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Research Article

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An Inception of Value Chain Development of Sweet Orange; Kinesis to Food Security in the Developing Countries Scenario

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Abstract

Sweet orange is one of the major citrus fruits of Nepal which is widely cultivated in mid-hills. This paper assesses the value chain of sweet oranges cultivated in the Ramechhap district of Nepal, considering its economic significance for farmers. The study adopts a qualitative research approach, utilizing key informant interviews and focus group discussions with various stakeholders. Participants were selected based on a list of producers collected from the Prime-Minister Agricultural Modernization Project (PMAMP) Ramechhap district, and the snowball method was employed to identify other actors. This study revealed that the value chain of sweet oranges in the Ramechhap district involves growers, vendors, wholesalers, retailers, and consumers as the main actors, while federal, provincial, and local agricultural service centres serve as enablers. Additionally, findings show vendors play a dominant role, in determining the per unit price and pressuring farmers to sell immediately after harvest due to limited storage capacity. Vendors are enjoying increased profit margins because they have greater bargaining power over farmers, who have inadequate storage facilities. The study suggests areas for improvement: using quality seedlings, managing nutrients effectively, and employing proper storage techniques like cold stores to prolong shelf-life and enhance quality, taste, and colour. Enhancing productivity via trifoliate rootstock, optimizing fruit quality, and extending shelf-life through improved storage facilities can substantially boost revenue for producers. Understanding the entire value chain provides insights into enhancing the overall performance of value chain actors. Further studies can explore additional dimensions of the chain in more depth.

Keywords : Sweet orange, value chain, food security, developing countries

Introduction:

Citrus fruits are being cultivated and are highly demanded worldwide. These fruits have distinguished taste, and aroma and are acknowledged as an integral part of the daily diet, playing a vital role in health and nutrition. In addition, having a better source of dietary fiber and nutritional values such as vitamin B, the industrial demand for citrus fruits to produce juice has increased (Liu et al., 2012; Neves et al., 2020). Among the citrus fruits mandarin and sweet oranges are mostly consumed by a wide range of consumers across the globe (Adhikari et al., 2018). Additionally, the consumption of processed or concentrated fruit juices has risen significantly due to their affordability and the marketing efforts of multinational corporations (Chen et al., 2016; Lee et al., 2010). Study shows per capita consumption of frozen concentrated orange juice (FCOJ) increased by 23.7% during the period of 2003-1018 (Neves et al., 2020). Meanwhile, developed economics focused on both production and industrial processing, while a surge in consumption has been accentuated in the developing economies over the period.

Sweet orange (also known as Junar in Nepali) is botanically known as Citrus sinensis Osbeck and falls

under the plant family Rutaceae. This fruit is believed to have originated at Okarani and Purano Gaun, a hill at 1000-1700 metres above sea level of Ramechhap municipality in Ramechhap and distributed across the district and consequently all over Nepal (Personal communication PMAMP Ramechhap, 2023). The production status of Sweet oranges in Nepal and Ramechhap is presented in the Table 1.

Table 1 : Statistics of Sweet orange production in the year 2020/21

Region	Area (ha)	Productive area (ha)	Total production (ton)	Production ton/ha
Ramechhap	1323	787	10,744	13.65
Nepal	6813	4333	46865	10.2

Source: (MoALD, 2021)

It is a common fruit in the mid-hills of Nepal. Ramechhap district is the top sweet orange producing hub where sweet orange cultivation contributes remarkably on the livelihood of many farmers.

Considering the role of sweet oranges in the income generation of farmers in Ramechhap, various government and non-governmental projects are being launched in the region. A "Special Sweet orange Production Program" at Ramechhap and Sindhuli district of Nepal in 1981 (during the sixth five-year plan period) can be marked as an ignition of Junar sector development in Nepal (Kaini, 2013). Japan International Cooperation Agency (JICA) funded Janakpur Agriculture Development Program prioritized the establishment of Sweet orange nurseries and orchards in Ramechhap and Sindhuli districts. The National Citrus Priority Program during 1983/84 in 20 mid-hill districts of Nepal recognized Sindhuli and Ramechhap districts as prioritized sweet orange production centres. In addition, Sindhuli and Ramechhap district was declared a Sweet orange production pocket when the Late King Birendra visited in 1985 (Paudyal et al., 2016). The Horticulture Development Project initiated in 1985 proved to be the milestone for Sweet Orange's development (Kaini, 2013). Citrus fruits including Sweet oranges prioritized by the government of Nepal through policies (MoALD, 2015) and programs. Under the Prime-minister Agricultural Modernization Project (PMAMP) zones and superzones (PMAMP, 2019) are developed in the potential districts to promote production, marketing and industrial support.

