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Analysis of Mustard Oil Value Chain in Province 2 of Nepal: Evidence from Logistic Regression

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Abstract

Background: Mustard oil is used by millions of People in south Asian region due to its health benefit, livelihood and employment opportunities. For smooth operation from growing to reach at customers hand value chain supports a lot. It is not only helping farmers but also generating opportunities in each stage. Thus, this study aims to identify value chain analysis of mustard oil in Nepal.

Objective: Aim of this study is to identify the on-Value Chain Analysis of Mustard Oil.

Method: The paper followed the design of explanatory research and collected data using structured questionnaires. Binary Logistic Model was used for inferential analysis. Siraha and Saptari Districts are chosen purposely. 164 respondents were conveniently sampled from farmers and traders.

Result: The study shows the cooperatives play role in accessing credit, accessing input and training with the help of government and non- government organizations. The study tells us the fact that the mustard value chain functions in a traditional way, there is no innovative way of integrating the chain actors. Though the cooperatives are involved in both input supply and in credit services, their role is not as expected. Farmers are not getting adequate advisory service from cooperatives. Ages, off-farm income, access to information, access to input are the factors that add value in mustard value chain.

Conclusion: The study concluded that the value chain is currently underdeveloped; there is no innovative way of integrating the chain actors in value chain. Farmers are not getting adequate advisory service from cooperatives.

Paper Types: Research Paper

Keywords: Value Chain Analysis, Farmer, Traders, Value addition, Logistic Model, Kobo toolbox.

JEL Classification: N55, Q8, Q18 and Q2

Introduction

Mustard is one of the important oilseed crops of Nepal which belongs to family Cruciferae and is popularly known as tori in Nepal. It occupied 214,835 ha of land area, with the production of 179,145 t and productivity of 0.83 t/ha. Its seeds contain 40-50% oil and 20-25% protein. Similarly, 4.8% nitrogen, 2% phosphorus and 1.3% potash can be obtained from mustard oil cake (Dhakal et al., 2015).

Mustard is an entomophilic plant that is cross pollinated. For optimal pollination and seed production, a large number of pollinating agents is required. Honeybees pollinate plants naturally across their native area. The primary function of honey beekeeping is pollination, with honey and wax as supplementary outputs. Mustard is a condiment made from the seeds of the mustard plant (Sinapis alba, white/yellow mustard; Brassica juncea, brown/Indian mustard, or B. nigra, black mustard). Mustards (Brassica spp.) are herbaceous perennial plants of the Brassicaceae family that are cultivated for their spice seeds. Mustard plants are herbaceous plants with yellow flowers that are small and herbaceous. The plant's leaves are toothed, lobed, and often have bigger terminal lobes. Plants can grow to be 16 cm (6.3 in) long. Specific yellow flowers are 8 mm (0.3 in) in diameter and emerge in spike-like clusters of 2–12 flowers. Each flower produces seeds that range in color from red to brown. Mustards are also being referred to as mustard, brown mustard, red mustard, yellow mustard or wedlock and are believed to have originated in the temperate regions of Europe (Shirsath et al., 2017).

The introduction of mustard to Spain is credited to the Roman legions, who brought the seeds with them during their conquests (Dunmire, 2004). Later, Portuguese explorer Vasco da Gama is believed to have introduced mustard to India, enriching the subcontinent's culinary traditions (Boileau, 2010; Madison, 2017). Different mustard varieties have distinct origins: Brown Sarson is native to Eastern Afghanistan, Nepal, India, and Pakistan (Sharma et al., 2024); Yellow Sarson hails from the eastern parts of India and Nepal (Pandey et al., 2023); Gobhi Sarson originated in Europe (Sharma et al., 2024); and Taramira, although widely cultivated in India, has its roots in southern Europe and North America (Sastry, 2003). Each type of mustard has adapted to its respective region, contributing to diverse agricultural practices and culinary uses across the world.

Mustard (Brassica campestris L. Var. toria) is a major oilseed crop in Nepal. It is a member of the Cruciferae family and is known locally as tori. With a production of 179,145 t and a productivity of 0.83 t/ha, it occupied a land area of 214,835 ha. Its seeds are made up of 40% to 50% oil and 20% to 25% protein. In the same way, mustard oil cake contains 4.8 percent nitrogen, 2% phosphate, and 1.3 percent potash. In Nepali families, mustard oil is the primary cooking oil. Nepalese people also use mustard oil to encourage healthy hair development and as a massage oil to relieve aches and pains. Mustard oil of good quality keeps for a long time. As a natural preservative, it's utilized in deep-frying and numerous pickles and chutneys. Furthermore, mustard oil is used in various Nepali Sandheko meals (salad-like dishes) and stir-fries to enhance flavor. One of the causes is mustard's cultural and religious significance. To cleanse themselves, they wash their heads and bodies with mustard oil dregs. "We have to purify and qualify everything from birth to death and other important rites using mustard oil dregs." Several Newar villages and towns surrounding the big cities in the eighteenth century. Despite the fact that no historians have been able to find Khokana's documents, the town has its own unique identity. Per the author, "outside of the three major cities, there are numerous old and traditional Newar villages with their own religious, cultural, and historical significance." As a result of the advent of packaged mustard oil made by larger companies, small cottage enterprises employing traditional methods are unable to compete in the local market. In the last decade, many conventional oil mills have closed or been decommissioned.

Mustard seed is Nepal's second most significant edible oilseed crop after groundnut, accounting for almost 30% of the country's total oilseed production. Mustard oil is produced by the extraction of crushed mustard seeds. During the oil manufacturing process, pressed seeds cakes are preserved with

a little amount of oil, which is then distilled and utilized as oil cakes and animal feed. Mustard is an important edible oilseed, with oil content ranging from 38 to 46 % in the seeds. Because of its high cost, mustard oil is only used in a restricted number of industrial applications.

Several intriguing sustainability issues have emerged along the agri-food Value chains, which encompass a variety of socioeconomic and environmental factors. Household wages, price fluctuations in food goods, gender inequalities, health concerns, and many other socioeconomic issues are mostly concerned with local communities or customers. Food shortages, pre-/postharvest reductions, demand-supply imbalances, limited land ownership, price increases, customer demand for nutritious and quality goods, nutritional stability, farmers' access to market knowledge, exposure to global markets for free trade or technology transfer, and a lack of up-to-date information and intelligence are some of the other obstacles (Bhat & Jõudu, 2019).

