

Production Efficiency of Offseason Chili Value Chain in Punakha District



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Production Efficiency of Offseason Chili Value Chain in Punakha District

A Research Project Submitted to Van Hall Larenstein University of Applied Sciences in partial fulfilment of the requirements for the degree of MSc in Agricultural Production Chain Management, specialisation in Horticulture Chains

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Dedication

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Abbreviation

ASSR	Agriculture Sales and Service Regulation
BAFRA	Bhutan Agriculture Food Regulatory Authority
BCR	Benefit Cost Ratio
CBA	Cost Benefit Analysis
CNR	College of Natural Resources
DAMC	Department of Agriculture and Marketing Centre
DAO	District Agriculture Office
FAO	Food Agriculture Organization
FCB	Food Corporation of Bhutan
FFS	Farmer Field School
FMCL	Farm Machinery Corporation Limited
GAP	Good Agriculture Practices
ISO	International Standard Organisation
Kg	Kilogram
Km	Kilometre
LG	Local Government
Masl	Meter Above Sea Level
MoAF	Ministry of Agriculture and Forest
MT	Metric Ton
M ²	Meter Square
Nu	Ngultrum (Bhutan Currency)
RGoB	Royal Government of Bhutan
SPSS	Statistical Package for Social Science
SWOT	Strength Weakness Opportunity Threat
SMEs	Small Medium Enterprises
Sq. Km	Square Kilometre
USD	United State Dollar
VCA	Value Chain Analysis

Unit Conversion

1 Acre	0.405 Hectare
1 Decimal	435.6 sq. ft
1 Euro	78 Ngultrum (Exchange rate on 28/08/2019)

Abstract

The objective of this research was carried out to explore the current situation of chili value chain and economic efficiency of offseason chili production in Punakha district, western Bhutan. The study primarily aimed at value chain analysis and economic feasibility of offseason chili production, to advise district agriculture office the area of intervention and strategies to upgrade offseason chili production in Punakha district. The study was carried out in Bapisa, Guma and Kabjisa blocks under Punakha district. The data were generated using structured questionnaire for survey and checklist for interviewing the chain supporter to gather on constraint and potential of producing chili in offseason and. This study was carried out based on a case study using both qualitative and quantitative approaches. 30 smallholder offseason chili growers were selected using purposive sampling and 30 peak season growers were selected randomly. The data was analysed using Microsoft excel and Statistical Package for Social Science (SPSS) version 25. Triangulation and data validation were conducted by using various journals, books, reports, and websites.

The value chain analysis mainly focuses on identifying the relationships among actors involved in the chain. The enabling and hindering factors of supporters were identified by analysing their role and gap in the chili value chain. The Marketing channel was identified with the value and profit shares for actors involved in the chain. Cost benefit analysis was also conducted to see the commercial viability of offseason chili. Value chain analysis was used as a tool to describe the role of actors, supporters and enablers involved in the chili value chain. Value share and profit margin of each actors were calculated to indicate the economic efficiency of growing offseason chili.

About 47% (N=30) of the growers have less than two years of experience in growing offseason chili and only 7% for four years. It was found that the experience of growing offseason chili was highly correlated to income generated from sale of offseason chili. Indian chili variety IR-8 was selected for offseason and local variety Bogap Ema for peak season. Offseason chili are grown inside a low-cost plastic greenhouse and the size covers only (100 m²) and peak season chili were grown in open area covering (2024 m²). The average land holding size in study was 1.77 acres. The reasons for growing offseason chili was mainly due to high market demand 62% (N=30) and 55% (N=30) were due to high price in the market. The grower agreed that the major challenges due to high infestation of pest and diseases with 49% (N=30) growers agreed to it. About 30% said it was due to the cold and unfavourable climate in the winter and 14% of the growers mentioned it can be due to limited experience to grow offseason vegetables.

The study found out that the main actors involved in the chain were input supplier, smallholder producer, local trader, wet market retailer and consumer. The main chain supporter was district agriculture office (DAO), extension agents, agriculture research development centre (ARDC) and Bhutan agriculture food regulatory authority (BAFRA). The producers hold the highest value share in peak season with 61% and 81% in the offseason. The profit share for the retailers was highest in peak season with 52%, producers take the profit share of 29% and traders only take 19% of the total profit share. Even in the offseason, retailer takes the highest share of 53% and producers take 43% of the total profits. The benefit-cost ratio (BCR) for Bogap Ema was 1.21 and 1.16 for Indian chili IR-8, which indicate that chili cultivation for both the season is feasible in the study areas. Therefore, there is need to streamline the linkages and collaboration with the chain supporting to upgrade the efficiency of offseason chili to fill the acute shortage of chili.

Key word: chili, offseason, peak season, value chain, benefit-cost ratio, chain actors, value share, profit share

Chapter 1: Introduction

1.2 Background information

Bhutan is a small landlocked mountainous country situated in the southern slopes of Eastern Himalayas that lies between latitudes 26° 45'N & 28° 10'N and longitudes 88° 45'E & 92° E. The forest covers about 70.46%, arable land 2.93%, meadow land 4.10%, shrubs land 10.43%, snow cover land 7.44%, and bare area 3.20% of the total geographical area of Bhutan. The country's total geographical area is 38,394 square kilometres with a population of about 727,145 (NSB, 2018). Bhutan has only 2.93% of agriculture cultivated land where 69% of the populations depend on agriculture. Majority of the population are subsistence farmers who depend on agriculture and livestock for their livelihoods. Due to a rugged landscape (limited agriculture land) and extreme climatic surroundings (short growing season), severely effects agricultural activities in the country is (FRMD, 2018).

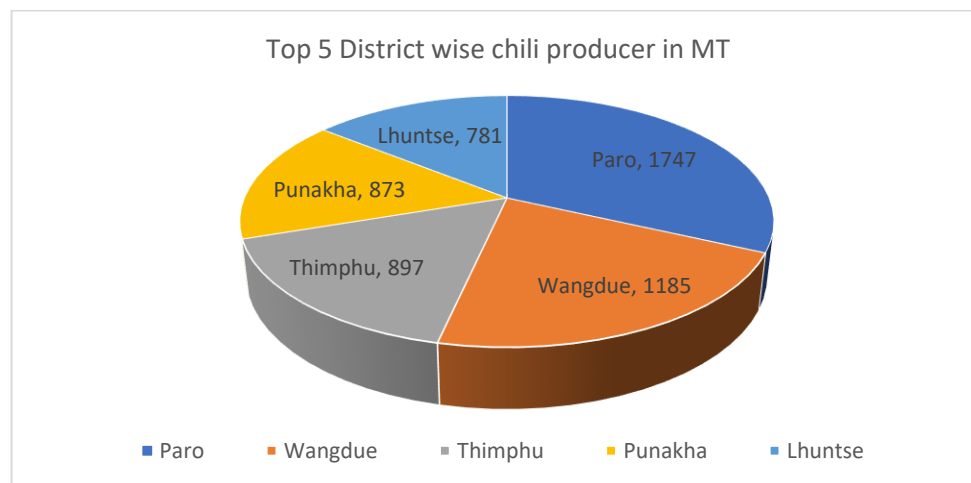
Chili is cultivated in all districts in Bhutan. Farmers consider chili as an important cash crop, as the income are higher, and potential to achieve profit in one growing season. Till lately, chilies were generally grown at a small scale (kitchen garden) with a limited input. Nevertheless, farmers in areas such as Thimphu, Punakha, Paro, and Wangdue district have progressed growing chilies on a commercial scale (NBC, 2015). Varieties of chili which are cultivated in Bhutan are Indian chili IR-8, SV2319HA, SHP4884, PAN1498 and Sha ema (NSC, 2018). In 2017, the total chili production in Bhutan was 13,606 MT and Punakha district alone has produced 873 MT (Bhutan Agriculture Statistics, 2018).

In 2016 the government of Bhutan banned the import of chili from India due to high pesticide residue and farmers in Bhutan are not able to produce enough chili during the offseason leading to a shortage of chili supply in offseason (BAFRA, 2016). The government of Bhutan imported chili from certified producers from India and the record kept by agriculture ministry states that within January and March 2017, a total of 157.89MT worth about 57,532 USD of green chili were imported from India to meet the demand during the offseason (Kuensel, 2017).

To encourage farmers to produce offseason vegetables, the ministry has invested 28,779 USD to supply continuous inputs to farmers and farm machinery with protected cultivation technologies and high yielding seeds from the national vegetable program. The department of agriculture marketing and cooperatives (DAMC) has allied farmers with the wholesaler and vegetable vendors in capital Thimphu to bring the fresh chilies to Thimphu (Kuensel, 2017).

The farmers in the district as Thimphu, Punakha, Paro, Lhuntse, and Wangdue are the top five chili growers on a commercial scale (Agriculture Statistics, 2016). Figure 1 shows the top five chili producers in the year 2016, where Punakha district is ranked fourth chili producer in Bhutan. Therefore, this indicates that the Punakha district have a great potential to be important supplier of chili in Bhutan.

Figure 1: Top five chili producer in Bhutan for the year



Source: (Agriculture Statistics, 2016)

This study will focus on developing chili chain map as there is no documented chili value chain map in Bhutan and it will also focus on the efficiency of growing chili in offseason. This study will be able to understand the driver that determines the production of chili in offseason, constraints, and opportunity for various stakeholders to upscale the chili value chain.

1.3 Problem Statement

Chili is one of the important foods in Bhutanese's diet and it's widely grown throughout the country, but a substantial amount of chili was imported from India during the winter (NBC, 2015). In 2016, import of chili was banned by the government of Bhutan due to high pesticide residue (*Pyrethroids and Carbonate*) in imported chili from India (BAFRA, 2016). Bhutan is an agrarian society with 69% of its population depending on agriculture, Bhutan is facing an acute chili shortage, especially during offseason from the end of November till April, because domestic production is not able to meet the demand after the import ban of chili. More than 10 Metric Ton vegetable worth 15 million USD were grabbed from the smuggling following the ban of chili, bean, and cauliflower in the country from 2016 till December 2018 (Wangchen, 2019). The country not being able to meet the demand is becoming a threat to food self-sufficiency. However, some farmer in Punakha district has adapted to grow Indian chili IR-8 a cold resistant variety, but more than 50% of the crop was lost to chilling injury and some were damaged by frost, thus the economic efficiency of producing chili in offseason is unknown. Therefore, there is a need to conduct study on gaps and opportunity of producing chili in offseason and identify areas of intervention to upscale chili productivity and marketing during the offseason.

1.4 Problem Owner

District Agriculture Office plays a key role in enhancing sustainable rural livelihood through innovation agriculture, market access, and commercialization of farming. Securing access to food has been a principal policy goal of the Royal Government Bhutan for several years and in the twelve five year plan the government pledge to address poverty through enhancing food security through increasing food availability with secured access to food. To achieve food security government started to provide inputs at a subsidized rate, training to farmers and support services from extension agents. Hence, District Agriculture Office plays a crucial role in enhancing the food security by helping farmers to produce more and College of Natural Resources is only institute under Royal University of Bhutan who offers Diploma and bachelor's degree in agriculture, therefore institute can play a vital role by conduction research on innovation agriculture and climate-smart agriculture to combat the food insufficiency in Bhutan.

1.5 Objectives of the study

The objective of this research was to study the current situation of the chili value chain and efficiency of producing offseason chili, to advise District Agriculture Office of the areas of intervention to upscale the offseason chili production in Punakha District.

1.6 Research Question

1. What is the existing structure of the chili value chain in Punakha district?

Sub-questions

- What are the responsibilities of actors and stakeholders in the chili value chain?
- What is the hindering and enabling factor in the chili value chain?
- What is the value share and profit margin shared by the actors along the chain?
- What is the dimension of gender in the chili value chain?

2. What is the reason that facilitate the adoption of growing offseason chili?

Sub-questions

- What is the farmer perception towards offseason chili production?
- What are the drivers that determine for growing chili in offseason?
- What is the economic efficiency of growing offseason chili in Punakha district?
- What is the sustainability for farmers producing and marketing chili in the off-season?

1.6.1 Limitation and scope of the study

The study limits to an area of coverage and depth information due to limited time. The results reflected in this report need to be considered with some point of limitation because the data was collected only from three blocks. Therefore, repetition of the finding may not resemble to another region in the district and other district.

The important limitation in this study which could be explored in future research is this study focuses only on factors effecting the efficiency and competence of growers to produce offseason chili. There is a scope to conduct study on adaptability of high yielding varieties in higher altitudes to diversity the products.

The finding of this result will help all the stakeholders to put more efforts on the gaps that will help to upgrade offseason chili growers. The new chain map developed from this study will ease the better coordination of chain actors and strengthen the function of all the supporters.

1.7 Definition of the Concept

1.7.1 Value Chain

Michael Porter defined the term “Value Chain as a representation of a firm’s value-adding activities, based on its pricing strategy and cost structure” (Urbig , 2003). Vermeulen, et al., (2018) have also mentioned value chain as a categorisation of all the activities that can create a product or provide a service to the society. The people involved in the activities are the input suppliers, producers, traders (wholesalers and retailers), processors and consumers. Katie D (2014) stated that enhancing the value chain approach helps to spread the risk and offers essential services to a community.

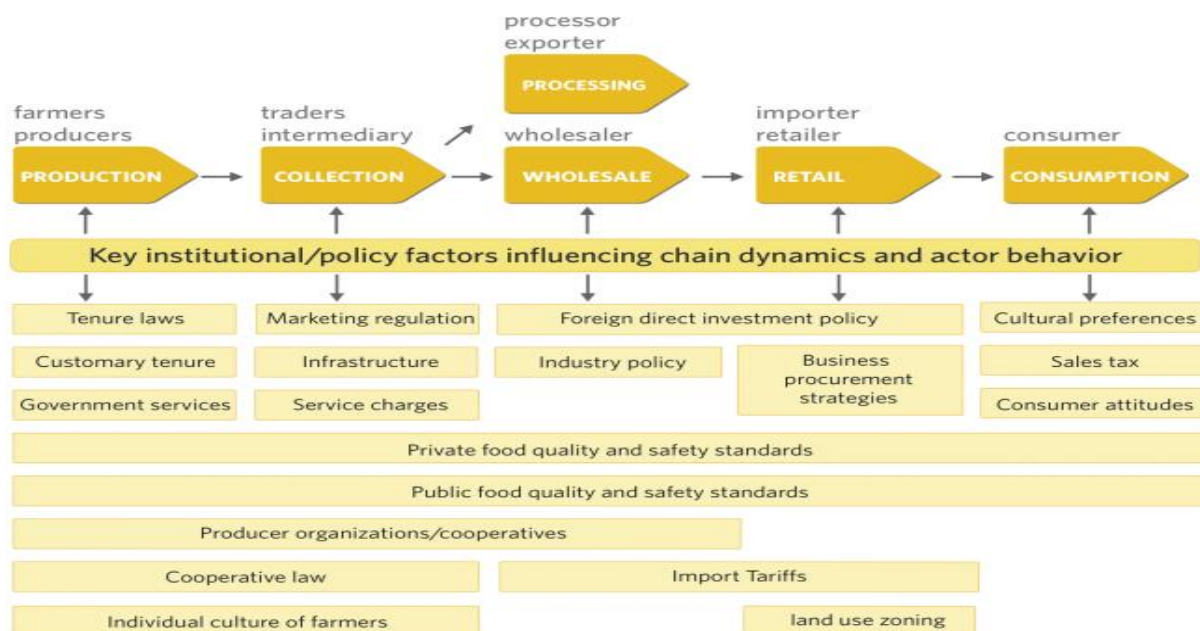
1.7.2 Value chain Analysis

Kumar and P.V. (2016) have mentioned “Value Chain Analysis as an association of the enterprises who collaborate vertically in a chain to accomplish a rewarding position in the market.”

Value Chain Analysis can be used to frame competitive strategies, and know the basis of competitive advantage, and recognise the linkages between the various activities in a chain that creates value (Ensign, 2001).

Joshi and Gurung (2009) also described that value chain analysis can help to reduce postharvest losses and save the cost of transport. VCA is a tool that can be used to examine the current situation of the chain and identify the area of intervention to upscale the chain which can be accomplished by strategic planning to maintain the opportunity and uniqueness of the value chain to achieve sustainable development goals. Value chain development model for this study was adopted from (Centre International for Tropical Agriculture , 2012) illustrated in figure 2.

Figure 2: Value chain development model



Source: Adapted from Centre International for Tropical Agriculture (2012)

1.7.3 Smallholder Farmer

Smallholder farmers are that farmer possessing limited plot of land less than 2 hectare. Farmer use those land to grow crops mostly for home consumption. Farmer grow one or two cash crops depending upon on size of family labour. The important characteristics of production systems adopted by smallholder farmers are simple, out-of-date technologies, low returns, high seasonal labour variations and women playing a vital role in production (DAFF, 2012).