Despite having a good scope to become an established source of income, the production and market aspect is not specifically described in the form of a value chain. There is a lack of information on product, process and information flow across the value chain. In addition, challenges and scope for improvement in the sweet orange value chain have not been studied yet. Hence, the study so far siloed the other chain-wide aspects, thus a comprehensive study of the value chain is critical for policymakers and researchers which is lacking in Nepal. Furthermore, the result of the study will help value chain actors improve their operations at various stages in the chain. Results will guide to strengthen the linkage, build collaboration and thus reduce the loss.

This study employs the value chain mapping methodology (Collins et al., 2016; Kaplinsky & Morris, 2000) for value chain analysis (VCA). VCA involves the mapping of the product, process, information and governance. The study provides the critical structures, functions and challenges in the existing value chain and explores the areas for future improvement. Thus this study aims to identify and access the structure and function of the sweet orange value chain, along with the challenges.

Materials and methods:

This study was conducted at Ramechhap district, Ramechhap municipality ward number 6, between January 23-29, 2023. The study site was purposively selected based on secondary information considering the major production area of sweet oranges. This research adopts the following research questions:

1) Who are value chain actors involved in the sweet orange value chain?
2) What is the structure of sweet orange production and its flow to the consumers?
3) What critical problems are concerned with the sweet orange value chain?
4) What are the improvement opportunities in the sweet orange value chain?

Study area

Ramechhap district of Bagmati province, is the largest producer of sweet oranges. In the district, ward number 4,6,9,13 and 14 of Manthali municipality and ward number, 1,2,4,5,6,7 and 8 of Ramechhap municipality are designated sweet orange zones. Preliminary discussion with the Prime-minister Agricultural Development Office, Program Implementation Office (PMAMP, PIU), Ramechhap suggested that ward number 6 Ramechhap Municipality is the major contributor to the district's production, therefore we considered this location as the origin of our study.

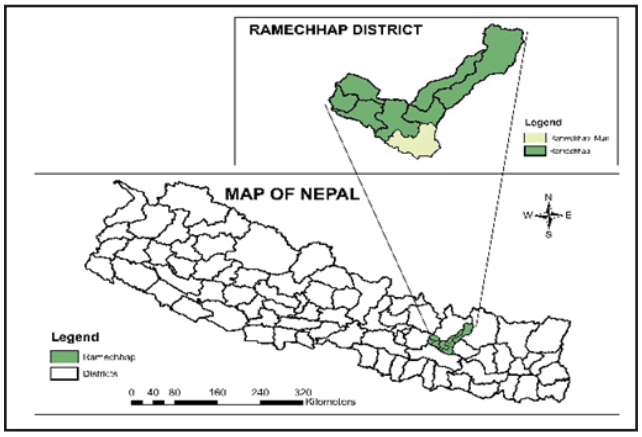

Figure 1: Map showing the starting point of the value chain study

Selection of participants

A list of producers was identified from the published annual report of PMAMP PIU, Ramechhap. Information was collected by visiting the individual farm and interviewing the farm owners who are the key informants.

Key informant interviews

Key informant interviews (KIIs) with relevant PMAMP PIU staff working for the sweet orange sub-sector, the Senior officer of the Agriculture Knowledge Centre, Commercial producers, traders, retailers, processors, and local level mayor, chief administrative officer, farmer leaders and consumers were done. In total, 16 key informant interviews were conducted, on top of key informants, previous researchers and other stakeholders were consulted to access the stakeholder analysis. At the end of each interview, each participant was requested to suggest another person in the chain they feel is important to be considered (snowball sampling).

Focus group discussions (FGDs)

Participants in the focus group discussion were selected based on commercial farming adaption and discussion was conducted independently of the group. Three FGDs were conducted with the commercial growers at Okhrani, Gaitar and Puraogaun and participants were invited to the commonplace based on their comfort. Each focus group discussion had 10 participants who were commercial sweet orange growers, forty per cent of female participants were ensured in the FDG. Details of the people who participated in the FDGs and KIIs are given in Table 2.