According to a study of studies from various countries, the value chain in agriculture products involves both companies and their operations such as planting, procurement, and refining, all of which should be in tandem with one another for a good net profit (Nguyen & Thien, 2011). Harvesting, pre-cooling, grading, packing, storing, and transportation are all critical postharvest handling activities and treatment methods for consistency, not just in preserving quality but also in extending shelf life (Arah et al., 2016). If quantity and quality of mustard oil supplied to the market is improved either through partnerships with public or private then it would have sustaining impacts (Mazhar et al., 2019). It is evident that the mustard oil plays the role of mediator between traders and farmers with higher bargaining power then individual farmers. They will also help you save money on ads by lowering freight and commission rates (Niroja et al., 2015).

In order to be successful, modern marketing and management knowledge is essential. Small farmers in developing economies can ascend to agricultural entrepreneurship despite challenges (Rai et al., 2020, Adhikari, 2015, Kharel et al., 2022). Such role could be played by mustard value chain (Hanf, 2014). Mustard connects to value chains by obtaining access to short- and long-term credit, improving production efficiency, and decreasing their risk of asset depletion and insecurity. Mustard is engaged in value addition by manufacturing, indirectly assisting farmers by stabilizing the demand and creating new markets or stimulating new usage through providing newly produced processed goods (Niroja et al., 2015). The current literature reveals a vast range of documentation of smallholders' failure to satisfy market conditions for market protection. To supplement their income, smallholder farmers depend more on intensive mustard seed farming. At all levels of processing, postharvest storage, and trade, the current mustard value chain processes are not well organized. The complex nature of issues at each stage of the value chain poses a major constraint in improving livelihood of the small scale mustard value chain stakeholders (Mazhar et al., 2019). Although there is no doubt that safety standards have had a short-term effect on smallholders, there have been instances where, with financial resources and enough time, certain smallholder schemes have been able to effectively compete in high-value markets.

The current decision-making challenges in agribusiness, particularly in terms of promoting cost-effective production and delivery alignment (Devkota et al., 2017), seeking solutions to fixed market imperfections and resulting price distortions, and how to incorporate private strategies in agriculture and related industries, as well as uncertainties in knowledge through agribusiness-related stakeholder groups, have focused agribusiness as an industry to watch. These issues remain unresolved in terms of needed assistance and remedies, but more importantly, they remain unresolved in terms of theoretical and practical study Negi and Anand (2015). Research focusing on the interdependencies between barriers and considering the dynamic ways in which barriers develop and persist is essential. Such research would help explain the barriers to adaptation and provide insights into how to overcome them effectively (Phuyal et al., 2017). Therefore, investigating other mustard is an opportunity for

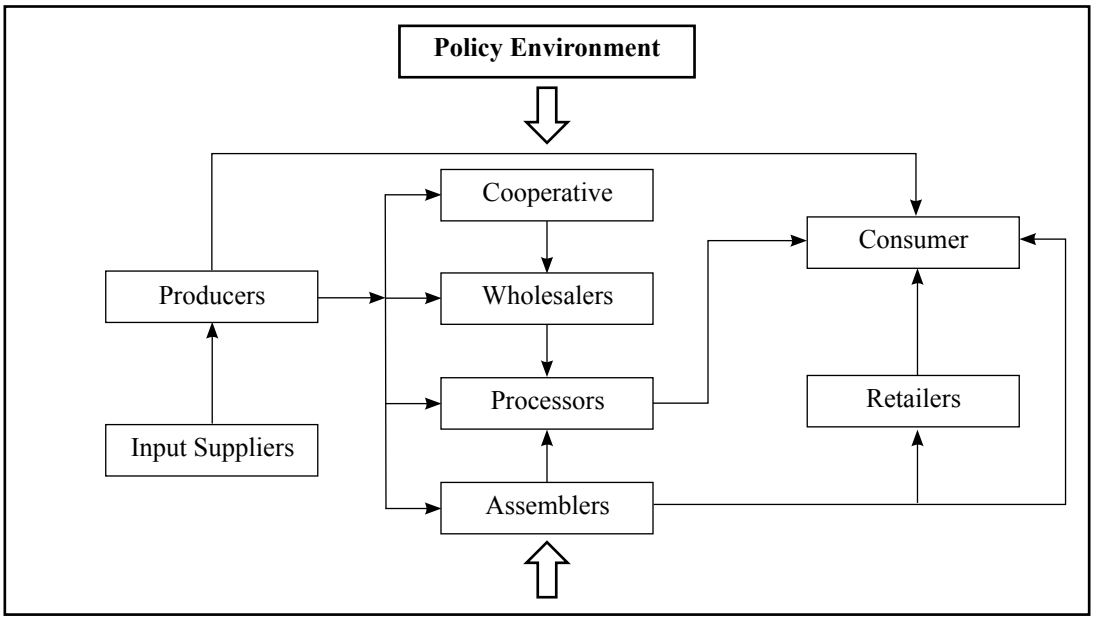
future research. Also, the governing mechanisms of leadership, financial arrangements, and negotiating power balance have not been thoroughly examined in this article, and these are areas where further research is needed. Hence, this study aims to identify the value chain analysis of Mustard Oil in the context of Nepal.

Research Method

This study is multidisciplinary as it combines numerous corporate strategy and human relation philosophies, as well as a methodology related to the area of mustard value chain research. Several theories explained for the study are: value chain theory, Planned Behavior theory, Comparative theory, Reasoned action theory and social network theory. The value chain theory describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky & Morris, 2000). Value chain theory instead tends to overlook that not only decision made in the chain are responsible for coordination structure. The theory of planned behavior (TPB) states three core components, namely: attitude, subjective norm, and perceived behavioral control, which together shape an individual's behavioral intentions. In turn, behavioral intention is assumed to be the most proximal determinant of human social behavior (Carfora, 2021). Social network theory explains the patterns of the interdependence of the diverse relations, the resultant behavior of the individual and lastly the impact of the entities' qualities on the patterns of relationships (Mapanga et al., 2017). Another is *Comparative advantage.* It is defined as an economy's ability to produce a particular good or service at a lower opportunity cost than its trading partners. The *theory of comparative advantage* introduces opportunity cost as a factor for analysis in choosing between different options for production (Nangole et al., 2011). Similarly, The Theory of Reasoned Action (TRA) suggests that a person's behavior is determined by their intention to perform the behavior and that this intention is, in turn, a function of their attitude toward the behavior and subjective norms (Ajzen & Fishbein, 1975).

