

Reducing Post-harvest Losses and Enhancing Food Safety

The role of the midstream traders in the case of mango and vegetable value chains in Southern Philippines

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Summary

The agri-food system contributes about a quarter of the country's gross national product. In Mindanao, its share to the total output is higher being an agri-based economy and when agri-based outputs of the industry and service sectors are accounted for, the share of the agri-food system reaches to more than 60% of its economy (World Bank 2017). An important component of this system is formed by the many informal value chains which include the majority of small-scale farmers and enterprises. Involving actors operating in informal sectors in food system transformation will impact both rural livelihoods and urban food availability. However, these value chains and their principal actors are not well studied in the Philippines particularly their nature, their motivations to remain informal and how to effectively harness their potential particularly in addressing post-harvest waste and losses and food safety.

Mango, cabbage, and tomato were selected as case studies due to their critical roles in the agricultural value chains and the substantial post-harvest losses they experience, with some products more affected than others. In addition to the losses, the quality of these crops often suffers from poor handling practices, leading to significant economic losses for all value chain actors. These challenges are further compounded by concerns around food safety, as inadequate post-harvest practices can lead to contamination and compromise consumer health.

Improving post-harvest practices and adopting technological innovations can mitigate these issues, enhancing both the quality and safety of the products. However, a key barrier is the limited understanding of the motivations and behaviors of the midstream actors, who are responsible for much of the handling and distribution in these chains. These actors, often operating informally, play a crucial role in influencing the adoption of new technologies and practices. Without a more profound understanding of their motives and decision-making processes, it remains difficult to address the dual challenges of reducing post-harvest losses and ensuring food safety across the value chain.

Therefore, this study focuses on this informal sector particularly its role in achieving food system outcomes such as reducing post-harvest waste, losses and improving food safety in order to provide better access of consumers to safe and nutritious food.

Specifically, the aim is to:

- Examine the internal factors affecting midstream actors in informality, such as their motives, actions, and strategies in dealing with risks;
- Assess the external factors such as policies, market requirements and competition that affect their actions and strategies;
- Analyze the incentives and disincentives that drive adoption of innovation and practices to reduce post-harvest losses and enhance food safety; and
- Recommend approaches on how to enhance their contribution in attaining food system outcomes, particularly on reducing post-harvest losses and improving food safety.

Methodology

To address these objectives, we used a framework by de Steenhuijsen et al. (forthcoming) with some modifications to guide our case analysis (See Figure i). This framework was developed to understand the behavior of actors in the informal sector in terms of their decisions and strategies, it is essential to examine the factors that drive their actions. Each actor in the informal sector and its enterprise is a microeconomic unit driven by its motives or objectives to improve income, manage risks and act based on necessity, opportunities, trust, reputation and reciprocity and other conditions including drivers external to the informal business or enterprise. These drivers internal to the actor or informal sector enterprise as well as those external drivers such as policies, market requirements and competition translate to incentives and disincentives for the informal sector. These internal and external factors serve as the basis or influence their decisions and strategies. These, in turn, affect food system outcomes such as reduction of post-harvest losses and improvement in food safety.

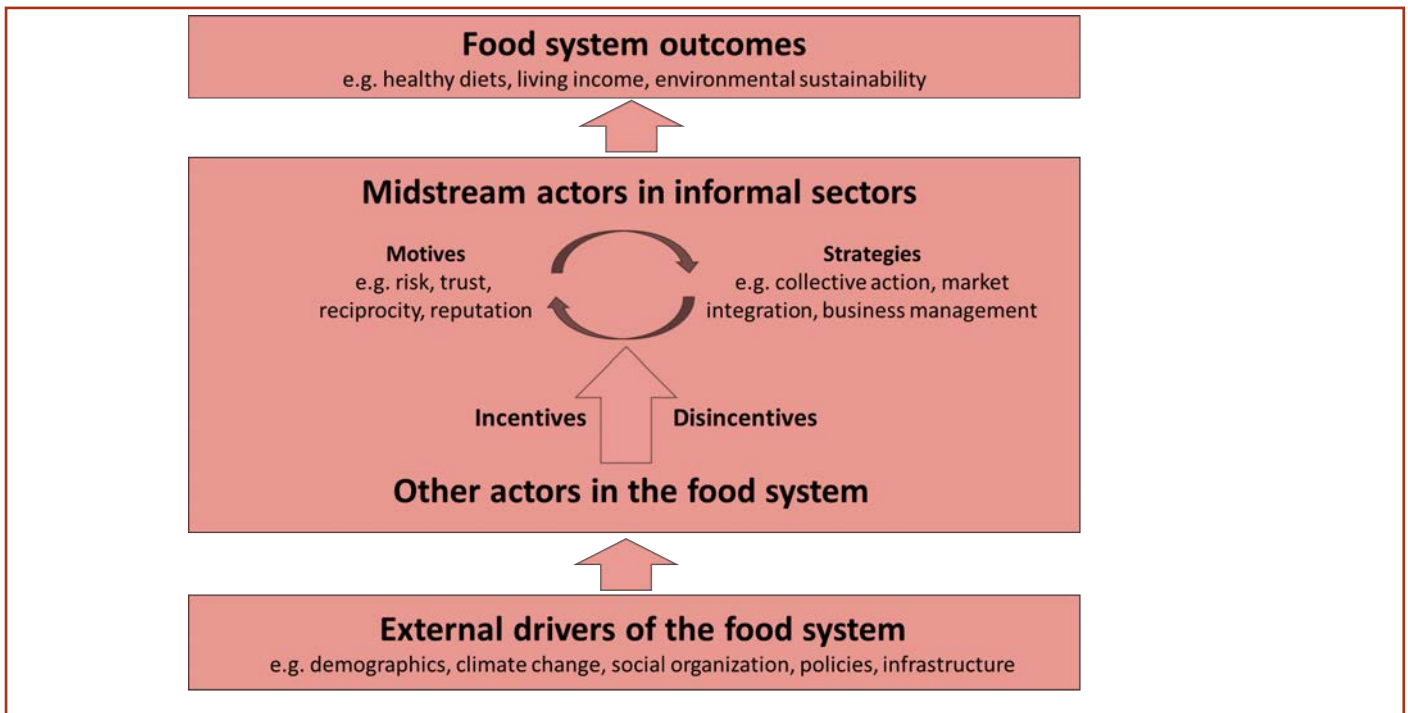


Figure i. Analytical framework

Source: de Steenhuijsen et al. (forthcoming)

We applied this framework to study three cases in the mango and vegetable value chains in Southern Philippines focusing on the informal sector in the midstream node of the chain. These are the mango chains from Samal and Davao del Sur to markets in Davao and other markets in the Philippines and abroad. The two vegetable chains include cabbages from Kapatagan, Davao del Sur and tomato from Maragusan, Davao de Oro to markets in Davao City and other markets in the country. We interviewed a total of 38 key informants, 31 of which were from the informal sector.

Table 1. List and number of key informants/FGD informal actors

Cases	Value chain Actors <i>Informal</i>	Number of informants/FGD
Mango	Grower-sprayer contractor-trader (1), grower-sprayer contractor (1), grower-sprayer contractor-newspaper bag maker (3), grower-sprayer contractor-input supplier-trader-wholesaler-processor-retailer (1), wholesaler-retailer (2), ambulant vendor (1), laborer (1), 1 (Focus group discussion)	11
Vegetable - Kapatagan	Farmer-financier-trader (2), farmer-trader (1), farmer-financier-dicer-trader (1), trader-wholesaler (1), wholesaler-retailer (2), retailer (1), ambulant vendor (2), laborer (1)	11
Vegetable - Maragusan	Farmer (1), farmer-financier-consolidator (1), farmer-trader-wholesaler (1), wholesaler-retailer (2), retailer (1), ambulant vendor (2), laborer (1)	9
<i>Formal</i>		
All chains	Local and national government units and mango exporter	7
Total		38

Key findings

Case 1: Mango

Value chain actors

In the Southern Philippines' mango value chain, it was found that apart from the large-scale traders, exporters, and processors, the majority of the chain actors operate informally. Mango contractors, wholesalers, jumlbers, retailers, ambulant vendors, and laborers are all considered to be the actors belonging to the midstream informal sector.

Flow of activities between chain actors

To further visualize the flow of activities in this chain, the value chain map of the mango industry in Davao region based on the findings of the study is provided below (see Figure ii).

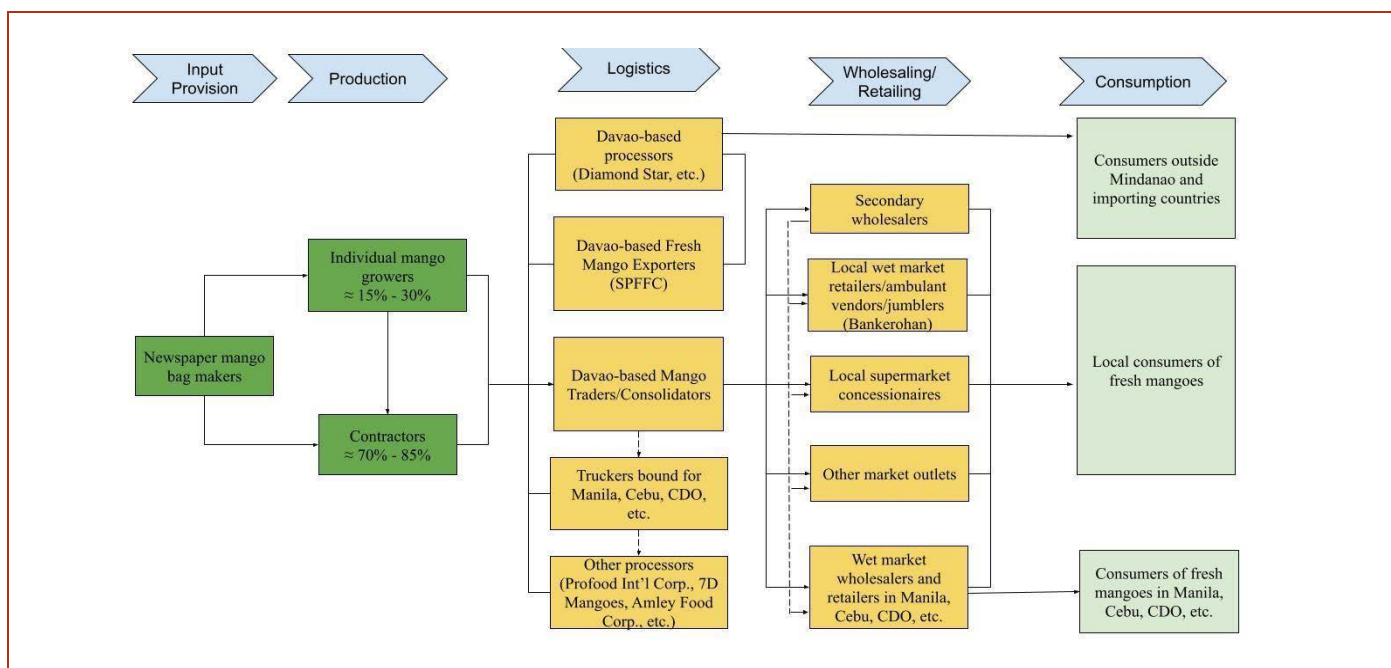


Figure ii. Value chain map of mangoes in Davao region

Power, governance, and margins

In terms of the competitive forces existing in the industry, it was found that the smallholder informal chain actors perceived that the mango processors who are mainly operating formally hold the highest market power, specifically in price setting. This was attributed to the fact that on average, 60% of the mango volume produced in the region was traded to these processors; hence, the other informal suppliers (individual smallholder mango growers, and some contractors) hold lower bargaining power over them. It also supported why the wholesaling node (dominated by export and processing industry) has higher total average net value for 10 years (2012 to 2022) amounting to PhP 2.9 billion than retailing node with PhP 2.7 billion due to the market power and share they hold.

Risks

There were also limiting factors which include the risks and disincentives for these informal chain actors' operations in the mango industry. One obstacle they face is the limited market space during peak season of mangoes (November to December). Jumlbers and ambulant vendors who lack permanent stalls to display their mangoes find it hard to keep up with market dynamics and demand during this period. Also, as most of the

wholesalers/retailers/jumblers selling mangoes in the market use Calcium carbide to hasten the ripening process, they are exposed to health risks as well. Meanwhile, the fruit laborers who carry loads, boxes, and baskets of mangoes manually from the dropping area to the respective stalls of the vendors, also face physical and safety hazards in their daily activities. Mango growers/suppliers along with those vendors engaging with the consignment system experience delayed payments from their buyers and resellers, respectively. Moreover, the remaining 40% of the mangoes that are not supplied to processors were highly vulnerable to spoilage if left unsold in the market.

Motives and strategies against risks

To sustain a steady flow of profit and business operations with better opportunities and lower costs, weak enforcement of regulations, combined with low market demand for mangoes in the formal sector, has encouraged chain actors to continue operating informally within the industry. These are partnered with the extension of the shelf life of their mangoes, improvements their qualities, and an increase in the volume of mangoes they daily trade. Collectively, these factors translate into higher productivity and profitability of chain key players.

To counter the effects of these challenges in the chain, the jumblers and ambulant vendors who struggle with limited market stalls are negotiating with other mango wholesalers and retailers to let them display their products on their vacant tables. More so, given that their mangoes are more vulnerable to microbial and mechanical damages, ambulant vendors and jumblers charge lower prices for their mangoes to reduce post-harvest losses. Other chain actors are also strategizing by means of income diversification through raising livestock. Some of them are working as hired laborers to other mango businesses and farms to generate additional income.

Incentives and disincentives for innovation

Approximately 5% of mangoes are lost post-harvest, a relatively low figure that can actually hinder the adoption of innovation in the sector. Especially since Midstream actors often sell lower-quality mangoes, which contributes to the perception of low post-harvest losses, as these products are still sold rather than discarded. However, poor handling practices significantly impact quality, leading to substantial economic losses throughout the value chain. In terms of innovation, only the fresh mango exporters have Hot Water Treatment (HWT) facilities provided that only export markets strictly require this practice in improving the quality grade of mangoes. Taiwan paper bags, although proven by literature to be effective in improving the quality and sales of fresh mangoes by 31%, are not yet widely used by mango growers and contractors in Davao region. Additionally, due to the absence of better and more affordable alternatives for the ripening agents of mangoes, the existing practice of the midstream actors involved the use of Calcium carbide. In the case of mango packaging, the use of carton boxes is prevalent among the chain actors which slowly replaced the use of large mesh bamboo baskets (bukag) and polyethylene sacks. Conversely, there were also disincentivizing factors in the adoption of these innovations. The findings revealed that these include actors' perceived cost of adoption/investment on these innovations while dealing with the lack of market spaces to sell their mangoes and very low demand and consumer differentiation toward "safe" mangoes.

Other chain actors to be tapped

Thus, with only few could pass and sustain wholesaling functions to exporters and processors due to high volume and food safety requirements, it is more important to focus interventions to the majority of smallholder midstream informal actors. Further, by providing sufficient and free training, seminars, and other technical assistance toward these midstream informal mango chain actors, they will be more encouraged to adopt innovations, if there is a business case for it. These interventions can be provided by other chain stakeholders such as the different government agencies, especially the Department of Agriculture; the local government units (LGUs), academe, and even private companies conducting extension visits to farmers. The Department of Trade and Industry and formal buyers (e.g., processors and exporters) can also help in terms of marketing opportunities support in relation to innovation training and adoption of mango farmers and informal midstream actors.

Case 2: Cabbage

We examined the cabbage value chain in Kapatagan, Davao del Sur which is the main producer of vegetables in the entire Davao region. It is known for its cooler temperature which is suitable for highland vegetables like cabbage. According to the data provided by the City Agriculture Office of Digos (2023) where this barangay belongs to, on average, Kapatagan was able to produce 43.3 metric tons of cabbage per week as of September 2023. This is equivalent to 38% of the total volume of the commodity being produced in the entire Davao region with an average annual productivity of 8.83 metric tons per hectare in 2012 to 2022 (PSA, 2023b). Based on the findings of the study, Kapatagan supplies the majority of cabbages being traded and sold in Davao market outlets, especially in Bankerohan wet market.

Value chain actors

Apart from the large-scale traders in Kapatagan, the rest of the midstream and even upstream chain actors which can be estimated to represent 90% of the entire value chain are operating informally in the cabbage industry. Dicers, wholesalers, warik-wariks, retailers, and ambulant vendors or locally known as laray made up the midstream informal actors in this particular chain.

Flow of activities between chain actors

Figure ii presents the value chain map of cabbage in Davao region, focusing on Kapatagan and Bankerohan. It can be seen how informal groups in the cabbage value chain in Kapatagan play significant roles because the majority of the chain actors, especially in the midstream node, operate informally.