1.7.4 Strategy

Nickols (2011) have defined as identification of realistic goal and objectives of any firm by adopting a specific progression of action and precisely allocating the resources for achieving those goals and objectives.

1.7.5 Upgrading

Gibbon (2001) mentioned upgrading as any enterprise who try to shift into higher activities in a chain to benefit the people involved in chain. Those activities can be only achieved by improving the linkages between the stakeholders and institutions to direct the strategies, introduction of technology and innovation.

1.7.6 Business Sustainability

Formentini and Taticchi (2016) defined business sustainability as the capability of any enterprises or firms to successfully adapt business with a long-term vision on the welfare of people, planet and profit.

Chapter 2: Literature review

2.1 Upgrading value chain to improve efficiency of chain

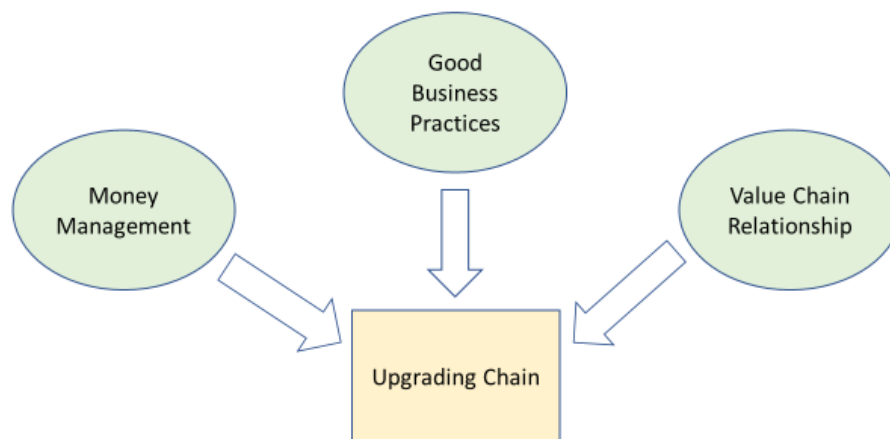
Wang (2012) stated that upgrading value chain support to progress the efficiency and competence of the chain. It will enhance product diversification; upgrade progression of anti-season crops and advance the functioning and integration of the chain actors and and provide the producer-oriented chain structure by reducing the gap between producers and consumers. To assist farmers to gain more profit share, contract farming can be a better resolution for the famers, however the size of companies may bound the involvement of contract farmers. Non-contract farmers can try to find for joint actions with their supporter or stakeholders to overcome the cost of productions and improve their accessibility to market and bargaining power. This is in line with finds of Wang (2012)

Trust building among key players a relation between the different chain actors, supporters, influencers and facilitators, and the involvement of private partners and stakeholders are the key condition for strengthening the value chain partnership. Partnerships on the Value chain can facilitate to bring changes that are desirable for the inclusion of small producers and small and medium enterprises (SMEs) in value chains (Drost, 2012). Small producers and SMEs should be properly organized to develop their capacity to be able to supply volumes, quality, and guarantee to supply regularly. Thus, partnership and collaboration can facilitate to share the risk, sharing of resources, create enabling environment for collective learning, and develop market power (KIT, et al., 2006).

Management of capital, selection of business strategies, and networking partnership as three important actions in upscaling the chain Manfre and Sebstad (2010).

1. Money management action include the savings and wise expenditure for upgrading;
2. Business strategy includes those related to the adoption of aspiring business/agricultural innovation practices and the adoption of technologies and adopting business models that support access to inputs, services, and markets.
3. Value chain relationships include both horizontal and vertical coordination that will allow developing wider commercial networks, access into new marketing channels, and enhanced information flow and trust building.

Figure 3: Behaviours related to upgrading value chain



Source : Adapted from Manfre, C. and Sebstad, J., 2010.

2.3 Achieving sustainable development through value chain approach

Gupta and Vegelin (2016) specified sustainability along on three aspects 1) Environmental inclusiveness, 2) Social equity and 3) Economic prosperity. The environmental aspect focuses on the preservation of natural earth like air, water, land, and ecosystems as well as the effective management of biodiversity. Social equity facilitates in providing an equal opportunity to all the human and equal sharing of transboundary resources. Economic prosperity guide in creating equal economic opportunity for both the enterprise and its stakeholders. While developing & implementing strategies for development all the enterprise must accept broad and holistic approach so that their strategies and goal must cover all three Ps of sustainable development goal i.e. People (Society), Profit (Economy) & Planet (Environment) Tan and Zailani (2009).

The value chain analysis will help to deliver an equal opportunity to learn and contribute to create value, value actions, and relationships among the stakeholders. Thus, it reduces the excessive use of other resources and helps to be able to build a competitive advantage with available resources. Competitive advantage can help to construct various dimensions like total quality management, capital management, organized learning, and innovative production. All these can help in bringing efficiency and effectiveness in the organization and thus, it fulfils the economical responsibilities Sultan and Saurabh (2013).

2.4 Governance Structure

Formentini and Taticchi (2016) has mentioned that governance structure should take responsibility to make decision which will benefit the chain actors in long term, and it requires a depth acquaintance on the integration of chain governance for sustainability of value chain. Analysis of chain governance will help in recognising how the whole chain is controlled when some actors in the chain become more powerful than others. The governance of the chain is classified into two category producer driven and buyer driven chain where producer driven chain are vertically integrated in the chain and buyer driven chain are dominated by buying power of rich retailers and supermarkets Gereffi and Fernandez (2011).

2.5 Legislation and Policy Review in Bhutan

As per the Food Act of Bhutan (2005), all the food which are imported into Bhutan should be certified by the standard authority from the exporting nation and imports are permitted through an officially designated border point. The Act subjects all food businesses in Bhutan to meet the standards for health and safety of the people. The Pesticides Act of Bhutan (2000) mentioned, "An authorized pesticide must only be used by complying with professional practice. Good professional practice must in consideration of careful observation of the guidelines issued by the Board. The ideologies of integrated pest management must be adopted as priority. A person may sell a pesticide only if the premise where the pesticide is kept is licensed under this Act".

According to Royal Government of Bhutan (2018), the leased land for commercial agriculture shall be utilized within two years from the date of approval. The proponent shall submit the project proposal for commercial agriculture farming to the Ministry of Agriculture and Forest (MoAF). The concerned Department or Agency under MoAF shall review the project proposal and carry out the technical assessment on the suitability of the proposed lease for commercial agriculture farming within one month from the receipt of the application. For the short-term lease, the maximum lease is for three years and for the long-term lease is permissible for thirty years and after the term, the land must be handover to the local authority.

2.6 Effect of Vegetable Production on Farmer Income

An income determines the purchasing power at households' level, as high-income level can meet basic social services and have a more comfortable life. According to Schutzbank (2012), the market of a farmer is time intensive and risky, but it generates a higher return to households' income through the sale of vegetables. This indicates that vegetable production has a significant positive contribution towards raising the household's income. As per Josh, et., al (2006), vegetable production diversification is the emerging sector in agriculture farming system as it generates a household's income and creates more employment for rural communities.

According to Dorji (2014), the self-sufficiency of vegetable production stands only at 60 %, after the awareness campaign led by the Ministry of agriculture on importance of growing local food and incentives were provided to farmers in a form of production as well as marketing to encourage large scale production. The success was credible as an income of 8.04 Million USD was generated from the sale of vegetables compared to the expenditure of 6.16 Million USD in the same year. Vegetable production plays a vital role in enhancing the livelihood of rural and urban peoples. The increase of crop diversity in the integral agriculture will add to an increase in its production and generate cash income and create employment opportunities to rural communities. Schreinemacher, et al., 2016 stated that producing vegetables out of their cropping calendar when supply is low, and the price is higher, can give better profits to the farmers and more choice to consumers.

2.7 Factors Determining the Production of Offseason Vegetables

2.7.1 Good Agriculture Practices (GAP) and Food Quality in Chili Production

FAO (2016) defines GAP's as a "set of principles which are important to apply on-farm production and postproduction processes, to ensure the safety of food and non-food agricultural products, considering the economic, social and environmental sustainability." In addition, implementing GAP also help to promote sustainable agriculture and contribute to establishing the national interest in environmental conservation together with social development. A smallholder farmer who received training on healthy seedling production, cultivation techniques, and management of pest and disease by implementing integrated pest management has shown better in term of production and profit from growing vegetables in offseason compared to the non-trained farmers in Bangladesh (Schreinemacher, et al., 2016).

In Indonesia, many farmers reported that despite chili farming being a profitable business, but the price variations for inputs and high amount of crop loss to pests and diseases, were the main drivers affecting the farmers' decision for not to grow chili (Mariyono, 2009). According to the study conducted by Divya and Sivakumar (2014), the main limitations confronted by the chili growers in Tamil Nadu, India were the insufficient knowledge on good agriculture practices, increase in the cost of production and limited land size for a farmer. Table 1 shows the GAP's adopted by chilies grower in Tamil Nadu, India.

Table 1: Good agriculture practice for chili cultivation

Sl.no	GAPs Adopted in Chili Cultivation
1	Certified seeds
2	Seed treatment methods
3	Follow nursery farming
4	Not using untreated as fertilizer
5	Avoiding toxic chemical fertilizer
6	Picking the pod upward while harvesting
7	Exclude entry of rodents, pests, animals, and livestock from the growing area
8	Using proper packaging during for transport in the market
9	Exclude debris from packaging and cold storage by cleaning

Source: Adapted from Divya and Sivakumar (2014)

2.7.2 Gender Dimension in Agriculture Food Value Chain

Manfre, et al., (2013) stated that the examination of information on gender differences to identify their contribution in term of divisions on labour, resources management, challenges, needs, opportunities, and interests of various groups, which includes men and women, girls, boys, and transgendered persons, in a given context. It will help to understand how gender roles and relations can form opportunities for achieving various development goals. Gender comprises of economic, political, and socio-cultural qualities, challenges, and opportunities associated with being women and men.

Women contribution to the agriculture start right from production till the marketing level, despite such contribution most of the women lack appropriate information for improved/innovative production and technical competency. Women are found to have limited access to participation in record keeping, leading household and attending training on farming and operation of farm machinery compared to our men Adeola and Ayoade (2011). The women contributions towards the value chain development usually remain underprivileged throughout the value chain, and their productive potential remains unacknowledged. The balanced combination of women in value chain development can generate various linkages between the value chain to take advantage of new market opportunities together emerging food value chains (Emmanuel, 2018).

2.7.3 Income Level and Accessibility to Credit

The higher the income level of farmers, higher is the possibility of adopting climate-related timing approaches, by adoption of technologies such as plastic mulches, greenhouse, organic pesticides and irrigation technology which requires substantial investment of financial resources Accessibility to credit was has positive influence in the possibility of a farmer's adoption on innovation and climate-smart farming. This is because if farmers are access to financial resources it enables them to purchase improved varieties that suit the changing environment and they can hire labour Knowler and Bradshaw (2007).

2.7.4 Agroecological Zone and Fertility Status of Soil

Agro-climatic factors directly influence the planting time, life cycle of crops, infestation of new pest and diseases, farming pattern and the productivity of crops. According to Katwal (2013), the agriculture production environment in Bhutan is challenged due to temporal and spatial difference in climate. The growing season, temperature, rainfall pattern widely varies over short distances in a locality because of mountain and valley. In the higher altitudes, early initiation of forest and cold reduces the growing season of crops and in subtropical hailstones and drought are found to be more disastrous to crops. Therefore, there are greater challenges to identify suitable technology that suit the different agroecological zone.

2.8 Value share analysis

According to Mendoza (1995), the total gross marketing margin is always related to the price paid by the final consumer and expressed in percentage. To calculate the value share and profit share of value chain actors per kg the following formula was employed.

Total Cost= Purchase price + Marketing Cost

Value Added= Selling Price - Purchase Price

$$\text{Value Share} = \frac{\text{Actor's Value Added}}{\text{Total value added along the chain}}$$

Actors profit = Selling Price – Total Cost (Purchasing Price+ Marketing cost)

$$\text{Profit share} = \frac{\text{Actor's Profit}}{\text{Total Profit along the chain}}$$

2.9 Cost benefit analysis

The following profit equation was adopted from Hoq and Omar (2014) to assess the economy analysis of Chili production in the offseason.

Net return/profit of the producer

$$\Pi = \text{PF} \cdot \text{QF} - (\text{TVC} + \text{TFC})$$

Where Π = Profit of producer

PF = Per unit price of green chili (Nu/kg)

QF = Quantity of green chilli (kg/ac)

TVC = Total variable cost of green chili producer

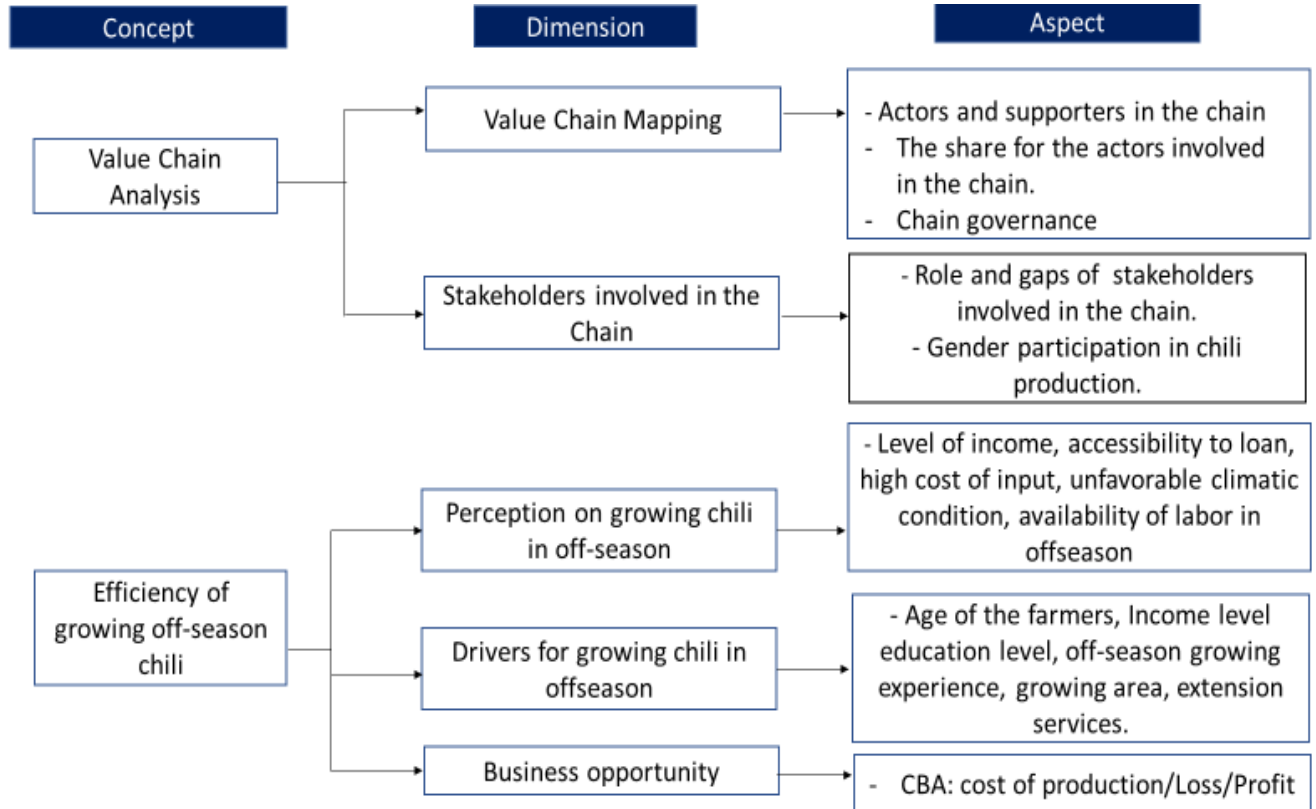
TFC = Total fixed cost of green chili producer

Benefit cost ratio=total benefit/total cost

2.10 Conceptual framework

The main concept of the study was to understand the value chain of chili and economic efficiency of growing chili in the off-season in Punakha district. Value chain analysis was used as a tool to describe the role of actors, supporters and enablers involved in the chili value chain. Value share and profit margin of each actors were calculated to show the economic efficiency of growing offseason chili. An economic analysis was also conducted to compare cost-benefit return between chili grown peak season and off-season. The overall framework is explicitly mentioned in figure 4.