Table 2 : People interviewed in the Sweet Orange value chain

Function	Role of people	No. of FGDs (No. of people)	No. of KIIs (No. of people)
Growers	Production, harvesting and collection	3 (30)	
Vendors	Loading, unloading and transportation, contract with growers		3 (5)
Retailers	A direct sale to consumers		5 (8)
Supporters/ enablers	Provide subsidy and policy facilitation		4 (6)
Consumers	Buy and consume		4 (10)

Data collection

Primary data was collected from FGDs and KIIs. A discussion guide was followed for FDGs and a set of questionnaires was administered to KIIs. Secondary data from government reports and other published articles were analysed to understand the whole value chain. Five members of the research team and three research assistants were involved in the research field data collection. Three research assistants were assigned, an agricultural technician from Junar zone Ramechhap, and two local leader farmers to support the research team. One of the members directly facilitated FDGs and KIIs while other members took notes, and audio and video recordings. In addition to schedule guideline researcher observed the activities performed by the participants such as production practices at the commercial farms, collection and transportation methods, and consumer preferences. The collected key information was noted for relevant discussion. Furthermore, probing questions were asked for the participants to agree on the main theme. Questions were asked to each key informant about their interactions with other value chain actors, supporters, enablers, and their position in influencing the chain.

Data entry and analysis

Audio recordings were transcribed and themes were systematically organised. The common themes were coded and analysed based on computer-assisted qualitative data analysis software, NVivo 12. Participants were given pseudonyms to secure anonymity. Thematic qualitative analysis was done to understand patterns and interactions. Data collected from the FGDs were triangulated with KIIs. When the discrepancies were observed they were triangulated with the other experts, recorded videos, and or contacted the key informants by telephone.

Results:

Value chain mapping

The value chain mapping was done based on data collected from the FDGs and KIIs. The value chain study was started at the sweet orange growing pocket at Ramechhap Municipality of Rmaechhap district and ended at consumers at Manthali, Khurkot and Kathmandu. The upstream of the chain comprises the growers and vendors while the downstream of the chain involves wholesalers, retailers and consumers (figure 2).

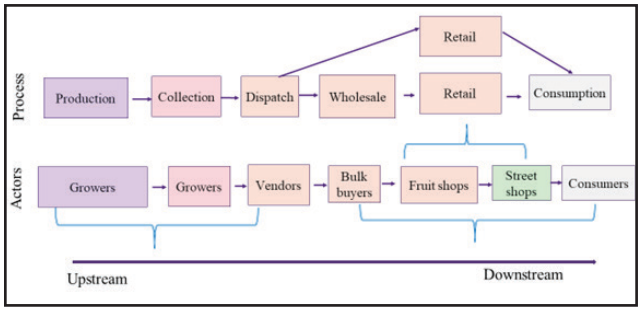

Figure 2: Value chain map showing the flow of actor and process at upstream and downstream

Product flow takes place in various ways, predominantly it flows as fresh fruits to the consumers. Some of the farmers stored late-harvested sweet oranges for 1-2 months at normal room temperature at their houses. No physical damage in the storage was reported by farmers. Meanwhile, they pursued additional NRs of 10 per kg when sold later. Thus stored fruits received 25-30% more price without any cost on holding. Also, some farmers sold fruits having a smaller size, and black shaggy spots on the skin to juice industries (figure 3)

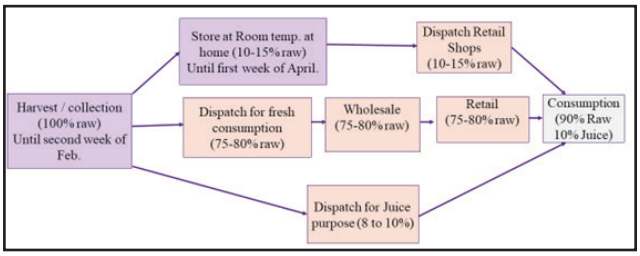

Figure 3: Value chain map showing the flow of product

Mapping product and the process was followed by material, information, relation, and price flow and areas improvement. The material flow was evaluated at three levels based on the established adapted methodology (Ariyawardana & Collins, 2013; Collins et al., 2016). The material-wise activities were classified as follows:

1. Value-adding: Activities, add value to the consumer; increase the willingness to pay and motivate them to purchase.
2. Necessary, but non-value-adding: Activities, do not add value to the consumer but are prerequisites unless the current value chain is drastically changed.
3. Wasteful: Activities that are neither necessary nor add value to the consumer's eye.