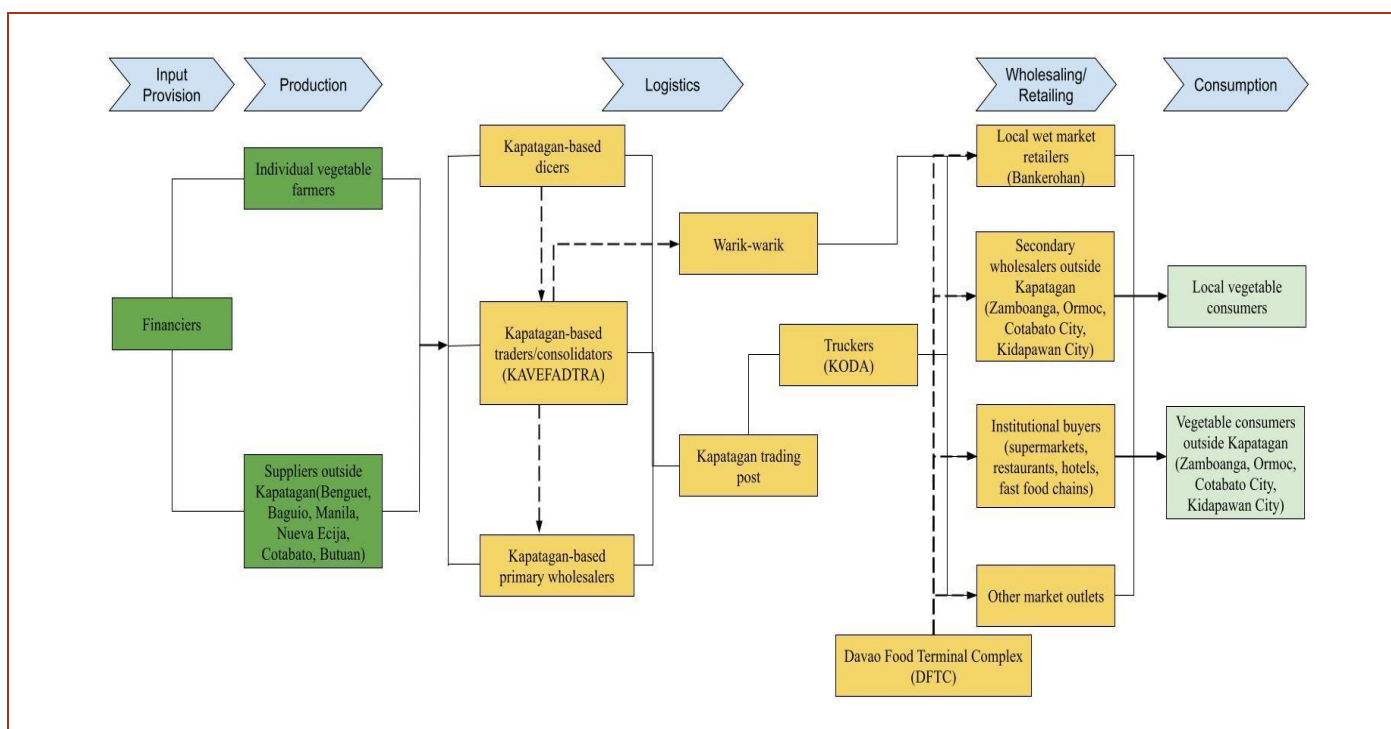


Figure iii. Value Chain Map of Vegetables in Kapatagan, Davao del Sur

Power, governance, and margins

In terms of power and influence, the cabbage chain actors in Kapatagan perceived that it is the large-scale vegetable traders who hold the market power. The informants estimated that their influence covers up 95% of the entire Kapatagan vegetable value chain as most of them were also financiers and growers of cabbage at their own farms. The majority of these traders are formally registered. This is because according to them, they will not be

allowed to trade to other provinces and cities outside Davao if they lack travel and business permits. Meanwhile, the retail node of the chain was found to receive the highest average net value for 10 years (2012 to 2022) due to high market margins it enjoys as compared to farm and wholesale nodes in the chain. Its value amounted to PhP 219.7 million for the said period, a PhP 141.8 million difference to the farm level node of the cabbage chain on average.

Risks

In contrast, the chain actors in the cabbage industry of Kapatagan value chain, especially those operating informally also face several risks and disincentives. Financiers, traders, and wholesalers suffer from credit-based transactions which sometimes end up as bad debt because of the lack of formal and legal documents to prove the validity of their transactions. The reasons these informal midstream actors cited as to why their transactions ended up as bad debt were the irregularities in their operations due to bad weather and road conditions, post-harvest losses, price fluctuations, and compounding credits from other midstream actors. As with most vegetables, seasonality issues persist over time in cabbage as well which causes price fluctuations in the market due to the changes in the pattern of demand and supply conditions. During June to September, the midstream actors are already anticipating a decrease in their sales. This is because of two reasons: (1) Baguio City and Ormoc City experience peak season of cabbages and other vegetables creating surplus in the market even at Davao, leading to prices plummeting significantly; and (2) households are budgeting their finances as the classes in schools will start within this period. More importantly, this study has a huge relevance to the issue of high post-harvest losses in the cabbage value chain of Kapatagan faced by its key players. Spoilage and damages occur due to logistics and handling practices by the chain actors (e.g., overpacking polypropylene sacks with untrimmed cabbages, careless piling and throwing of laborers of the sack full of cabbage and stacking them over the other). By doing so, an automatic 25% discount per sack of cabbage is implemented to cover up the untrimmed leaves and future losses the buyers will incur.

Motives and strategies against risks

The results of the study revealed the significant internal and external factors affecting the functions and contributions of the vegetable informal chain actors in Kapatagan. The motivations of these informal actors include acting based on necessity, operating with the help of family members and relatives, and building trust and reciprocity among other chain actors, most especially the buyers, suppliers, and consumers. Moreover, they perceived that operating informally entails huge advantages in terms of cost-efficiency by only paying a daily market tax of PhP 20 instead of regularly renewing their permits. Another incentive for the chain actors is to anchor their daily operations to the dynamics of the market such as producing and trading particular crops for a specific period of time according to their seasonality patterns.

Playing multiple functions in the chain instead of focusing on one role is one way for the Kapatagan chain actors in dealing with the aforementioned risks and disincentives. Some of the informal retailers in Kapatagan public market were forced to register formally with the fear of getting demolished with vegetable products being confiscated and pay the penalty of PhP 10,000 to PhP 20,000 even at first offense. On the other side, the cabbage ambulant vendors in Bankerohan charge their products lower than the retailers as they are not paying for the commercial stalls, only displaying them on sidewalks. Next strategy employed by the chain actors is by controlling and some have already stopped the credit-based transactions with those buyers or resellers known for delayed payments and bad debts. Two informal organizations in Kapatagan (KAVEFADTRA and KODA) for traders, dicers, and truckers also keep the actors in the informal chain to remain operating informally. This is due to the collective power and action these organizations provide toward them.

Incentives and disincentives for innovation

Post-harvest losses for cabbages are around 13%. The poor post-harvest practices result in significant quality degradation, leading to (economic) losses across the value chain. For post-harvest reduction innovations in the

chain, their main incentives for adoption include the assurance of extending the shelf life of cabbages and that the innovation must be affordable and cost-efficient. At the retail node of the chain, retailers practice minimally processed vegetables (MPVs) by cleaning, trimming, and cutting the cabbages. The usual processing of cabbages is for the mixed or "sari" package of vegetables for "chopsuey" or "pancit" – two known Filipino recipes for celebrations.

Also, with the training held at Baguio City in Benguet, the organization leaders and prominent chain actors from Kapatagan implemented similar practices and innovations from Baguio to Kapatagan. These include the use of 25-kilogram polyethylene bags as vegetable packaging and proper handling (loading and unloading) of loads of cabbages to and from the vehicles. They were also able to adopt the individual wrapping of cabbage by paper to extend shelf life because of the buyers' requirement from Ormoc. In addition, the Executive Order No. 42 of Davao City government made the Davao Food Terminal Complex in Toril as the main and center of vegetable trading/marketing in the entire region. This facility also required the innovative practices mentioned to improve quality, extend shelf life, and ensure food safety of vegetables for the consumers. However, due to several complaints of the traders and wholesalers in Kapatagan and Bankerohan with their trucks being underloaded per transaction, as well as the poor cooperation of the other chain actors in adopting them, the implementation only lasted for 2 months.

Other chain actors to be tapped

The local government units (LGUs) in Davao del Sur could take part in terms of alleviating the market access and ease of vegetable transport in and out of Kapatagan by constructing better farm-to-market roads. Chain institutional buyers such as supermarkets and malls could contribute to innovation adoption by requiring them to their suppliers of cabbage in Kapatagan to incentivize them to adopt as well. Additionally, the DFTC guidelines and usage must be strictly implemented or can be amended accordingly in order to make use of the cold chain facilities and post-harvest losses reducing practices.

Case 3: Tomato

Similar with the case of cabbage, the tomato value chain also focused on a particular area - in Maragusan, Davao de Oro and Bankerohan wet market as well. The former has an average productivity of 9.84 metric tons per hectare from 2012 to 2022, more than 3 metric tons higher than the Davao region itself.

Value chain actors

The midstream informal actors in the Maragusan vegetable chain are the dicers, traders, wholesalers, warik-wariks, retailers, and ambulant vendors. Opposite to Kapatagan’s case, the traders in Maragusan along with the other midstream actors mentioned above are operating informally. Some of them were previously registered and operated in the formal sector of the chain but due to the Covid pandemic where volatility and irregularity in vegetable prices and demand were intense, they were incentivized to shift to informal operations. That is, they did not renew their permits and legal registrations to reduce their incurred costs which was sustained at present since they find this more favorable and profitable on their end.

Flow of activities between chain actors

As shown in Figure iii, it can be observed that there are other buyers from other provinces or regions. They are wholesalers and/or retailers from Mindanao such as in Tandag, Surigao del Sur; Agusan del Sur; Butuan City (in Agusan del Norte); along with Tacloban City in the Visayas region. Institutional buyers can also be traced but most of them find it more accessible to transact with the wholesalers in Bankerohan, Davao City.

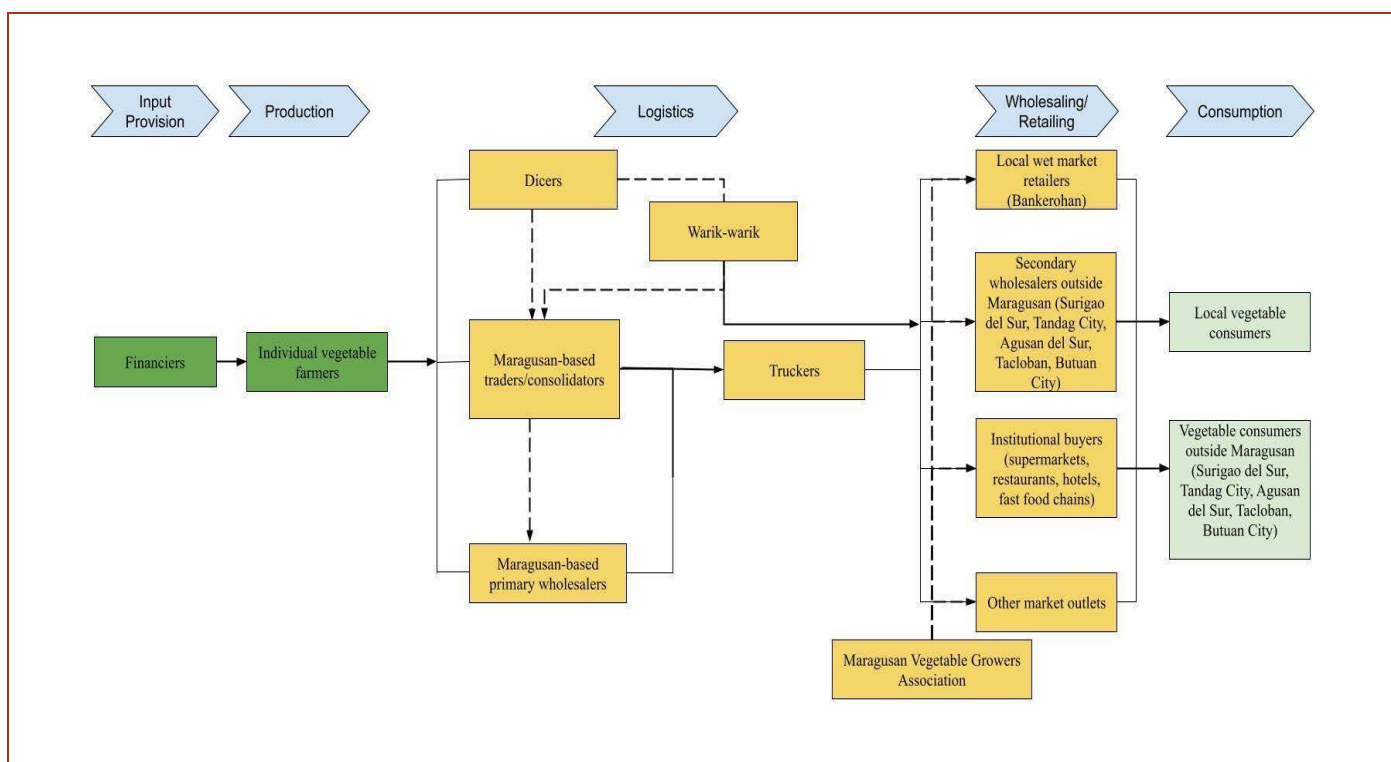


Figure iv. Value chain map of vegetables in Maragusan, Davao de Oro

Power, governance, and margins

According to the informants, the dicers who are also known as middlemen hold the highest chunk of bargaining power in dominate the tomato chain of Maragusan. This pushed the other chain actors to slowly take off the power from them by creating the Maragusan Vegetable Growers Association. Unfortunately, on its initial stage, the organization members who also happened to be grower-traders raised the concern that this goal is such a huge bottleneck for the chain. It is due to the fact that these dicers play a crucial role in transacting with large-scale

buyers and traders from the vegetable growers and suppliers to ensure regular volume and flow of their operations. On the other hand, smallholder vegetable growers find it difficult to remove their engagement with the dicers since these actors provide convenience, cost efficiency and immediate transactions with institutional buyers through consolidation.

Risks

Inversely, there were corresponding risks and disincentives for the tomato chain actors in Maragusan that were found based on the results of this study. Aside from dealing with the usual price volatility concerns, they also struggle with the lack of formal documents to prove informal transactions in the chain when bad debt happens. Majority of the chain actors in this case also give passive regard to the high levels of post-harvest losses of tomatoes from farm to market caused by logistics and handling practices. They treat this as an inevitable part of their operations as they deal with fresh vegetables with soft pericarp and highly vulnerable to spoilage contamination with other infected tomatoes (microbial, physical, mechanical). Both buyers and consumers of tomatoes have limited knowledge toward food safety as they are found to be more price-sensitive about it. Volatility of prices due to seasonality, irregularities of informal operations, lack of farm to market roads, and limited access to market information and government interventions were more felt by the midstream informal actors.

To cushion the impacts of the risks and disincentives to their operations, the midstream informal actors in the tomato chain in Maragusan strategize accordingly. Since trader-financiers are the most disadvantaged when it comes to credit-based transactions that often end up as uncollectible accounts, some of them decided to stop their financing services. To those who remained on such systems, especially during lean seasons, they screen the farmers availing the financing services. Also, they try to be very hands-on in visiting and monitoring the financed farms to avoid repetition of incidents. In their financed farms, they also advise to minimize chemical application and require proper packaging and handling practices (e.g., using wooden crates and quality sorting) for the welfare of both workers and consumers of tomatoes).

Motivations and strategies against risks

The motivations of the midstream informal chain actors in Maragusan are similar to those in Kapatagan which are based on necessity and opportunity, and the low barriers to entry for warik-wariks and ambulant vendors in Bankerohan. It was claimed as such because the latter mentioned chain actors have low capital investment, no proper stall/table to display which made them sell on the sidewalks. Their incentives on one hand include the advantages of operating informally in the chain by having lower cost of operations and capital (as renewal of registration and permits are not included). They also experience a sense of autonomy in their operations, especially during unfavorable market conditions which spare them in bearing the risks of being forced to sell due to renewal and permit payments.

Incentives and disincentives for innovation

In terms of innovation to reduce post-harvest losses and implement food safety measures, there are at least 2 out of 10 trader-financiers who follow and adopt based on the informants' estimation. Interestingly, in this chain, the midstream actors are well aware of the innovations in storage, logistics, and packaging. This is because of the previously built trading post offering cold chain facilities (e.g., cold storage). However, due to mismanagement issues, high electricity consumption, and negative reception of the chain actors (i.e., facilities are deemed unnecessary due to cool temperatures in the area), it all failed. Fortunately, the midstream actors are already using wooden crates to pack the tomatoes instead of polypropylene sacks or carton boxes that are prone to spoilage and damage. The introduced innovation of using polyethylene bags and incorporating paper linings on wooden crates for better protection are yet to be adopted by these actors in Maragusan. Their primary reasons were risk aversion and must be assured that these innovations are cost-efficient and effective in improving the quality and shelf life of tomatoes, otherwise, they will just increase their operations cost.

Other chain actors to be tapped

Similar with that of Kapatagan's case, the issue of farm-to-market roads can be assisted by the local government units (LGUs) to offer better logistics of vegetables from upland farms or remote areas growing vegetables to the nearest market outlets. The municipal agriculturist office (MAO) must also intensify their efforts in promoting Good Agricultural Practices (GAP) in vegetable production and ensuring the food safety of consumers. This local agency should also oversee and assist the proposed Maragusan Vegetable Growers Association to assure that this would not end up as "white elephant" like the previously built association that acts as a trading post in Maragusan.

Comparing cases: drivers and (dis)incentives for innovation.

In Tables i to iv, both the internal and external factors affecting the decisions and operations of the chain actors in mango, cabbage, and tomato are summarized. These are their motives, risks faced, the external drivers from the enabling environment, along with the incentives and disincentives to adopt innovations in attaining food system outcomes. The chain key findings were also attached next to the factors to better understand each and every element included in these tables.