For the study five models on the basis of value chain theory were chosen. The first model is Triple Value Model (3V). 3V is a systems paradigm that portrays the value flow and linkages between industrial, societal, and environmental system. It may be used to characterize environmental issues and to investigate the potential impacts of different policies and activities. The second model is Value chain analysis model. VCA is a tool used in the process of achieving collaborative allocation and management of resources within and between businesses in a chain, the purpose of which is to improve the competitiveness of the chain as a whole. Fundamentally, VCA identifies what consumers value and will pay for in a product or service (i.e., its value attributes), and where that value is created or destroyed in the chain. The third Conceptual model, is a representation of a system that uses concepts and ideas to form said representation. It is used across many fields, ranging from the sciences to socioeconomics to software development. Conceptual models and conceptual diagrams are used in artificial intelligence to construct expert systems and knowledge-based systems; here, experts are concerned with representing expert judgment on what is true rather than their own ideas on what is real. Similarly, fourth model CGE models are an appealing contrast to econometrically dependent macro models. CGE models demand less data in general than econ models. The last model is behavioral Change model, which provides a basis for considering the possible link between environmental knowledge, environmental awareness and attitude. Improvement of the value chain creates synergy in the process and provides the best option for value chain players. This in turn increases farmers' comparative advantage by increasing the volume of supply, quality of the product and consistency (Bammann, 2019). Figure 1 shows the conceptual framework developed for the Mustard Oil Value chain.

Figure 1: Conceptual Framework



Source: Modified from Usman (2016)

Empirical Framework

A logistic regression model was selected to identify the significant variable that determines whether farmers are adopting available adaptation options (Shakya et al., 2023). Assume that Y is the farmer's available adaptation alternative, and that X reflects economical, institutional, social, and other variables. The inferential statistical analysis used in this thesis for such a dichotomous result is a logistic model (Mabe et al, 2014; Phuyal, & Devkota 2017, Devkota et al., 2020). Logit and probit models are frequently used to investigate logistic regression (Maharjan et al., 2020)A binary logit model can be used to estimate the influence of X on answer probabilities, P(y = j/x). which is expressed as.

$$P(Y_i / X) = F(Z_j) = e^z i / 1 + e^z i = 1 / 1 + e^{-z} i$$

$$P(Y_i = J/X_i) = F(Z_j) = e^z i / 1 + e^z i = 1 / 1 + e^{-z} i$$

$$Z_i = \beta_0 + \beta_1 X_{1i} + ... + \beta_n X_{ni} + \mu_i + ... \quad (3.3)$$

The logit regression equation that is used to ascertain variables influencing determinants of mustard value chain is

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + ... + \beta_n X_n + \mu_0 ... \quad (3.4)$$

Where,

P = Probability of the outcomes

β_0 = Intercept term

$\beta_1 ... \beta_n$ = Coefficient

$X_1 ... X_n$ = Independent Variables

Variable Used

The study explores factors influencing value addition in the agricultural value chain of mustard oil. The primary dependent variable is a dummy variable that indicates farmer participation in value addition,

coded as 1 if the farmer participates and 0 otherwise. The independent variables hypothesized to affect this dependent variable include several key factors. Table 1 shows the variables and its associated relations.

Table 1: Variables and Expected Sign of Variables

Variable	Description	Value	Expected sign
		Dependent Variable	
Factors affecting value addition	Represents whether the farmer participates in value addition or not.	1 = if the farmers participate in value addition. 0 = otherwise	±
		Independent Variable	
Access to market information	Mustard producer gets market information	1 = If the farmer has access to market information. 0 = otherwise	+
Access to extension service	Household had access to extension services	1 = if a household had access to extension services 0 = otherwise	+
Size of farmland	Total area of farmland a farmer owned, rented in and/or shared	Continuous (Katha)	+
Livestock	Farmers who have many livestock.	Continuous (Livestock unit (LU).	±
Farming experience	Household engaged in farming activities	Continuous (years)	±
Education level	Formal schooling of the household	1 = if Follow formal education, 0 = if Illiterate	+
Family size	Number of members in a household	Continuous (number)	+
Age	Age of respondent	In years	+
Distance to nearest market	The closer a household to the nearest urban center	Continuous (Km)	+
Inputs	Source of input and access to Input would enhance the production capacity of the farmer	1 Yes, 0 Otherwise	+
Storage	Household having storage facility	Continuous (Days)	+
Training	Household that had training and related activities	1 Yes, 0 Otherwise	+
Family type	The types of family	1 nuclear, 2 joint. 3 extended	±
Income from non/off farm activities	Household obtained income from off/nonfarm activities	1 Yes, 0 Otherwise	+

Variable	Description	Value	Expected sign
Access to credit	Access to credit would enhance the financial capacity of the farmer	1 if the household takes loan 0 = otherwise	+
Ownership of market transport facilities	Specifically vehicles, carts and transport animals	1= households owned transportation facilities 0 = otherwise	+

As shown in the table, Access to Market Information is a dummy variable set to 1 if the farmer has access to market information, reflecting a positive impact on market supply as suggested by Alemayehu (2012) and Abraham (2013). Size of Farmland is a continuous variable representing the total farmland owned and rented, measured in katha (0.033 hectare). It is hypothesized that a larger farmland size supports higher yields, with Alemayehu (2012) indicating that an increase in farmland area can significantly boost market deliveries. Livestock is another continuous variable, measured in cattle units (LU), which influences land use for grazing and economic strength. Studies such as Mussema (2006) and Urgessa (2011) show mixed effects on market sales, with larger herds potentially impacting livestock production and financial capacity. Farming Experience, measured as the number of years in agriculture, is a continuous variable that is positively correlated with marketable harvests, as noted by Abraham (2013).

Family Type is represented by a dummy variable with values 1 for nuclear families, 2 for joint families, and 3 for extended families. This variable has been shown to positively impact value addition, according to Tewodros (2014). Education Level is also a dummy variable indicating whether the household head has formal education. This variable is expected to have a favorable influence on marketable supply, supported by Holloway (2000), who found that education enhances market participation. Age, a continuous variable representing the household head's age, serves as an indicator of experience and resource management. Its impact on market participation and output is mixed, with Tshiunza et al. (2001) and Abraham (2013) noting different effects on marketable produce. Family Size, a continuous variable representing the number of household members, affects domestic consumption and market involvement. Larger families might be less engaged in markets due to higher domestic consumption, as observed by Berhanu and Moti (2010).