The KII with vendors showed cleaning, grading, price, colour, and quality were value-adding activities. Some of the farmers at Puranogaun mentioned that they used to wash sweet oranges with detergent powder to remove the black sooty mould marks. However, washing fruits with detergent was not found to be a recommended practice as reported by the agri-technician of PMAMP Ramechhap district. Moreover, washing manually was costly so they were not practicing this technique. Also, farmers graded sweet oranges into three categories as listed in Table 3.

Table 3 : Various grades of Sweet orange in the selected value chain

Grade	Number of Sweet oranges/ kg	Normal price (NRs) range /kg	Mode of consumption
Garde A	4-5	>60	Fresh fruit
Garde B	6-7	50-60	Fresh fruit
No grade (All mix)	8-10	30-40	Juice

The price of different grades as shown in Table 3 indicates that grading is among the value-adding activities. KII with consumers shows regular consumers were familiar with the sweet oranges produced at Nepalese origin however, some of the consumers were confused with Kinnow fruit that was imported from India. Regular consumers preferred Nepalese sweet orange even if it had a higher price than Kinnow because they perceived it as organic and good in taste. However, novice consumers were looking for cheaper prices. Moreover, consumers mostly preferred sweet oranges with having orange colour rather than a yellow colour.

The growers noticed that the Rough Lemon (Jyamir) rootstock produces yellowish sweet oranges that are less preferred by consumers. Farmers also experienced trifoliate orange rootstock as best as compared to rough lemon due to better quality fruits in terms of colour and taste. Origin was also observed as one of the important variables to consider in the value chain of sweet orange. Sweet oranges from Sindhuli district were recognized as the best quality, though no specific distinction on the physical quality of fruit was recorded. Nevertheless, in terms of production Ramechhap district was ahead of Sindhuli and vendors from Sindhuli had collected fruits from Rammechhap. Vendors branded Sindhuli's Sweet orange though they were collected from other areas too. Indeed, consumers and farmers at Ramechhap mentioned their fruits are competitive with Sindhuli or even better.

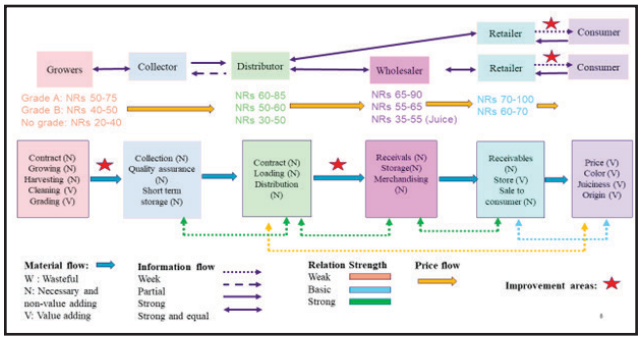

Figure 4: Value chain map showing material, information, relation and price flow and improvement areas

Partial information flow was observed between the distributor and collectors/growers, weak information flow was identified between the retailers and consumers while interviewing with vendors, retailers and consumers. Vendors reported that many retailers sold sweet oranges by giving the name as Sindhuli's origin (Sindhuli ko Junar). This was because consumers had less information about other possible sources of sweet orange supply.

A basic relationship was observed between the retailers and consumers, as retailers, were mostly motivated towards short-term profit. They could sell Kinnow if they would have more profit. A weak relationship was marked between the distributors and consumers because distributors were less informed about food safety, fruit injury and overall consumer preferences. Regular consumers also revealed that cleaning, grading, storage, price, colour, juiciness and origin are the factors that add value.

Problems in the whole value chain

Various types of problems were identified in the sweet orange value chain. Fundamental problems were at the production site which included water scarcity for irrigation, sooty mould disease, scale insect and fruit fly infestation. Most of the farmers relied on rainfed farming and a few farmers have been relying on seasonal small water sources such as springs. Some farmers have constructed canals and plastic ponds to supply water to the orchard. Plastic pipes were used for delivering water in the reservoir tank and for distribution to the orchard. Good quality fruits for instance shiny orange colour development, and bigger fruits were found in the irrigated orchards. Chinese citrus fruit fly known as Bactrocera minax Enderlein has damaged the orchards of Junar in Rammechhap and Junar Zone has implemented the Area Wide Control Program (AWCP). The program has been found effective in managing this insect (Personal communication, Technician Junar Zone, 2023/01/27). Farmers reported they had encountered up to 80% unprecedented loss due to fruit fly infestation in the past years, these years 90% of fly infestation is controlled and loss decreased to below 10%.