Table i. Internal drivers of the three chains

Internal Drivers	Chain/Case Findings
Motivations	
Necessity and opportunity	Operating in informal sector due to immediate need of cash; convenient access to inputs, credit and financing assistance from informal actors in the chain; autonomy in operations; ability to sustain operations and profits; multiple chain activities/roles played by single informal chain actor;
Low cost of operations	Paying a daily market tax of PhP 10 to PhP 20 instead of formal and legal registration from DTI or BIR; small-scale chain actors could transact with truckers or commute with PUVs to transport lower volume of mangoes or vegetables;
Trust and reciprocity	Ensuring trust through transparent and on-time payment and transactions among buyers and co-midstream actors; relational system of operations where functions and roles are also played by their family members or relatives to capture higher trust and reciprocity benefits;
Limited formality requirement from the market	10 percent of the buyers require formal registration and business permits from their suppliers in the chains (e.g., exporters, processors, and institutional buyers), the rest are already transacting with informal chain actors
Risks	
Seasonality	<p>The demand for fresh fruits and vegetables start to heighten during November until December due to the holiday season; June to September is also the season of harvest in other fruit and vegetable producing regions (e.g., Cordillera and Leyte) dropping Mindanao prices; high variability in weather/extreme weather conditions increases production and post-production losses and costs</p> <p><i>Strategies employed:</i> Control production schedules and volume with regard to seasonality and market demand; Grow all year round by planting to ensure monthly harvest (mangoes), or through crop diversification and rotation (vegetables); supplying to processors within Davao region</p>
Credit-based and delayed payments	<p>Some buyers transact on credit or consignment terms but delay payments, or worse lead to uncollectible debts</p> <p><i>Strategies employed:</i> Control or totally discontinue financing and credit-based transactions to untrusted growers/buyers; traders/wholesaler allot buffer funds to be paid to growers or other midstream actors when buyers issue delayed payments</p>
Post-harvest losses passive perception	<p>Collectively agree that it is inevitable for fresh fruits and vegetables to incur high post-harvest losses than other commodities; considered as given rather than something that can be managed or minimized</p> <p><i>Strategies employed:</i> charge lower prices for low quality produce; minimally processing; some are open to adopting innovations that are effective and low cost</p>
Health and safety risks	<p>Growers' heavy reliance and application of chemicals; laborers' risks in handling and carrying heavy loads of mangoes and vegetables to be delivered (logistics to consumption nodes)</p> <p><i>Strategies employed:</i> Minimizing the use of yellow-labelled chemicals; careful handling and carrying of loads</p>

Table ii. External drivers of the three chains

External Drivers	Chain/Case Findings
Legislation	Daily market tax collection of PhP 10 to PhP 20 in Bankerohan wet market; poor implementation of Barangay Micro Business Enterprises (BMBEs) Act of 2002 and Food Safety Act of 2013; and DFTC turning to be the white elephant project of Davao region
Information and technology transfer	Private chemical companies’ technicians doing knowledge and technology transfer to remote areas; inadequate efforts of MAO to inform the chain actors of government programs and registration guidelines (e.g., RSBSA and association creation)
Market access	<p>Institutional buyers requiring appropriate and innovative practices in terms of storage, handling, and packaging translates into the fact that they contribute to the adoption of certain innovations in these chains while also providing better market access. This includes acquiring price premia, more regular volume of products traded, and opportunities to transact with processors and exporters</p> <p>Existing associations and other organizations serve as leverage for collective power and action to achieve better market access in the chains.</p>
Support from the enabling environment (other government programs and support services)	Coordination and encouragement through MAO and LGU efforts in innovation adoption (e.g., PhilGAP adoption training and promotion) but still on its initial stage to promote food safety guidelines in the local agri-food systems; linking with established associations and cooperatives in these chains to channel government and private programs and assistance; improvements in the facilities, accessibility, and implementing rules and regulations of DFTC; and there is also a need to construct farm-to-market roads in these three major fresh fruit and vegetable producing areas of the project

Table iii. Incentives of the midstream actors in the three chains

Incentives	Chain/Case Findings
Quality improvement	Another pathway to adoption of innovation would be to see there are improvements in the quality of mangoes and vegetables after adoption than traditional practices; lower chemical residue, higher volumes of premium or Class A produce sold in the market; free of mechanical, microbial, and physical damages; which also translate into higher prices and more favorable profit margins, hence, higher income for the informal chain actors
Longer shelf life	Due to seasonality of fruits and vegetables, extension of shelf life to meet high demands during off-season is another pathway to adoption of innovation; preservation of fruit and vegetables’ quality and freshness after logistics - result to higher volume of good quality mangoes and vegetables traded in the chain, generating higher profits for the midstream actors and better quality for the end-consumers
Market-driven operations	Chain actors reported to be forced to adopt innovations in storage, handling, and packaging whenever their buyers are requiring them to do so; some fruit and vegetable growers follow the biodynamic calendar of production to combat seasonality and price volatility effects to their operations.
Informal organizations’ existence	<p>The existing organizations for growers, dicers, traders, truckers, wholesalers, retailers, and ambulant vendors in these chains are also operating informally; very low lifetime membership fee (PhP 1,000) but benefits do not directly improve chain operations</p> <p>Benefits: low membership fee, collective action, emergency and burial assistance, gathering and fellowship among chain actors</p>

Table iv. Disincentives of the actors in the three chains

Disincentives	Chain/Case Findings
Risk aversion	High perceived costs in adopting innovation in the chains and high perceived benefits from traditional practices; DFTC facilities are still not operational due to chain actors' negative perception and limited knowledge of the innovations' benefits
Current practices	Use of polypropylene sack packaging; overloading of transport vehicles; use of Calcium carbide; sitting on top of loads of fruits and vegetables; using refrigerated vehicles but occasionally use air condition to minimize cost - all significantly contribute to high incidence of post-harvest losses and food safety issues
Operational irregularities	After the pandemic period, chain actors experience volatility in prices and operation irregularities - pushed the previously registered chain actors not to renew and remain in informal sector; this also incentivized the small-scale chain stakeholders to operate informally due to the sense of autonomy whether to continue or impede operations during unfavourable market conditions
Limited demand for "safe" fresh fruits and vegetables	Buyers and consumers are less particular with safe fruits and vegetables in the market as they are more price-sensitive and quality-sensitive based on appearance and taste
Lack of market information and government interventions	Operating informally in these chains entail limited market information and government programs and subsidies unlike those chain actors in the formal sector (e.g., RSBSA-registered growers; traders with business and travel permits can expand services rendered in the chain)

Table v also shows the current practices and existing innovations per chain among the midstream actors in the covered areas of Kapatagan, Maragusan and Davao region for mangoes. The indicated practices and innovations are responsible for the incidence of high post-harvest losses, most especially in tomatoes with 30% as compared to the cabbage with 13%. Mango on the other hand has the lowest post-harvest losses (5%) because apart from the longer shelf life it possesses over the two vegetables, the midstream actors also have more options and strategies to reduce the losses. Selling different quality graded mangoes at varying prices, access to processors for Class B mangoes during lean seasons, and existence of exporters and institutional buyers are some of these advantages in the mango value chain in Davao region.

Table v. Post-harvest practices and losses of chain actors in cabbage, tomato, and mango

Chain/ Commodity	Current Practices	Losses (%)	Cause(s) of Losses
Cabbage	<i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle <i>Packaging:</i> polypropylene sack, recycles carton box <i>Washing/Cleaning:</i> NO <i>Trimming:</i> Damages leaves and butt-end <i>Repacking:</i> polyethylene/plastic bags <i>Sorting:</i> YES <i>Minimal processing:</i> YES <i>Display arrangement:</i> Bamboo/wooden rack, plastic tray	13	Soft rot, insect damage, wilting, trimming loss

Tomato	<p><i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle</p> <p><i>Packaging:</i> wooden crate</p> <p><i>Washing/Cleaning:</i> water/water with detergent in Agdao market</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags</p> <p><i>Sorting:</i> YES (separating/removing damaged and overripe, then, charge for lower prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic trays, wooden crate (unlined)</p>	30	Soft rot, physical bruises, decay, overripe, skin blemishes, mechanical injuries
Mango (ripe)	<p><i>Transportation:</i> bongo trucks</p> <p><i>Packaging:</i> recycled carton box, bamboo mesh basket "bukag"</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags, bamboo mesh baskets "bukag" for Calcium carbide application</p> <p><i>Sorting:</i> YES (different quality grade charged for varying prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic rays, wooden crate</p>	5	Decay, bruises, fruit fly damage, overripe, shrinkage
Mango (green)	<p><i>Transportation:</i> bongo trucks</p> <p><i>Packaging:</i> polypropylene sack</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> NO</p> <p><i>Sorting:</i> YES (damaged and downgraded quality charged at low prices)</p> <p><i>Minimal processing:</i> YES (sliced street mangoes)</p> <p><i>Display arrangement:</i> wooden table, carton box, bamboo mesh</p>	5	Decay, bruises, fruit fly damage, overripe, shrinkage

Source: Secretaria et al. (2023) with modifications

Recommendations and impact pathways for the midstream informal sector in the three chains

The findings of the study showed the importance of midstream actors in informal sectors of the vegetable value chains examined. Improving their performance in terms of managing post-harvest losses and food safety can contribute to achieving food system outcomes particularly in providing consumers better access to safe and healthy foods. The three cases showed how the existing innovations and practices of the chain actors, especially those in the informal sector could relate into their motivations, strategies, as well as the corresponding incentives, risks, and disincentives for innovation adoption. However, there is still a huge gap that needs to be addressed in

translating the benefits, and advantages of these innovations and in maximizing and improving benefits of government programs (e.g., technology transfer, DFTC, organizations, public and private agricultural agencies). Table vi summarizes the impact pathways for these informal actors in the three chains.

Table vi. Six impact pathway questions for informal sectors in the food system and recommendations

Impact Pathway	Recommendations
1. What food system outcomes need to be improved?	<p>To reduce post-harvest losses: improvements in current chain practice should be done, especially in the logistics node, proper use of packaging materials, adequate legislation enforcement, and the adoption of innovation in order to improve quality and shelf-life of fresh fruits and vegetables</p> <p>To strictly implement food safety standards: Food Safety Act of 2013 must be strictly imposed by government agencies and LGUs, proper handling and packaging practices must also be included in the requirements set by the buyers alongside the promotion of PhilGAP adoption.</p> <p>To have better access healthy foods: reduce post-harvest losses, increase the demand for safer fresh fruits and vegetables, market information and benefits of consuming safer food products must be prevalent and disseminated to consumers/buyers, prices should be lowered to attain better accessibility of safer and nutritious food products in the market</p>
2. Which actors in the informal sectors of the food system are important to achieve this goal?	Farmers, financiers/contractors, traders, truckers, wholesalers, retailers, processors, institutional buyers, ambulant vendors, and laborers per chain must be involved accordingly.
3. What are the principal motives of these informal midstream chain actors?	To motivate the informal midstream chain actors, necessity and opportunity, low-cost operations, trust and reciprocity, limited market formality requirements must be provided by the chain stakeholders and other enablers. Formal chain actors such as processors, exporters, and large-scale traders could also contribute positively in incentivizing these informal midstream actors to improve their overall functions in these chains.
4. What are the business strategies of these actors?	To cushion the effects of risks and disincentivizing factors in their operations, the chain actors are controlling their production, buffer funding, controlling financing services, lower pricing strategy, minimal processing, and applying judicious chemical.
5. Which other actors in the food system can influence the behavior of these actors in informal sectors?	Private input suppliers, formal traders (exporters and processors), supermarkets, hypermarkets, government agencies, informal associations, policymakers, private sectors, non-government organizations, consumers
6. Which incentives can be deployed by these other actors?	Legislation (BMBEs and Food Safety Act), market information, technology transfer, training, organization, disrupting bureaucracies, financing services, and other incentives such as subsidies must be deployed to incentivize the chain actors.

In summary, recognizing the vital role of often overlooked midstream actors, or the “hidden middle,” is essential. This requires a deeper understanding of their ability to enhance productivity and drive innovation. Assessing their capacity to contribute to food system outcomes is crucial, particularly because they primarily operate in the informal sector, an area that still demands greater insight and attention from research, policy and development.

Nevertheless, it was determined that in order to achieve the food system outcomes of reducing post-harvest losses, increasing food safety, and providing better consumers' access to healthy foods, there must be improvements done in the current practices in the chain. Innovation adoption also depends on the legislation enforcement by the stakeholders and policymakers. Also, knowledge and information transfer through seminars and trainings must be incorporated in these efforts of the enabling environment's role toward the chain actors to fulfil these outcomes. The necessary incentives and motivations influencing the adoption and compliance of the informal chain actors to the innovations and legislations must also be highlighted. These include their positive response toward necessity and opportunities provided, low cost of operations in the informal sector, trust and reciprocity among chain actors, and improvements in the quality and shelf-life of fresh fruits and vegetables flowing in the chains. The presence of both informal and formal associations in the chains discussed in this paper is also pivotal for incentivizing informal actors to align with desired outcomes.

List of abbreviations

ACIAR	Australian Centre for International Agricultural Research
BIR	Bureau of Internal Revenue
BMBEs	Barangay Micro Business Enterprises
CDO	Cagayan de Oro
DA	Department of Agriculture
DFTC	Davao Food Terminal Complex
DOLE	Department of Labor and Employment
DTI	Department of Trade and Industry
FGD	Focus Group Discussion
FIVCO	Fresh Integrated Vendors Cooperative
FS	Food Safety
HWT	Hot Water Treatment
IRRs	Implementing Rules and Regulations
KAVEFADTRA	Kapatagan Vegetable Farmers Dicers Traders Association
KII	Key Informant Interview
KODA	Kapatagan Operator Drivers Association
LGU	Local Government Unit
MAO	Municipal Agriculture Office
MPV	Minimally Processed Vegetable
MT	Metric ton
PhilGAP	Philippine Good Agricultural Practices
PHL	Post-harvest Losses
PSA	Philippine Statistics Authority
PUVs	Public Utility Vehicles
RSBSA	Registry System for Basic Sectors in Agriculture
SPFFC	Southern Philippines Fresh Food Corporation
TPB	Taiwan Paper Bag
VHT	Vapor Heat Treatment

1. Introduction

The informal sector in the agricultural value chains in the Philippines is generally not well studied and understood. We know that many small players in these chains such as farmers, traders, processors, retailers and laborers are generally informal. That is, their enterprises are not registered, nor do they acquire government permits to operate. Also, they comprise the majority of the actors in all nodes in the agricultural value chains: upstream, midstream and downstream nodes. However, their roles particularly in the midstream node of the chain are not well understood especially how they affect performance of chains in terms of achieving food system outcomes such as food and nutrition security.

Because the informal sector faces many challenges such as access to capital, better technology and skills, many government programs aim to assist them. These include organizing small farmers and processors to better access markets or extension services and infrastructure support. Although these programs use a value chain approach, the focus is usually on small producers such as farmers and microenterprises that engage mainly into food processing. Thus, attention is mainly given on the upstream part of the value chain. While microenterprises in food processing can be considered as part of the midstream node of the chain, roles of other actors in this node such as traders, consolidators, agents, wholesalers and retailers are not well understood. There is a considerable literature though on food retail particularly on the evolution and impact of modern retail such supermarkets and hypermarkets (Reardon et al., 2012; Reardon, 2015) but few, at least in the Philippines, had been done on traditional and informal retailers.

Traders, consolidators, wholesalers, small retailers and laborers in the midstream part of the value chains are relatively not well-organized and largely informal. Their role and contribution in meeting food system outcomes like reducing post-harvest losses or improving food safety and access to healthy foods need to be further examined to better assist them to contribute to achieving these outcomes.

This study will cover three cases in vegetables and mango chains in Southern Philippines focusing on the actors of the informal sector of the midstream node to:

- Examine internal factors such as their motives, actions and strategies
- Assess external factors such as policies, market requirements and competition that affect their actions and strategies
- Analyze incentives and disincentives that drive adoption of innovation and practices to reduce post-harvest losses and enhance food safety
- Recommend ways on how to enhance their contribution in attaining food system outcomes particularly on reducing post-harvest losses and improving food safety

This study is organized as follows. The approach or framework used in the analysis of the three cases is presented in section II. This is followed by the discussion of the three cases. The mango case is discussed in Section III followed by cabbage and tomato in sections IV and V respectively.

2. Approach

To understand the behavior of actors in the informal sector in terms of their decisions and strategies, it is important to examine the factors that drive their actions. Each actor in the informal sector and its enterprise is a microeconomic unit driven by its motives or objectives to improve income, manage risks and act based on necessity, opportunities, trust, reputation and reciprocity and other conditions including drivers external to the informal business or enterprise. These drivers internal to the actor or informal sector enterprise as well as those external drivers such as policies, market requirements and competition translate to incentives and disincentives for the informal sector. These internal and external factors serve as basis or influence their decisions and strategies. These, in turn, affect food system outcomes. For example, reducing post-harvest losses by adopting new ways of packaging vegetables or post-harvest techniques introduced by the market and development agencies would depend on how these affect the motives of the informal actors. These include the risks perceived by them in the chain. For traders or agents, for example, the question for them is whether they will be able to recover the additional costs or time incurred in adopting these new practices. Whatever decisions they make or strategies they implement, these will have an impact on the food system outcomes like reducing losses.

The approach or framework used in the analysis of the cases is presented in Figure 1 which is based on the paper by de Steenhuijsen et al. (forthcoming) with some modifications.

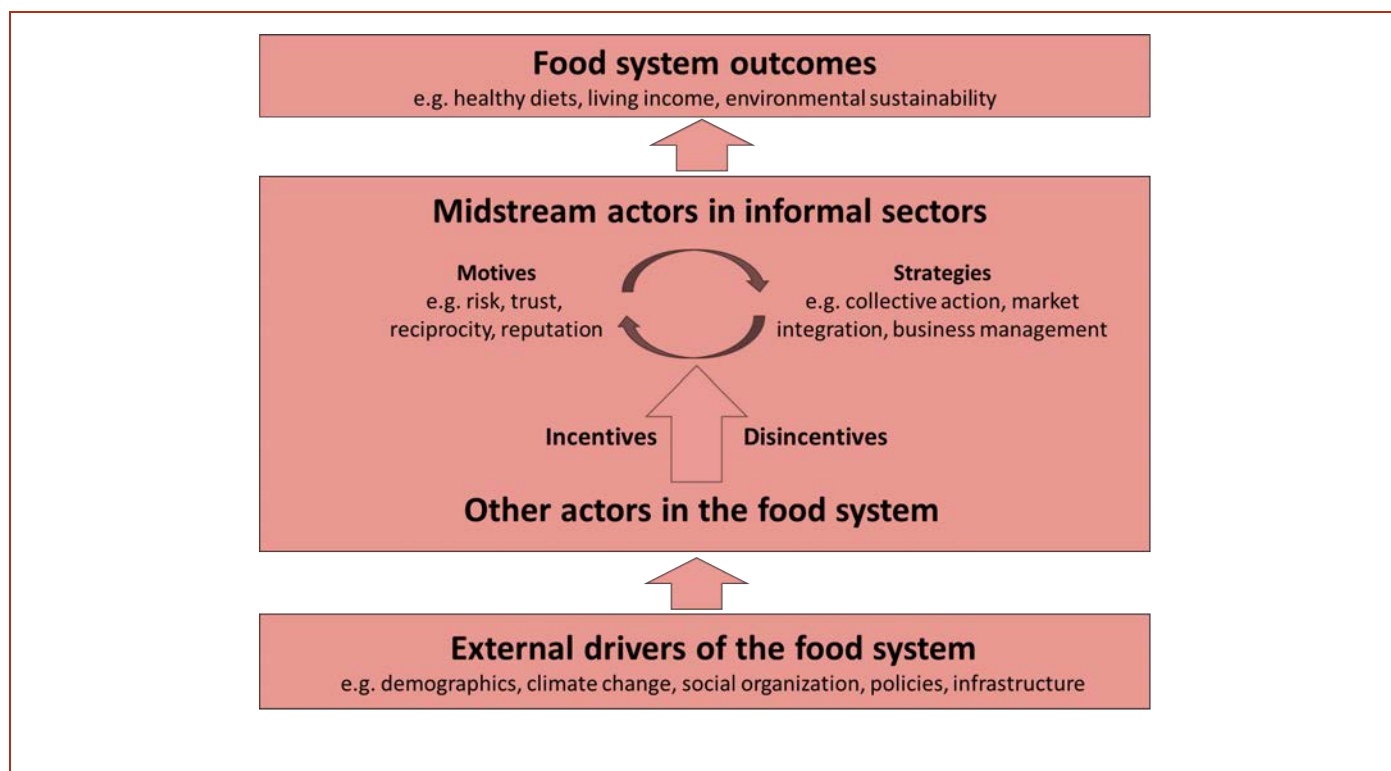


Figure 1. Analytical framework

Source: de Steenhuijsen et al. (forthcoming) with some modifications

This study covers three cases in the mango and vegetable value chains in Southern Philippines. These are the mango chain from Samal and Davao del Sur to markets in Davao and other markets in the Philippines and abroad. The two vegetable chains include cabbages from Kapatagan, Davao del Sur and tomato from Maragusan, Davao de Oro to markets in Davao City and other markets in the country.