Figure 4: Conceptual framework



Source: Adapted from Regoniel (2015)

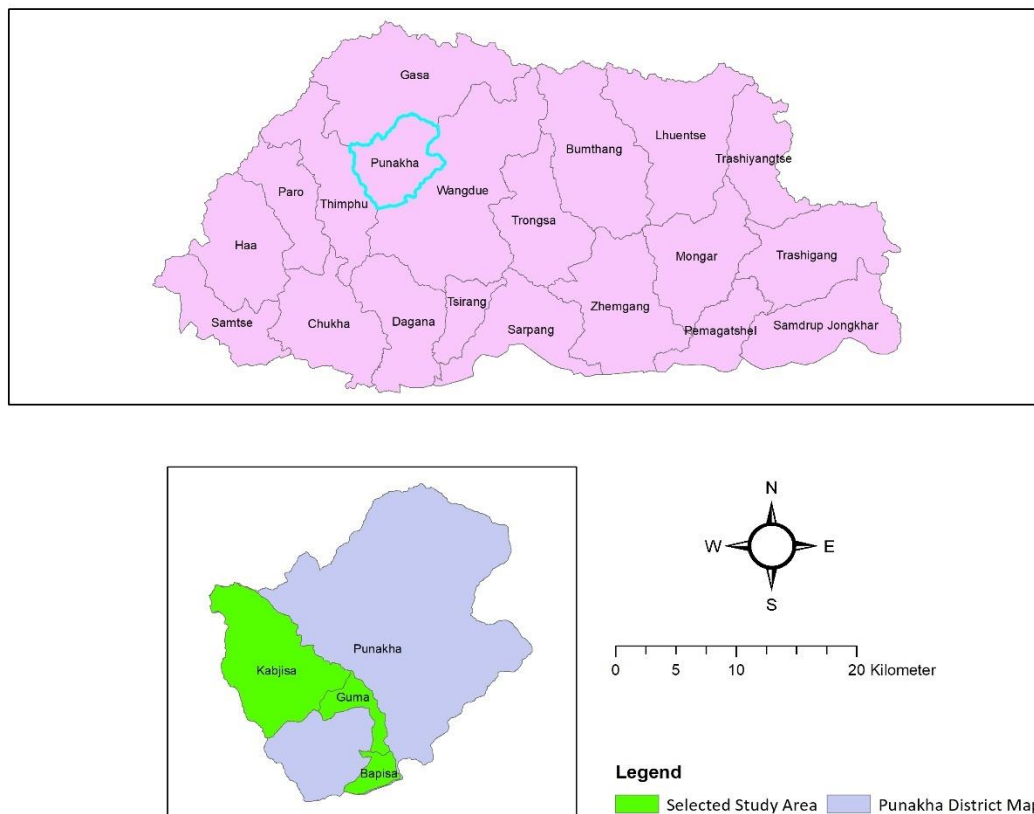
Chapter 3: Research methodology

3.1 Description of selected study area

Punakha District is located in the Central-Western part of Bhutan and it consists of 11 blocks and 3506 households with a total population of 28,740 (NSB, 2018). The total area of a district is 1,109.81 sq. km. The main soil types found in the district are sandy, sandy loam to clay and are in general fertile and good for agriculture. The average mean temperature for the warmest months of June and July is about 26°C and the mean temperature for the coldest month of January and February is below 5°C (Bhutan Agriculture Statistics, 2018). The study was carried out in Bapisa, Guma and Kabjisa blocks under Punakha district, as indicated in the map given below in figure 6. The people cultivate rice, wheat, maize, potato, chili, and barley are important annual crops (FRMD, 2018).

Bapisa block has a cool sub-tropical to a temperate climate with altitude ranging from 1300 to 1800 meters above sea level (masl) and Guma and kabjisa block ranges from 1200- 2400 masl. The total arable land in Bapisa block is 974.78 acres with 271 households and villages connected to 16.95 km farm road, total arable land in Guma is 1388.5 acre with 485 households connected by farm road of 65 km. Kabjisa block has total arable land of 1263.26 with 474 households connected by 33 km farm road. All the blocks are accessible to the extension service centre and market shed to sell farmers vegetables (NSB, 2018).

Map 1: study area

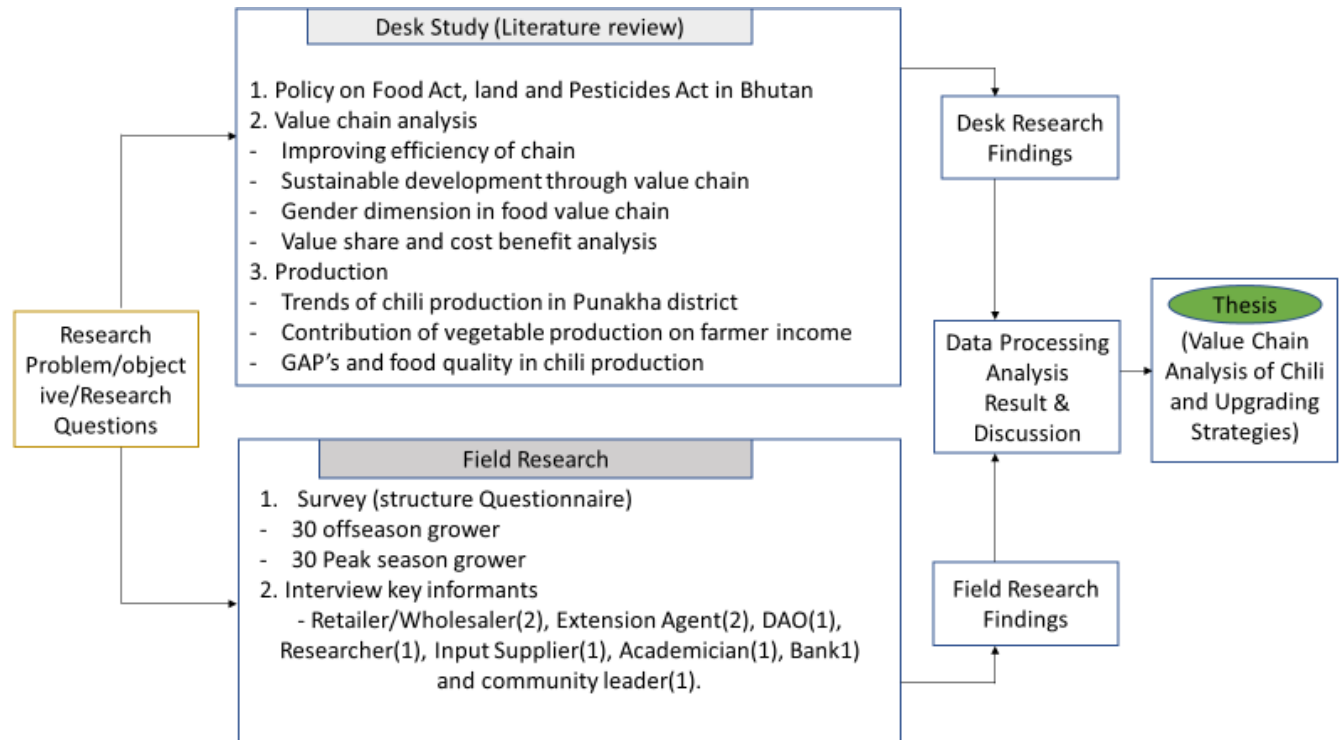


Source: Extracted using ARC GIS

3.2 Research framework

The outcome of this study was based on field study and desk research. For field study, a structured questionnaire was prepared for a farmer's survey and checklist to interview key informants, the detail research framework is illustrated in figure 5 given below.

Figure 5: Research framework

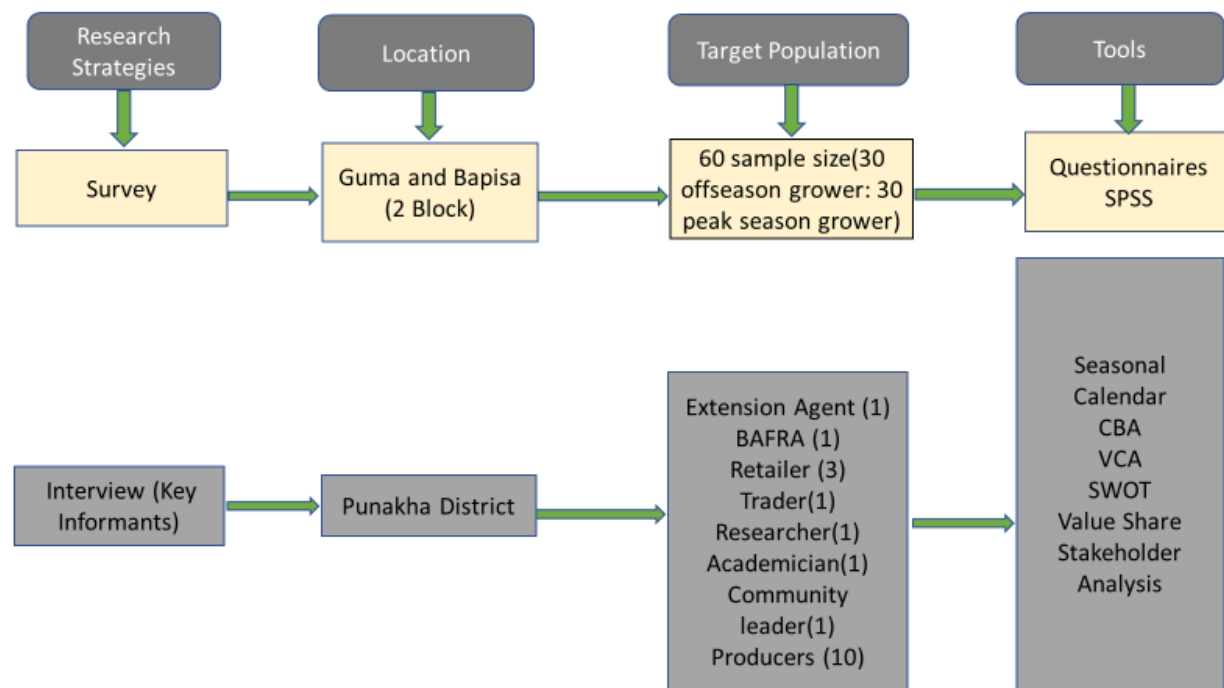


Source: Adapted from Presentation of Pleun van Arensbergen (2019)

3.3 Research design and sampling method

This study was carried out based on a case study using both qualitative and quantitative approaches. 30 smallholder farmer who have already adopted growing chili in winter were selected using purposive sampling and 30 farmer who produced chili in peak season were selected using excel to randomly select from a household list such method assures representatives of population and cost-saving (Anderson, et al., 2011). The community leaders, professionals, firms, and companies who have in-depth knowledge about the community and those involved in the chain will were selected as key informants for interview to investigate the research problem in depth and the detail research design are illustrated in figure 6.

Figure 6: Research design



Source: Adopted from Presentation of Pleun van Arensbergen (2019)

3.4 Data collection

The quantitative data required for this research were collected from Bapisa, Guma, and kabjisa block through survey questionnaire (**see appendix 1, pp.49-52**) and checklist (**refer appendix 2, pp.53-55**) were used for interviewing key informants to gather constraint and potential of producing chili in offseason and in the peak season. Triangulation and data validation were done by using various journals, books, reports, and websites. Ethical clearance was received from DAO to collect data from the selected study area (**Refer appendix 3, p.56**)

3.5 Secondary information

3.5.1 Desk study

Prior to going into the field for data collection preparatory activities such as gathering of secondary information which includes the current statistics of chili production, the background of the problem, description of the study and government policy's on land, food, and agriculture was collected from report compiled by the Ministry of Agriculture and Forest (MoAF) and RNR statistics journal with consultation from supervisor. The research articles, books, and reports were used to understand the concept of research and the strategies for upgrading value chain and marketing systems and support service structures. The literature was reviewed to understand the potential of producing chili during the offseason and search for cases on drivers to upscale offseason productivity.

3.6 Primary information

3.6.1 Survey

Survey questionnaires were prepared to collect quantitative data from farmers which included only structured questions to obtain data such as general farming background and household characteristics, details of chilies farming pattern, quantity of input as well as quantity of output, prices, marketing of chilies, income and adoption of good agricultural practices and the problems incurred in chili production.

Figure 7: Survey with chili grower



Source: Field survey (Dorji, 2019)

3.6.2 Interview

As pointed out by Alshenqeeti (2014) open-ended interview creates better flexibility to the interviewee as well as to the interviewer, as it allows the interviewer to ask deeper by getting the opportunity to probe and interviewee get chance to speak out their own voice and express their thought. Thus, open-ended (unstructured question) were prepared to collect information from a wide range of people including community leaders, district agriculture officer, retailers, Bhutan agriculture food regulatory authority (bafra), researcher, academicians, and extension agents to gather their role in the chain and their challenges that hinder the function of a chain.

Figure 8. 1: Interview with wet market retailer



Source: Field survey (Dorji, 2019)

Figure 8.2 :Interview with stakeholder



Source: Interview (Dorji, 2019)

3.7 Data analysis

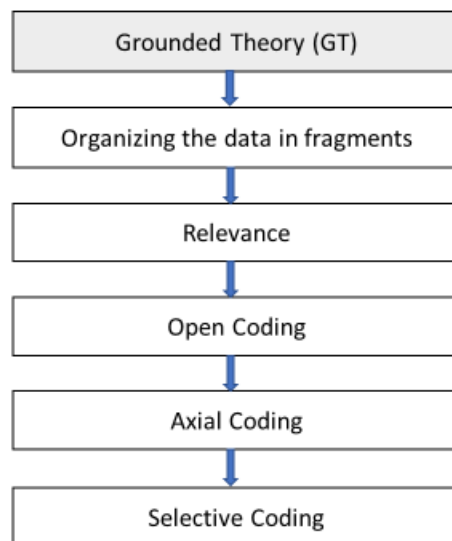
3.7.1 Quantitative data analysis

Quantitative data was analysed using SPSS version 25 and microsoft excel for tabulation, ranking and calculate the percentage of the respondents. Simple histograms, bar graph, and pie charts will be developed to illustrate the better presentation of the findings. Kruskal wallis test was used to find the significant difference for the income generated from offseason chili and peak season. One way anova was used to see the test significant difference for generated from offseason chili. Spearson correlation was conducted to see if the total household income effects the adoption of chili production during offseason.

3.7.2 Qualitative data analysis

The qualitative data from the interview and meeting minutes were analysed using grounded theory and the procedure for grounded theory is shown in figure 9. Other tools such as cost-benefit analysis was used to draw cost of production and revenue generated from producing chili and project the business opportunity for off-season chili grower. Value chain analysis was applied to come up with the gaps between the actors and stakeholders involved in the chili value chain and SWOT analysis to understand the strengths and weaknesses for the offseason chili growers.

Figure 9: Steps of processing data using grounded theory



Source: Adapted from (Baarda, 2014)

Chapter 4: Result

4.1 Demographic characteristics

4.1.2 Gender, education Level, and age

The study showed that the male respondents at 67% dominated the female respondents, which was only 33% (Table 2). Education is crucial for the adoption of any improved technology in agriculture. Over 48.3% of respondents were illiterate. Only 12% of the respondents had been to a high school. The dominant age group of the study area was from 76-67. The maximum age of the respondents was 68 years, while minimum was 25 years old. The average landholding was 2.17 (SD $\pm$ 0.867) acre in the study area, the minimum land holding was 1 acre and maximum 4 acres (See appendix 4, pp.57-58)

Table 2: Demographic information

Characteristics	Total respondent (N=60)				
	Barp	Guma	kabjisa	Total	Percentage
Gender					
Male	14	13	13	40	67
Female	11	4	5	20	33
Total	25	17	18	60	100
Education level					
None	16	7	6	29	48
None formal education	4	2	9	14	25
Primary Education	5	3	1	9	15
High School	0	6	2	8	12
Total	25	18	18	60	100
Age					
26-46	7	10	10	27	45
47-56	16	7	8	31	52
>68	2	0	0	2	3
Total	26	17	18	60	100
Landholding Size					
1 acre <	9	2	3	14	23
2 acres<	9	8	9	26	43
3 acres<	7	5	4	16	27
4 acres	0	2	2	4	8
Total	25	17	18	60	100

Source: Field Survey (Dorji , 2019)

4.2 Household income and their effect on offseason chili production

The average annual household income was Nu. 180,000, the mean of household incomes is higher than the corresponding median incomes which come to about Nu.150,000 (see appendix 5, pp. 58-59). Table 3 indicate the annual household income level in the study area.