Access to Extension Services is a dummy variable set to 1 if the farmer has access to these services, which can enhance knowledge and technology adoption. This is supported by Lerman et al. (2004) and Berhanu et al. (2013), who found positive impacts on market access and technology use. Distance to Nearest Market affects market access and choices, influencing marketing strategies. Income from Non-Farm Activities is a dummy variable indicating whether the household earns from non-farm sources. According to Mussema (2006), non-farm income can affect market participation, as farmers may prefer local markets over distant ones. Access to Credit, another dummy variable, influences financial capacity and investment in value addition.

Ownership of Market Transport Facilities is a dummy variable reflecting whether the household has transportation means. This factor can enhance market access and choice, reducing market distance limitations as noted by Maina (2015). Storage is a continuous variable representing the availability of storage facilities, which is crucial for reducing post-harvest losses and improving value addition, supported by Kalauni & Joshi (2020). Inputs, a dummy variable indicating access to agricultural inputs, enhances output capacity and value chain performance, with Abayneh (2019) highlighting its significance in production. Training, another dummy variable, reflects participation in training programs, which is vital for improving value chain efficiency, as emphasized by Gligor et al. (2018).

Study Area

Saptari and Siraha districts were chosen as the study's focus areas. Saptari district of Nepal was chosen specifically because of its increased production potential. The district of Saptari is located in Nepal's province number two. Saptari is placed at a mean height of below 305 meters and 61 meters above sea level and is located in latitudes 26° 35′ 0″ N and longitudes 86° 45′ 0″ E. Terai district includes Saptari. (Shresth et al., 2021). This district has a population of 639,284 people and occupies an area of 1,363 km2 (526 sq mi) with cultivable land of 81667.89 hector, of which mustard cultivation contributes 9500 hector (Census, 2011). Saptari is known for its agricultural production, and the huge Sapta Koshi River runs through it to the east (Praja et al.,, 2021). In the mustard producing pocket, there are two sorts of farmers: commercial and reliable. Smallholder farmers are farmers who have a long history of producing consistently. These farmers work with little plots of land and consume a large amount of the output (Gc & Hall, 2020). According to USAID (2014), such farmers eat around 30 percent of the mustard produced in their houses. Other preserved mustard pieces are sold at the local market, and the proceeds are used for personal expenses. Commercial farmers, on the other hand, benefit from the mustard they grow (Baral, 2016). The study areas were selected based on intensity of agriculture, vulnerability, and accessibility. The geographic coordinates of Siraha district are: 26.7957° N, 86.2971° E and It is situated in the Terai belt of Nepal and its district headquarters, covers an area of 1,188 km 2 (459 sq mi). The cultivable land of Siraha district is 73913 hector in which mustard farming contribute 6165 hector of land. It has the population of 637,328 (Census, 2011). The district is bordered by Dhanusha district on the West, Udhayapur district on the North and Madhubani district of India on the South. Majority of the population here is Yadav, Tharus, Muslims and ethnic minorities with majority population speaking Maithili language and Nepali language. The district consists of seventeen municipalities, out of which eight are urban municipalities and nine are rural municipalities.

Population and Sample Size

Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of non-probability or non-random sampling in which members of the target population who meet certain practical criteria, such as easy accessibility, geographic proximity, availability at a specific time, or willingness to participate, are included in the study. The target population's members are assumed to be homogenous, which is the fundamental assumption connected with convenience sampling. That is, the study results acquired from a random sample, a local sample, a cooperative sample, or a sample taken in an unreachable portion of the population would be same (Etikan, 2016). It is selection of exploratory studies (Chamhuri & Batt 2013).

Sample size determination is the technique of choosing the number of observations for sample. In Siraha and Spatari districts, three municipalities Golbazar, Saptakoshi, Rajbiraj are purposively selected. Within Golbazar municipality ward no 4 & 5 and within Rajbiraj and Saptakoshi municipality ward no 13 & 3 were selected purposively. The total households in ward no 4 & 5 are 823 & 509 and within ward no 13 & 3 are 806 & 236 (CBS, 2011). Pre-focus group discussion regarding total households involved in mustard farming revealed that approximately 85 percent to 90 percent of farmers cultivate mustard production in ward no 4 & 5 of Golbazar municipality and 80 percent to 85 percent in ward no 13 & 3 of Rajbiraj & Saptakoshi municipality. This study follows 85 percent of the total household as mustard farmers. The following explains how the Finite Population Correction Factor (FPC) is used to adjust a variance estimate when sampling without replacement (Berger, 2004, Karki et al., 2021, Devkota et al., 2021).

The following formula for the sample size n:

$$n = N*X / (X + N - 1),$$

Where,

$$X = Z_{\alpha/2}2*p*(1-p) / MOE^2,$$

And $Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2 (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size. A Finite Population Correction has been applied to the sample size formula. Based on the formula following calculation is done to determine the sample size for the study.

Instruments, Procedure of Data Collection and Data Analysis

Field observation was used to verify or add new information. The formulated structured questionnaires are maintained in kobo toolbox for data collection. Convenience sampling is chosen due to extended pandemic time and travel time to remote areas. Due to such condition the data collection took a period of four months (April to July 2021). The interview lasted 20 to 30 minutes and involved one interviewer and one responder. After determining the sample size of the known population, 164 respondents were chosen from Saptari and Siraha districts. In the Siraha area, ten vendors were specifically picked for data gathering. The data from producers and traders was analyzed using three methods of data analysis: descriptive statistics, value chain analysis, and econometric analysis.

Data Analysis and Results

Socio-demographic Characteristics of the Respondent

This section covered the general information about the value chain analysis of mustard oil in Siraha and Saptari Districts. Various factors like Age, Gender, Working experience, Education of the respondents. This helps to know the type of respondents are responds through their different characteristic.