In these three chains the focus is on the informal sector in the midstream node of the chain. The specific actors interviewed per chain are presented in Table 1.

Table 1. List and number of key informants/FGD informal actors

Cases	Value chain Actors <i>Informal</i>	Number of informants/FGD
Mango	Grower-sprayer contractor-trader (1), grower-sprayer contractor (1), grower-sprayer contractor-newspaper bag maker (3), grower-sprayer contractor-input supplier-trader-wholesaler-processor-retailer (1), wholesaler-retailer (2), ambulant vendor (1), laborer (1), 1 (Focus group discussion)	11
Vegetable - Kapatagan	Farmer-financier-trader (2), farmer-trader (1), farmer-financier-dicer-trader (1), trader-wholesaler (1), wholesaler-retailer (2), retailer (1), ambulant vendor (2), laborer (1)	11
Vegetable - Maragusan	Farmer (1), farmer-financier-consolidator (1), farmer-trader-wholesaler (1), wholesaler-retailer (2), retailer (1), ambulant vendor (2), laborer (1)	9
<i>Formal</i>		
All chains	Local and national government units and mango exporter	7
Total		38

A total of 30 informants from the informal sector were interviewed. There were 10 informants and one focus group discussion for mango chain while there were 11 and 9 key informants interviewed for cabbage and tomato chains respectively. There were also 7 informants interviewed from the formal sector composed mainly of informants from local and national government agencies and one exporter (Southern Philippines Fresh Food Corporation).

3. Case 1: Mango

3.1 Introduction

The case study was conducted in Davao Region, Philippines (Figure 2). Davao region is an administrative region in the Philippines, located in the southernmost part of the country. It covers five provinces namely Davao de Oro, Davao del Sur, Davao del Norte, Davao Occidental and Davao Oriental, as well as one highly urbanized city, the city of Davao. The region generally enjoys a good climate throughout the year, which is conducive to the production of agricultural crops such as banana, cacao, mangoes, vegetables, durian and mangosteen (Department of Agricultural Reform, 2023).

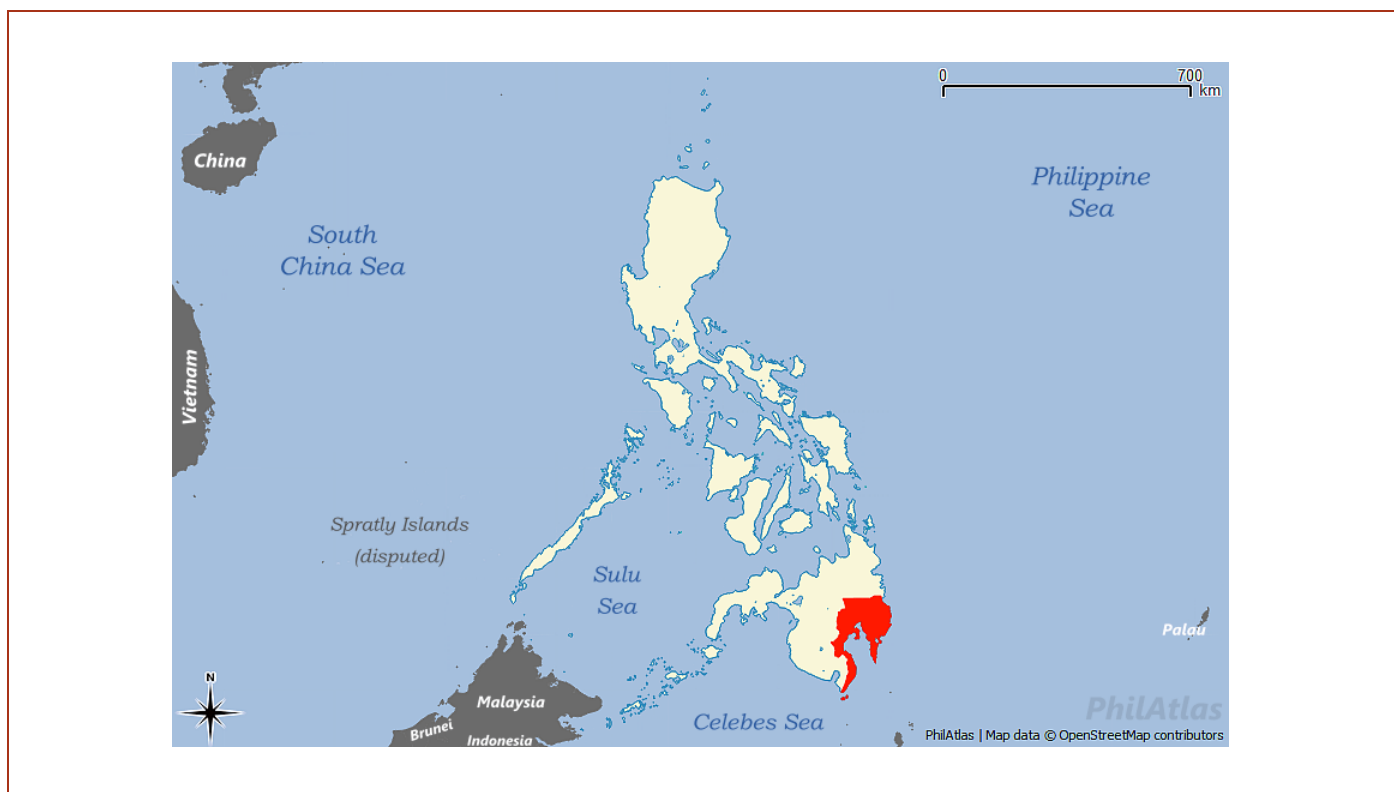


Figure 1. Philippine map, highlighting the Davao region

Image source: PhilAtlas.com

The Davao region has a population of over 5 million individuals as of 2020, which accounts for about 5% of the country's population (Philippine Statistics Authority, 2020). The most populous area is the City of Davao, which accounts for 34% of the region's population in 2020. Davao City is classified as a highly urbanized city, which serves as the major trading center in the region. It has several public markets, including the Bankerohan market, the largest public market in the city where most goods are sourced and supplied to other parts of the city and the region.

3.2. Description of the food system in which the case study is located

The Davao region contributes to about 7% of the country's total mango production in 2022 (Figure 3). The highest mango-producing area in the region is Davao del Sur, which contributes about 68% of the region's total mango production in 2022. The majority of the mangoes produced in Davao region, as well as those from the neighboring provinces of North Cotabato and South Cotabato, are traded in the Bankerohan market in Davao City.

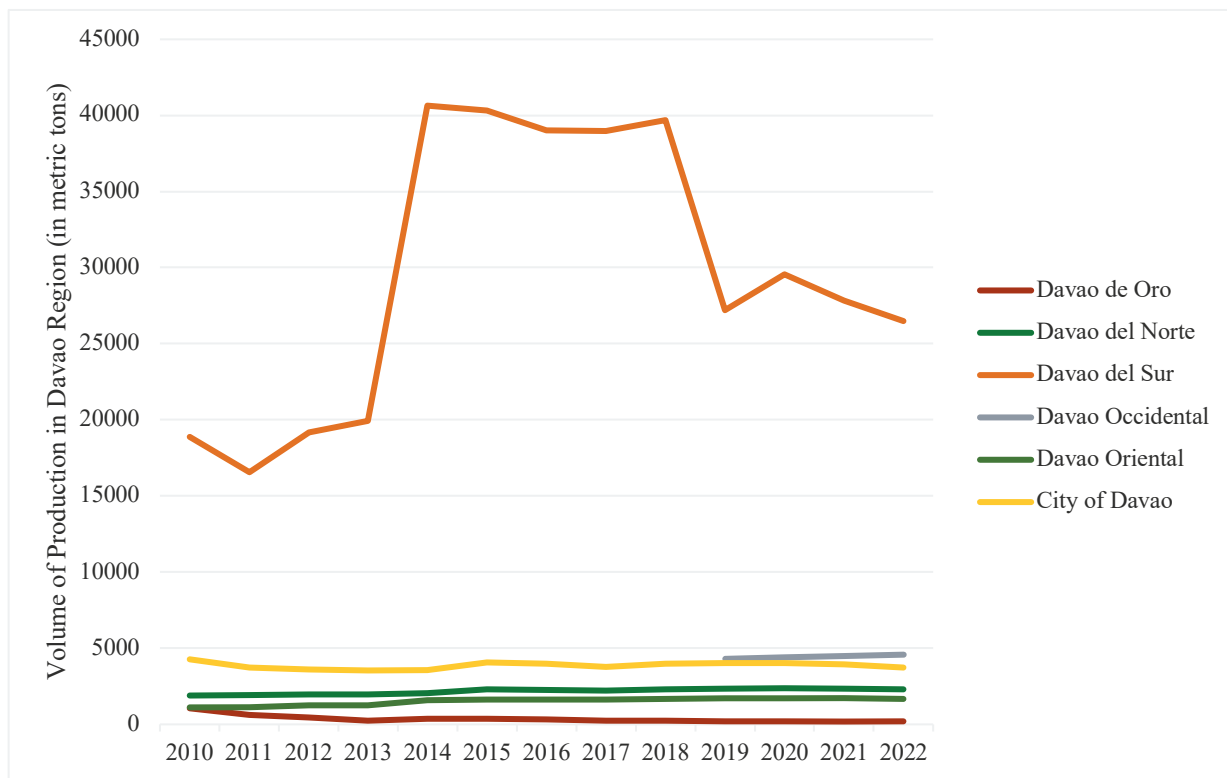


Figure 2. Volume of production in Davao Region (in metric tons)

Date source: Philippine Statistics Authority (2023)

3.3. Results

3.3.1. The value chain, its key actors, enablers, and its governance (formality & informality)

The majority of the mangoes in Davao region are supplied by contractors, while a relatively small percentage is supplied by independent growers (Figure 4). The contractors and independent growers supply directly to Davao-based processors, fresh mango exporters, wholesalers, and truckers bound for Metro Manila, Cebu and Cagayan de Oro City. These wholesalers sell directly to local wet market retailers, modern retail outlets, and institutional buyers.

For this case study, the respondents include exporters, wholesalers, retailers, ambulant vendors and laborers.

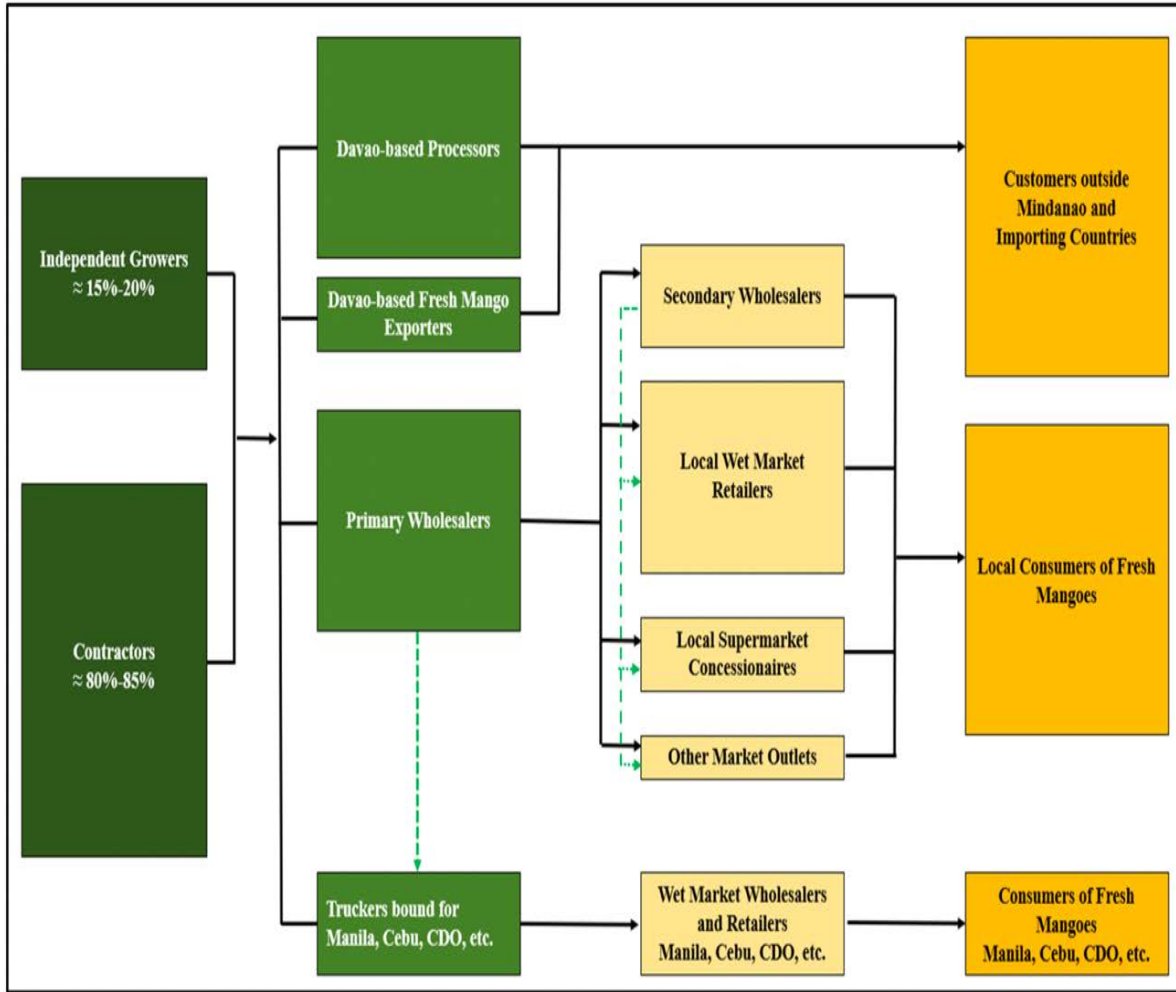


Figure 3. Value chain of mangoes in Davao region

Source: Shuck et al, 2022

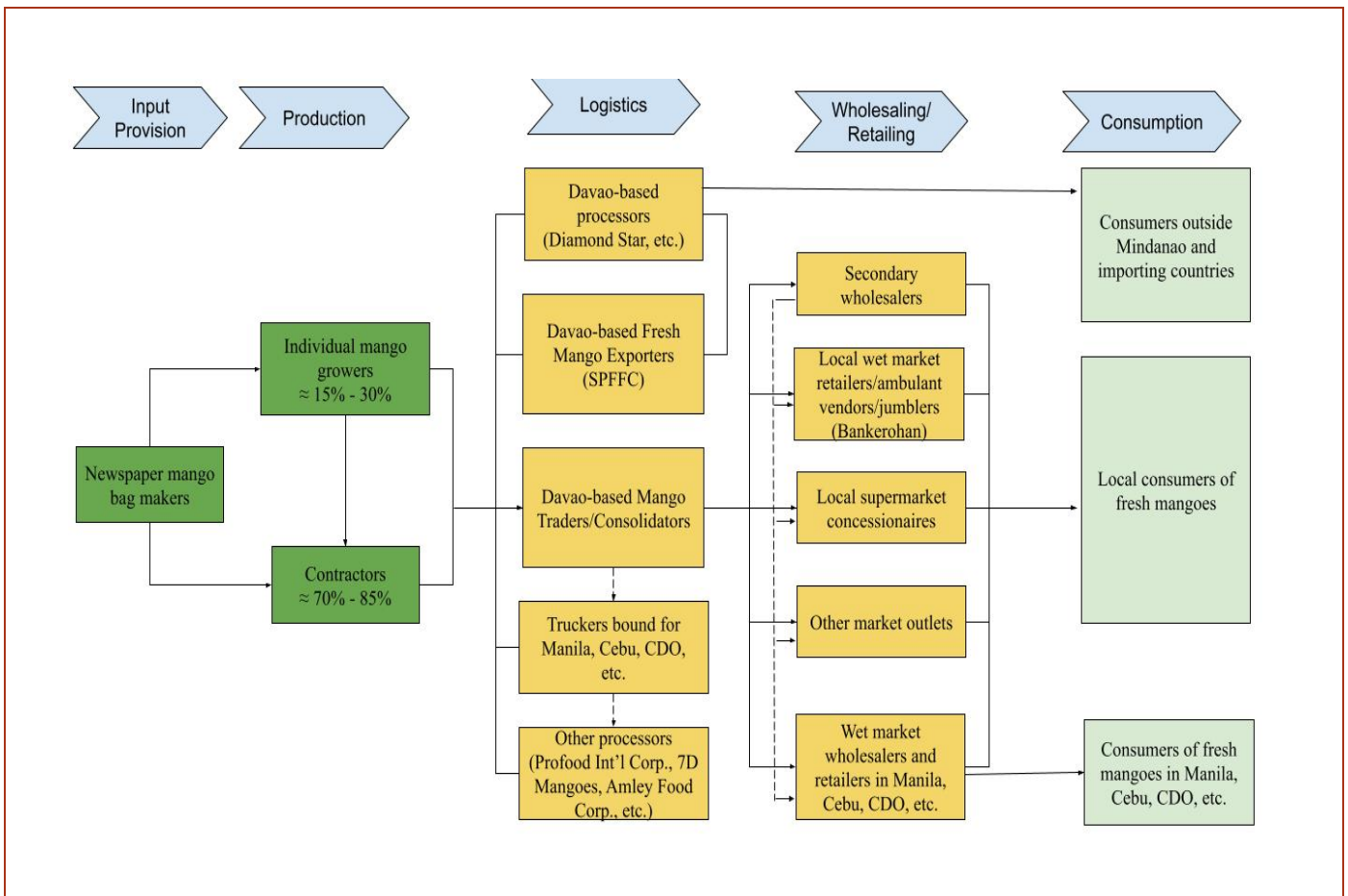


Figure 4. Value chain of mangoes in Davao region

Data source: Key informant interview and Shuck et al. (2022)

Mango bag makers. They specialize on buying old newspaper in the market by bulk, cut and form them into small bags as protection for mango fruits against winds, rainfall, and insect infestation. However, this role in the chain can also be played by large-scale traders and contractors to maximize the services rendered in the chain and through tapping with individual smallholder mango growers.