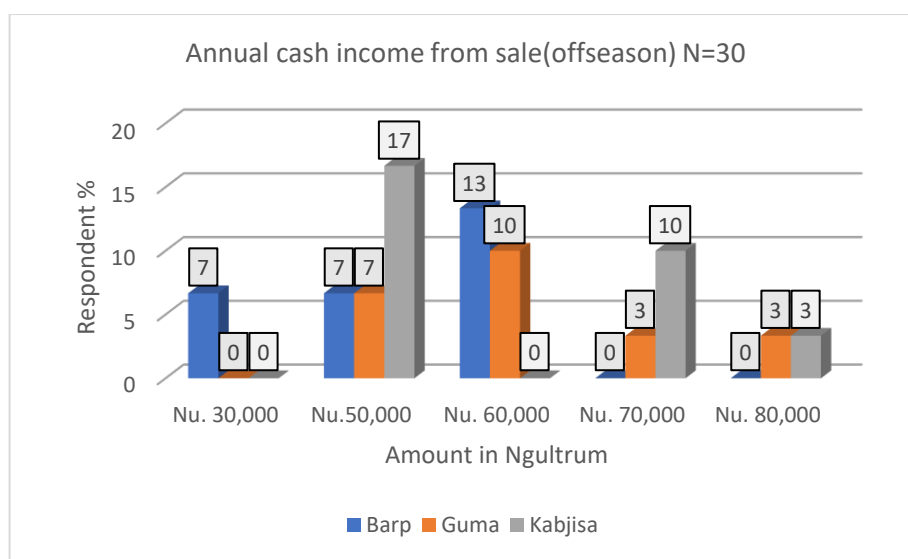
Table 3: Annual household income

Amount	Frequency (N=60)	Percentage %
100,000	17	28
150,000	22	37
250,000	10	17
300,000	11	18
Total	60	100

Source: Field survey (Dorji, 2019)

The one-way anova test showed that there was no significant difference with the income generated from sale of offseason in the study are $F(2, 27) = 0.069$, $p = 0.934$ as presented in appendix 6, p.59. As shown in figure 10 about 7%(n=2) of the offseason chili grower mentioned that their annual income from offseason chili was Nu.30,000, 31 % (n=9) earned Nu.50,000, 23%(n=7) earned Nu. 60,000, 13% (n=4) earned Nu. 70,000, 6%(n=2) earned Nu. 80,000 and 20% (n=6) growers said their income was zero because chili was mainly cultivated for self-consumption. Therefore, there was not difference in the income generated from sale of offseason chili in the study area.

Figure 10: Income from sale of offseason chili



Source: Field Survey (Dorji, 2019)

4.3 Experience of growing offseason

About 47% of the growers have reported that they had less than last two years of experience in growing offseason chili and only 7% for last four years (Table 4). This indicates that the offseason chili production has started in the last few years.

Table 4: Experience in growing offseason chili

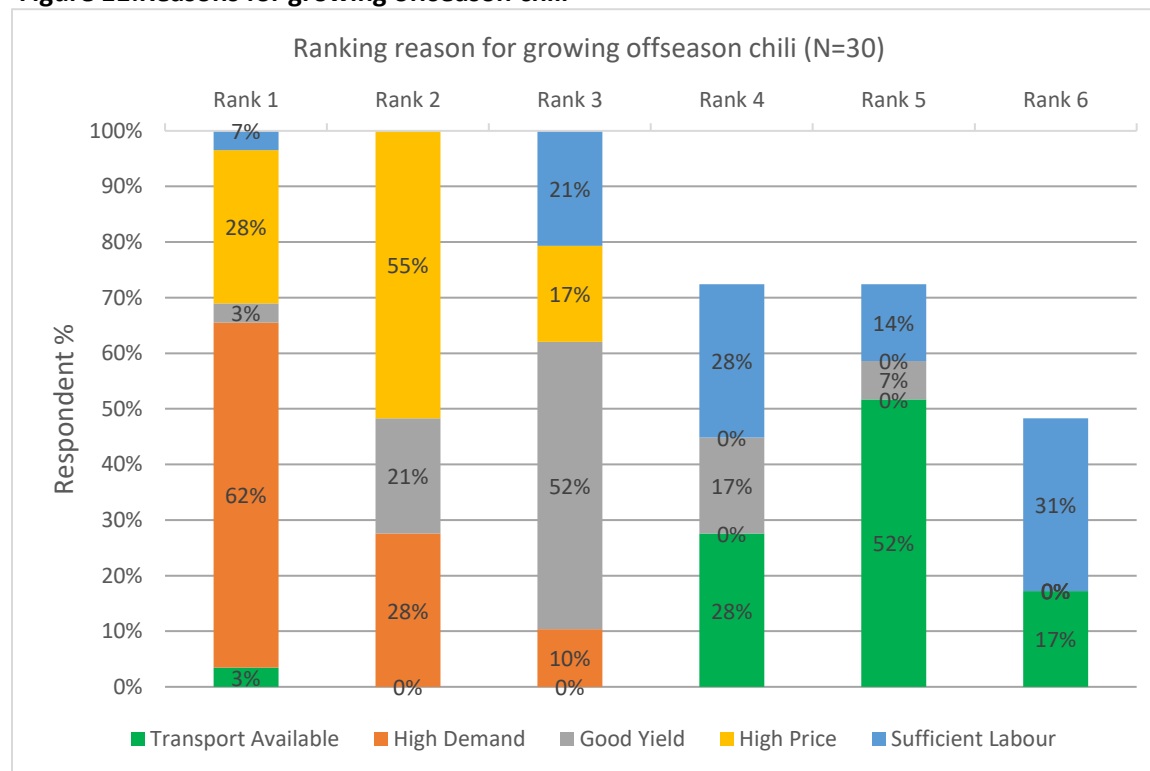
Particular	Frequency (N=30)	Percentage %
1 Year	18	27
2 Year	14	47
3 Year	6	20
4 Year	2	7
Total	30	100

Source: Field Survey (Dorji, 2019)

4.4 Opportunity for offseason chili production

Figure 11 indicates about 62% of the offseason chili grower claimed that the reason for adopting to grow chili during offseason was due to high demand in the market and due to high market price with 55% agreeing to it and this indicate the potential for growers to adopt offseason chili due to market demand and the price (see appendix 7, p.60).

Figure 11: Reasons for growing offseason chili



Source: Field Survey (Dorji, 2019)

4.5 Purpose of growing chili

Both the offseason and peak season chili grower stated that they mostly grow chili for cash with 47% respondents in the study area and 27% of the respondent stated they grow mainly for self consumption and surplus are sold in market (table 5)

Table 5: Purpose of growing chili

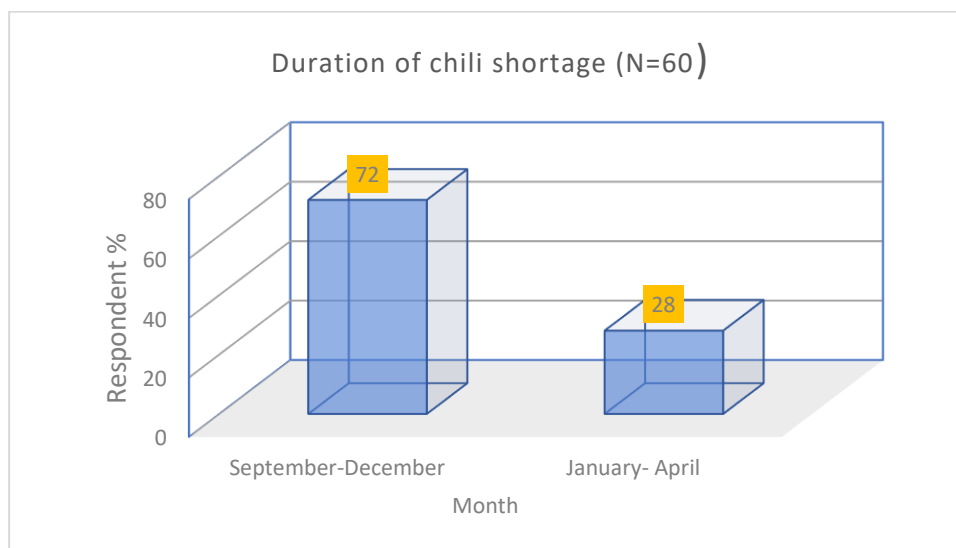
Purpose	Frequency (N=60)	Percentage %
Food	9	15
Cash	7	12
Cash but mostly for food	16	27
Food but mostly for cash	18	47
Total	60	100

Source: Field Survey (Dorji, 2019)

4.5.1 Chili self sufficiency situation

About 60% of the growers reported that they were not able to produce enough chili; instead, they purchase chili from another district during the offseason (**see appendix 8, p.60**). The study found that most of the farmers face food shortage during the month from September-December 72%, January-April 29% as shown in figure 12.

Figure 12: chili shortage in a year

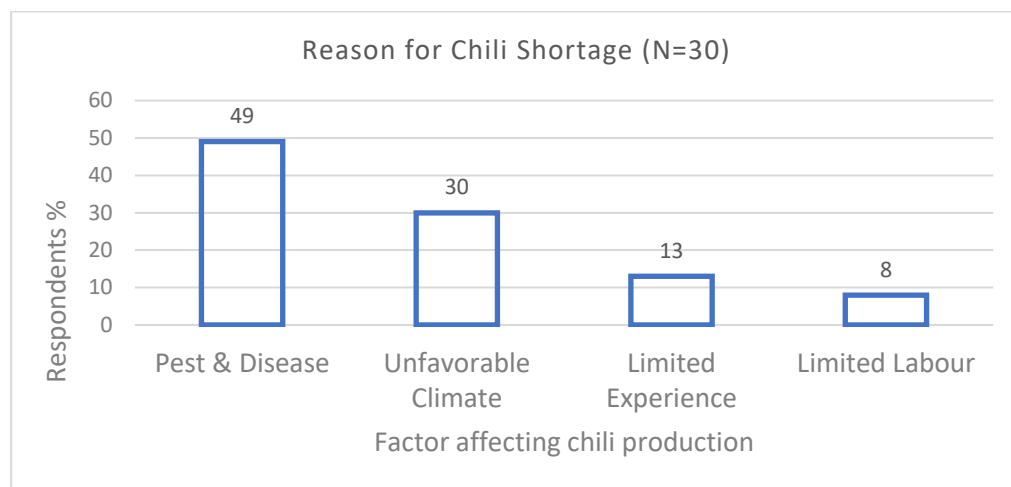


Source: Field Survey (Dorji, 2019)

4.5.2 Reason for shortage of chili supply

The study found reason for acute shortage of chili supply during offseason (winter) were due to high infestation of pest and diseases with 49% growers agreed to it , 30% said it was due to the cold and unfavourable climate in the winter and 14% of the growers has also mentioned it can be due to limited experience to grow offseason vegetables as illustrated in figure 13. The spearson correlation test showed that the experience in growing offseason chili is significantly correlated with income generated from offseason chili $r=0.228$, $p=0.225$ (see appendix 9, p.61). It indicates that the income was higher growers who had more experienced in growing offseason chili.

Figure 13: Reason for shortage of chili



Source: Field Survey (Dorji, 2019)

4.6 Adoption for offseason chili production

Only 33 % of the total peak season chili growers mentioned that they had tried to produce chili during offseason and 67% of the respondent stated haven't cultivated chili during offseason (table 6).

Table 6: Grower who adopted to grow offseason chili

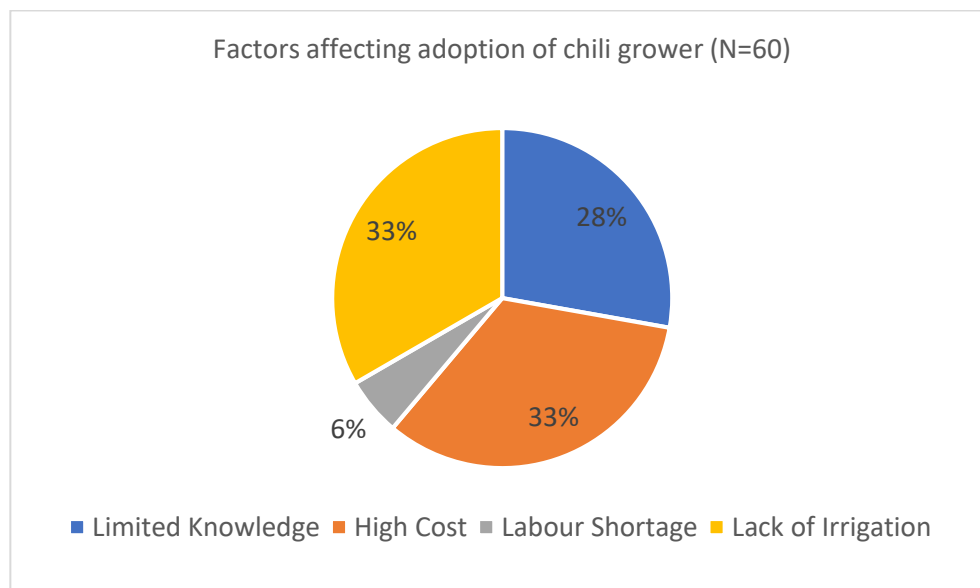
Particular	Frequency (N=30)	Percentage %
Yes	10	33
No	20	67
Total	30	100

Source: Field Survey (Dorji, 2019)

4.6.1 Factors affecting offseason chili growers

The major challenges responded were a shortage of irrigation and high cost of production with 33% each (figure 14). This was also supported by key informants 2 and 5 that the source of irrigation is drying and they are facing difficulty in finding new sources for irrigation. Key informant 1 and 4 also said due to high cost for greenhouse and due to the lack of irrigation are limiting the interest of chili growers despite high demand for chili in the market. 28% of the growers stated they have limited knowledge in managing greenhouse and key informant 1 responded by saying that most of the chili growers lack irrigation control in the greenhouse which has led to mass killing of chili inside greenhouse.

Figure 14: Factor effecting adoption of chili growers



Source: Field Survey (Dorji, 2019)

4.7 Gender role

About 52 % of the respondent said men in the household have better excess to information and mobility and 57% of the respondent also mentioned most of the time women are involved in farming activities (Table 7.1 &7.2)

Table 7. 1: Excess to information and mobility

Gender	Frequency (N=60)	Percentage %
Female	26	43
Male	31	52
Both	3	5
Total	30	100

Source: Field survey (Dorji, 2019)

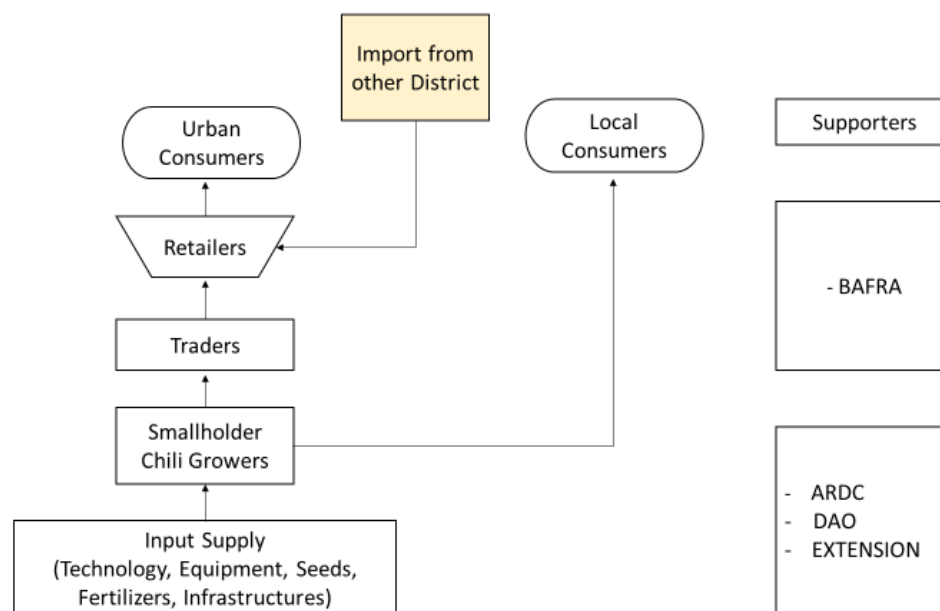
Table 7. 2: Participation of women

Role	Frequency (N=60)	Percentage %
Farming	34	57
Training	10	17
Financial Management	5	8
Marketing	11	18
Total	60	100

Source: Field survey (Dorji. 2019)

4.8 Existing chili chain map

The study found out that the Punakha district doesn't have a formal value chain for chili. The actors and supporters are not systematically organized and linkages among chain actors were found missing. Figure 15 shows the existing chain and in offseason during cold winter from November till March in. It is during that time the people of Punakha district experience acute shortage of chili and the gap were filled by importing chili from another district.