Furthermore, the problem existed with soil and orchard management. About 50% of the farmers have not used any fertilizer or manure in their orchards. About 25% of farmers used only cow dung, and the rest 25% used a combination of chemical fertilizers and compost in their orchards. The orchards applied with fertilizers and timely irrigation was reported for better fruit quality and farmers have fetched better price. For example, the farm gate price of sweet oranges at poorly managed orchards having small size fruit sizes was NRs 40-50 per kg while in the well-managed orchard, it was NRs 66-75 per kg. Farmers reported that the price they received was fairly good because their production cost was lower. Poor quality rootstock was found another factor affecting quality sweet orange production. Trifoliate rootstock has performed good quality fruits compared to Jyamir. Late harvesting was reported in most of the orchards, growers said late harvesting affects the flowering in the next season, resulting in to decrease in the next year. Farmers and vendors made contracts during August-September and fixed the buying price for the following year. According to the contract, fruits should be harvested before February. However, vendors want to collect at a later date to fetch a better price. Consequently, farmers waited another one or one and half months for the vendor to sell their fruits. Thus farmers were forced to harvest later than they should be because of lack of storage facility, late harvesting may cause a loss in production in the next year.

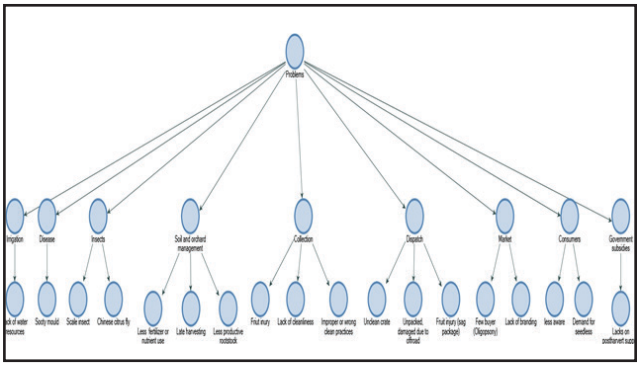

Figure 5: Problem tree of the sweet orange value chain

The collection point was another problematic site in the value chain. Many orchards have practised good picking practices, however, fruit injuries have been observed during loading and unloading. Moreover, poor cleaning practices existed, for instance, crates were never cleaned, and fruits were stored on the open floor. Likewise, pickers were aware of picking practices however they were less aware of fruit handling and possible fruit injuries.

Vendors reported that the transportation of sweet oranges faces several challenges, including transportation on unclean, broken and dusty crates, off-road conditions, and fruit injury due to an overload on the crate. Unclean crates during transportation can result in the spread of diseases and pests, negatively impacting the quality of the fruit (Zacarias et al., 2020). Off-road conditions, such as bumpy roads, can cause physical damage to the fruit, leading to bruises and other injuries (Ladaniya, 2010). Therefore, improper handling during transportation resulted in fruit injury and reduced the overall market value and freshness of the product.

The value chain analysis of sweet orange revealed that the market was facing significant challenges, including limited number of buyers and lack of branding. A few buyers resulted in low bargaining power for farmers, leading to lower prices for their produce. This also had an impact on farmers to invest in their farms to improve production and quality, which in turn limits the ability of the firm to expand. The absence of a brand for sweet orange was challenging for the industry to differentiate its products and attract customers, particularly in a highly competitive market, for instance, competition with Sindhuli's Sweet orange. These factors contributed to a difficult market situation for the sweet orange industry, highlighting the need for intervention and investment to enhance the competitiveness of the sector.

The research on the value chain analysis of sweet oranges exhibited that there was another problem in the market with less aware consumers and consumer demand for seedless fruits. Consumers were becoming more fascinated by seedless fruits, which put pressure on the sweet orange industry to provide seedless varieties. However, many farmers were still unaware of seedless varieties of sweet orange. On the other side, many consumers were less informed about the quality of domestic and imported sweet oranges. To address this issue, there is a need for increased consumer education and marketing efforts to raise awareness and develop consumer-preferred crop varieties.