Contractors. The contractors, or contract growers, manage mango farms and incur all production costs. Depending on the agreed profit-sharing arrangement, most contractors take 75% of the profit after harvest, while growers or farm owners take 25% of the profit. Dealing with contractors is usually the preferred arrangement of mango growers as mango production is capital intensive, and most of the growers do not have enough capital for mango production. Contractors take ownership of the product and sell it to a wide portfolio of buyers. They usually pay cash to mango growers during the harvesting of mangoes. Most contractors do not have business permits, but they have been operating in the industry for several decades now. Contractors prefer a greater proportion of output that can be classified as *Export grade*, *Hong Kong grade* or *local Manila grade* as these translate to premium prices. However, due to the emergence of pests and diseases, poor weather conditions, and poor farm management, only a small percentage of the total produce is classified as high-quality grades.

Wholesalers. Wholesalers buy mangoes from contractors. In most transactions, they pick up mangoes at the farm and can provide support services such as packaging, product handling, transportation and input financing. Wholesalers are maintaining relationships with a number of different downstream buyers. Due to the perceived diminishing supply of mangoes and competition with Korean buyers who are visiting farms and directly buying from farms, wholesalers are now performing the aggregation function by searching suppliers or relying on agents.

The wholesalers of mangoes in Davao City operate at the Bankerohan market, but some of them sell mangoes directly to Metro Manila during off season in Luzon. Wholesalers source mangoes from the provinces of Davao del Sur, Davao del Norte and North Cotabato. They also hire agents to search for mangoes in various provinces in Mindanao.

Exporters. This node is represented by firms exporting fresh mangoes to Japan, South Korea, Hongkong and other importing countries. Some exporters manage their own farms, but they source the majority of their produce from contractors and farmers. They offer the highest market price of mangoes—80% to 100% higher than those sold for local market consumption. Exporters normally pay in credit which usually takes at least three days to process. They can also pay in advance depending on the request of a key supplier. Suppliers are required to deliver mangoes at the warehouse/office of the exporter. Delivered mangoes should be packed in corrugated carton boxes to minimize rejects from any transport and handling damage. As a buying practice, exporters only buy the export grade mangoes, and the rejects are returned to suppliers.

Processors. This node is represented by registered firms that process mango (frozen cuts, dried mangoes, and mango puree) for importers in Japan, North America, South Korea and other importing countries. Processors source mangoes from wholesalers, contractors, and mango farmers. Processors only buy local market grade and process grade mangoes. They require the suppliers to sell their mangoes after 110 to 120 days from the flowering stage to ensure that mangoes are mature enough to produce a sweet taste with a required Brix Level of at least 15. Processors perform a floating test on delivered mangoes to check the maturity of the mangoes. If the sample does not pass the floating test, the entire delivery is rejected. Some processors are also managing their own mango farms through a contract growing scheme.

Wet Market Retailers. They sell mangoes in traditional markets, which are privately and publicly managed. They source mangoes from wholesalers in the Bankerohan market. They do not have business permits, but they pay stall rental fees to the owner of the building where they operate.

Hotels, Restaurants and Institutions. They actively look for alternative sources of mangoes that can be bought at a cheaper price, but they prefer key suppliers with business permits. In terms of market share, this segment takes only 5% of the volume traded for mangoes in the city. Hotels and restaurants pay in credit terms following the hotel policy for procurement. They prefer mangoes that are well packed when delivered to their establishments to avoid damage from product handling and transportation.

3.3.2. Focus on the midstream actors: who they are, how they are organized, their motivations, strategies and sensitivity to incentives

Informal midstream chain actors

Table 2 shows that there is a 5% loss incurred in the chain which is attributed to the strategies of the midstream actors in selling mangoes of different quality at varying prices. By this, the average net value of the commodity for 10 years in the region was remarkably the highest from farm to retail nodes among the three cases covered in this study. However, it can be observed that the total average net value at wholesale node was unusually higher than the retail. This can be associated with the lower average retail price of mangoes influenced by seasonality factors that make the prices more volatile over time.

Table 2. Total value of mango in Davao region from 2012 to 2022

Chain Node	Average Price (in PhP)	Average Gross Volume (in MT)	Average Losses (%)	Average Net Volume (in MT)	Total Average Gross Value (in PhP)	Total Average Net Value (in PhP)
Farm level	36.18	41,241.23	5	39,179.17	1,492,295.16	1,417,680.46
Wholesale	74.41				3,068,647.45	2,915,215.19
Retail	69.70				2,874,637.46	2,730,905.69

Source: PSA (2023b, 2023c) and Secretaria et al. (2023)

The majority of the midstream actors are unregistered businesses or individuals. In the mango value chain in Davao region, these include contractors, wholesalers, jumlbers, retailers and fruit laborers. These actors will be explained below.

Contractors

Contractors have been in the industry for several decades. Despite the huge capital requirement to contract farms for mango production, they have continued to play an important role in the industry. This includes ensuring that the production protocols are followed to manage diseases, flower induction, bagging and harvesting. They supply to several outlets that include processors for low grade mangoes as well as to wholesalers, retailers and exporters for higher grade mangoes.

Wholesalers

In Davao City, mango wholesalers are situated in the Bankerohan market, the largest trading center in the city. Mango wholesalers in Davao City source their produce from the nearby mango-producing areas of Digos City, and the municipalities of Bansalan and Matan-aw in Davao del Sur, and from the Island Garden City of Samal in Davao del Norte. On average, their volume requirement is at two tons per week. Most, if not all, of them are unregistered and are not members of any organization. They supply mangoes to retailers, jumlbers, and processors.

While wholesalers do not have business permits, they pay rent to the owner in the area where they operate, with daily stall rental fee of PhP 275 exclusive of payment of utilities such as water and electricity. They are also required to pay an annual renewal fee.

Jumlbers

Jumlbers serve as agents in the mango trading and distribution. They source mangoes from wholesalers and add a mark-up of PhP 5 per kilogram. They sell mangoes to retailers and other wholesalers.

Ambulant Vendors and Retailers

Ambulant vendors and retailers in Davao City are also located in the Bankerohan market. The key informants identified the months of September, October and July as the lean months while December as the peak month for retailing mangoes. The retailers are not formally registered with the Department of Trade and Industry, but they secured a mayor's permit during the pandemic because the permits were necessary to sell mangoes for faster mobility during quarantine restrictions. The retailer interviewed pays PhP 20 per day for the issuance of the business ticket in order to operate. They also pay a rental fee of PhP 70.

Laborers

Laborers, or those paid on hired labor, are registered and are issued identification cards by the office of the market administrator, but their registration is not accredited with the Department of Trade and Industry, the Bureau of Internal Revenue, or the City Government of Davao. They are members of an association of laborers in the area, with a membership fee of PhP 600. While anyone is permitted to be a fruit laborer in the market, they still need to submit biodata to the market administrator and undergo an interview with the president of the association of laborers in the area.

Motivations

Sustained sales and profit

Despite being unregistered, key players are motivated by the regular sales and profit that they earn from mango production and distribution. They have been in the industry for several decades, and they have sustained profits despite the fluctuations in prices, and other factors affecting the demand and supply of mangoes. Contractors do not have formal registration, but they engage in capital intensive mango production because of the revenues that they earn from their operations. They also play a key role in providing employment opportunities for on-farm and off-farm labor.

Aside from contractors, the wholesalers and retailers have been operating for almost 25 years now without formal registration. They are selling mangoes year-round, with weekends as the peak days of the month. On the part of the retailers, they are also selling other fruits aside from mangoes such as banana, papaya and watermelon. They pay tickets at PhP 10 per day to the owner of the building where they operate, which serves as their “permit” to sell in the market. The sustained profit in mango wholesaling provided for the needs of their families and sending their children to school. A wholesaler shared that one of her children recently completed an engineering degree from revenues earned in mango wholesaling and retailing alone.

Retailers, on the other hand, are selling other fruits aside from mangoes such as banana, papaya and watermelon. While they are not legally registered entities, they pay tickets at PhP 10 per day, which serves as their “permit” to sell in the market.

Established and sustained business operations

Key midstream players including contractors and wholesalers have been in the industry for several decades. They have established a strong supply base, a wide network of suppliers, considerable market information on prices, and a strong relationship with buyers. Most transactions with suppliers and buyers are based on personal relations. They have huge capital requirements due to the large volume of transactions involving cash.

Low cost of operations

The majority of the midstream players do not formally register their businesses; hence they do not process business permit applications, and they do not submit documentary requirements. Wholesalers and retailers pay a minimal fee of PhP 10 to PhP 20 per day for tickets, and they incur minimal costs of operations, including payment for utilities. They perceive that the permits and the documentary requirements are handled and processed by the building owner. Despite the informal nature of the business, they continue to operate and adhere to the rules set by the building owner such as regular payment of rental fees.

Opportunities for additional income

Despite being in the informal sector, there are opportunities for additional income among laborers. Aside from mangoes, the laborers earn additional income from hauling other crops and commodities sold in the market.

Poor enforcement of legislation

While there are existing policies that govern business operations at the local government level, poor enforcement of legislation aids more individuals and businesses to remain in the informal sector. Hence, there is no motivation or incentive for those in the informal sector to have their businesses registered as a legal entity.

Limited "market demand"

There is limited demand from the market to source mangoes from the formal sector. Among the key players in the midstream and the downstream nodes in the chain, only exporters and institutional buyers require that suppliers are registered business entities who can issue Official Receipts or Invoice. These key players only take about 10% of the total market share for mangoes in the city as the majority of the produce are sold at the processor and wholesale levels, who do not require formal registration of suppliers.

Risks and strategies

Inadequate market spaces during peak season.

Jumblers and ambulant vendors could hardly keep up with the dynamics and meet the demand in the market during peak season due to the lack of a permanent stall to display their products. Some of them are negotiating with other mango vendors who have extra tables where they can display mangoes.

Health and safety risks.

Laborers are faced with health and safety risks when doing hired labor. Since the work is labor intensive, there is a potential risk of injury when carrying or receiving heavy loads. There were also cases where laborers are prone to getting hit by mango boxes when hauling or delivering mangoes. One laborer was permanently fractured due to the nature of the work.

Delays in payment.

Some wholesalers face challenges of delayed payment from consignment transactions. As a coping strategy, they search for other income opportunities such as livestock raising and doing hired labor to harvest mangoes and other fruits on the farms.

Increase in postharvest losses.

This is evident among ambulant vendors who display their products on the sidewalk. Their products are prone to spoilage and damage due to prolonged exposure to rain or sunlight which shortens the shelf life of the fruits.

3.3.3. Power and influence: who plays the tunes in and around the value chain?

Interviewed farmers and exporters perceive that processors possess market power in terms of setting the market price for mango. In the case of Samal Island in Davao del Norte, most of the harvested mangoes (around 60%) are classified as processing grade and so farmers will not harvest their produce if the processors are not buying.

Based on the analysis of the competitive forces in the processing node, the threat of new entrants is low due to the required capital outlay, which limits entry to organizations that do not have access to sufficient capital (Table 2). The bargaining power of suppliers of processors is low. Processors buy large volumes of mangoes from contractors and farmers. About 60% of the mangoes in the market are supplied to the processors in the city. The table also shows that the bargaining power of buyers is low; transactions are based on customer relationships. There are also no direct substitutes for mangoes since the majority of the produce are sold to processors. Rivalry of processors is low as there are only few processors in the city. There is also a huge demand for mangoes which cannot be supported by the current production.

Table 3. Competitive forces in the mango industry

Competitive forces	Contractors	Wholesaler	Processors	Exporter	Institutional Buyer (Hotels, Restaurants, Supermarkets)	Wet Market Retailers
Threat of new entrants	Low	High	Low	Low	Not significant	Low
Bargaining power of suppliers	Low	Low	Low	Moderate	Low	Low
Bargaining power of buyers	Moderate	Low	Low	Low	Low	Low
Threat of substitute products	Moderate	Moderate	Low	Not applicable	Moderate	High
Rivalry	Low	Moderate	Low	High	Not significant	High

Source: ACIAR/AGB/2012/109 project, 2019

In the contracting node, the capital requirement is high because production is capital intensive and that they pay the farmers/growers in cash on the agreed profit-sharing arrangement. However, there is very limited product differentiation and there are no sufficient economies of scale. Hence, barrier to entry is perceived to be moderate. On the power of suppliers (farmers), they take price as given and rely on contractors on the profit-sharing arrangement. As such, bargaining of suppliers is perceived to be low. The bargaining power of buyers is perceived to be moderate as downstream buyers have considerable information and linkage with a wide variety of mango suppliers.

There is a low threat to new entrants in the wholesaling node due to high capital requirements because they pay cash upon delivery, and the volume of the transactions is high. Although there is limited product differentiation, economies of scale is high due to the requirement of a having a wide network of suppliers and buyers and huge volume of transaction.

In the case of exporters, the threat to new entrants is low as exporting of mangoes requires significant investments for the plant, vapor heat treatment facility, and working capital for purchasing and delivering mangoes to various players. The bargaining power of suppliers (contractors) is moderate. While only a few can produce good and superior quality mangoes, contractors that can meet the quality requirements can bargain prices with exporters, who need export-quality mangoes. In the sale of exported mangoes, transactions are mostly based on customer relationships so buyers' bargaining power is perceived to be low. Buyers have huge unmet demand, and they pay good prices and usually pay in advance to secure the supply.

3.3.4. Midstream actors and innovation: incentives and disincentives for change

Low demand for 'safe' mangoes in the midstream node

The Department of Agriculture (2018) reported an increasing market demand for natural and organically grown mangoes which are free from chemical residues. In Davao City, however, demand for safe produce is only observed at the exporter node, which has stringent phytosanitary requirements, particularly on maximum residue levels, as required by importing countries. Unfortunately, only a small percentage of produce is sold to exporters. At the wholesale and retail nodes, consumers are generally price sensitive and are not concerned with food safety. This disincentivizes the midstream actors to produce mangoes that are safe and poses lesser risks for consumers.

Degree of informality in the chain

In general, there is a relatively high degree of informality in the midstream nodes in the chain. Despite this nature, the majority, if not all, of the produce are largely sold in the market at relatively higher prices, which somehow disincentivizes them to adopt new innovations and change the current practice.

In summary, the incentives and disincentives per actor are presented in Table 3. The adoption of new technologies would result to longer shelf life of mangoes, which could provide incentive for the majority of the key players in the chain. Based on their current practice, however, several factors disincentivizes them to adopt new technology such as the perceived cost of new technology, and no permanent stalls for ambulant vendors.

Table 4. Summary of incentives and disincentives per midstream actor (mango)

Key player	Incentives	Disincentives
Wholesaler	Longer shelf life of produce	Perceived cost of new technology/innovation Limited to no demand for 'safe' mangoes from consumers
Retailer	Longer shelf life	Can sell all mangoes at different grades, and at varying prices. Hence, there is no incentive for them to invest in new technology or adopt innovative practices
Ambulant Vendors	Longer shelf life	No permanent stalls for their daily operations, which disincentivizes them to adopt new innovation High risks of spoilage due to their current conditions (selling mangoes in the roadside)
Processor	Longer shelf life Better quality	Associated costs of the innovation/new technology
Laborer	More volume of mangoes traded would mean greater profits for them	New technology/ innovation does not add/create value for these actors

3.3.5. Innovation

At the farm level, production is severely affected by the incidence of pests and diseases. The midstream players, on the other hand, are confronted with post-harvest issues which result to losses and low-price levels due to quality deterioration.

Contractors sell the mangoes to wholesalers and processors *"all-in"*, a term used by local players, which does not consider quality grades when setting the prices of mangoes. For wholesalers and retailers, Class B and rejects are automatically sourced out to other actors in the chain such as street vendors, those who sell sliced mangoes, or those who sell mango smoothies and mango desserts. The wholesalers inform their buyers ahead of time regarding the quality of the mangoes and sell these at a lower price. The unsold and severely damaged mangoes are automatically disposed. Laborers also incur losses when handling the mangoes. They are charged for the damage of the fruits due to bruising from mishandling of crates and boxes.

Sidewalk vendors with no stalls also incur losses due to shrinkage or weight loss caused by exposure to sunlight or rain (see Figures 6 and 7). The damaged mangoes are either thrown away or disposed at a very low price (from PhP 85 per kilogram to PhP 35 per kilogram), which are usually processed into mango desserts.



Figure 6. Mango ambulant vendors selling on the sidewalks

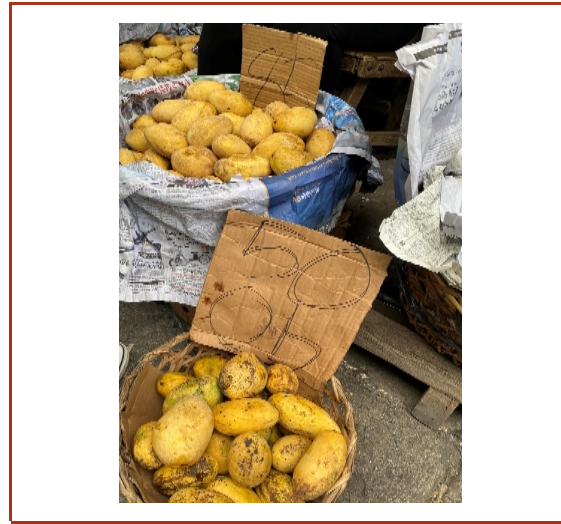


Figure 7. Differently graded and prices mangoes

Customers and vendors are well aware of the chemicals applied to make the mangoes achieve good quality and appearance but are not particular with it since the former are more concerned of the price rather than food safety. For example, the use of calcium carbide for ripening is banned in other countries but is still being used in the Philippines (see Figures 8 and 9. This is due to the absence of better alternatives that is less costly but effective (Lacap, et al 2023).