Figure 15: Existing chain map

Source: Field Survey (Dorji, 2019)

4.8.1 Chili variety grown in Punakha district

According to the study, 58% of growers in Punakha district said they cultivate Bogap-Ema during peak (summer) and 42% respondent said they cultivate hybrid variety which is Indian Chili IR-8 during offseason (winter) which are grown in low-cost greenhouse (Table 8). The chili cropping calendar is indicated in (see appendix 10, pp.61-62) for the growers in Punakha district, red colour indicates time of land preparation,

yellow colour represent time of sowing seed or raising nursery, Blue colour indicates transplanting period, purple indicates for stages of fruiting and green colour shows the time of harvesting.

Table 8: variety grown

Particular	Frequency (n=60)	Percentage (%)
Bogap-Ema	35	58
Indian Chili IR-8	25	42
Total	60	100

Source: Field Survey (Dorji, 2019)

4.9 Economic analysis of fresh chili production

The average cost of production was conducted both for production of chili in peak season where the maximum land cultivated was 50 decimal (2024 m²) and 2.5 decimal (100 m²) for offseason chili. The total cost of production for 50 decimals was Nu 94,790 and Nu. 86,507 for offseason (Table 9) a present the comparison of cost of production in peak season and offseason. A detailed cost of production is attached in **appendix 11, pp.62-63**.

Table 9: cost of production for chili

Cost	Bogap Ema	Indian Chili IR-8
Variable Cost	Nu. 87,790	Nu. 13,507
Fixed Cost	Nu. 7000	Nu. 73,000
Total Cost	Nu. 94,790	Nu. 86502

Source: Field Survey (Dorji, 2019)

4.9.1 Benefit-Cost Ratio of producing chili

The price of average Bogap-ema was Nu. 80 and Nu.200 for Indian chili and average yield from 50 decimal land was 2000kg and 500 kg from 2.5 decimal. The study found out that there was high significant difference between income generated from peak season over offseason, H (1) =0.640, p=0.425 (**see appendix 12, pp.63-64**). The benefit-cost ratio (BCR) for Bogap is 1.21 and 1.16 for Indian chili, which indicate that chili cultivation for both the season is profitable in the study areas (Table 10).

Table 10: Gross return for chili grower

Particular	Peak season	Offseason
Yield (Kg)	2000 Kg	500 Kg
Selling Price (Kg)	Nu ¹ .80	Nu.200
Total Cost	Nu. 94790	Nu. 86507
Gross Return	Nu.120,000	Nu. 100,000
Cost of Green Chili/kg	Nu.66	Nu.172
Benefit-Cost Ratio	1.21	Nu.1.16

Source: Field Survey (Dorji, 2019)

¹ Nu is a Bhutanese currency Ngultrum. 1 Euro is equal to 78 Nu as per exchange rate on 28/08/2019

4.9.2 Value Share and profit share for actor in peak season chain

Two marketing channels were identified in study (producer-trader-retailer) in peak season and (producer-retailer) in offseason). The producers hold the highest value share in peak season with 61% and 81% in the offseason. The profit share for the retailers was highest in marketing channel I with 52%, producers take the profit share of 29% and traders only take 19% of the total profit share. Even in the offseason, retailer takes the highest share of 53% and producers take 43% of the total profits (Table 11.1 & 11.2). Both the value and profit share were only calculated for one kilogram of chili. (Note: CP: Cost Price, PP: Purchase Price, SP: Selling Price) and formula used were value added= SP-PP, value share= Actors value added/Total value added along the chain, Profit= SP- (CP+PP) and Profit share= Actors profit/profit along the chain.

Table 11.1: Value and profit share of chain actors in marketing channel I per kilogram

Actors	CP	PP	SP	Value Added	Value Share	Profit	Profit Share
Producers	Nu. 66	Nu. 0	Nu. 80	Nu. 80	61%	Nu.14	29%
Traders	Nu. 6	Nu. 80	Nu. 95	Nu. 15	11%	Nu. 8	19%
Retailer	Nu.10	Nu. 85	Nu. 120	Nu. 35	28%	Nu. 25	52%
Total				130	100	48	100%

Source: Field Survey (Dorji, 2019)

Table 11.2: Value and profit share of chain actors in marketing channel II for per kilogram

Actors	CP	PP	SP	Value Added	Value Share	Profit	Profit Share
Producers	Nu. 172	Nu. 0	Nu. 200	Nu. 200	81%	Nu. 88	43%
Retailer	Nu. 10	Nu. 172	Nu. 220	Nu. 48	19%	Nu. 38	57%
Total				248	100	68	100%

Source: Field Survey (Dorji, 2019)

4.10 Key supporter and their function

The important stakeholder involved in the chain were carefully identified and analysed as per their supporting roles and current challenges in chili production in Punakha district. The key informant interviewed were retailers, traders, researchers, academicians, local government leaders, district agriculture officers, extension agents, and BAFRA. Their roles and challenges were analysed using grounded theory illustrated in given below table 12.

Table 12: Analysis of supporters involved in chili value chain

Name of the Supporters	Role	Challenges	Way Forward
Extension Agent (key informant 1)	- Seed/Fertilizer Supply - Install Green House. - Integrated Pest Management Support	- Shortage of input supply (plastic houses, seeds) - An outbreak of new pest & disease - Farmers outsourcing alternative source of income, showing less interest in growing offseason chili - Shortage of irrigation - Farmer have limited knowledge in growing offseason crops	- Increase input supply - Form farmer cooperatives - Punakha not a focal area for winter chili production
District Agriculture Office (key informant 2)	- Ensure continuous agriculture production in the district. - Raise awareness program on agricultural activities - Prioritization of budget for agriculture development	- Water source drying up - Budget is prioritized more for infrastructures such as road and their maintenance rather than improving agriculture program - Shortage of land for farmers	- Add value by installing chili dryer (included in 12th five-year plan - Initiate water pumping facilities - Initiate former linkages between farmers and institutional consumers.
BAFRA (key informant 3)	- Regulate the quality of food (test toxicology) - Monitoring illegal import of food - Awareness program on food safety and food regulation - Certify agriculture product - Ensure appropriate use of pesticide	- Limited budget for raising awareness program - Difficulty in identifying the varieties between chili grown in Bhutan and smuggled from India. - Limited facility to test toxic chemicals - People are not aware of authentication formalities	- We need to improve the authentication letter format so that it will be easier for people to understand the formality while importing food. - Provide more awareness programs on food safety and regulation. - Improve Quarantine laboratory
ARDC (key informant 4)	- Release new Seed Varieties - Provide training to extension and farmers - Monitoring pest and disease	- Difficult to convince farmers (they prefer indigenous farming method) - Greenhouse covers only 2 decimals	- Provide more land so the farmer can produce more - Introduce low-cost greenhouse - Introduce drip irrigation

		- Not able to release variety for high altitude. - Chili favorable only within 1200-1400 masl in Bhutan	- Release variety suitable for high altitude
Local Government (key informant 5)	- Securing budget for development activities - Collaborate with extension and DAO for agriculture development activities - Promote gender equity	- Shortage of Irrigation - Difficult in allocating new water sources for irrigation. - No training on agriculture are initiated through local government	- Propose training help for winter chili production. - Collaborated with DAO for prioritizing importance on winter chili production
CNR (key informant 6)	- Develop short term training - Provide refresher course to extension - Conduct sustainable agriculture production research	- No formal linkages with the Ministry of agriculture and forest in Bhutan. - Limited budget for research - Insufficient resource person	- Collaborate with ministry in prioritizing the capacity building of extension agents and faculty. - Develop project proposal for offseason chili production - Inking training course with current issues to solve the problems.
Retailer (key informant 7)	- Outsource and sell chili - Clean and grade chili	- More damage of chili from trader - Must import from another district during offseason	- Formalize chili marketing channel and linkages within the district and nearby districts
Trader (key informant 8)	- Buy chili from farmers and sell it to retailer	- No formal contact with farmers buys it randomly and sell it to any retailer	- Initiate linkages with progressive farmers

Source: Interviewing key Informants (Dorji, 2019)

4.10.1 SWOT analysis for chili growers

SWOT analysis found out that there is a lot of opportunities and strength for the chili grower in the study area, it also cautions the weakness and threats that may hinder the offseason chili production in Punakha districts. Table 13 shows the SWOT gathered from survey results and key informant interview.

Table 13: SWOT analysis

Strength	Weakness
Internal	
• Infrastructure in place (Key informant 2 & 4 also refer table 12, p.26) • Access to Inputs through government (Key informant 1 and 2, p.26) • Availability of extension service (Key informant 1 and 2, p.26) • Subsidized plastic greenhouse (Key informant 1 and 2, p.26) • The high demand for chili in market (62% of the growers also refer figure 11, p.19)	• Limited value addition is done by actors (key informant 2 and 7, p.27) • Labor shortage (Key informant 1 and 13% of the growers refer figure 14, p.22) • Limited land size (Key informant 1, p.26) • Limited irrigation (35% of the growers refer figure 14, p.22 and agreed by key informant 1 and 2, p.27)
Opportunities	Threats
External	
• Introduce varieties for high altitude (key informant 4, p.26) • Form farmer cooperatives (key informant 1, p.26) • Commercializing nursery farm (key informant 4, p.26) • Availability of market (55% of the growers, refer figure 14, p.21 and it was agreed by key informant 1, p.26) • Processing of chili into substitute products (Pickling, dried chili) (Key informant 2, p.26) • Expansion of farm for chili production (key informant 1 and 4, p.26) • Refresher course for extension agents (key informant 6, p.27)	• An infestation of pest and disease (49% of growers see figure 13, p.21 and agreed by key informant 1 table 12, p.26) • The unwillingness of farmers. (key informant 1 table 12, p.26 and 67% of respondent mentioned they don't grow offseason chili, see table 6, p.21)

Source: Field Survey (Dorji, 2019)

4.10. 2 Sustainability of chain

Sustainability of chain was broadly studied on gender empowerment, environment conservancy, and income stability in the study area to understand the efficiency of chain in the study area. Table 14 illustrates the finding of chain sustainability.

Table 14:Chain sustainability

People	According to respondents 5 and 15 Child labor is particularly on farms, where they are employed mostly for manual irrigation using water cans or pipe. Key informant 1 also stated due there is shortage of labor as most of youth stay out of the home for studies and other non-farm activities. About 57% of the respondent confirmed that women are involved in farming activities.
Planet	Key informant 2 and 3 indicated that the Government of Bhutan has always encouraged to emphasis more on green revolution or green agriculture, therefore use of hazardous chemical is completely banned. Most of the farmers practice indigenous knowledge-based agriculture. This is also confirmed as 100% of the respondent said they don't apply any sort of hazardous chemicals.
Profit	Key informant 2,4 and 5 stated due to ban of chili import government have always encouraged farmers to produce more chili by providing improved variety of seeds, establishment of greenhouse at a subsidized rate. Survey respondents and key informants 6 and 7 also confirmed the good income from chili and consistent demand in the market.

Source: Field Survey (Dorji, 2019)

Chapter 5: Discussion

5.1 Smallholder farmer perception on offseason chili

Only about 47% of the total respondents indicated that they have less than two years' experience in growing chili in offseason and only 7% of the respondent had less than four years' experience in growing chili in offseason. key informant 4 stated due to minimum experience, farmers faces difficulties on seed selection and still practice indigenous farming systems which led to a poor production of chili in greenhouse.

Farmers in a developing country are mostly smallholders having limited excess to technology, they depend mostly on the resources within their farm and local community. Therefore, in developing countries farmers must make utilization of affordable resources and accessible knowledge to increase the resilience of farm. However, if growers are accessible to basic knowledge of irrigating water, integrated pest management and soil nutrient management can mitigate the environmental stress and improve crop physiology at higher altitudes (Bhardwaj, et al., 2012). Hence, a farmer who were more experience in growing crops in higher altitudes are more advance on farm management practices which result in achieving higher yield than the farmer who have limited experience.

Divya and Sivakumar (2014), mentioned that if farmer follow a principle of GAP (as mentioned in table 1) will enhance sustainable agriculture. Therefore, it indicates the importance to encourage and support farmer to continue growing by providing them awareness on good agricultural practice (GAP) in high altitudes and ensuring the accessibility to new information that will enhance the efficiency of vegetable production in higher altitudes.

About 67% of the peak season grower said that they haven't tried growing chili during offseason. The major challenges responded were due to shortage of irrigation and high cost of production with 34% of the grower agreeing to it. This was also supported by key informants 2 and 5 that the source of irrigation is drying and they are facing difficulty in finding new sources for irrigation. Key informant 1 and 4 also said due to high cost for plastic greenhouse and lack of irrigation are limiting the interest of chili growers.

5.1.2 Challenges for growing offseason chili

About 49% of the growers stated that the major challenges in offseason chili production was due to high infestation of pest & diseases, 30% said it was due to the unfavorable climate and 14% of the grower also mentioned it can be due to the limited knowledge of growing offseason chili in cold weather. This was also confirmed by key informant 1,2 and 4 that cold weather in the winter minimize the cropping season and induces more fungal infestation which results in outbreak of diseases, they also agreed that farmers are not aware of agronomic management in the greenhouse which led to the decline of chili yield.

This contradict with the finding of Stobdan, et al., 2018 where it was reported that higher altitude has advantages over plain land due to its topography the farmers can grow offseason crops that cannot be cultivated in plains and due to the low humidity in higher altitudes lesser are the chances for infestation of pest and disease. Schreinemacher (2016) also reported that a farmer who are aware on producing healthy seedlings, raising bed in higher altitude, and management of pest and disease has shown better in terms of production and profit from growing vegetables in offseason. Thus, there is in need to provide more technical support to the offseason chili growers through extension agents.

Most of the farmers had limited land with an average land of 2.17 acre and due to acute shortage of labour as most of the potential worker is out for non-farm activities and youths are either in boarding schools and colleges. If smallholder farmer who are grouped into organisation, the farmer has better accessibility to extension information, improved planting materials and incentives from group (Fischer & Qaim, 2012).

Therefore, it was also agreed by key informant 1 and 4 that due to the limited land and shortage of labour and to overcome such gap the formation of farmer group could be the possible solution like dairy milk cooperative in Punakha district.

5.2 Potential of offseason chili

It was found that the growers in the study had a minimum experience of two years and the income generated from sake of offseason chili were highly correlated with experiences of growing year in the study area. This result clearly indicates the potential and efficiency of offseason chili production. Similar finding was reported by Ali, et al., 2018 where it was mentioned that the experienced growers can earn more income because, growers learn more from the earlier practices and are able to obtain yield by utilizing same available resources.

The frequency of contact with the extension agents, small size of family and vegetable market distance have positive benefit on efficiency of producing more. Therefore, extension agents should extend their contact with farmers and create awareness and the smallholder farmer must utilise the best use of rare resources and increase the efficiency of chili production. This is in line with the findings of Ali, et al., 2018.

5.3 Economic efficiency for offseason chili

The average land utilized for offseason chili production was only 2.5 decimals (1076.39 sq. ft) and the total cost producing in 2.5 decimals was Nu. 86, 507. The total cost for producing chili during peak season in 50 decimals (21,780 sq. ft) was Nu. 94,790 where the differences come to Nu. 8,283. This was because the major amount of money (Nu. 70,000) was incurred in plastic greenhouse installation for offseason chili offseason (**see appendix 11, pp.62-63**). Therefore, the cost of production is comparatively higher in producing chili during offseason and similar result was reported by (Ozkan, et al., 2005) where he stated that major amount of money was incurred in installation of plastic greenhouse, irrigation technology, and electricity consumed in producing vegetables greenhouse. Thus, growing offseason vegetable is expensive compared to the vegetables grown in the peak season.

The total gross return for offseason grower was Nu. 100,000 and Nu. 120, 000 for chili grower in peak season. The gross return difference was only Nu. 20,000 despite growing offseason chili only in 2.5 decimal over peak season chili cultivated in 50 decimals, this was because the price for peak season chili was Nu. 80 for one kilogram whereas, the cost for offseason chili was Nu. 200 for one kilogram (**see table 10, p.24**). This result was found similar to the finding of (Balaa, et al., 2011) who said the annual gross income for offseason vegetables growers were comparatively higher and it suggested to promote such kind of niche enterprise for offseason vegetable growers. The benefit-cost ratio (BCR) for offseason chili grower in study area was 1.16 and according (Shively, 2012) the feasibility of any enterprise and positive return for any investment the BCR should be more than 1.