Socio-demographic Characteristics of producer

Out of 164 respondent's majority of the respondents were male i.e., 116 respondents; 70.73% whereas 48 respondents were female. Among the total respondents, majority of the respondent i.e., 36.59% have cleared the +2 level (higher secondary school) whereas least respondents i.e., 2.44% of total respondents have the education level of master's and above master's level. Likewise, higher respondents were gathering from Golbazar municipality i.e.,50.61% followed by Rajbiraj and Saptakoshi municipality i.e., 27.44% and 21.95% respectively. 85.37% of those surveyed were married, compared to 11.59% who were single. The survey conveyed that most of the family involved in the production of mustard are nuclear family i.e., 48.78%. Similarly, joint family and extended family conveyed by the survey were 35.37% and 10.07% respectively. Moreover, highest respondents 92 out of 164 were in the family which have 5 to 7 family members.

Major source of income of the respondents is from sale of crops (85.98%). Moreover, sale of livestock or products, off-farm income and others accounted by 43.29%, 40.24% and 10.37% respectively. Moreover, the average farming experience is 12.5 years in vegetable production with a standard deviation of 1.91 years. The median and mode is 13 and 14 years respectively. Major occupations beside mustard product of the respondents are: agriculture (farming other crops besides mustard), remittance, business, service, government employment and others. From these sectors, majority of them were involved in farming of other crops. Among HH Head, father, mother, sister, elder brother and husband; in most of the family i.e., 39.02% HH head were the decision makers, whereas, contribution on decision makers made by father, husband, mother, elder-brother and sister were accounted by 35.37%, 10.98%, 10.37%, 3.05% and 1.22% respectively.

Demographic Characteristics of Traders

10 respondents cover by the study were the traders who were all men. The traders had an average of 8 years of experience in mustard trading (ranging from 6 to 10 years trade experience). The survey

revealed that roughly 10% of those polled are illiterate while 40% have a bachelor's degree and 30% have a +2 diploma. The respondent's degree of education aids networking, communication, and a better knowledge of diverse actors such as farmers and merchants. The average no of employees of the traders is 2.9 persons and ranges from 2 to 18.

Current Status of Mustard Farming

Small cottage industries using conventional methods are unable to survive in the local market as a result of the arrival of packaged mustard oil manufactured by larger factories. Many standard oil mills have closed or been decommissioned in the last decade. Land is perhaps the single most important factor of production and measure of wealth in the study area. Table 2 indicates that the average land size of respondents, rented land by the respondents and the total area use for the mustard farming.

Table 2: land Use for Farming

Land	Maximum	Minimum	Mean	STD. Dev
Total Land	120 Katha	5 Katha	37.69 Katha	22.14 Katha
Rented Land	50 Katha	0 Katha	6.53 Katha	28.62 Katha
Total Area Allocation of Mustard	60 Katha	1 Katha	10.64 Katha	9.31 Katha

Fertilizer, seed, herbicides, and pesticides were the inputs utilized by farmers in the research region. Agro vet is a significant fertilizer provider for farmers in the study region as it occupies 71% whereas government and NGOs provide less inputs i.e., 8%. Furthermore, for the needed productivity and marketable supply, appropriate application of the recommended fertilizer rate is critical. On the other hand, farmers use a variety of fertilizer rates while growing mustard. The average amount of inputs acquired each year differed across private stores, based on their money and market availability. Chemical providers also provide agricultural equipment, mustard seeds, and advise on chemical application to farmers in addition to selling chemicals. Use of improved seed varieties with its appropriate recommendation is also believed to improve production and productivity of mustard crop. The amount of input needed per Katha was 4 to 9 Kg depending on types of mustard farming. Also, the cost of input was Rs 500 to Rs 1000 per Katha depending on types of mustard farming. Majority of respondents i.e., 81% faced the problems like: shortage of supply, not available on time, costly while accessing the inputs.

Services that are expected to promote production and marketing of mustard include access to credit, access to extension service, and access to market information. Moreover, survey revealed that 85.63% of respondents have access to credit which are used for the purchasing of farming inputs. And, major source of credit services cooperative, microfinance and saving and credit association.

A well-organized market intelligence information system helps all the producers and traders freely interact with one another in arriving at prices. It has been postulated that farmers will choose a profitable mode of transaction if they can receive reliable market information on the prevailing market conditions. The major source of information of the study were FM/Radio, which is 86.86%. About 58.08% and 38.32% of the respondents can get market information from newspaper and TV respectively. Additionally, development agents and traders helped as sources of information by serving about 9.58% and 25.15% respondents respectively.

Challenges of Actors along Mustard Value Chain

One of the merits of value chain analysis is that it helps to clearly identify the development of the chain right from input supply up until the consumption level in intense way. The overall mustard value chains are constrained by a number of factors which hinder the development of mustard value chain.

Accordingly, a number of constraints are explained by different actors through questionnaire. Table 3 and Table 4 depict major constraints which are currently hindering the development of the mustard value chain can be categorized according to the three basic stages: the farm level and the marketing/ traders stage.

Table 3: Challenges of Actors Along Mustard Value Chain

Production Problem	Severe %	Moderate %	Slight %	No Problem %
Infestation of Insect and Diseases	14.55	76.36	7.27	1.82
Lack of Credit Facility	5.45	20.61	67.27	6.67
Lack of Irrigation Facilities	6.67	70.91	19.39	3.05
Lack of Quality Input	7.32	65.45	25.45	1.82
Supply of Inputs in Appropriate Time	10.30	72.12	12.73	4.85
High cost of Inputs	4.24	54.55	40.61	0.61
Unavailable Farm Labor	6.67	40.00	43.64	9.70
High Labor Wage	4.85	27.88	63.03	4.24
Lack of Technical Knowledge Support	4.85	67.88	23.03	4.24
Inadequate Government Support	18.79	53.94	24.85	2.42
Marketing Problem				
Low Farm Gate Price	7.27	80.61	10.91	1.21
High Price Fluctuation	2.42	36.97	58.18	2.42
No Timely Payment	3.03	76.97	13.33	6.67
Insufficient Processing Facilities	6.06	64.85	27.27	1.82
Insufficient Storage Facilities	6.06	70.30	21.82	1.82
Transportation Problem and Inaccessible Market	2.42	33.33	57.58	6.67
Insufficient Market Information (About Price and Quality)	1.21	47.88	49.09	1.82
Rejection of Crop by Traders Reasoning Low Quality	2.42	36.97	58.79	1.82
Presence of Middleman	1.82	30.91	63.64	3.64
Low Production	4.85	41.21	50.30	3.64

Table 4: Trade Stage Problem

Problems in Buying of Mustard Production	High Priority %	Medium Priority %	Low Priority %
Transportation	20	80	-
Market Information	20	40	40
Cost	20	60	20
Storing Capacity	40	40	20

Value Chain Analysis

The respondents' value chain activities are analyzed qualitatively in order to determine which factors influence the firm's value chain activities. The value chain is divided into three categories: primary activities, support activities, and factors that impact value chain activities. A real mustard volume is transported and consumed by the intended receivers from the farm to the market. To overcome roadblocks, it's critical to first understand the present situation and the plan that must be followed.