Figure 8. Calcium carbide application in mangoes as ripening agent



Figure 9. Artificially ripened mangoes wrapped in newspaper after Calcium carbide application for 3 to 5 days to retain freshness

To address these challenges, several innovations were introduced at the farm level and at the midstream nodes. At the farm level, specifically in Samal Island, the Taiwan paper bag was introduced as a bagging material, hot water treatment and harvesting practices. The study of Shuck et al (2023) showed that there is a significant improvement in the quality of mangoes when using Taiwan paper bags (TPB), which translated to higher revenue at 31%. In the same study which conducted large-scale bagging trial using Taiwan paper bag and newspaper bagging material, results showed that a greater proportion of export quality fruits were produced using TPB compared to newspaper bags.

Wholesalers and retailers use Calcium carbide in hastening the ripening process of mangoes. Only mangoes that are sold to the export market are subjected to Hot Water Treatment (HWT), and only fresh mango exporters have HWT facilities. HWT was also introduced to wholesalers, but they observed that it shortens the ripening period and causes severe damages or injuries to the mangoes. While they find HWT as an innovative practice, they perceive that this is riskier and more harmful for consumers than using Calcium carbide. They are currently not adopting any treatment to extend the shelf life of mangoes in reducing post-harvest losses. Some wholesalers and retailers did not adopt HWT as they perceive that this is not suitable for mangoes and it increases the risk of having physical damages to the fruits, resulting to higher losses. Some wholesalers are also not inclined to adopt HWT as they are accustomed to the traditional practice of using Calcium carbide.

For the packaging material, most wholesalers, retailers and laborers use boxes as it reduces the risks of having physical damage or bruises as compared to traditionally used sacks. Some also use wooden basket to pack mangoes, which are used as containers for the application of Calcium carbide. However, when transported, boxes are used to prevent damages.

If new innovations are introduced, midstream players are more likely to adopt the technology when the innovation is affordable, if it will offer higher positive impacts to profits and benefits to consumers, if the new technologies are proven to be effective and efficient than traditional practices, and if they are informed of the benefits of adopting new technologies through trainings and seminars.

3.3.6. Summing up: leverages for innovation, internal and external drivers of change.

Legislation

Legislation and strict enforcement of policies, which include tax collection and regulating business operations, can drive changes in the midstream node.

Information on the benefits of innovation

Providing information on the benefits of innovation can aid adoption. When midstream players are provided information and proper training on the benefits of innovation, particularly its impact on cost reduction, it is likely that they will adopt the innovation.

Encourage adoption of technologies to produce high quality mangoes

If the mango producers and contractors will produce high quality mangoes, they will be able to access markets that offer higher price, which could be an incentive for them to adopt new technologies and innovation. Table 4 shows the roles of the informal actors in the midstream in adopting technologies or innovations that help address the objectives of reducing post-harvest losses and improving food safety.

Table 5. Roles of informal actors in addressing the objectives in mango chain

Objective	Roles of informal actors in addressing the objectives
Reduce postharvest losses	Adoption of technology which includes the Taiwan paper bag and HWT Refrain from the excessive use of calcium carbide
Improve food safety	Judicious use of chemicals at the production node (among sprayer-contractors) and at the wholesale node (use of calcium carbide)

3.4. Conclusions

The majority of the midstream players in the chain belong to the informal sector, who do not have legal registration of their businesses. They continue to operate in this informal setting because they have sustained sales and profit, have often established a successful business, have low cost of operations, and they can continue to explore opportunities for additional income.

While there have been innovations introduced at the midstream nodes such as the HWT and Taiwan paper bag to improve the quality of mangoes and reduce postharvest losses, the midstream players do not adopt these technologies of the perceived costs of adoption, and that they perceived that the new technology (HWT) is not suitable for mangoes. In addition, the market is generally not concerned on food safety. Among the players in the chain, only the exporters are highly concerned on food safety as they need to adhere to stringent requirements from importing countries that strictly check the maximum residue levels of mangoes. While there is a price premium for selling mangoes at the wholesale node, a large market share is captured by the processing and wholesale nodes because the majority of the produce do not meet the standards for export-quality produce.

However, there are also opportunities to leverage for innovation. These include encouraging players to adopt new technologies through training and information dissemination on the benefits of adoption. This is supported by the results of the interviews which show that the players are willing to adopt the new technologies if these are cost-efficient and are proven to be effective than traditional practices.

4. Case 2: Cabbage

4.1. Introduction

There are two cases of vegetable chains covered in this study. One of these is the cabbage value chain in Kapatagan, Davao del Sur located in the southern portion of Davao Region in Mindanao, Philippines. Cabbage is one of the main vegetables produced in the country particularly in the upland areas where temperature is cooler and suitable for cabbage production. These areas include Kapatagan which accounts for more than a third of the total cabbage produced in the entire Davao region.

This case will focus on the informal actors in the midstream node of the cabbage value chain in Kapatagan. The cabbage produced in this area is sold to various markets that including Davao City and other cities in Mindanao and Visayas. For this particular case, the midstream informal actors examined are wholesalers, agents, retailers, and laborers in the vegetable chain located in Kapatagan and Bankerohan wet market Davao City, which is about 70-80 kilometers away from the Kapatagan, Davao del Sur.

4.2. Description of the food system in which the case study is located

As shown in Figure 10, in terms of the volume of cabbage production in the country, the Cordillera Administrative Region (CAR), particularly from Benguet Province which is the center of upland vegetable production in the country ranked first. The region of Davao with 916 metric tons was on the third place. Its average annual productivity as shown in Table 6 was 8.40 metric tons per hectare which made it able to slowly compete with Central Visayas region. The major contributor to this high production volume of the region was associated with the productivity of Davao del Sur with 8.83 metric tons per hectare annually on average. Additionally, for a duration of 10 years (2012 to 2022), it is the only province in the region to positively and significantly contribute with an average growth rate of 3.23%. On average, Kapatagan (the main area covered in the cabbage value chain of this study) produces 43.3 metric tons of cabbage per week, about 37.82% of the total volume produced in the entire region (Digos City Agriculture Office, 2023).

Table 6. Volume, area, and productivity of cabbage in Davao region and Philippines from 2012 to 2022

Region/Province	Volume			Area (in ha)		Productivity (average metric tons per hectare)	
	% Share in 2022	Average % share (2012-2022)	Average % Growth rate (2012-2022)	% Share in 2022	Average % share (2012-2022)		Average % Growth rate (2012-2022)
Philippines	100	100	-0.27	100	100	-1.08	15.58
Davao region	4.29	3.59	1.97	6.55	6.65	-1.63	8.40
Davao de Oro	0.09	0.08	-4.58	0.14	0.15	-4.61	7.94
Davao del Norte	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Davao del Sur	3.07	2.48	3.23	4.55	4.38	-0.02	8.83
Davao Occidental	0.12	0.05	0.00	0.23	0.08	0.00	8.81
Davao Oriental	0.00	0.00	0.00	0.00	0.00	0.00	1.30
Davao City	1.01	0.98	-0.85	1.63	2,04	-4.53	7.48

Source: PSA (2023b)

These figures imply the need to assess what are the influencing factors how the Davao region could potentially optimize its productivity in cabbage production. One way would be to examine the conditions on its top cabbage-producing localities (e.g., Kapatagan). The underlying reasons why the locality was able to maintain a high productivity level for 10 years amidst unprecedented circumstances (e.g., volatility, seasonality, and phenomena like the recent pandemic) must also be analyzed. More importantly, it is also notable to assess whether the productivity of the region accounts for post-harvest losses and food safety implementation in general.

4.3 Results

4.3.1. Value chain: key actors, enablers, and its governance (formality and informality)

In Kapatagan, Davao del Sur, the vegetables are mainly supplied by individual farmers. Some farmers finance other farmers of which are also handled by farmer-financiers they were also producing vegetables on their own farms aside from extending financing services to co-farmers (see Figure 11). It was also illustrated that these vegetable suppliers directly deliver their produce to Kapatagan-based dicers, traders/consolidators, and primary wholesalers. However, these three chain actors are also transacting with each other such that some vegetable dicers were tasked to consolidate volumes of vegetables from smallholder farmers and sell them to traders or towards primary wholesalers locally. One particular chain actor, the *warik-warik* also functions like a dicer that delivers vegetables on smaller volumes to large-scale traders. In some cases, are the ones who directly sells vegetables to local retailers, secondary wholesalers, institutional buyers, and other market outlets, together with the truckers. Lastly, the vegetables will be purchased by vegetable consumers locally and outside Davao region such as the ones from Zamboanga, Cotabato City and Kidapawan City (within Mindanao), and Ormoc City (in Visayas).

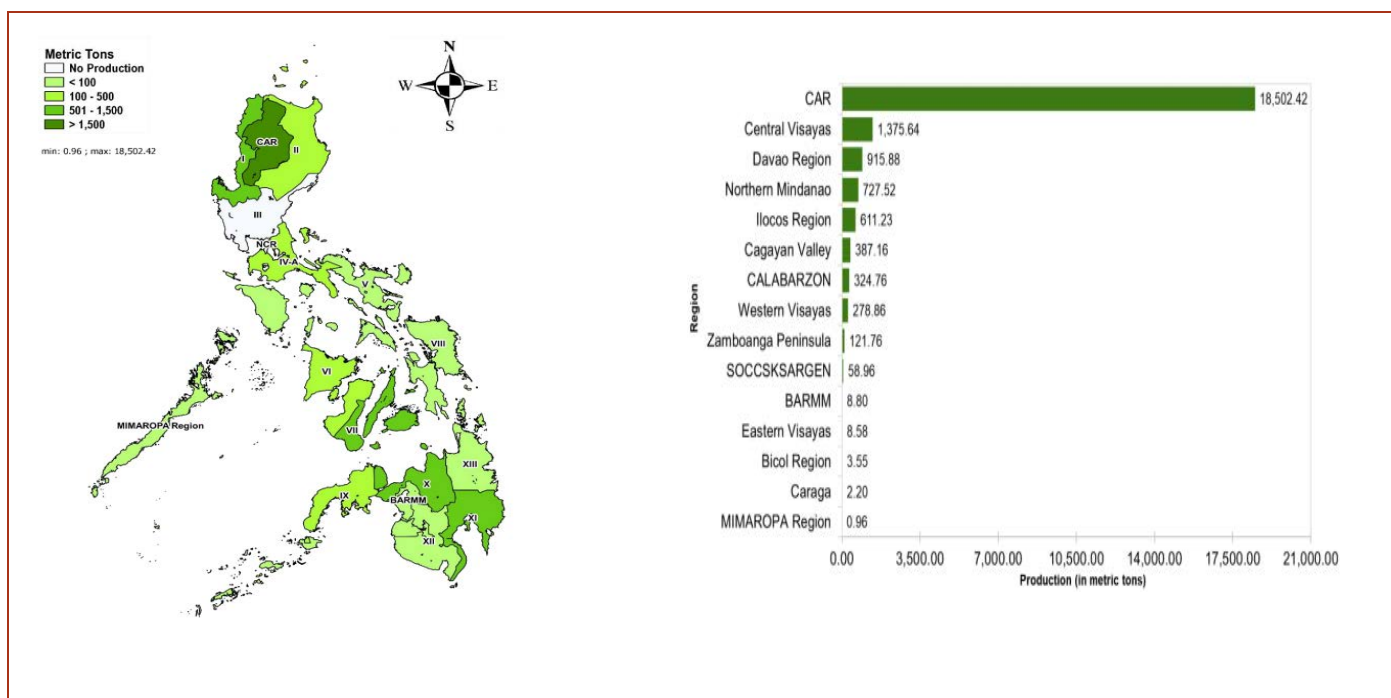


Figure 10. Volume of cabbage production by region, April to June 2023

Source: Philippine Statistics Authority (2023a)

Also, in Figure 11, the vegetable value chain map in Kapatagan was illustrated highlighting the midstream node and actors involved (the ones colored in golden yellow) in this project. Their functions fall under the logistics and wholesaling/retailing nodes of the chain.

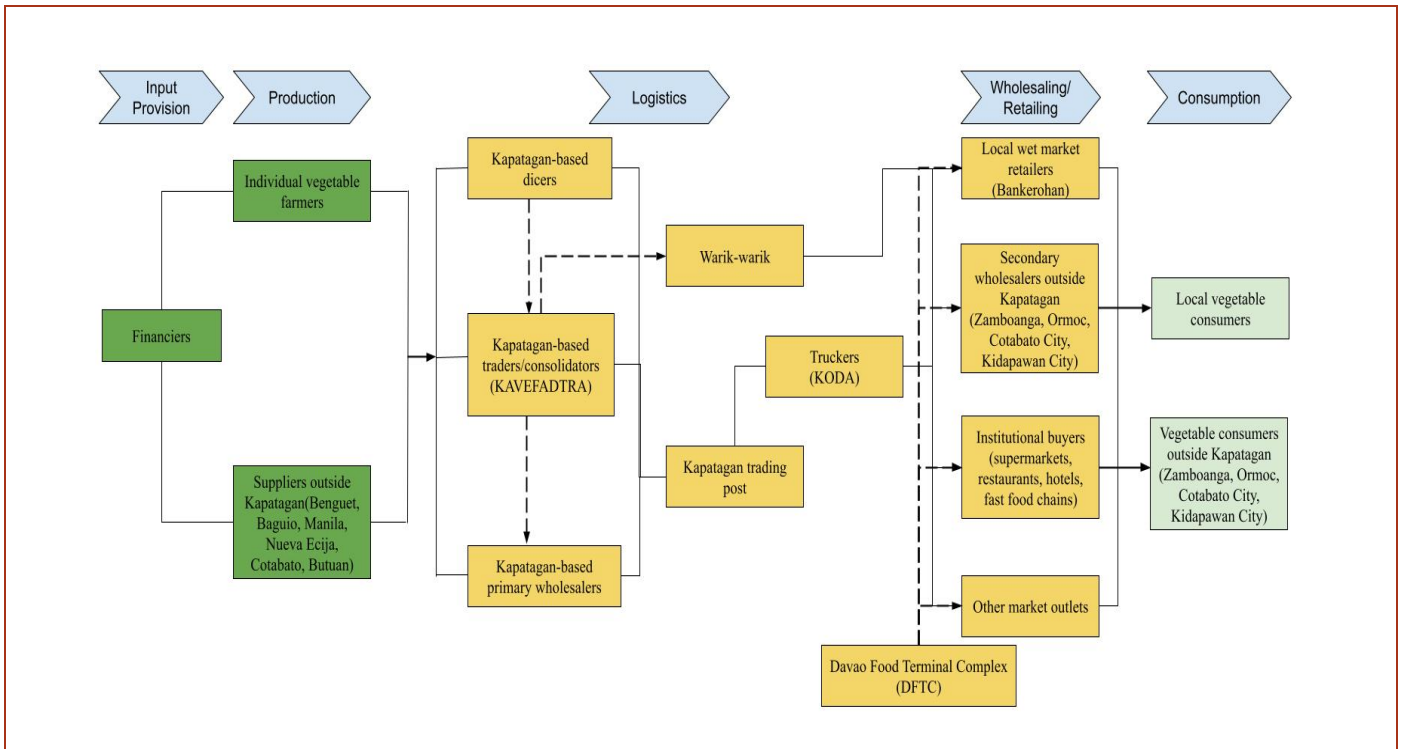


Figure 11. Value chain of vegetables in Kapatagan, Davao del Sur

Data Source: Key informant interview (2023) and World Bank (2019)

Farmer-financiers. These chain actors, from their title itself, are financing smallholder vegetable farmers within or outside their areas in Kapatagan, Davao del Sur. Farm inputs such as synthetic fertilizers and agro-chemicals for vegetable production are mostly provided by these financiers to the farmers (JICA, 2022). In the first phase of this project, it was found that in the cabbage value chain, the majority of the financiers are sourcing their farm inputs from known agrivet suppliers for highland vegetables (DA-Region VII, 2016). Ramgo International Corporation, Allied Botanical Corporation, and East-West Seeds, Inc. were the 3 major accredited input suppliers identified in the study (Commercial Crop Variety Database, 2022). In some cases, they are also financing in terms of cash assistance to the farmers in managing their own vegetable farms from inputs to labor until harvest. This unique offering serves as an incentive, especially for smallholder vegetable growers in getting financed by these chain actors. The common arrangement agreed in terms of profit sharing among these actors is 70-30, whereas 70 % will go to the financier while the remaining 30% will be received by the vegetable farmer who owns and manages the farms.

Suppliers outside Kapatagan. According to informants in Kapatagan, only specific commodities are being sourced out from these chain actors and this happens only when there is a shortage in production of such crops locally. For instance, traders and wholesalers are sourcing some of their highland vegetables from the cities of Manila and Baguio, particularly cabbage, carrots, and potatoes. This happens whenever there is a high local demand for these vegetables during the month of December when prices are higher. They opt to source out from these markets because of low price compared to the ones produced in Kapatagan. Price difference is significant that it is enough to cover logistics costs (transport and losses) in sourcing vegetables from these areas. Sometimes they source red onions from Luzon which started during the pandemic which gave them high profit of PhP 2 million. When supply is not enough to meet local requirements, it is profitable for these suppliers to source outside Kapatagan.

Dicers. These actors in the chain function either independently or work under large-scale traders. They are the ones responsible in personally “dicing” or buying the vegetables from smallholder farmers, especially those from far-flung areas, or areas almost near the peak of Mt. Apo. Independent dicers directly sell these vegetable supplies

to local wet market retailers or wholesalers within Kapatagan or Davao region using their own capital. The volume of vegetables they buy and sell is lower as compared to traders since the latter also requires higher level of capital investment in operating. On the other hand, those dicers who work under the large-scale traders can be: (1) selling the vegetables they have initially purchased from smallholder growers for a relatively lower price and charge them higher towards a particular trader; or (2) similar with the previous case but only to several traders in the vegetable chain in order to maximize their profits and for lower volume as well per trader.