5.4 Chain Sustainability

According to the key informant interviews and farmers (**refer table 14, p.29**), all the activities and the strategies are holistically implemented so that their strategies and goal cover all three Ps of sustainable development goals which are People (Society), Profit (Economy) & Planet (Environment) as stated by Tan and Zailani (2009). This was also supported by Murthy, et., 2019, protected and innovative agriculture will help to overcome the seasonal barriers and shortage of food thus helping to overcome the food sufficiency and economic stability for farmers.

The offseason chili was mostly cultivated in plastic greenhouses due to cold weather in winter and the yield and income were comparatively higher to peak season chili. However, this finding contradicts with the study conducted by Chang, et al., 2013 where it was mentioned that there was no difference in yield harvested from plastic greenhouses and open area. It was because the risk of diseases from plastic greenhouses was high due to high temperature and relative humidity, it induces microbial growth leading to outbreak of diseases in the greenhouse. Therefore, the yield was not observed different between the crop cultivated in open area and greenhouse.

Greenhouse can be used in cold winter as it will help to increase the season for few more month it should be detached during the peak season (summer) because sunlight can help to disinfect soil which will help to reduce infestation of disease. Plastic greenhouses also found to contribute to waste in a community as it needs to be changed every after three years and it also contribute in emission of greenhouse gases. Therefore, it indicated that the greenhouse operator needs to be highly skilled and should be aware of the negative impact to minimize the risk to crop as well as to the environment. This is in line with the findings of Chang, et al., 2013.

5.5 Role of stakeholder

After the ban of chili import district agriculture office (DAO) and agriculture research development center (ARDC) have played a major role in enabling farmers to produce chili during the offseason by providing subsidised greenhouse and hybrid seedlings. Bhutan agriculture food regulatory authority (BAFRA) has played an important role in creating awareness of food quality and regulation in the country. Therefore, the role of stakeholder in the chili value chain is clear and their support has facilitated the smallholder farmer to adopt offseason chili production in Punakha district.

The study found that there is less coordination and conflict of interest between the stakeholders and the local government (LG) because LG spend most of the budget for non-agricultural infrastructure development. Thus, other stakeholders mentioned that the local government can have influenceable role in upgrading the smallholder farmers as they are responsible for planning budget and framing policy in their region.

A similar finding was reported by Govindan (2018) that the chain supporter plays vital roles in providing necessary inputs whereas, influencer should help in monitoring or control the regulation to ensure food security, but all the stakeholders must function well coordinated. This is because the partnerships and collaboration between supporter and influencers of chain can facilitate to bring changes that are desirable for the inclusion of small producers and small and medium enterprises in value chains (Drost, 2012). Therefore, LG should closely collaborate with other stakeholders to enhance the linkages and ensure food sufficiency and economic stability of rural farmers.

Oloo (2010), mentioned that university and technical education school can contribute facilitating chain through research to solve problems and to advise stakeholder because, university has facilities and human resources to fulfil the. But, in the study area it was found that there is no collaboration between the university and other stakeholders. Therefore, there is need for collaboration within the stakeholder to initiate continuous food supply chain.

The College of Natural Resources, Royal University of Bhutan provides diploma and bachelor course and the graduates later work as extension, district agriculture officer, researcher and bafra who plays major role in steering the food security and regulation in the nation. There is also potential for development of farmer field school (FFS) for demonstration of practical agriculture practices. FFS has shown positive result for the smallholder farmer with low literacy rate and the production were also reported to be after joining FFS. This is in line with the findings of Davis, et al.,2012.

5.6 Chain coordination and governance

There were no formal linkages between the actors which have led to a disorientation of the chain, but it was found that there was an organized coordination within those supporters who have direct link to the producers. The agriculture research development center plays a vital role in releasing the hybrid variety and extension agents helps in sharing of new information and technical assistance.

Key informant 2, 6, and 7 also indicated the informal coordination in the chain. Producers meets trader in open market, and they negotiate the price on the spot and are sold to those traders. Therefore, there is no formal marketing channel and formal market. A similar finding was reported by Guarin (2013) that in developing countries intermediaries meet on the spot indicating the absence of formal linkages between the chain actors and such kinds of channels are classified as traditional methods of marketing. Thus, the challenges encountered by the actors need to be addressed by the chain supporter by formalising the chain.

At the chain level the role of the producers is mixed where some took part as trader and sometimes sell directly in open market and such activities indicate the vertical integration of grower in a chain. Such activities indicate the vertical integration of activities in the chain. Formentini and Taticchi (2016) has mentioned that the key function of governance structure is to make decision which will benefit the chain actors in long term, and it requires a depth coordination to function chain governance for sustainability of value chain. Therefore, there is need to intervene in formalising the linkages of the chain actors which can be accomplished by building trust between the different chain actors and supporters to reinforce the value chain partnership. Thus, partnership can help to facilitate in risk sharing, resources sharing, create enabling environment for collective learning to develop market power. This is in line with the findings of (KIT, et al., 2006).

5.7 Profit and value share for chain actors

The producers hold the highest value share in marketing channel I (peak season) with 61% and 81% in marketing channel II (offseason). The profit share for the retailers was highest in marketing channel I with 52%, producers take the profit share of 29% and traders only take 19% of the total profit share. Even in the marketing channel II, the retailer takes the highest share of 53% and producers take 43% of the total profits. The profit share was higher in offseason because the price for chili was comparatively higher in offseason due to acute shortage of chili in the market. A similar result was reported by Poudel (2012) that the profit share for off-season vegetables were higher but the reason was those crops were potential

which couldn't be grown in other areas. Whereas, in Punakha district profit share for growers were higher due to limited competition in the market.

It was reported by KIT (2008) that farmers hold the maximum value share but, low-profit share in the chain. This was because the expenditure cost incurred by the farmers are more compared to other actors in the chain whereas, traders and retailer incurred minimum cost compared to producers to add value. Therefore, the value share of farmers is higher and hold lower profit compared to retailers in the chain. The price of commodities keeps on increasing along the chain because the amount of buying the commodity from one chain to another keeps on increasing regardless of the amount of higher value share contributed by the producers. KIT (2008) also stated that higher the contribution of value share in chain indicates the amount of hard work put into by the producers in creating the goods.

To spread the equal profit share, the producers must make use of resources efficiently to minimize the cost in production. Formal marketing system will provide various channels to sell their products in effective ways will efficiently increase the profit share of producers. This is in line with the finding of Sodhi and Tang (2016).

5.8 Gender and literacy rate

The lower female respondents could be because of cultural biases against females in a largely Hindu patriarchal society that dominates the chili growing areas of Punakha district. Then this could indicate a low level of female participation in household decisions and they are mostly involved in farm management practices, such as weeding, harvesting, as well as in the marketing of the produce. Similar cases were reported by KIT and IIRR (2012) where the women are less credited and made visible in the chain despite their contribution in the whole chain and upgrading the women's role in the chain can improve the efficiency of chain due to their capability of management of resources.

It was also supported by Emmanuel (2018), where he mentioned that balanced combination of women in value chain development can generate linkages and take advantage of new market opportunities. Therefore, empowering the women can help in an equal distribution of task in the chain and limits the risk because everyone in the chain are able to access to information and improve their mobility.

The low literacy would mean a limited capacity to assess risk and opportunities to adopt changes in farming practices. Access to basic education has better potential for poverty reduction and economic growth because they have a better realization of new information and adoption of technologies Cremin and Nakabugo (2012). Similar finding was also reported by Ali, et al., 2018 that higher rate literacy has better adoption of technology and excess to new information's. Therefore, there is need to train farmers and help them to get exposure to technologies and information.

5.9 Reflection

The conceptual framework was found very useful while conducting research because it helps researcher to objectify their specific aims, research questions and to prepare survey questionnaires and interview check list for data collection. Overall, conceptual framework takes researchers through the process of framing the objective and derive research question from the objective, then it makes easier to prepare questionnaire from the research questions. Therefore, conceptual framework is an important tool for any researcher who wish to conduct research using rapid appraisal approach.

A research framework was observed helpful to outline all the procedure starting from introduction till the compiling of this report. Such framework help researcher to carefully follow up the activities that will help to answer their research questions and fulfil the objective of the study.

Data collection time overlapped with busiest months in the year during the paddy cultivation and peak cropping season. I have realised that it would have been better, if I could have gathered all the farmer for a meeting by paying daily allowance to compensate their time. The meeting with farmers could have been better medium to share and convince my research study. This could have given me a better medium to introduce myself and eased my data collection in the field. Therefore, in the future in the course of same circumstances it I must be mindful to study their situation and plan according to their convenience.

It took a longer duration to collect data and due to the limited time and focus group discussion was not being able to implement. However, data collection from 60 sample size was achieved though it consumed longer duration. Focus group discussion would have enriched the finding of study as it would help to gather the perception of group who had same opinion as well as different opinion which could answer the main research question of this study. Therefore, it is important for the researcher to design plan as per the situation in the study area.

In the process of this research, I went through several challenges during interviews and survey, because according to the plan, survey was supposed to be completed before key informant interviews. The data collection coincided with the peak season for rice and vegetable cultivation in Punakha district. The only time I had to meet farmers for survey was in the morning and during the evening after their field work. There was need to change my plan, where I started to make appointment with all the stakeholders. I conducted interviews in the day hours and survey in early and late hours so I will be able to complete data collection as per the schedule.

After conversation with the farmers during the data collection made me think the importance of applied research. This was because we can feel their challenges and their aspiration, and I have now realise that their problem can be minimise by conducting such kind of research and able to recommend the intervention based on farmer oriented. Therefore, I would like to strongly suggest the need of conducting more applied research to connect stakeholders and various channels with a farmers .

I have also experienced that during the interview, researcher must cautious while probing the interviewee. Researcher had to use the alternative technique by using words to use in probing, because there was incidence that probed interview beyond their level of control and such situation effects our interview sessions. Hence, there is need to put in limit to our probing and alternative way of asking questions.

Chapter 6: Conclusion and recommendation

6.1 Conclusion

The objective of this research was to explore the existing chili value chain and opportunities for off-season chili production through value chain analysis, which were guided by the research question (**heading 1.5 and 1.6 p. 3**). The survey questionnaires and check list for interviewing key informants (**Appendix 1, 2 and, pp.49-57**) were used for understanding the farmers perception on adoption offseason chili production, role of stakeholders and economic analysis of producing chili offseason and peak season to compare the cost benefit return for both the season.

The offseason chili growers selected for this study had a minimum experience in growing offseason chili. Growers adopted the offseason chili only after the ban of chili import by government of Bhutan. High demand and good price in the market were the main reasons for opting to grow offseason chili. Farmers who are active grower in peak season expressed that the important factors that challenged them to grow offseason chilies were due to high cost of production, unfavourable climate in the winter, and limited knowledge of growing offseason chilies. Acute shortage of chili severely affected from the month of September to December and gradually continuing till the month of April in a year. The reason for the acute shortage were due to high infestation of pest and disease with unfavourable weather condition and limited skill to grow chilies in offseason. Therefore, there is need to for a close coordination between to stakeholders to enhance the efficiency of growers to opt for better production technologies.

It was observed that there was no formal value chain and the actors are not systematically organized with the absence proper linkages between chain actors. Key informant expressed the need of collaboration among the supporters and stakeholders to formalise the chain. The district agriculture office (DAO) and agriculture research development center (ARDC) have played a major role in enabling farmers to produce chili during the offseason after the ban of chili import. Bhutan agriculture food regulatory authority (BAFRA) has played an important role in creating awareness of food quality and regulation in the country. Those supporters urged the need of local government (LG) intervention in monitoring as they hold most of the decision taking opportunity in their regions.

Women participation are mostly in farm where they are engaged in sowing, planting, weeding and harvesting of crops. Respondent also expressed men takes most of the house decision and men are more access to information and mobility.

Chili growers have mentioned that they cultivate Bogap-Ema during peak season in 50 decimal (2024 m²) and Indian Chili IR-8 during offseason on 2.5 decimal (100m²). The total cost of production for 50 decimals was Nu 94790 and Nu. 86507 for offseason (**see appendix 9, p.61**). The price of Bogap-ema was Nu. 80 and Nu.200 for Indian chili respectively and average yield from 50 decimal land was 2000kg and 500 kg from 2.5 decimal. The total gross return for offseason grower was Nu. 100,000 and Nu. 120, 000 for chili grower in peak season.

Two marketing channels were observed (producers-traders-retailer) marketing channel I common in peak season and (producers-retailers) marketing channel II during the offseason. The producers hold the highest value share in offseason and in peak season. The profit share for the retailers takes was highest in in both the chain (**see table 7.1 &7.2, p.25**). The benefit-cost ratio (BCR) for offseason was 1.16, which indicate the feasibility of offseason chili production in Punakha district and the sustainable of chain is positive if the chain are coordinated officially.

6.2 Recommendations

To fulfil the objective of this study, the college of natural resources (CNR) and Local government (LG) administration can be substantial supporter in chili value chain. Food cooperation of Bhutan (FCB) has a huge potential to take part as wholesaler to upgrade chili value chain in long term. **Table 15, p.42-43** shows the area of intervention for short term goals.

1. College of natural resources

The institute has boarding facilities and 10-hectare land with relevant infrastructures to introduce training program for the farmers. It can be a medium to demonstrate sustainable land management (SLM), good agriculture practices (GAP) as per the principle of food agriculture organization (FAO) and international standard organization (ISO). Such kind of activities will help in creating awareness to implement SLM, GAP and improve quality of crops. It will immensely benefit all the actors involved in the chain because it will improve the efficiency of farmer with good quality yield and participation of traders will be consistent and it will help in filling the gap of vegetable shortage.

Lead: College of Natural Resources, Royal university of Bhutan

Supporter: District agriculture office, Agriculture research development center

Implementation: By 2022

2. Food cooperation of Bhutan

Food cooperation Bhutan should initiate the auctioning of green chili, FCB have cold storage facilities, processing unit and delivery services. The key function of FCB should be buying chili from the farmer and processed it into either chili powder and flakes and supply it to the farm shops during acute shortage of chili.

Lead: DAO

Supporter: LG

Implementation: By 2022

3. Local government administration

The LG should be aware of food security and collaborate with District agriculture office (DAO) and agriculture research development center (ARDC) to enable them to efficiently support smallholder farmers to achieve food self-sufficiency. LG administration should plan budgeting in consultation of DAO and release fund for agriculture development program.

Lead: Local government administration

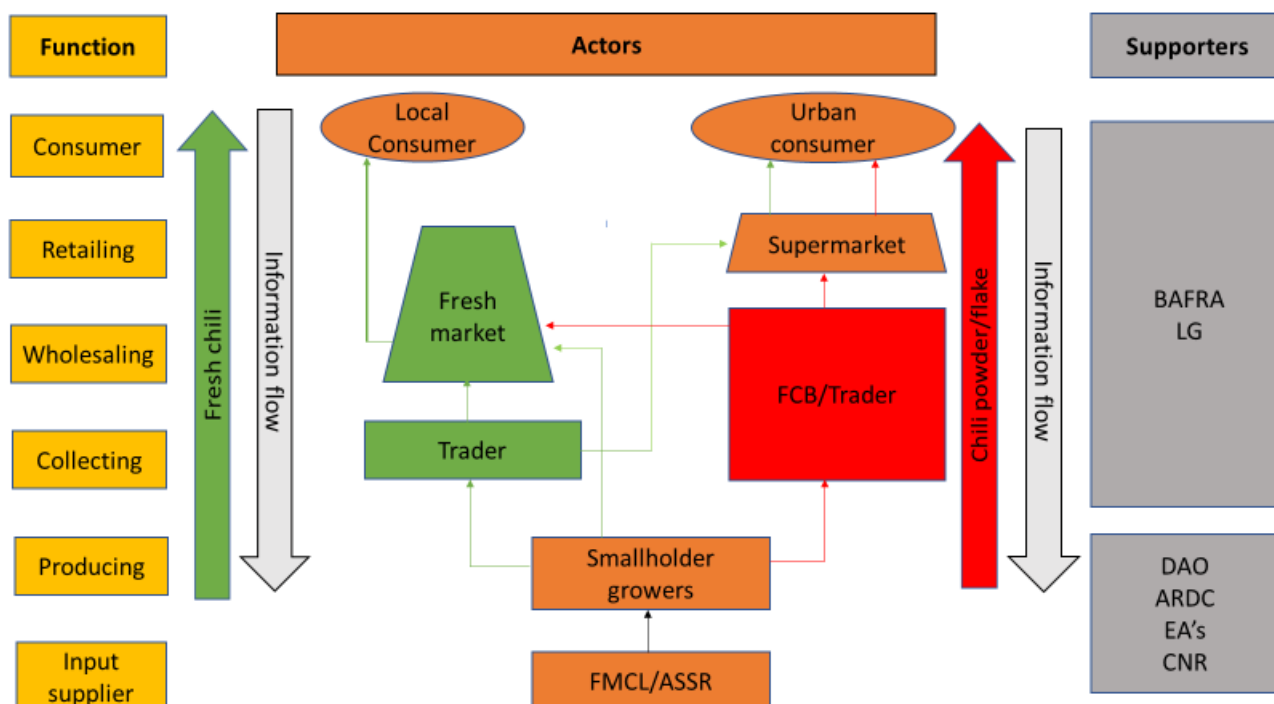
Support: ARDC/DAO

Implementation: By 2020

4. Formal chili value chain

Figure 16 shows a new formal chili value chain designed for Punakha district. The chain specifies actors and their role. Food corporation of Bhutan is included as a new actor as it they have linkages with various distribution channels and infrastructure to diversify the product. The chain also shows the opportunity of outsourcing dried chili from the farmer in the form of chili powder and flakes.

