Dzongkhag** a) Kanglung b) Radhi c) Barsham
Samdrupjongkhar Dzongkhag a) Orong b) Dewathang c) Phuntshothang	**Tairang Dzongkhag** a) Mendelgang b) Goserling c) Tsholingkhar

Annexure 3: Field Trip Schedule

Dates	**Field Visit**
First group	
11/9/2019	Thimphu-Monggar
12/9/2019-13/9/2019	Visit to Chali RNR center and HHs
14/9/2019	FGD Chali
15/9/2019-16/9/2019	Visit to Chaskhar RNR center and HHs
17/9/2019	FGD Chaskhar
18/9/2019-19/9/2019	Visit to Drametsi RNR center and HHs
20/9/2019	FDG Drametsi
21/9/2019	Monggar-T/gang
22/9/2019-23/9/2019	Visit to Radhi RNR center and HHs
24/9/2019	FDG Radhi
25/9/2019-26/9/2019	Visit to Barsham RNR center & HHs
27/9/2019	FDG Bartsham
28/9/2019-29/9/2019	Visit to Kanglung RNR center & HHs
30/9/2019	FDG Kanglung
1/10/2019	T/gang to Bumthang
2/10/2019	Bumthang-Thimphu
Second group	
11/9/2019	Thimphu-Tsirang
12/9/2019-13/9/2019	Visit to Mendregang RNR and HHs
14/9/2019	FDG Mendregang
15/9/2019-16/9/2019	Visit to Goserling RNR and HHs
17/9/2019	FDG Goserling
18/9/2019-19/9/2019	Visit to Tsholingkhar RNR and HHs
20/9/2019	FDG Tsholingkhar
21/9/2019	Tsirang to S/jongkhar
22/9/2019-23/9/2019	Visit to Orong RNR center and HHs
24/9/2019	FDG Orong
25/9/2019-26/9/2019	Visit to Dewathang RNR center & HHs
27/9/2019	FDG Dewathang
28/9/2019-29/9/2019	Visit to Phuntshothang RNR center & HHs
30/9/2019	FDG Phuntshothang
1/10/2019	S/Jongkhar – P/ling
2/10/2019	P/ling to Thimphu

Annexure 4: Questions to Maize Producers (Village Households)

I. General Information

1. Name of Respondent _____ 2. Gender_____
3. Village_____ 4. Gewog_____
5. Dzongkhag_____ 6. Level of Education_____
7. Area under cultivation:

Langdo	Acre	Decimals

8. Variety cultivated:
Local ☐ Improved ☐

II. Inputs used

1. What is your source of seed? Tick appropriate one

Self ☐ Neighbour ☐ National Seed Center ☐ Import ☐

Agent/agriculture sales and service representative ☐ Others (Specify)_____

2. Details of seed used

Variety	Quantity	Unit	Price/Unit

3. Do you use fertilizers for the crop? If so what ones do you use?

Type of Fertilizers	Quantity	Unit	Price/Unit	Source of fertilizers
FYM				
SSP				
Urea				

Note: source could be own, neighbour or agents etc.

If brought from the agents, what is the mode of transportation and the cost of transportation from agent to farm stead?

Mode of transportation	Cost of transportation (Nu.)
Bus	
Taxi	
Truck	
Friends	
Own	

4. Do you use chemical pesticides in the maize crop? If so, provide the details as shown below.

Type of Pesticides	Quantity	Unit	Price/Unit	Source of fertilizers

5. Are these pesticides readily available? If no, what are the problems and issues?

6. What are the procedures to avail the pesticides?

7. What are the tools used for maize crop? When did you buy and its costs for each of the tools?

Type of Tools	Quantity	Unit	Price/Unit

III. Labour, Machine and Draught Power

1. Numbers of activities are involved starting from land preparation until harvesting, cob shelling and processing. Ask the respondents about these processes and if any of the activities are missed out, list down below along with man-days spent and the rate per day.

Activities involved in production of maize	Man-days used	Wage/Day
First Land preparation		
Second Land Preparation		
Third Land Preparation		
FYM application		
Chemical fertilizer application		
Seed sowing		
First weeding		
Second weeding		
Third weeding		
Pesticide application		
First Harvest		
Second Harvest		
Third Harvest		
Cob Shelling		

2. If machine and draught power are used, provide the details as below:

Activities involved in production of maize	Machine hrs used	Cost per hour	Draught power days	Cost per day
First Land preparation				
Second Land Preparation				
Third Land Preparation				
FYM application				
Chemical fertilizer application				
Seed sowing				
First weeding				
Second weeding				
Third weeding				
Pesticide application				
First Harvest				
Second Harvest				
Third Harvest				
Cob Shelling				

3. If machine is used, when did you purchased the machines as detailed below:

Type of machine used	Year purchased

IV. Production

1. What was your maize production from the area reported in the latest production year in Kg? (Note: If used different units of production from different places, need to ask them about equivalent conversion to Kg)

2. Have you notice any change in production over the years? Has it increased or decreased? What are the reasons? List down production over the past 3 to 5 years.

Year	Quantity	Unit

3. How much is being retained as seed from the total production?

Year	Quantity	Unit

V. Processing

1. What are the major products of your maize? Please specify the quantity of maize used for producing each of the products.

Products	Quantity	Unit
Khazang		
Tengma		
Ara		

2. What equipment do you use for processing maize into Kharang?

   Traditional Rangtha ☐ Maize Miller ☐

3. For both the methods, what is the milling recovery rate? For example, how many kilos of maize would be required to get a kilo of Kharang?

Kharang Equipment	Recovery Rate
Traditional Rangtha	
Maize Miller	

4. What is the cost of producing Kharang?

Kharang Equipment	Man-days/hours	Cost per day/cost per hour
Traditional Rangtha		
Maize Miller		

5. In the case of traditional method, what are the activities involved in processing maize into kharang? How many labour days/hours does it take for each activity?