Traders/consolidators. As described by the chain actors interviewed in this study, the traders/ *consolidators* dominate the vegetable chain in Kapatagan with an estimated total number of 112. They are also playing dual functions as most of them are also large-scale vegetable growers of their own farms while also doing trading activities (at least 20 Kapatagan-based traders per day are delivering to and from Kapatagan). Based on the estimation of one of the traders in the area, smallholder vegetable growers only cover about 5% of the entire chain actors and most of this percentage were also handled by trader-financiers. From the three traders interviewed, the overall volume of vegetables they trade weekly, on average accounts to 266.5 tons. These are distributed to different market outlets within and outside the Davao region such that the highest to lowest volume being delivered is as follows: Tagum City (105 tons per week), Davao City particularly in Bankerohan local wet market for fruits and vegetables (42 tons per week), Zamboanga (41 tons per week), Ormoc (38 tons but only when the vegetable prices in Luzon or Baguio will increase significantly), Kapatagan local retailers and wholesalers (21 tons per week), Cotabato City (12 tons per week), Kidapawan City (4 tons per week), and lastly, Digos City (3.5 tons per week). Their chain functions also involve repacking and minimally processing the cabbages (e.g., trimming) before selling them to the aforementioned market outlets/buyers.

Primary wholesalers. They are comprised on Kapatagan-based vegetable wholesalers who are buying their stock on bulk (which can oftentimes be differentiated against retailers in the market by means of the type of vegetable packaging they are selling as the former use sacks or cartons of vegetables). These actors are also supplying some of their vegetables to nearby retailers in Davao region such as in Bankerohan, especially those who own vehicles to transport them more easily, while some are opting to transact with truckers if necessary.

Warik-warik. Functions similarly with dicers in terms of directly buying vegetables from the farms of smallholder growers and can also work under large-scale traders outside Kapatagan - descriptions attributed to these chain actors. However, as described by the Kapatagan-based traders in the chain, these are commonly prohibited since they are not members of the traders'/dicers' association in the area. They are working mostly undercover due to this reason, which also makes those who owns ten-wheeler trucks or smaller vehicles to park them in secluded areas (or areas far from the trading post) in executing their operations.

Truckers. As indicated by their title as chain actors in the vegetable value chain of Kapatagan, they are functioning as those who offer trucking services - allowing traders, dicers, or wholesalers from the area to rent their vehicles (mostly wing-vans and ten-wheeler trucks). Meanwhile, the warik-wariks are excluded from the list as most of them function independently with their own private vehicles. Aside from paying the rental fee, the actors who borrowed/rented these vehicles should also pay the transaction fee of PhP 150 per vehicle/truck. However, the trucks that are delivering to and from Kapatagan that are neither registered to their association, and not owned by the Kapatagan-based chain actors, they must pay PhP 500 per truck for the same purpose; otherwise, they will be banned.

Local market retailers. These are commonly found in Bankerohan, Davao City where the vegetable traders/dicers/wholesalers are directly delivering their vegetables to. As compared to wholesalers, they are purchasing vegetables on a relatively lower volume since they are selling them on a per kilogram basis or in small quantities.

Secondary wholesalers. As mentioned in the previous section, the traders from Kapatagan are supplying vegetables to other provinces, cities, or even regions apart from Davao region. Given this, those markets where they are delivering their vegetables to also include wholesalers that further supply them to the retailers in their respective areas (e.g., Zamboanga, Ormoc City, Cotabato City, and Kidapawan City in the province of North Cotabato).

Institutional Buyers. These chain actors are composed of high-end market outlets such as supermarkets, restaurants, fast food chains, and hotels within Davao region purchasing assorted vegetables in bulk. Based on the primary data collected, these vegetables are mostly supplied by wholesalers since they are also strategizing in targeting these buyers. They do so by minimally processing these vegetables (cleaning them thoroughly such as peeling off the covering of cabbage balls, removing the mud sticking to root crops) to be charged higher, and also improve the appearance and highlight the quality of vegetables. In some cases, they are cutting these vegetables to conveniently offer the consumers from these buyers (e.g., "sari-sari" or "all in one packaging" of vegetables for specific Filipino dishes like "pinakbet," "chopsuey," and "pancit guisado." According to the findings of this project's Phase I, the major institutional buyer/processor of fresh vegetables in Davao region is the Dizon Farms. This buyer directly sells fresh vegetable salad packages to other institutional buyers such as hotels, hospitals, supermarkets, and hypermarkets (JICA, 2022).

Ambulant vendors or "Laray". Another type of vegetable retailers who are mainly operating in Bankerohan market but are either selling limited crops (in type and volume) than the regular retailers in the market. Also, the majority of the vegetable supplies they are selling come from their own farms, and rarely source out from other farmers. They can also be found displaying their vegetables on top of sacks in the sidewalks of the main vegetable section of the Bankerohan market while the regular retailers are renting stalls in the center or innermost section of the market.

4.3.2. Focus on the midstream actors: who they are, how they are organized, their motivations, strategies and sensitivity to incentives

Midstream actors

As previously cited, the literature pointed out the hidden information about the midstream node in the agrifood system in spite of their significant contribution (Reardon *et al.*, 2012; Reardon, 2015). One of the aims of this study is to highlight the role and involvement of the midstream node, particularly the informal sector in achieving the three identified food system outcomes – post-harvest losses reduction, food safety measures implementation, and access to healthy foods. As shown in Table 7, in Davao region, the total average net value of cabbage from 2012 to 2022 is remarkable with PhP 77,937, PhP 130,364, and PhP 219,709 at farm, wholesale, and retail levels, respectively (PSA, 2023c). The bottom line is that, with the given data from the key informant interviews and focus group discussion, it was estimated that 90% of the chain actors operate informally, at least in the vegetable case. Meanwhile, the involvement of the midstream actors account to about 30% to 40% of the total value added in the vegetable industry. This is similar with the findings of Reardon (2015). Therefore, it can be inferred that at farm level, the contribution of the informal sector in Davao region's vegetable value chains amount to about PhP 70,143. For the wholesale and retail levels, the informal sector's contribution in terms of average net value for a decade are approximately PhP 117,327 and PhP 197,738, respectively. Since the wholesaling and retailing activities fall on the midstream node, out of the PhP 315,065, PhP 94,520 to PhP 126,026 of it comes from the midstream informal sector in general.

Table 7. Total value of cabbage in Davao region from 2012 to 2022

Chain Node	Average Price (in PhP)	Average Gross Volume (in MT)	Average Losses (%)	Average Net Volume (in MT)	Total Average Gross Value (in PhP)	Total Average Net Value (in PhP)
Farm level	19.95	4490.38	13	3906.63	89,583.08	77,937.27
Wholesale	36.37				163,315.12	130,364.24
Retail	56.24				252,538.97	219,708.87

Source: PSA (2023b, 2023c) and Secretaria et al. (2023)

In Kapatagan, its vegetable value chain consists of several midstream actors who are operating informally (unregistered and unorganized individuals or group of individuals) but significantly offer services in the entire chain. These include the dicers, wholesalers, *warik-warik*, retailers, and ambulant vendors or *laray*.

Dicers

As aforementioned, these chain actors are directly visiting vegetables from smallholder farmers, either acting independently to trade them to retailers and/or wholesalers outside Kapatagan or consolidating supplies of vegetables for large traders within and outside Kapatagan. Although most of the traders in the area have business permits, members of associations for trading and trucking activities, and also pay for travel permits to function properly in the chain, these dicers operate conversely from these traders. They are offering buying, consolidating, and/or trading services in the chain without formal registration or permits as they are not required to do so, or in some cases were working under the protection of traders' permits.

Wholesalers

Similar with dicers, they are also commonly operating informally as they are not required to secure any permit or registration to play their roles in the chain. One major reason as to why they operate on this manner is their relation to large traders since some wholesalers are either a direct family member or a relative of the trader who has a permit or registered formally. This presents that trading-wholesaling activities are primarily played on a family or relation basis.

Warik-warik

These particular midstream actors are also referred to as "informal agents of Davao buyers" since they are commonly operating informally (without permit or registration even at barangay level of Kapatagan) to supply vegetables to Davao traders and wholesalers but not based or also registered in Kapatagan. Some of them as previously discussed, own private vehicles but are positioning/parking them farther from the trading post to secretly transport vegetables without the Kapatagan-based traders/dicers noticing them. They are creating spot markets for small vegetable growers in Kapatagan but offer slightly lower farmgate prices than other midstream actors (e.g., dicers, traders, wholesalers). On one hand, Davao buyers were said to prefer these actors as they cut transaction cost in sourcing out from the trading post. In other words, *warik-wariks* compensate the lower farmgate prices and higher buying prices charged to traders/wholesalers by their convenience and immediate cash payments.

Retailers

In one of the sections in Bankerohan market, the Farmer's market, is where retailers and even wholesalers are registered and operating with business permit. However, in the section that was mainly managed and handled by a private entity (the Marfori), vegetable retailers who are displaying there are mostly operating without business permits from the city office or from the Bureau of Internal Revenues (BIR) and any registry from the Department of Trade and Industry (DTI). However, they are paying a rental fee to the private office of this market that range from PhP 550 per table per day to PhP 18,000 per stall. In addition, they are also paying a market tax or locally known as "arkabala" of PhP 20 per day to the barangay office in Bankerohan which also serve as a permit for them to sell in the market, albeit informally.

Ambulant vendors or "laray". Another type of vegetable retailers who are mainly operating in Bankerohan market but are either selling limited crops (in type and volume) than the regular retailers in the market. Also, the majority of the vegetable supplies they are selling come from their own farms, and rarely source out from other farmers. They can also be found displaying their vegetables on top of sacks in the sidewalks of the main vegetable section of the Bankerohan market while the local market retailers are those renting stalls in the center or innermost section of Bankerohan wet market.

Motivations

Necessity-driven operations

Given the estimation of the chain actors in Kapatagan that the majority of them are operating on a large-scale basis while also acting as financier-traders, they have cited that one of the factors for their decision to extend their functions was because of necessity. The interviewed traders in this study all reported that they have started as smallholder vegetable farmers or laborers in the chain. However, due to the rising demands in their daily living, partnered with unpredictable market conditions in the vegetable industry, these motivated them to save up and start expanding their roles in the chain. Additionally, they have observed better opportunities in financing and trading than remaining in being independent vegetable growers and laborers. This is because of the profit margins they could receive such that they could earn PhP 7 per kilogram more in trading their own crops than heavily rely on other traders.

Relational advantage

From vegetable growers up until retailers in Kapatagan, they all have mentioned that relational operations have been an advantageous motivation for sustainability. This pertains to how chain actors are somehow one way or another related, in most cases, as married couples. Gender roles can also be highlighted such that, the husbands are assigned to farm visitations, deliveries, and farm management while the wives were tasked to do the financial management, and marketing strategies. This practice was also traced up until the retail market in Davao (Bankerohan) where the chain operations in the family has been a legacy and a primary motivation for filial relationships to sustain accordingly. Moreover, since the activities are being played by different members of the family, there would be a more stable supply of vegetables that flows in the entire chain.

Low operational cost

As stated by the chain actors in the vegetable value chain that trace up to and from Kapatagan, operating in the industry does not necessarily entail high capital investment. This is due to the fact that most of these actors do not have business permits or any legal/formal registration from government agencies like DTI and BIR to operate. Except for large-scale traders and retailers who also happen to have other businesses (such as but not limited to grocery stores, and commercial stalls for rent), the rest of them are only paying for daily market tax or "arkabala" and barangay ticket in order to operate. The market tax is uniformly set to be PhP 20 per actor per day may it be for vegetable wholesalers, retailers, or ambulant vendors. More so, for traders and dicers (unregistered and

registered), they need to pay PhP 5 per sack of vegetables, and PhP 150 per truck/vehicle before being allowed to deliver their stock to their next buyers (retailers, wholesalers, and institutional buyers).

Trust and reciprocity

Despite the chain actors are commonly related, they are still motivated to operate due to the established trust and reciprocity among their co-chain actors. These include even their spouses wherein they must be honest and transparent in playing their roles regardless of relationship as much as how they must be in dealing with their buyers. Maintaining good customer relationship and creating “suki system” in operations are other ways of motivation as far as trust and reciprocity are concerned. This can be done by having timely payments to suppliers/farmers for financiers and midstream actors involved in logistics and trading activities; and truthful transactions toward buyers/consumers. They stated that this is a vital element to consider for new entrants in the chain since building of trust and initiating reciprocity of benefits between and among chain actors is challenging. More importantly, by doing so, these factors will create an impetus for a more sustained operations if managed carefully and effectively.

Risks and strategies

Seasonality

Since vegetables are seasonal crops which are grown usually twice a year, the chain faces seasonality in terms of market conditions. This is attributed to how these commodities behave with regard to changes in supply and demand in the market. During the months of November and December, the demand for vegetables, particularly highland (e.g., carrots, cabbage, lettuce, potatoes, radish, and chayote) are at their peak. Meanwhile, in January, the demand for lowland vegetables will start to increase as consumers shift their consumption for healthier vegetable dishes like “pinakbet” and “law-uy” after the Yuletide season. On the other side, periods of lean season occur during June to September due to two reasons: (1) a surplus of vegetable in the market as this is also the period when Ormoc and Baguio are harvesting their vegetables driving market prices down, most especially for tomatoes, cabbage, and bell pepper; and (2) household budgeting during the start of classes in schools.

Given these, the chain actors strategize to turn them into opportunities. For instance, vegetable growers (which also include those with multiple functions in the chain who are acting as financiers, traders, dicers, wholesaler, retailers, and ambulant vendors at the same time), control their production. They adjust the period of harvests that should not fall between the months where vegetable producing regions/provinces like Baguio and Ormoc face vegetable season to avoid market surpluses. This will also help them in sourcing to these areas whenever they face shortages after their harvest season, and vice versa. Through this, they are not only sustaining their income stream from vegetable operations but also ensure constant supply of vegetables in the market all year-round.

Risks of informal operations

As aforementioned, most of the vegetable chain actors involved in Kapatagan operate informally where they do not have any legal or formal registration or business permits. This condition put them to higher risks which could be associated into limited access to inputs and government assistance/programs and being prone to demolitions and payment of fines. The first risk was experienced by all chain actors while the second was commonly observed by vegetable retailers, ambulant vendors, and even laborers.

For smallholder vegetable growers and midstream actors, operating informally may have spare them from the government interventions but they still find it favorable. They pointed out that they are not required to be registered since their scale of operations is only smaller and not permanent. To add, operating in an informal market setting entails higher profits for them since they will not be paying for the costs that are necessary for application and renewal of registry and/or permits. Thus, they also charge relatively lower prices as compared to those actors who are registered, as well as renting commercial stalls within the public and private markets within and outside Kapatagan.

In the case of the retailers and ambulant vendors of vegetables in Kapatagan public market, some were pushed to secure at least a business permit because the Bureau of Internal Revenues (BIR) are conducting unannounced inspections in the area. The BIR personnel will automatically impose a penalty by means of fines amounting from PhP 10,000 to PhP 20,000 per chain actor where in some cases, even without a first warning for the violation. On the other hand, the ambulant vendors and laborers in Bankerohan who are also sourcing out vegetables from Kapatagan are prone to demolitions given that they are only displaying their vegetables and carts on the sidewalks which causes traffic in the market. Whenever this happens, their products and carts will be confiscated by the City Transport and Traffic Management Officer (CTTMO).

However, this is contrary to the legislation that has been enacted for more than 2 decades in the country (last November 13, 2002) which was the Republic Act No. 9178 or also known as the Barangay Micro Business Enterprises (BMBEs) Act of 2002 (Official Gazette, 2002). This particular act is allowing the BMBEs to be legally registered through the issuance of Certificate of Authority that would also serve as their advantage in accessing the benefits and privileges accordingly. Any person, cooperative, and association with total assets of not more than PhP 3 million is eligible to apply and register in this act within their city or municipality and must be free of charge. Incentives of registering include being exempted of income taxes or local fees from the operations and their employees are not covered under the Minimum Wage Law given that they are also receiving the same benefits as to the regular employees in the industry they belong. The only downside would be that the exemption and free charges indicated in this act is only encouraged to be imposed to the local government units (LGUs) but should not exceed to PhP 1,000 which could create an impetus for bureaucratic issues.

Credit-based transactions

In connection with the trust and reciprocity motivation of the vegetable chain actors, they were challenged as well with credit-based transactions. This mainly include transactions between the growers and the midstream actors or among the midstream actors where the payment of their products will be on a credit basis. The cases vary where some experience delays in receiving the payments from the buyers, while some who ended up closing the deal as an unpaid or bad debt from their buyers (i.e., one of traders lost about PhP 5 million for the unpaid credit-based transactions he had with his buyers and consignment partners).

To counter and somehow cushion the effects brought by this risk in their operations, the chain actors are minimizing their transactions from those buyers who have a history of delayed payments. Meanwhile, they are no longer transacting with those who have not paid at all their debts as some of them have already stopped operating in the chain or are residing outside Kapatagan. They could not also file a lawsuit toward these individuals since they do not have any formal contracts to validate and legalize the transactions since having such documents would make these chain actors to become highly apprehensive to transact with them.

4.3.3. Power and influence: who plays the tunes in and around the value chain

According to the chain actors in Kapatagan, large-scale farmer-traders dominate the entire vegetable chain in their location. They have estimated that they cover about 95% of the operations in the chain while the remaining 5% were smallholder vegetable growers but are also mostly handled by financiers, and other chain actors. As previously discussed, these traders have business and travel permits since these will allow them to deliver their vegetables outside Kapatagan and even outside of Davao region. However, not all of them are formally operating in the chain since they mentioned that being formally registered is not a requirement but an optional decision for them to take. Some stayed in the informal sector of the vegetable industry because their other family members who are also functioning as traders are already registered which will serve as their primary alibi when asked for their legal business documents. Furthermore, it would incur them additional costs and time to comply with the necessary requirements for application and renewal of registry and permits in their operations.

Furthermore, Table 8 supports how the traders/consolidators experience low threats from new entrants and product substitutes in the chain, along with the low bargaining power of their suppliers. This is because the majority of the smallholder cabbage growers in Kapatagan were financed by these chain actors. Meanwhile, those who function independently prefer to trade with them as well due to price and volume stability as compared to

dicers, warik-wariks, and/or wholesalers. On the other hand, the buyers of these traders/consolidators have moderate bargaining power as they also have the discretion in buying vegetables to other midstream actors. The influencing factors according to the informants why these buyers shift their transactions toward traders include: quality, freshness, and most of the times, the price.