Figure 16 : Formal chili value chain



Abbreviations

- | | |
|--|------------------------------------|
| -FMCL: Farm machinery cooperation limited | -DAO: District agriculture office |
| -ASSR: Agriculture sales & service regulation | -EA's: Extension agents |
| -FCB: Food cooperation of Bhutan | -CNR: College of Natural Resources |
| -BAFRA: Bhutan agriculture food regulation authority | -LG: Local government |
| -ARDC: Agriculture research development center | |

Legends

- Chili powder and flakes
- Fresh chili

4.1.1 Actors

The main should be input supplier, smallholder farmer, collector, wet market wholesaler and retailer. The input supplier agriculture sale & service representative (ASSR) in the district should supply certified seed, planting material and herbicides to the farmers. Farm machinery cooperation limited (FMCL) should continue proving farm mechanisation tools at affordable price. The producer should adopt chili producing in peak season and in offseason.

Trader should play important role in collecting chili from the farmer and supply it to the wholesale wet market and to the retailers. Food cooperation of Bhutan should buy chilies from the farm in a scheme of auction yard and distribute to small farm shops.

4.1.2 Supporters

- District agriculture office must support by facilitating to introduce the agriculture infrastructure in the region.
- Agriculture research development center look for possibility of introducing different variety of chili to spread the risk and production diversification.
- Bhutan agriculture food regulatory authority should continue to monitor the quality of food and awareness campaign on food quality.
- Local government must collaborate with DAO for financial planning for agriculture infrastructure development.
- Extension agent have key function in bridging the ground reality farmers to other stakeholders and they should provide technical assistance.
- College of natural resources should provide training extensions agents and support them by providing production manuals.

Table 15: Areas of intervention to upgrade chili value chain

Intervention	Activities	Responsible		To Whom	Timeline
		Lead	Supporters		
Irrigation technology	1. Introduce low cost reservoir tank/pool	District agriculture officer	Local government	30 Chili growers	By 2022
	2. Pump water from river to fill reservoir				
	3. Introduce rain water harvesting technology				
Training in offseason vegetable production	1. Prioritise problem and design training (ToT) curriculum accordingly	College of natural resources (Tashi Dorji)	District agriculture office and faculty of CNR	Extension agent, and researcher	By 2020
	2. Production manual/booklet				
Chain coordination	1. Formalizing linkages between the chain actors	District agriculture officer	Extension agent and Local government	Farmer, trader, broker, retailer	By 2020
	2. Establish information center				
	2. Introduce variety that can be sun dried and convert it into chili powder or flake				
Post-harvest management training	1. Training on vegetable storage	College of natural resources (Agriculture Department)	National post - harvest center	Farmer, trader, retailer (30 participants per training)	By 2020
	2. Value addition				

Training on business management	1. Training on financial management/book keeping	College of natural resources (Tashi Dorji)	District agriculture office	Farmer, retailer, trader, extension agent (30 participant per training)	By 2020
Women empowerment	1. Create awareness/seminars on benefit gender equity	College of natural resources (Social science department)	Local government	District agriculture office, extension agent, farmer, students.	By 2020

References

- Adeola, R. G. & Ayoade, A. R., 2011. Extension Agents' Perception of the Information Needs Of Women Farmers in Oyo State, Nigeria. *Global Journal of Human Social Science*, 11(10).
- Agriculture Statistics, 2016. *Department of Agriculture: Ministry of Agriculture & Forest*, Thimphu: Ministry of Agriculture and Forest.
- Alshenqeeti, H., 2014. Interviewing as a Data Collection Method: A Critical Review. *English Linguistics Research*, 3(1), pp. 39-45.
- Ali, Q., Khan, M. T. I. & Ashfa, . M., 2018. Efficiency analysis of off-season capsicum/bell pepper production in Punjab-Pakistan: A DEA Approach. *The Journal of Animal & Plant Sciences*, 28(5), pp. 1018-7081.
- Anderson, D. R., Sweeney, D. J. & Williams, T. A., 2011. Sampling and Sampling Distributions. In: *Statistics for Business and Economic*. USA: South-Western, Cengage Learning, pp. 265-299.
- Baarda, B., 2014. *guidelines on how to design, perform and evaluate quantitative and qualitative research*. 2 ed. Netherlands: FSC.
- BAFRA, 2016. *Bhutan bans the import of chilies from India*. Thimphu: MoAF.
- Balaa, B., Sharma, N. & Sharma, R., 2011 . Cost and Return Structure for the Promising Enterprise of Off-Season Vegetable Growers in Himachal Pradesh. *Agricultural Economics Research Review*, Volume 24, pp. 141-148.
- Bhardwaj, M. L., Sharma, H. D., Kumar, M. & Kumar, R., 2012. *Vegetables Production under Changing Climate Scenerio*, Himachal Pradesh: Dr. Y S Parmar University of Horticulture and Forest.
- Bhutan Agriculture Statistics, 2018. *RNR Statistics Division, Ministry of Agriculture and Forest*, Thimphu:Bhutan: Renewable Natural Resources Statistics Division (RSD).
- Boateng, W., 2012. Evaluating the Efficacy of Focus Group Discussion (FGD) in Qualitative Social Research. *International Journal of Business and Social Science*, 3(7), pp. 54-57.
- Centre International for Tropical Agriculture, 2012. *Link Methodology: A Participatory Guide to Business Model that link Smallholder farmers to Market*. Cali, Colombia: CIAT.
- Chang, J. et al., 2013. Does growing vegetables in plastic greenhouses enhance regional ecosystem services beyond the food supply. *Frontier Ecological Environment*, 11(1), pp. 43-49.
- Cremin, P. & Nakabugo, M. G., 2012. Education, development and poverty reduction: A literature critique. *International Journal of Educational Development*, Volume 32, pp. 499-506.
- Davis, k. et al., 2012. Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa. *World Development*, 40(2), pp. 402-413.
- Divya, k. & Sivakumar, S., 2014. Adoption of good agricultural practices(GAP) in chilies cultivation by farmers in southern districts of Tamil Nadu, India. *Agriculture Update*, 9(2), pp. 178-180.
- DoA, 2017. *Bhutan RNR Stastisitc: Department of Agriculture, Ministry of Agriculture and Forests*. Thimphu. s.l.:s.n.

- Dorji, T., 2014.). *Towards Winter Vegetable Self Sufficiency.* , Thimphu: RNR Newsletter, Ministry of Agriculture and Forest.
- Drost, S., 2012. *Key conditions for successful value chain partnerships: A multiple case study in Ethiopia*, Rotterdam, The Netherlands: The Partnerships Resource Centre: Working Paper Series.
- Emmanuel, E. O., 2018. Gender Dimension in Agricultural Food Value Chain Development in Nigeria: The Women Perspective. *International Journal of Agriculture and Earth Science*, 4(3), pp. 37-45.
- Ensign, P. C., 2001. Value Chain Analysis and Competitive Advantage. *Journal of General Management*, 27(1), pp. 18-42.
- FAO, 2016. *A Scheme and Training Manual on Good Agriculture Practices(GAP) for Fruits and Vegetables*, Bangkok: FAO, United Nations Regional Office for Asia and the Pacific.
- Food Act of Bhutan, 2005. *Food Rules and Regulations*, Thimphu: Ministry of Agriculture.
- FRMD, 2018. *Land Use and Land Cover of Bhutan, 2017 Maps and Statistics*. Thimphu: Bhutan: Forest Resources Management Division, Department of Park and Services(MoAF).
- Govindan, K., 2018. Sustainable consumption and production in the food supply chain: A conceptual framework. *International Journal of Production Economics* , Volume 195, pp. 419-431.
- Guarín, . A., 2013. The Value of Domestic Supply Chains: Producers, Wholesalers, and Urban Consumers in Colombia. *Development Policy Review*, 31(5), pp. 511-530.
- Gupta, J. & Vegelin, C., 2016. *Sustainable development goals and inclusive development.*, University of Amsterdam: International Environmental Agreements: Politics, Law and Economics.
- Hoq, S. M. & Omar, M. I., 2014. Production and Marketing of Green Chilli in two Copious District of Bangladesh. *Asian Academic Research Journal of Multidisciplinary*, 1(18), pp. 785-799.
- Joshi, P., Joshi, L. & BIRTHAL, P. S., 2006. Diversification and Its Impact on Smallholders: Evidence from a Study on Vegetable Production. *Agricultural Economics Research Review*, Volume 19, pp. 219-236.
- Joshi, S. R. & Gurung, B. R., 2009. *Potato in Bhutan -Value Chain Analysis*, Thimphu: Regional Agricultural Marketing and Cooperatives Office (RAMCO), Mongar. Department of Agricultural Marketing and Cooperatives, Ministry of Agriculture.
- Katwal, T. B., 2013. Popularizing Multiple Cropping Innovation as a Means to Raise Crop Productivity and Farm Income in Bhutan. In: M. Musa, A. A. Kalam & T. R. Gurung, eds. *SARRC Agriculture Center*. Daka: SAARC Agriculture Center, pp. 35-64.
- KIT, Faida MaLi & IIRR, 2006. *Chain empowerment: Supporting African farmers to develop markets*. s.l. Amsterdam, Netherlands: Royal Tropical Institute, Arusha, Tanzania: Faida Market Link and Nairobi, Kenya: International Institute of Rural Reconstruction.
- KIT & IIRR, 2012. Gender Equity in Agriculture Value Chain Development. In: P. Mundy, ed. *Women in a mens world*. Amsterdam: Royal Tropical Institute, pp. 130-135.
- KIT, Faida Mali & IIRR, 2006. *Chain empowerment: Supporting African farmers to develop markets..* s.l.:Amsterdam, Netherlands: Royal Tropical Institute, Arusha, Tanzania: Faida Market Link and Nairobi, Kenya: International Institute of Rural Reconstruction..

- KIT, 2008. Value Share of Actors involved in Chain. In: P. Mundy, ed. *Trading Up: Building Cooperation between Farmers and Traders in Africa*. Amsterdam: Royal Tropical Institute and IIRR, pp. 39-43.
- Knowler, D. & Bradshaw, B., 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy*, Volume 32, pp. 25-48.
- Kuensel, 2017. *44MT of local chilies to hit the market soon*. [Online]
Available at: www.kuenselonline.com
[Accessed 30 May 2019].
- Kumar, D. & P. V., R., 2016. Value Chain: A Conceptual Framework. *International Journal of Engineering and Management Science*, 7(1), pp. 74-77.
- Manfre, C. & Sebstad, J., 2010. *Behavior Change Perspectives on Gender and Value Chain Development*, s.l.: USAID.
- Manfre, C. et al., 2013. *Reducing the Gender Gap in Agricultural Extension and Advisory Services: How to Find the Best Fit for Men and Women Farmers*, s.l.: USAID FROM PEOPLE OF AMERICA.
- Mariyono, J., 2009. *Chili production practices in Central Java, Indonesia: a baseline report*. , University of Pancasila - Indonesia: AVRDC – The World Vegetable Center.
- Murthy, S., Prabhakar, B. & Hebb, S., 2009. Economic feasibility of vegetable production under polyhouse: A case study of capsicum and tomato. *Journal of Horticulture Science*, 4 (2), pp. 148-152.
- NBC, 2015. *The history of the introduction and adoption of important food crops in Bhutan*. Serbithang, Thimphu : Bhutan: National Biodiversity Center, Ministry of Agriculture and Forest.
- NSB, 2017. *Annual District Statistics*, Thimphu: Bhutan: National Statistics Bureau.
- NSB, 2018. *Statistical Yearbook of Bhutan*. Thimphu:Bhutan: National Statistics Bearuea.
- NSC, 2018. *National Seed Center, Ministry of Agriculture and Forest*. [Online]
Available at: <http://www.nsc.gov.bt>
[Accessed 29 May 2019].
- Oloo, J., 2010. Food safety and quality management in Kenya: An overview of the roles played by various stakeholders. *African journal of food agriculture nutrition and development*, 10(11), pp. 4379-4397.
- Osterwalder, A. & Pigneur, Y., 2010. Business Model Generation: A handbook for visionaries, game changers, and challenges. *African Journal of Business Management*, 5(7).
- Ozkan, B., Fert, C. & Karadeniz, C. K., 2005. Enegry and Cost Analysis for Greenhouse and Open-Field Grape Production. *Energy*, Issue 32, pp. 1500-1504.
- Poudel, P., 2012. Marketing margin assessment of off-season vegetables value chain in Surkhetdailekh road corridor. *The Journal of Agriculture and Environment* , Volume 13, pp. 27-31.
- RGoB, 2018. *Land Lease Rules & Regulation*. Thimphu: National Land Commission.
- Ricketts, K. D., 2014. Value chain approaches to development: Smallholder farmer perceptions of risk and benefits across three cocoa chains in Ghana. *Journal of Agribusiness Development and Emerging Economic*, 4(1), pp. 2-22.

- Schreinemacher, P. et al., 2016. Farmers training in offseason vegetables: Effect on income and pesticides use in Bangladesh. *Food Policy*, Volume 61, pp. 132-140.
- Schutzbank, M. H., 2012. *Growing vegetables in Metro Vancouver: Urban farming census*, s.l.: The University of British Columbia.
- Stobdan , T. et al., 2018. Vegetable Production Scenario in Trans-Himalayan Leh Ladakh Region, India. *Defence Life Science Journal*, 3(1), pp. 85-92.
- Sultan, A. & Saurabh, 2013. Achieving Sustainable Development through Value Chain Analysis. *International Journal of Managing Value and Supply Chains*, 4(2), pp. 39-46.
- Shively, G., 2012. *An Overview on Cost Benefit Analysis*, s.l.: s.n.
- Sodhi, M. S. & Tang, C. S., 2016. Supply chain opportunities at the bottom of the pyramid. *cross mark*, 43(2), pp. 125-134.
- Tan, T. J. & Zailani, S., 2009. Green Value Chain in the Context of Sustainability Development and Sustainable Competitive Advantage. *Global Journal of Environmental Research*, 3(3), pp. 234-245.
- The Pesticides Act of Bhutan, 2000. *An Act to regulate the safe use and handling of chemicals to prevent public health*. Thimphu: Royal Government of Bhutan.
- Urbig , D., 2003. The value chain's values: Interpretations and Implications for firm and industry analysis. *Business Informatics Research (BIR)*, pp. 1-15.
- Umar, A., Sasongko, A. H., Aguzman, G. & Sugiharto, 2018. Business Model Canvas As a Solution for Competing Strategy of Small Business in Indonesia. *International Journal of Entrepreneurship*, 22(1), pp. 1-9.
- Vermeulen, S., Woodhill, J., Proctor, F. & Delnoye, R., 2008. *Chain-Wide Learning for Inclusive Agrifood Market Development: A guide to multi-stakeholder processes for linking*, s.l.: International Institute for Environment and development London, UK and Wageningen University and Research Center, the Netherlands.
- Wangchen, J., 2019. *Bafra Seizes over 10 MT of baned vegetables*. [Online]
Available at: www.pressreader.com
[Accessed 19 May 2019].
- Wang, J., 2012. *Organic Vegetable Value Chain Study: Emerging Organic Market and Opportunities for smaller holder for Farmers in China*, Berlin: Humboldt-Universität zu.