The value chain analysis also revealed a significant problem in the sweet orange industry was the lack of

government support for post-harvest practices and technology. This has resulted in a significant loss of revenue for farmers and the inability to meet the growing demand for fresh and processed sweet oranges in the market. Despite the high demand, farmers struggled with poor post-harvest technologies that resulted in significant losses in terms of quality and quantity. The lack of government support in providing adequate infrastructure and investment in technology to improve post-harvest practices such as cellar storage and cold storage. The poor post-harvest practice was one of the major hindrances to the growth and development of the sweet orange industry. This has resulted in decreased competitiveness, lower quality products, and reduced income for farmers.

Improvement opportunities in the value chain

The research on the value chain analysis of sweet oranges highlights several upgrading opportunities that can lead to value chain competitiveness. These opportunities were derived from coded interviews in the NVivo software. One key area of focus was the establishment of an irrigation system, which would help to ensure a stable water supply to the crops and improve overall productivity. There were limited options for springs, rivers and other natural water resources. However, farmers were interested in harnessing rainwater harvesting technologies if they would have subsidized support. Another important upgrading opportunity was the use of high-quality seedlings, which will result in stronger and healthier trees, increasing yields and better fruit quality with desired colour. For instance, there was an opportunity for replacing old orchards having Jyamir grafted rootstock. Maintaining the cleanliness of the fruit was also crucial in ensuring that the product meets market standards and meets the expectations of consumers. Moreover, farmers mentioned the establishment of cold stores will extend the shelf life of sweet oranges and improve their storage

Figure 6: Word map of improvement opportunities derived from NVivo 12

capabilities, making them more accessible to a wider market.

This study showed that implementing efficient fertilizer use practices could lead to increased production and greater revenue. Application of 50 kg compost, 250 gm urea, 220 gm Diamonium Phosphate, and 60 gm Murate of Potash on 5-10 year's plants showed more yield, increased sweetness, and better colour development. Secondly, the analysis highlighted the need for better fruit fly management practices, including the use of integrated pest management (IPM) strategies, which would improve the quality of the fruit and reduce losses due to infestations. Finally, the study underscores the importance of consumer awareness and education programs that could improve consumer awareness on the selection of good quality sweet oranges and increase demand for the fruit. These upgrading opportunities, if implemented, could lead to a more sustainable and economically viable sweet orange value chain.

Discussion:

This study showed that growers, vendors, wholesalers, retailers and consumers were the major actors in the value chain of sweet orange. While federal, provincial, local level agricultural service centres, JICA were the supports/enablers of the chain. Vendors were the dominant players in the value chain as they were the price makers. There were a few vendors involved in contracting the orchard and making the decision on the per-unit price for the harvesting year. On one hand, it was easier for the farmer to minimize the price risk before harvest on the other hand they had less chance for price negotiation. Farmers in developing countries are forced to sell their commodities immediately after harvest because they need cash in hand to run their household activities and they also have limited storage infrastructures (Kongai et al., 2018). Moreover, the value chain of kinnow in Pakistan shows when the producer has limited access to diverse markets and less scope of value addition there used to sell through pre-harvest contract. However, when farmers explore international market opportunities

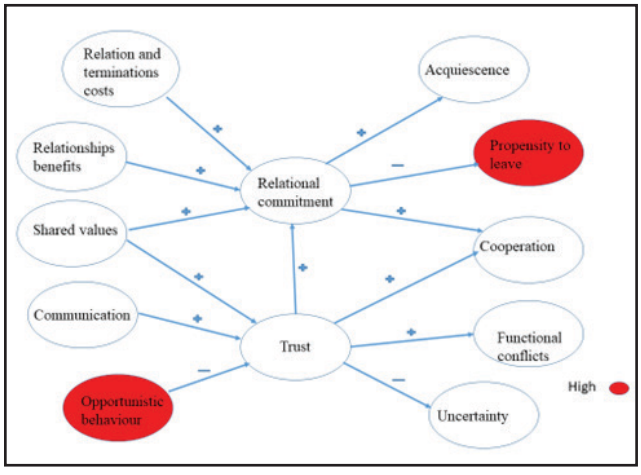

Figure 7: Commitment-trust dynamics in the value.
Source: Adopted from Morgan and Hunt (1994), and modified based on research data

they gradually change and sell directly to the local and international markets (Siddique, 2018).

Partial information flow was observed between the distributor and collectors/growers, week information flowed between the retailers and consumers. A basic relationship was observed between the retailers and consumers, as retailers, were mostly motivated towards short-term profit. Relational commitment and trust were analysed based on the commitment-trust theory developed by Morgan and Hunt (1994). Relational benefits, shared values, and cooperation were identified as positive as most of the actors have trust and ethics. In addition, results showed the sweet orange market has the possibility of volatility and consumers may switch to another close substitute, therefore we can infer consumers have higher opportunistic behaviour and propensity to leave the value chain.