Primary actors

The primary actors in mustard value chain in Siraha and Saptari were seed and other input suppliers, farmers, traders and consumers. Each of these actors adds value in the process of changing product title. Some functions or roles are performed by more than one actor, and some actors perform more than one role.

Input Suppliers

Many actors are involved directly or indirectly in agricultural input supply in the research region at this stage of the value chain. Currently, the main sources of input supply are the District Agriculture Development Office (DADO), Agro vet, principal cooperatives/unions, and GO/NGOs. Farmers that cultivate mustard took part in this stage, mostly for seed supply. Agricultural inputs such as better seed types, fertilizers, herbicides, insecticides, and farm tools are vital inputs during the production stage, and all of these actors are accountable for supplying them. The bulk of the sample producers utilized their own seed for main mustard produced in Siraha and Saptari.

Producer

Mustard growers are the major actors who perform most of the value chain functions right from farm inputs preparation on their farms or procurement of the inputs from other sources to post harvest handling and marketing. The diverse agro-climatic conditions can make growing vegetable crops highly cost-effective and competitive, and provide vast opportunities in study areas. Unfortunately, these opportunities have not been exploited by the farmers due to the lower price they receive for their product in the markets, as well as bearing the cost of post-harvest losses. Mustard production in the study area was based on rainfed and irrigation system. In the study area 76.65% of the respondents, respectively use irrigation for mustard production. Both sole cropping and intercropping production of mustard is practiced in Siraha and Saptari. Post-harvest handling, which includes different activities like sorting, grading, packing, storing, transportation, loading and unloading is done by the farmers themselves or traders or brokers. If mustard is sold at the farm gate which is the case in both districts, all aforementioned activities are performed by the buyer (traders or broker). The availability of financial sources for credit is crucial for farmers. Some farmers are using as an important input for agricultural activities

Collector/Assembler

These are traders that collect mustard from farmers in village markets and fields in order to resale it to wholesalers and retailers in assembly marketplaces. They buy mustard in quantity from the surrounding region using their financial resources and local expertise. They serve a significant function and are well-versed in various areas. Collectors are important players in the mustard value chain, since they are in charge of moving mustard from producing regions to wholesale and retail markets in the study areas. Buying and assembling, repacking, sorting, transporting, and selling to wholesale marketplaces are all tasks that collectors engage in.

Brokers/Middle Men

Brokers play an important role in linking farmers to market and other stakeholders of the commodity chain while the ability of market accession of farmers is limited and market demand requires an improvement in quantity amount as well as diversity of products type. The brokers sometimes go beyond facilitation of transaction and tend to control and fix prices, create price symmetry and make extra benefits from the process in addition to convincing the producers to sale their mustard at the prices set by wholesalers. More over brokers are divided into village level brokers, urban brokers and commission agents. Village level brokers facilitate transaction by convincing farmers to sale his mustard and facilitating the process of searching good quality and quantity mustard to traders and urban brokers. Commission agents are brokers working for specific traders. In the study area, almost 10% of farmers sell their product through brokers.

Wholesalers

Wholesalers are primarily responsible for purchasing mustard in bulk from collectors and manufacturers and distributing it to exporters, retailers, and consumers. They also keep goods on hand for up to three days. According to the findings of the survey, wholesale marketplaces are the primary assembly locations for vegetables in their respective districts. They have easier access to storage, transportation, and communication than other dealers. Almost every wholesaler has a warehouse in a market, whether it is their own or rented.

Retailers

Buying mustard, getting it to retail stores, grading, exhibiting, and selling it to customers are all part of the retail chain. In the research region, retailers are important players in the mustard value chain. They are the final link in the chain between manufacturers and consumers. They mostly purchase from wholesalers and resell to end users. They might even buy straight from the producers on occasion. Consumers often purchase products from merchants because they cater to their needs and spending power. Rural merchants are situated in local markets and buy from farmers before selling to customers. Urban retailers buy from frames and wholesalers and then sell to city residents. Within and beyond the research region, retailers play an important role in the mustard value chain. These are renowned for their restricted purchasing and handling capability, as well as their financial and information capacities. They are the final link in the chain between manufacturers and consumers. Consumers in the research region often purchase products from merchants because they cater to their needs and spending power.

Mustard Consumers

Consumers are the people buying things to consume. Households, restaurants, and institutions are the three categories of mustard customers recognized. Private consumers buy mustard from producers, retailers, and wholesalers, with retailers accounting for the majority of purchases. Farmers account for a significant portion of rural customers since they eat a portion of their own produce. Institutions buy their products from wholesalers who can provide them on a long-term basis based on contractual agreements. Customers are looking for a mustard product that is in good form, color, and size and is not damaged. In general, people have their own set of quality standards for mustard purchases.

Supporting Actor

Supportive actors include those who provide training and extension, information, financial, and research services. According to Eling and Lehmann (2018), the level of success of value chain players is determined by access to information or expertise, technology, and finance. The major supporting players who play a central role in the provision of such services include DADO, NARC (Nepal Agriculture Research Council), Department of Agriculture (DOA), Agriculture Information and Council Center, primary cooperatives, micro financing, and NGOS.

Value Chain Governance

The governance structure provides information on the smallholders' position in the supply chain as well as the relationships between smallholders and purchasers. Facilitation is a role played by the dominating value chain actors. They control the flow of goods and the level of pricing. In effect, they dominate the value chain, and the majority of other participants in the chain follow the rules established throughout the marketing process. The findings of the study show that wholesalers, with the help of brokers, are the primary value chain regulators. Due to the lack of a proper market information system and minimal bargaining power, farmers are forced to sell their product at the price offered by traders. Overall, the governance of the mustard value chain is buyer driven with minimum trust between various actors. The producer's position in price negotiation is not good in the study area. Due to lack of valuable market information and not well-organized producers heavily depend on traders. Hence, they are price takers and hardly negotiate the price due to fear of post-harvest loss, in case the product is not sold. Moreover, the study also revealed that the governance structure exercised was favorable to wholesalers and retailers and leaves smallholders and consumers in a weak position with other value chain actors.