Activities	Labour man-days	Cost/day

Tengma Processing:

1. What equipment do you use to convert maize into Tengma?
   ☐ Traditional ☐ Machine

2. For both the methods, what is the milling recovery rate? For example, how many kilos of maize would be required to get a kilo of Tengma?

Tengma Equipment	Recovery Rate
Traditional method	
Machine	

3. If used machine, when did you purchased it and at what cost?
   Year purchased: Cost of machine:

4. What is the cost of producing Tengma?

Tengma Equipment	Man-days/hours	Cost per day/cost per hour
Traditional		
Machine		

5. In the case of traditional method, what are the activities involved in processing maize into Tengma? How many labour days/hours does it take for each activity?

Activities	Labour man-days	Cost/day	Total cost

Ara Distillation

1. What is the quantity of maize used for ara production and how much is being produced?

Quantity of maize used	
Quantity of ara distilled	

2. What are the activities involved in producing ara? How many labour days/hours does it take for each activity?

Activities	Labour man-days	Cost/day

3. What are the other products produced from maize? What are the costs of producing these products?

Type of products	Labour man-days	Quantity produced	Cost/day

4. Maize and maize products sold and price

Products	Quantity	Unit	Price/Unit	Transportation cost	Market
Maize					
Maize Roasted					
Maize Boiled					
Kharang					
Tengma					
Ara					

5. What role does maize play for income generation or source of food?

6. What is your annual income from the sale of maize?

7. How do you sale your maize products?

8. What are the issues and problems? Please tick appropriate ones
   a) Crop damage by wild animals
   b) Seed supply constraint
   c) No water
   d) No tools or machineries
   e) Limited access to market
   f) Labour shortage
   g) Limited land
   h) Others specify_____

Annexure 5: Questions to Processing agents

I. General Information

1. Name of Respondent _____ 2. Gender_____
3. Village_____ 4. Gewog_____
9. Dzongkhag_____ 6. Level of Education_____
7. Location of mill:

II. Inputs/processing

1. From where do you get your supply? Who are your service users?

2. How much do you charge per unit (specify the units) for each of the products?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

3. If the products are with held by your processing plant, then how much you charge for the maize as input supply?

Products	Quantity	Unit	Price/Unit
Maize			

4. What are the prices for the output products that you sell to others?

Products	Quantity	Unit	Price/Unit
Kharang			
Tengma			

5. Who are your customers to buy your products?

6. How much do you sell in a year?

Products	Quantity	Unit
Kharang		
Tengma		

7. What are the issues and problems?

Annexure 6: Questions to Traders

I. General Information

1. Name of Respondent _____ 2. Gender_____
3. Village_____ 4. Gewog_____
6. Dzongkhag_____ 6. Level of Education_____

II. Inputs/processing

1. From where do you get your supply?
2. How much do you do you charge for each maize product from the delivery point?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

3. Where do you deliver your products?
4. What is the selling price of the products?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

5. What is the annual sale of each of the products?

Products	Quantity	Unit
Maize		
Kharang		
Tengma		

6. What are the issues and problems?

Annexure 7: Questions to Retailers/whole sellers

I. General Information

1. Name of Respondent _____ 2. Gender_____
3. Location

II. Transaction

1. From where do you get your supply?

2. How much do you do you charge for each maize product from the traders?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

3. What is the selling price of the products?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

4. What is the annual sale of each of the products?

Products	Quantity	Unit
Maize		
Kharang		
Tengma		

5. What are the issues and problems?

Annexure 8: Questions to Road side vendors

I. General Information

1. Name of Respondent _____ 2. Gender_____
3. Location

II. Transaction

1. From where do you get your supply?
2. How much do you do you charge for each maize product from the suppliers?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			
Tengma			

3. What is the selling price of the products?

Products	Quantity	Unit	Price/Unit
Kharang			
Tengma			
Roasted maize			

4. What is the annual sale of each of the products?

Products	Quantity	Unit
Kharang		
Tengma		
Roasted maize		

5. What are the issues and problems?

Annexure 9: Questions to AWP/Karma Feed

I. General Information

1. Name of Agency _____ 2. Location

II. Input supply/processing

1. From where do you source your supply (maize)?
2. Where is the delivery point?
3. If not sourced currently, will you be interested in sourcing of your supply (maize)? What you be the requirements, terms and conditions and others?
4. How much do you do you pay for the maize?

Products	Quantity	Unit	Price/Unit
Maize			

5. What is the annual demand of the maize?

Products	Quantity	Unit
Maize		

6. What is the quantity of maize imported in a year?

Products	Quantity	Unit
Maize		

7. What are the issues and problems?

Annexure 10: Questions to FCB

1. From where do you get your supply?

2. How much do you do you charge for each maize product from the delivery point?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			

3. Where do you deliver your products?

4. What is the selling price of the products?

Products	Quantity	Unit	Price/Unit
Maize			
Kharang			

5. What is the annual sale of each of the products?

Products	Quantity	Unit
Maize		
Kharang		

6. What are the issues and problems?

Annexure 11: RNR Extension Officers

a) What are the production potentials of the gewog in maize production in terms of number of HHs engaged, area under maize production and annual production?
b) What inputs and supports are required to exploit the potential?
c) What are the Inputs Demand and Supply situation for maize production? (Varieties of maize, fertilizers, PP chemicals)
d) How can we improve this situation?
e) What will be the impact of this situation?
f) What changes has taken place during the last five years in production and consumption of maize products?
g) How do people market their maize products?
h) What will be the major maize products from the gewog?
i) What are the issues and challenges in maize production?