In Nepal, there are few studies attempted to describe the production, disease/pest management (Adhikari et al., 2018; PMAMP, 2023) and postharvest practices (Kaini, 2013). This study concludes that there are several improvement opportunities in the areas of crop management and postharvest practices. Irrigation supply can enhance productive efficiency by up to 66% in some crop varieties (Parra et al., 2020). Another scope to use quality seedlings for example farmers mentioned that trifoliate root stock yields high. Additionally, the quality of sweet orange fruit can be improved through proper fertilizer and nutrient management. Study showed the application of nitrogen and potassium fertilizers increased the fruit size, juice content, and total soluble solids in sweet oranges (Chen et al., 2022; Kumar et al., 2017; Wen et al., 2021). The researchers also observed improved fruit colour and reduced incidence of disorders such as alternate bearing and fruit drop. This finding demonstrates the significance of proper fertilizer and nutrient management in enhancing the quality of sweet orange fruits.

Improvement opportunity has existed in quality seedlings. Many farmers have preferred trifoliate grafted seedlings. A study in Brazil showed sweet oranges that were grafted on a trifoliate hybrid had a greater amount of juice content and higher TSS as compared to other rootstocks (Domingues et al., 2021; Kumar & Ganapathy, 1992). Moreover, management of sooty mould and fruit flies can enhance the fruit quality thus more return can be achieved.

Study shows potential benefit can be obtained by storing sweet oranges either in cold stores or cellar stores. Sweet oranges can be stored in cold stores to maintain their quality extend their shelf life and pursue more returns in the offseason. According to a study by Zhang (2018) and Rehman (2018) revealed that storage temperatures between 1°C and 5°C are suitable for sweet oranges, with a relative humidity of 90% to 95%. The study found that the low temperature and high humidity conditions slowed down the respiration rate of the fruits, reducing the rate of decay and preservation of the sweet orange's taste, aroma, and colour. However, it is important to note that long-term storage at low temperatures may result in physiological disorders such as chilling injury, so it is recommended to monitor the storage conditions regularly. Furthermore, cellar storage is an option that is better than cold room storage in the case of apples (Shrestha, 1996), similarly sweet orange stored in zero energy cool chamber had greater shelf life compared to ambient lab condition storage (Khalid et al., 2023). Thus, we can test this practice in Sweet oranges. Overall, the proper storage of sweet oranges in a cold storage facility can lead to a significant increase in revenue for producers by captivating higher prices in the off-season.

The sustainability of the sweet orange value is important because farmers could leave the business if they were not facilitated by government policy. In the selected value chain supporters such as government agencies, industries, financial institutions, insurance companies and cooperatives are working to enable the value chain. In this context, policy must address production and development processes in a way that ensures sustained income growth for marginal farmers and developing nations. Value-chain analysis can assist in identifying key areas of private and public policy and offer perceptions of the obstacles to policymaking that private and public players must overcome (Kaplinsky, 2004).

Conclusion:

A study of the sweet orange value chain in the Ramechhap district showed that sweet orange farming was the one the majority of the enterprises of that locality. The main obstacles to its success are limited irrigation, poor quality rootstock, shooty mould, fruit fly infestation, poor orchard management, storage facilities, and weak relations between retailers and consumers. In addition, poor transportation, poor handling after harvest, insufficient value addition to the fruit, and less informed consumers' awareness also existed in the value chain. To improve competitiveness, the of the sweet orange value chain, it is crucial to put policies in place to ensure better orchard management keeping priority on irrigation, balanced use of fertilizers and nutrients, proper post-harvest handling, the establishment of a good relationship between value chain actors, and informing the consumer about good quality fruits. Furthermore, investment in small-scale cold storage or cellar storage potentially paid a higher return. Finally, three areas for improvement in the value chain were remarked, 1) growers to the collectors; this was the areas to improve cleaning and grading practices. 2) Distributors to wholesalers/retailers; loading, packaging, and safe fruit handling practices were lacking. 3) Retailors to consumers; Consumers were less informed. These upgrading opportunities will enable the sweet orange value chain to increase competitiveness, meet market demands and increase profitability.

Declaration of conflict of interest and ethical approval:

Authors announce self-funding for this research and there is no conflict of interest.

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