Inferential Analysis

Summary Statistics

In this segment, variables are analyzed on the basis of their observation, mean, minimum and maximum value, and standard deviation. Under this, the variables except age, family member, total land, land allocated for vegetable, Level of education, Family types, nearest market, storage have been assigned values zero and one where zero holds minimum value and one maximum value where one represents yes and zero otherwise.

The study inspects that, under socio-demographic variables (age, farming experience, family type, level of education, off farm income), age has highest mean and standard deviation of 42.33 and 9.96 respectively with minimum value 24 and maximum value 72. Meanwhile, under the source of information variable (information from radio, information from newspaper, information from TV, information from cooperatives, information from traders, information from internet and information from GOs/NGOs), information of mustard from radio had the highest mean and standard deviation of .69 and .46 respectively. Similarly talking about source of input (input from own source, input from agro must, input from cooperatives, input locally available, input from GOs/NGOs), input from own sources have the highest mean and standard deviation of .89 and .31 respectively. Likewise input quantity at the right time have .67 and .46 of mean and standard deviation respectively. Similarly talking about total land, the mean and standard deviation are 38.42 and 21.81 with maximum land of 120 katha and minimum land of 5 katha followed by land allocation for vegetable having mean of 12.92 and 8.93 with maximum land of 40 katha and minimum land of 4 katha respectively. In case of training, the mean and standard deviation is .89 and .30 followed by days of storage with 4.68 and 4.0 of mean and standard deviation with maximum days of storage of 15 days and minimum days of one day. Likewise, ownership of transportation has .93 mean and .25 standard deviation which is followed by transportation from vehicle having mean and standard deviation of .89 and .31. The mean and standard deviation for access to credit are .85 and .34 followed by problem in getting credit with .59 and .49 of mean and standard deviation. Similarly, ownership of livestock has .73 and .44 of mean and standard deviation followed by extension service with .70 and .45 of mean and standard deviation. The dependent variable (factor affecting in participation of value addition) has the mean and standard deviation of .87 and .33 respectively. Likewise, the mean and standard deviation of nearest to market 2.68 and .90 with maximum distance of 5 km and minimum distance of 1 km respectively. The maximum family member in the family is 20 members and minimum member of family in the family is 2 members. Likewise, the maximum years of farming experience is 35 years and minimum of experience of 4 years.

Logistic Regression

The value pf Wald chi2(31) of the dataset is 41.08 which explains that our model is fit and the data can be taken for further processes. Likewise, the value pf pseudo R2 is 0.0528. It indicates that the independent variables, undertaken for the study explained dependent variable by 50.76%. It is very good in terms of logistic regression. According to Allison (2014) r-square value .26 or above indicate high effect size. Similarly, log pseudolikelihood value is -30.89. The coefficient value of constant is -8.93.

In order logistic regression, the odds ratio represents the constant effect if a predictor X, on the likelihood that one outcome will occur. In regression models, we often want a measure of the unique effect of each X and Y. The dataset has eleven significant variables having p-value less than 1% or 5% or 10%. Further, table 5 showed that the age of the farmer add value in mustard value chain as it increases the value addition by 1.301 times at 1% significant level. Similarly, if farmer is engaged in non-farming income, the odds of value addition increase by 24.99 times at significant level of 5%. If land allocated for mustard is increased then the value addition increases by 0.860 times at significant level of 5%. Again, decrease in problem of getting credit, the odds of improving value addition by 54.03 times at significant level of 1%. Moreover, information of mustard helps to increase the production, the odds of value addition increases by 0.0975 times at 10% of significant level. Member of cooperative, family member, level of education, input of own and input quantity at right time are 0.116, 1.792.1.976.67.90 and 0.095 times at significant level of 5%, 5%,5%, 5% and 5% respectively.

Marginal effects describe the average effect of changes in explanatory variables on the change in probability of outcomes in order logistic regression and other nonlinear models. Table 5 showed ten significant variables in marginal effect, which are age, member to cooperatives, family member, level of education, off farming income, land allocated for mustard, input from own source, quantity at the right time, problem in getting credit, information of mustard. The result shows a marginal effect of age, family member, level of education, off farm income, input from own source and problem of getting credit are 0.01555, 0.0344, 0.0401,0.190, 0.249 and 0.235 respectively. Furthermore, value addition decreases by 0.127 with a marginal change due to membership to cooperative, 0.00891 by mustard land, 0.139 quantity at the right time and 0.137 by information of mustard.

Discussion

A growing focus in Nepal is on building efficient agricultural value chains, with several creative and successful value chains emerging (Kumar & Sharma, 2016). Mustard cultivation enables smallholder farmers in both districts integrate into the market due to its excellent agro-ecology and irrigation water availability, and it is suited for mustard production. The current agribusiness decision-making challenges, particularly in terms of promoting cost-effective production and distribution coordination, finding solutions to fixed market imperfections and resulting price distortions, and how to incorporate private strategies in agriculture and related sectors, as well as information uncertainties across agribusiness-related stakeholder groups, have all contributed to the current agribusiness decision-making challenges (Francesconi & Wouterse, 2015).

The level of education and experience of the respondent (owner) helps in networking as well as in communication and better understanding of various actor such as farmer and retailers. The survey revealed respondents have higher education in line with the finding of Fentie (2020) education helps in networking and in communication. Most commonly grown vegetables in terms of the number of sampled growers are onion (78.05%), potato (92.68%), tomato (55.66%) and 79.27% of respondent were engaged in production of other mustard crops as well. Mazhar et al. (2019) found that the smallholder farmers rely more on intensive mustard farming for growing three crops every year in an attempt to earn higher income.

The lowest and highest landholdings for mustard cultivation among the respondents are 40 Katha and 2 Katha, respectively. Hailu (2014) found that the quantity of land dedicated to coffee, red pepper, and papaya cultivation had a substantial and positive influence on farm-level marketed supply of each commodity. Training and instruction on mustard cultivation are critical in the development of the crop. The majority of farmers feel that by receiving education or training in various agricultural practices, they will be able to increase their output. As Kumar and Sharma (2016) emphasis the role of information technology and communication in agricultural should be developed and advertised. Training should be given to farmers time to time not only at district headquarters but also in villages and at their farms.