Appendix 1: Survey questionnaire

Village: _____

Block/Section: _____

Farmer's Name: _____

Enumerator Name: _____

Date: _____

Part 1

Household Characteristics

1. Respondent Information

District				Punakha	
Block	Guma	☐		Bapisa	☐
Gender	Male	☐		Female	☐
Age	Below 25	☐	26-46	☐	47-67 ☐ Above 68 ☐

2. Education of the respondent

a. None ☐ b. NFE ☐ c. Primary ☐ d. High School ☐
e. Diploma ☐ f. Bachelor ☐

3. Off farm or other source of income generation

a. Carpentry b. Business c. other(specify) _____

4. What is the annual income of your household?

a. Less than Nu. 100,000 ☐ c. Nu. 150,000 – 250,000 ☐
b. Nu. 300,000- 500,000 ☐ d. More than Nu. 500,000 ☐

Part 2

Landholding size and cropping pattern

1. What is the total land area?

a. Less than 1 acre ☐ b. Less than 2 acres ☐ c. less than 3 acres ☐
d. Less than 4 acres ☐ e. More than 5 acres ☐

3. The total area of land (acre) used for growing chili during peak season in 2018?

a. Less than 1acre ☐ b. 2-3acre ☐ c. More than 3acre ☐

4. The total area of land (acre) used for growing chili during offseason in 2018? (**ONLY FOR OFFSEASON GROWERS**)

b. Less than 1acre ☐ b. 2-3acre ☐ c. More than 3acre ☐

5. Why do you grow chili?
 a. Food ☐ b. Cash ☐ c. Both but mostly food ☐ d. Both but mostly cash ☐

6. How many years have you been cultivating chili in offseason? (**ONLY FOR OFFSEASON GROWERS**)

a. Less than 5 years ☐ b. 5 to 10 year ☐ c. above 10 years ☐

7. What chili variety did you cultivate during peak season?

a. Bogap-Ema ☐ b. Indian Chili IR-8 ☐ c. PAN 1498 ☐ d. SHP4884 ☐
 e. SV23197HA ☐ f. others ☐

9. What chili variety did you cultivate during offseason season? (**ONLY FOR OFFSEASON GROWERS**)

a. Sha-Ema ☐ b. Indian Chili IR-8 ☐ c. PAN 1498 ☐ d. SHP4884 ☐
 e. SV23197HA ☐ f. others ☐

10. Where do you prepare your nursery for chili seedlings during offseason? (**ONLY FOR OFFSEASON GROWERS**)

a. Open Area ☐ b. Greenhouse ☐ c. Both ☐

11. From where did you get your chili seed?

a. Own ☐ b. Government supply ☐ c. Purchased from others ☐
 d. Neighbor (Free of cost) ☐

12. What was the income from the chili during peak season?

a. Less than Nu. 50,000 ☐ b. Nu. 51,000-80,000 ☐ c. Nu. 81,000- 100,000 ☐
 d. More than Nu.100,000 ☐

13. What was the income from the chili during offseason? (**ONLY FOR OFFSEASON GROWERS**)

a. Less than Nu. 50,000 ☐ b. Nu. 51,000-80,000 ☐ c. Nu. 81,000- 100,000 ☐
 d. More than Nu.100,000 ☐

14. Pick one main reason constraint incurred in offseason chili production?

a. The high cost of input ☐
 b. Labor shortage ☐
 c. Damage by pest and disease ☐
 d. Lack of irrigation ☐
 e. Undesirable variety ☐

15. How often do you contact Extension agents in a growing season?

a. Never ☐ b. 1-2 times ☐ c. 2-3 times ☐ d. More than 3 times ☐

Part 3

Production and Marketing

1. What proportion of your chili are marketed according to following methods?

a. _____% direct to the consumers in the village/road side.

b. _____% in the local open market.

c. _____% to the traders/dealer.

d. _____% other(specify)

2. What is the distance to the vegetable market?

a. 0-10 km ☐ b. 11-30 km ☐ c. 21-50 km ☐ d. More than 51 km ☐

3. What price do you charge for your chili/kilo for:

a. _____ direct to the consumers in the village/road side.

b. _____ in the local open market.

c. _____ to the traders/dealer.

d. _____ other(specify)

4. Do you intend to continue growing chili in offseason?

a) Yes ☐ b) No ☐

4.1 If No, Why?

.....
.....
.....

4.2. If Yes, rank the reasons given the following?

Sl.No.	Factors
1	Good Production
2	High market demand
3	Availability of transport
4	Good market price
5	Sufficient land size
6	Sufficient manpower
7	Other (Specify)

Part 4

Food self-sufficiency situation

1. Were you able to produce enough food crops for your household in all 12 months during 2018?

a. Yes ☐ b. No ☐

If no, then continue with section 1.2

1.2. In which month(s) did you experience food shortage?

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Select one important reason from the following for not able to meet food self-sufficiency?

- a. High cost of input ☐
- b. Limited land holding ☐
- c. Damaged from wild animal ☐
- d. Farm labour shortage ☐
- e. Unproductive land ☐
- f. Natural calamities ☐

Part 5

Participation in Training and Meeting

1. Have you ever participated in any training?

a. Yes ☐ 2. No ☐

2. If yes, specify the types of training.

- a. Nursery Management ☐
- b. Soil Management ☐
- c. Post- Harvest Management ☐
- c. Book Keeping ☐
- d. others ☐

3. Who participates the most during the meetings and training?

a. Male ☐ b. Female ☐

4. Who takes most of the household decision?

a. Male ☐ b. Female ☐

5. What type of activities do women participate mostly in the given below?

- a. Farming ☐
- b. Attend training ☐
- c. Marketing ☐
- d. Financial Management ☐

Appendix 2. Checklist for Interviewing Stakeholders

Researcher/Academician

1. Perception of agriculture trend in Bhutan
2. Project in offseason vegetable production
3. Type of contribution to agriculture development (offseason)
4. Solution for food sufficiency
5. Challenges in your role
6. Way forward

Bank

1. Financial support for agricultural projects
 - Types of agricultural activities supported (crop, livestock, agribusiness, etc.
 - Bank policy to support the agricultural sector
2. Type of loans provided to farmers
3. Requirements for loan
4. The trend of agricultural loan repayment
5. Challenges with agricultural financing
6. The way forward

BAFRA

1. Role in food quality control
2. Policy and standard on food quality
3. Awareness program on food act and standard
4. Challenges in implementing policy and standard
5. The way forward

Input Supplier

1. Source of supply
2. Farmer's perception of your input supply.
3. Who decides the price of input?
4. Government policy and support on sourcing the different types of input
5. Challenges of your role
6. The way forward

Extension Agent

1. Type of service delivered to a farmer (offseason)
2. How do you deliver those services?
3. Opportunities do you see in producing vegetables in offseason
4. Challenges in your role.
5. Way forward

Local Government

1. Local government policy on offseason vegetables
2. Role of LG in producing offseason vegetables

3. Farmer's perception of producing offseason vegetables
4. Challenges in agriculture in your community
5. Land tenure system for commercializing vegetable production
6. Budget allocation for farmers training
7. The way forward

Retailers/wholesaler/middlemen

1. Source your products (location)
2. Relation with producers
3. Price of chili/kilogram
4. Final market place
5. Information about market (Neighbour/ buyer/ media)
6. Marketing channel cost (Transportation/labor/packaging)
7. The challenges of retailing during offseason
8. The way forward

Cost of production

Respondent Information

Name:

Village:

Block:

Cost Item	Price Per Unit	Amount	Cost
Variable Cost			
1. Labour (Hired and Family Labour)			
Land Preparation			
Seed Sowing			
Planting			
Earth Breaking and Weeding			
Fertilizer Application			
Irrigation			
Harvesting			
Transportation			
Total Human Labour cost			
2. Land Preparation Cost			
Power tiller/Draft Power			
Total Land Preparation Cost			
3. Material Input Cost			
Seed/Seedling			
Farm Equipment			
Farm Yard Manure			
Biopesticides			

Pesticides (if any)			
Total Cost of Inputs			
Total Variable Cost (VC)			
Fixed Cost			
Rental Value of Land			
Interest Loan			
Others (if any)			
Total Fixed cost (FC)			
Total Cost (VC+FC)			

Return from chili Produce			
Produce	Total output(kg)	Price Per Unit	Total Value of output
Chili			
loss to pest & diseases			
Total Revenue			

Appendix 3: Ethical clearance letter to conduct data collection



དཔལ་ལྷན་འབྲུག་གཞུང་། རྫོང་ཁག་འཕད་གསུལ་ ལྷུང་མ་བླ་ཁ།
Royal Government of Bhutan
Dzongkhag Administration, Punakha

DAP/HR-17/2018-2019/ 5890 June 28, 2019

The Gup,
Barp and Guma Gewog,
Punakha

Dear Sir,

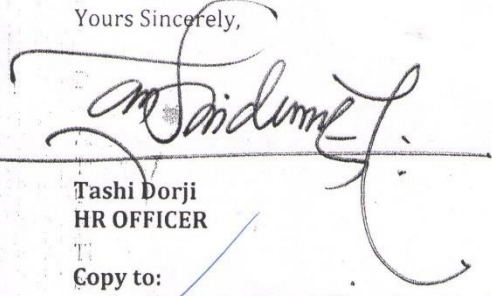
As per letter no. CNB/PER-01/2019 dated 27th June 2019 of the President, CNR, Lobesa, Mr. Tashi Dorji, associate lecturer at the College is requesting to conduct research on "Off-Season Chili Production," in your Gewog.

Therefore, kindly provide the official with necessary assistance from your office in order to carry out his research works efficiently.

Your kind corporation will be highly appreciated.

Thanking you,

Yours Sincerely,



Tashi Dorji
HR OFFICER

Copy to:

1. Dz. Agriculture Officer, Punakha Dzongkhag for kind information.

Tel.: Dasho Dzongdag:584110/(F:584461), Dasho Dzongrab:584117, ADM:584215/(F:584121), HRO:584534,
CO:584536, RO:584532, Sr.PO:584524, DEO:584539, DAO:584166, DLO:584104, Dz.FO:584267, DE:584531,
BO/AAO:584537, EO:584528, DzEO:584596, DHO:584255, LO:584223, PO:584200, DYT:584223, ICT:584530.

Appendix 4: Demographic background of the study area

Name of Block * Gender Crosstabulation

Count

		Gender		Total
		Female	Male	
Name of Block	Barp	11	14	25
	Guma	4	13	17
	kabisa	5	13	18
Total		20	40	60

Name of Block * Age Crosstabulation

Count

		Age			Total
		26-46	47-67	68<	
Name of Block	Barp	7	16	2	25
	Guma	10	7	0	17
	kabisa	10	8	0	18
Total		27	31	2	60

Name of Block * Education of Respondent Crosstabulation

Count

		Education of Respondent				Total
		None	NFE	Primary	High School	
Name of Block	Barp	16	4	5	0	25
	Guma	7	2	3	5	17
	kabisa	6	9	1	2	18
Total		29	15	9	7	60

Name of Block * Total Land of household Crosstabulation

Count

		Total Land of household				Total
		1 Acre<	2 Acre <	3 Acre <	4 Acre <	
Name of Block	Barp	9	9	7	0	25
	Guma	2	8	5	2	17
	kabisa	3	9	4	2	18
	Total	14	26	16	4	60

Statistics

Total land of household

N	Valid	60
	Missing	0
Mean		2.17
Std. Deviation		.867
Minimum		1
Maximum		4

Appendix 5: Total Income from sale of offseason chili

Total Income from offseason Chili

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50,000<	33	55.0	61.1	61.1
	51,000 Nu - 80,000 Nu	19	31.7	35.2	96.3
	81,000-100,000	2	3.3	3.7	100.0
	Total	54	90.0	100.0	
Missing	System	6	10.0		
Total		60	100.0		

Annual Income of a Household

Statistics

Income of household in a year

N	Valid	60
	Missing	0
Mean		180000.00
Median		150000.00
Std. Deviation		75464.662

Appendix 6: One-way Anova test to find income difference in three different blocks

ANOVA

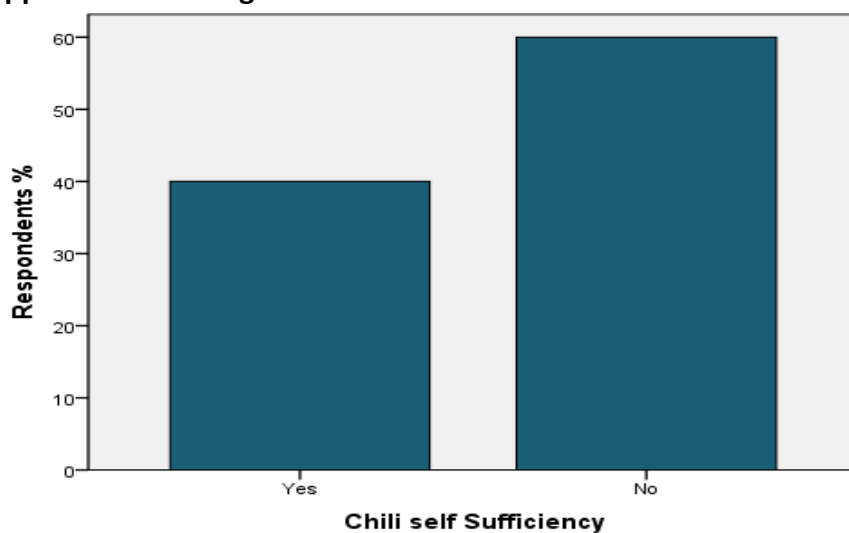
Total Income from offseason Chili

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.385	2	.192	.069	.934
Within Groups	75.782	27	2.807		
Total	76.167	29			

Appendix 7: Chili growing ranking on reason for growing offseason chili

Ranks	Good Yield	High Demand	Transport Available	High Price	Sufficient land	Sufficient labour
Rank 1	3%	62%	3%	28%	7%	0%
Rank 2	0%	28%	21%	55%	0%	0%
Rank 3	0%	10%	52%	17%	21%	3%
Rank 4	28%	0%	17%	0%	28%	21%
Rank 5	52%	0%	7%	0%	14%	28%
Rank 6	17%	0%	0%	0%	31%	48%
sum	100%	100%	100%	100%	100%	100%

Appendix 8: Shortage of chili



Appendix 9: Correlation test between years of experience in offseason chili growing and their income

Correlations

		How many years they have been growing offseason chili	Total Income from offseason Chili
Spearman's rho	Correlation Coefficient	1.000	.228
	How many years they have been growing offseason chili		
	Sig. (2-tailed)	.	.284
	N	30	24
	Correlation Coefficient	.228	1.000
	Total Income from offseason Chili		
	Sig. (2-tailed)	.284	.
	N	24	24

Appendix 10: Cropping Calendar

chili Cropping Calendar for Indian chil IR-8

	Months											
	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Chilli												

Legends:	
Sowing	
Nursery	
Transplanting	
Fruiting	
Harvesting	
Fallow	

Source: Stakeholder Interview

chili Cropping Calendar for Local Variety Bogap-Ema

		Months											
		Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Chilli													
Legends:													
Sowing													
Nursery													
Transplanting													
Fruiting													
Harvesting													
Fallow													

Source: Stakeholder Interview

Appendix 11: cost of production for chili

	Cost Items	Peak Season (Bogap-ema) (n=30)	Offseason (Indian chili) (n=30)
A. Variable cost	Human labor (Family labor/Hired labor)		
	Land preparation	Nu.3200	Nu.800
	Seed Sowing	Nu.6000	Nu.800
	Planting	Nu.6000	Nu.800
	Earth Breaking & Weeding	Nu.20,000	Nu.1200
	Fertilizer application	Nu.12,000	Nu.800
	Irrigation	Nu.2000	Nu. 400
	Harvesting	Nu.1600	Nu.1200
	Transportation	Nu.5000	Nu.5000
	Land preparation Cost		
	Power tiller/ Draft power	Nu.2500	Nu.500
	Material inputs cost		

	Seed/Seedlings	Nu.1500	Nu.200
	Fertilizer and Manure Cost		
	Inorganic:		
	▪ Urea	Nu.220	Nu.20
	▪ Suphala	Nu. 1770	Nu.17
	▪ SP	Nu.1000	Nu.70
	Other fertilizers (if any)		
	FYM	Nu. 25,000	Nu. 500
Total Variable Cost		Nu. 87790	Nu. 13,507
Fixed Cost	Equipment/Infrastructure	Nu.5000	Nu.70,000
	Maintenance	Nu.2000	Nu. 3000
A. Total Fixed Cost		Nu. 7000	Nu. 73,000
Total Cost (A+B)		Nu. 94,790	Nu. 86,507

Appendix 12: Kruskal Wallis Test to determine significant difference income from off and peak season chili

Ranks

	What kind of chili do they grow	N	Mean Rank
Total Income from offseason Chili	Sha-ema	6	10.58
	Indian Chili IR-8	18	13.14
	Total	24	

Test Statistics^b

	Total Income from offseason Chili
Chi-Square	.640
df	1
Asymp. Sig.	.424

a. Kruskal Wallis Test

b. Grouping Variable: What kind
chili do they grow