The average quantity purchased per year varied among the private shops depending on their capital and availability of the market which is in line with the finding Willy (2018) fertilizer application is one of the most important agricultural practices that are used by mustard growers in the study area. The main problem of farmers in accessing these input are shortage of supply, not available on time, costly and remoteness of input which is in line with Rahman et al., (2020) found that the problems in accessing the input mainly occur due to lack of governance activity by the government and coordination between the value chain actors.

In the research area, access to financing, extension services, and market knowledge are among the most important services anticipated to increase mustard production and commercialization, which is consistent with the findings of (Fentie, 2020). The most serious credit problems are a shortage of supply and credit insufficiency. Mustard is cultivated in the research area with the use of irrigation and a rainwater harvesting system. Cooperatives play an important role in providing credit in rural area to access input supply and to provide better financial services. The precondition for cooperatives is membership and collateral and is considered an easy in accessing to credit service among all source of credit. The main problem in credit is few or less supply and inadequacy of credit. Most producers sell their products to the traders while some of them sale for consumers as the finding of (Karim & Biswas, 2016).

The study used ordered logistic regression reporting that age, off-farm income, cooperative membership, total land, mustard land, input from own source, input from cooperatives, input quantity at the right time, credit availability, credit difficulty, information from radio, newspaper, traders, and the internet, as well as days of storage, all influence value addition. Farmers' age has a statistically significant beneficial influence on value addition. In contrast to the findings of the study, Orinda (2013) asserts that access to finance, age, and information all influence value addition participation. Off-farm income has a large and positive influence on value addition. This is because the bulk of farmers' non/off-farm occupations include remittance, business, services, and government jobs, all of which provide cash for mustard production.

Table 5: Final Regression

	(1)	(2)	(3)
VARIABLES	**Logit Model**	**Odds Ratio**	**Marginal Effects**
fac_aff_valadd			
Nearmkt	-0.893	0.409	-0.0526
	(0.591)	(0.242)	(0.0354)
_mem_cop_	-2.154**	0.116**	-0.127**
	(0.967)	(0.112)	(0.0563)
age	0.263***	1.301***	0.0155***
	(0.0724)	(0.0942)	(0.00388)

	(1)	(2)	(3)
VARIABLES	**Logit Model**	**Odds Ratio**	**Marginal Effects**
_f_memb_	0.584**	1.792**	0.0344**
	(0.264)	(0.474)	(0.0158)
_l_education_	0.681**	1.976**	0.0401**
	(0.291)	(0.575)	(0.0168)
_f_types_	0.145	1.156	0.00855
	(0.579)	(0.669)	(0.0341)
_farm_exp_	-0.106	0.900	-0.00622
	(0.0763)	(0.0686)	(0.00440)
offfarmincm	3.218**	24.99**	0.190***
	(1.296)	(32.38)	(0.0702)
totalland	0.0270	1.027	0.00159
	(0.0233)	(0.0239)	(0.00132)
_mustard_land_	-0.151**	0.860**	-0.00891**
	(0.0640)	(0.0550)	(0.00355)
inpown	4.218**	67.90**	0.249***
	(1.649)	(112.0)	(0.0942)
_inpagr_mut_	-0.663	0.515	-0.0391
	(1.531)	(0.789)	(0.0903)
_inploc_ava_	1.980	7.245	0.117
	(1.713)	(12.41)	(0.102)
inpgos	-2.630*	0.0720*	-0.155
	(1.597)	(0.115)	(0.0961)
inpqntrgttim	-2.354**	0.0950**	-0.139**
	(0.928)	(0.0881)	(0.0549)
_access_credit_	-1.163	0.313	-0.0685
	(0.950)	(0.297)	(0.0533)
probcredit_	3.990***	54.03***	0.235***
	(1.149)	(62.07)	(0.0588)
trnstveh	-1.773	0.170	-0.104
	(1.262)	(0.214)	(0.0734)
_infmustfmrad	-2.328*	0.0975*	-0.137*
	(1.311)	(0.128)	(0.0710)
infmusttv	-1.189	0.305	-0.0701

VARIABLES	(1) Logit Model	(2) Odds Ratio	(3) Marginal Effects
	(1.155)	(0.352)	(0.0677)
infmustcoop	-0.948	0.387	-0.0559
	(2.212)	(0.857)	(0.129)
_inf_must_trad_	1.321	3.747	0.0778
	(2.245)	(8.414)	(0.131)
_inf_mustint_	0.394	1.483	0.0232
	(1.498)	(2.222)	(0.0883)
_inf_mustmobsms_	-2.542	0.0787	-0.150
	(2.385)	(0.188)	(0.141)
_ext_sev_	-0.978	0.376	-0.0576
	(0.880)	(0.331)	(0.0519)
own_livstc	0.189	1.208	0.0112
	(0.810)	(0.978)	(0.0480)
_must_train_	0.870	2.387	0.0513
	(0.983)	(2.346)	(0.0564)
_sto_prmust_	0.143	1.154	0.00842
	(0.133)	(0.154)	(0.00777)
Constant	-8.935***	0.000132***	
	(3.138)	(0.000413)	
Observations	164	164	164

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusion

The agro-ecological appropriateness of the terrain and irrigation potential make mustard cultivation and sale in Nepal a viable possibility. However, the value chain is currently underdeveloped. According to the study, the mustard value chain operates in a traditional manner, with no novel ways of integrating chain players. There is no formal organization for input supply, production, or marketing, and there is no quality control or grading of products. Despite the fact that they are involved in both input supply and credit services, their performance is not as planned, and they are unable to lower transaction costs. Lack of adequate storage and transportation facilities, as well as poor post-harvest management, restrict the value chain. Mustard processing is still in its infancy. There is no platform or accountable organization working to ensure that value chain participants are linked effectively and efficiently. The mustard value chain is constrained by the lack of support for producers and traders (technical, business or financial), the poor infrastructure facilities (storage and transportation), and lack of integration among chain actors. Some recommendations for policy makers, developments actors and researchers

who have strong interest in promoting mustard production and marketing for equal benefits among value chain actors are: participants/actors should work together to boost output, minimize post-harvest losses, and build long-term market linkages, improve the input supply system, improve smallholders' business planning abilities, use better agricultural practices, establish a well-organized regional and national mustard production and marketing system.

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