Conversely, the ambulant vendors are considered as the chain actors facing the highest risks through intensely competing with the other midstream actors. Given that they only sell and grow smaller volumes of vegetables as compared to the large-scale traders and warik-wariks, buyers have higher bargaining power where to purchase from. In addition, the quality of their products is oftentimes affected by heat, multiple handling, and vulnerability to various hazards. These include mechanical, microbial, and physical damages provided that they only display them on top of sacks in the sidewalks.

Table 8. Competitive forces in cabbage industry

Competitive forces	Dicer	Trader/ Consolidator	Warik-warik	Trucker	Institutional Buyer (Hotels, Restaurants, Supermarkets)	Wholesaler	Local Market Retailers	Ambulant vendors
Threat of new entrants	Moderate	Low	Low	Low	Low	Moderate	Moderate to High	High
Bargaining power of suppliers	Low	Low	Moderate to High	Low to Moderate	Low	Low to Moderate	Moderate	Low to Moderate
Bargaining power of buyers	Low	Moderate	Low	Low	Moderate to High	Low to Moderate	Moderate	Moderate to High
Threat of substitute products	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Moderate to High	High
Rivalry	Moderate	Moderate	High	Moderate to High	Moderate	High	High	High

Source: Key Informant Interview and ACIAR Project/ABG/2012/109 (2016)

4.3.4. Midstream actors and innovation: incentives and disincentives for change

Existing Informal Organizations

At present, there are two existing associations that incentivize the vegetable chain actors in Kapatagan to informally operate their businesses. In spite that large-scale traders are formally registered, they are also members of these associations - the Kapatagan Vegetable Farmers Dicers and Traders Association (KAVEFADTRA) and Kapatagan Operator Drivers Association (KODA). These associations were established for 20 years, registered within their barangay, and with 412 members (112 for KAVEFADTRA and 300 for KODA) at present according to the information given by their Vice Chairperson. In their one-time membership fee of PhP 1,000, they will receive various benefits such as the confidence to operate in the chain within Kapatagan since these associations are also responsible in controlling the number of midstream actors that enter and exit their locality. Non-members will be warned but will automatically pay a fine amounting to PhP 500 per actor/truck which is the case for warik-warik that pushes them to operate undercover in the chain.

Conversely, since these associations are not registered under the Department of Labor and Employment (DOLE) and only at barangay level, they could not implement programs to improve their vegetable operations in the chain. The interviewed chairperson emphasized that they already have the necessary requirements indicated by DOLE but until now, they have not yet applied for registry. This is because all of the members do not have the time

and their schedules do not align to attend the seminars as part of the requirements for application provided that they are travelling on a daily basis. With these, the main aim as to why they have organized these association to help the vegetable chain actors in Kapatagan was not yet realized by its members for two decades. The chairperson added that before they were collecting monetary contributions from their members for the implementation of their planned programs, however, due to the failure of DOLE registration, they were advised to discontinue it. So, these two associations only incentivize these chain actors to operate informally with perceived benefits of being locally allowed to dice, trade, or render trucking services. However, the primary advantages of the members were only limited to resolving conflicts among themselves, have burial and medical assistance, and organized for gathering purposes (i.e., Durong and Sugbahan Festival in Kapatagan).

Similarly, in Bankerohan market, the wholesalers, retailers, and ambulant vendors are also members of an organization called Fresh Integrated Vendors Cooperative (FIVCO). They are paying PhP 50 but not on a regular basis because this fund will only act as emergency fund for all its members given that the cooperative is also unregistered to DOLE or any government agency. Thus, the same with the previously tackled organizations in Kapatagan, its benefits are not associated with their functions as wholesalers, retailers, or ambulant vendors in the market/chain but more on the emergency and gathering purposes. Additionally, since they are paying the daily market tax and are members of this informal cooperative, they also perceive that they have gained advantage in processing necessary documents in their barangay office than the normal citizens.

Davao Food Terminal Complex (DFTC)

Executive Order No. 42, series of 2022 states that all vegetable farmers, traders, dicers, wholesalers, retailers, and even consumers within Davao region must drop and purchase vegetables from the Davao Food Terminal Complex. The facility will serve as the main trading and dropping post of all vegetables within the region. The vision of this intervention initiated by the government is to organize the vegetable flow in the region where farmers and midstream actors will drop their produce while the wholesaling/retailing actors and consumers will source out their vegetable stocks regularly. The incentives from the chain actors to comply with this legislation include the access to the different facilities in DFTC like the cold storage to store and extend the shelf life of vegetables which is the major cause of high post-harvest losses. Innovative practices and packaging materials will also be implemented in DFTC to ensure good quality and safe vegetables in the market. Through which biodegradable transparent plastic bags (5 kilograms to 25 kilograms each), crates, and large mesh baskets (locally known as bukag) will be the only packaging allowed, banning the use of traditional sacks (Llemit, 2022).

Although the plans and objectives as to why the DFTC was built and established were to positively reinforce and incentivize the vegetable chain actors in Davao region, they were on the other hand, disincentivized to follow. This is because of several reasons comprised of: (1) the inconvenient location of DFTC as it is situated in the inner part of Toril, Davao City where public utility vehicles are inaccessible, (2) the per kilogram dropping fee of vegetables from the existing City Revenue Code that imposes a per sack/load of vegetables, (3) the packing requirement was perceived to cause additional cost, labor and higher incidence of post-harvest losses since it is not perforated which causes spoilage. To comply with the legislation signed by the city mayor, they followed the required trading and dropping systems proposed by the executive order. Another factor that contributed to their compliance was how the city government placed checkpoints that would direct the traders/dicers/wholesalers/retailers to DFTC. However, due to the cited problems above, it only lasted for a short period of time, the mayor himself discontinued it due to the heightening complaints raised by the chain actors both from Kapatagan and Bankerohan market. This made DFTC to be a white elephant strategy by the government to improve the vegetable value chain in Davao region.

High Post-harvest Losses

This is the major disincentive associated with the vegetable chain since the commodities involved are highly perishable. Aside from the volatility of prices in the market because of fluctuating demand and supply of vegetables, severe weather conditions at the logistics stage, and traditional practices in terms of handling and packaging also contribute to this huge gap in the entire chain. The City Revenue Code for the dropping fee of vegetables in Bankerohan as well as the trucking fee from Kapatagan via KODA are all on a per sack basis, the

farmers and midstream actors are incentivized to use sacks in packing their vegetables to maximize the weight. Traders mentioned that they are overloading these sacks by putting vegetables weighing more than their capacity. For example, a 50-kilogram sack will be loaded with 55 kilograms of cabbage, 82 kilograms of potatoes, and sometimes could even reach up to 90 kilograms of vegetables. More so, since the trucking and dropping fee for large vehicles amounts to PhP 150 per vehicle, these will be overloaded as well with sacks or cartons of vegetables in maximizing the capacity which leads to over stacking, further resulting to bruises, spoilage, and other damages to vegetables, especially the leafy ones.

One advantage would be the cool climate in Kapatagan that could slightly preserve the quality of the vegetables despite these gaps in handling and packaging practices of the chain actors. Albeit, there is a favorable climate, it is still highly encouraged to make use of cold chain facilities, especially in transporting the leafy vegetables such as using refrigerated vehicles because they must be pre-cooled for not more than 1 hour after being harvested. Multiple handling during the logistics stages also contribute significantly to high post-harvest losses which is uniform to the results found in one of the studies of World Bank (2019) in the Philippine vegetable value chain. Moreover, based on this article, PHL can also affect the goal of providing accessible, affordable, safe, and healthy foods to the Filipino consumers because when the market price of vegetables will be lowered, retailers and wholesalers bear the highest burden due to the incidence of losses.

In Table 9, it shows how retailers and wholesalers receive the highest share in terms of post-harvest losses in the chain. Since the commodities that this project covers are the cabbage and tomatoes, it can be seen that tomatoes have higher PHL than cabbages. This difference was accounted for tomato’s vulnerability to spoilage and shrinkage as it loses high levels of water when they are unsold for more than 2 days with no proper storage facility. Also, one tomato ambulant vendor mentioned that this crop is very sensitive as the contamination of spoilage is more rapid than other vegetables sold in the market, hence, higher losses are incurred. So, to counter its effects on their income levels, they employ the mechanism of discounting which was also practiced by traders and dicers in Kapatagan even at farm level.

Table 9. Average post-harvest losses in each market level of vegetables

Vegetable	Average Post-harvest Losses		
	Farm	Wholesale	Retail
Cabbage	Carried over by wholesalers	Default of 10%	4.5% to 5%
Tomato	5%	Carried over by retailers	5% to 8%

Source: Laorden et al. (2013) as cited in World Bank (2019)

In Table 10, the summary of the incentives and disincentives faced by the midstream actors in cabbage value chain was presented. The new technologies introduced in the chain include: individually wrapping the cabbage balls with paper, alum treatment, and the use of polyethylene clear bags instead of polypropylene sacks. As mentioned, these innovations were already implemented in Kapatagan but failed to sustain it due to midstream actors’ complaints. The identified incentives for these chain actors consist of attaining longer shelf life, improved quality, reduction of post-harvest losses, lesser risks and hazards, and more volume of cabbages being traded in the entire chain. However, the attainment of these innovation adoption benefits was influenced by the disincentives they face. These include the higher labor and cost requirements of adoption and perceived unnecessary or lack of added value to their current practices. Also, they reported that the transport vehicles were underloaded. Lastly, the lack of demand from consumers and institutional buyer who require these innovations hugely affect their willingness to adopt.

Table 10. Summary of incentives and disincentives per midstream actor (cabbage)

Key player	Incentives	Disincentives
Dicer	Longer shelf life	Perception that the innovations would be costly and unnecessary given their direct transaction or delivery to traders/consolidators/wholesalers; additional labor requirement
Trader/Consolidator	Longer shelf life; deduction of post-harvest losses and discounts (gross weight of untrimmed cabbages)	Labor intensive to clean and individually wrap or treat cabbages by alum solution; more costly packaging and underloaded trucks
Trucker	Longer shelf life, avoid overloading and mishandling of cabbages leading to higher post-harvest losses	Underloaded vehicles during transport/delivery; perceived cost of innovation; vehicle types are not the same with that in Benguet (with metal frames) as well as the temperature (Benguet has cooler temperature than in Kapatagan toward Bankerohan and other market outlets within the Davao region)
Warik-warik	Improved quality and longer shelf life	Additional cost and perceived unnecessary of innovations in chain function (trading directly to traders and/or wholesalers outside Kapatagan at smaller volume)
Wholesaler	Improved quality and longer shelf life	Perceived higher cost and labor requirement of innovations; lower demand for safe vegetables in the public market (biggest was in Bankerohan); lack of institutional buyers requiring these innovations
Retailer	Improved quality and longer shelf life	They can sell different grades of vegetables and even minimally process them (MPVs as chopsuey or pancit mix) at varying prices; low demand for safe and premium quality vegetables in the market
Ambulant Vendor	Improved quality and longer shelf life	Lack of permanent stalls to display or sell vegetables and prone to demolitions and products confiscation; perceived unnecessary of adopting innovations in selling smaller volume of vegetables; current practices of selling in the sidewalks of the market heightens post-harvest losses
Laborer	More volume of mangoes delivered entails higher profit; lesser health risks in loading/unloading vegetables due to reduced weight (from gross to net by 25 kilogram-polyethylene bags)	Lack of perceived benefits from the innovation; costly and less efficient given that the delivery fee is charged on a per load/sack basis

4.3.5. Innovation

To reduce the post-harvest losses and strictly implement the food safety measures since vegetables are products of agri-food system, it is equally important to assess the existing and new innovations in the chain. In Kapatagan, the leaders and some members of the KAVEFADTRA were given the opportunity to attend week-long seminars and training in Baguio City in terms of innovation in these two sections of the chain (post-harvest losses and food safety measures). This is because the vegetable chain actors from Baguio City in Benguet were ahead in terms of innovative practices and technologies to reduce these two incidences. Based on how the Kapatagan traders would describe, Baguio chain actors are using the transparent polyethylene bags to pack their vegetables with a maximum weight of 25 kilograms. By doing so, the buyers will be more assured of the vegetables' quality as they can clearly see them from the packaging as compared to sacks and cartons. In addition, they are also individually wrapping the balls of cabbage to protect them from spoilage and other physical damages that usually happen at the logistics stage.

From the learnings and information, they gained from the trainings and seminars they attended in Baguio City, the vegetable traders in Kapatagan implemented these innovations in their area. This was done through KAVEFADTRA and the help of Kapatagan's barangay captain to require the adoption of such practices in the chain - the use of polyethylene clear plastic bags that are locally known as "vacuum cellophanes". The implementation period however, only lasted for 2 months because of the complaints of the chain actors, similar to their response to DFTC. Reasons for its failure include the following: (1) additional labor requirement to wash, clean, and pack the vegetables on the desired capacities of packaging (e.g., clear plastic bags), (2) additional costs for the labor and purchasing of innovative packaging as compared to sacks with larger capacity, and (3) their vehicles take time to be fully loaded or some were forced to travel underloaded since the packaging was reduced from sacks to clear plastic bags. These factors pushed the dicers and traders in Kapatagan to complain and asked to discontinue the adoption because they reasoned out that apart from the additional costs and labor requirements, Kapatagan is different to Baguio. The nuances can be traced into the actors' behavior, the topographic condition, and the transport vehicles that have frames which secure the vegetables packed in the plastic bags.

The first nuance relates to the chain actors' non-cooperative behavior in terms of adopting innovations in the chain. One consideration would be, similar to Baguio City as well that successfully implemented them for 20 years, it is quite challenging to replace the traditional practices, especially when it entails additional costs and changes in the labor arrangements in the chain. After 2 months of adoption, the traders negatively perceived the innovation in packaging as they associate it to higher losses in terms of profit and vehicles capacity maximization. Secondly, they pointed out that Baguio City has cooler climate than Kapatagan and the orientation of vegetable chain actors are more organized than that in Kapatagan. For the reason that, Baguio chain actors have the capacity to initially clean and pack the vegetables at farm level because of accessible trading posts to encourage these practices. Meanwhile, in Kapatagan, the issue of non-cooperative chain actors despite having KAVEFADTRA and KODA, along with the problem in the farm to market roads connecting the location of vegetable farmers on the peak of Mt. Apo to the trading post situated in the center of Barangay Kapatagan.

Lastly, these chain actors showed risk aversion through comparing the loaded capacity on their vehicles. Even so, it would be better if they will consider adopting the introduced practices in handling and packing the vegetables to reduce the post-harvest losses and ensure food safety for their buyers. This is due to the fact that currently, though their vehicles are fully loaded with sacks of vegetables that weigh 55 kilograms to 90 kilograms each (see Figure 12), the traders indicated that these are still gross to their actual sales. The cabbages still need to be packed with their outer leaver to protect the balls inside, hence, their net volume per sack will automatically be deducted by 25%. For Chinese cabbage, the discount would be 30%, while for squash, the buyers will deduct 2 kilograms per sack. These discounts also motivated the KAVEFADTRA chairperson to promote the use of clear plastic bags (see Figure 13), and individually wrapping of cabbages as he perceived them to be more beneficial for them and the buyers, given they could see the quality of the vegetables.



Figure 12. Cabbages packed in Polypropylene sacks in Kapatagan trading post



Figure 13. Cabbages packed in Polyethylene plastic bags in DFTC.

Source: Secretaria et al. (2023)

In addition, practices such as stacking the sacks of vegetables on top of each other (see Figure 14), and in some cases, the laborers will sit on top of the stack piles, will then be avoided to further reduce post-harvest losses during logistics.



Figure 14. Transport vehicles stacking sacks of cabbage and Chinese cabbage in bongo and elf trucks.

On the other hand, the retailers in Kapatagan public market and even in Bankerohan are already adopting the polyethylene clear plastic bags. They reported that using these packaging indeed extended the shelf life of their vegetables. For the reason that they are using it as temporary storage of the vegetables that are yet to be displayed on their tables or stalls. They mentioned that displaying them all at once incite faster shrinkage and physical damages. But they highlighted that the suitability of these packaging materials is limited to the type of vegetables being packed. Given that polyethylene bags are not perforated, leafy vegetables like cabbage and Chinese cabbage when packaged or stored for a longer period inside these bags leads to faster spoilage rate. Also, they added that this packaging will only be better if the buyers' location is only a few meters away from the market.

Alum treatment was another innovation being introduced to them during the week-long seminar they had in Baguio City. The stalk/stem of the cabbage of Chinese cabbage will be dipped to the alum solution in order to preserve their quality and crispness even the transport period would take more than 1 hour after leaving the farms. However, the existing practice of Kapatagan vegetable chain actors was instead of administering the alum treatment, they prefer to flip the cabbages upside down after being cut at farm level to drain the stored water inside their leaves which hastens the spoilage rate. This strategy entails no additional cost or labor, unlike how the alum treatment requires out of them.

Retailers on the other hand have this practice of minimally processing the Class B or reject vegetables in the market (not of good quality and with minimal damages but can still be consumed). They are washing, peeling, cutting, and removing the slight damages from these vegetables by either trimming the infected leaves, to make it appear fresh (see Figure 15) or by re-packing them to smaller plastic cellophanes as a mixed vegetable package or "sari" (see Figure 16). The types of vegetables being packed together must be complementary to a specific dish such as *pinakbet* and/or *pancit* that would also offer efficiency and convenience to the consumers. This practice, however, is only practices in Bankerohan market and not in Kapatagan since they said that there is no demand for MPVs (minimally processed vegetables) given that most of the residents and consumers visiting the marketplace are also accessible to vegetable farms in the area.



Figure 15. Trimmed cabbages in the retail market



Figure 16. Minimally processed vegetable mix package "sari" sold in Bankerohan market

However, MPVs, though helpful in minimizing the losses in the entire chain even at retail level, it is still subject to food safety hazards. This is because apart from safeguarding the interests and benefits of the producers, traders, processors, and exporters, the most essential stage of the value chain was mainly driven by how the end-consumers', buyers', and market outlets' needs and requirements were met within the chain's activities/functions. Quality standards set in the chain are considerably understandable given that the welfare and safety of the consumers are primarily at stake.

In line with this, the Philippine government formulated the "Food Safety Act of 2013" as a regulatory requirement within the food industry to protect and guarantee consumers' health and safety (FAO, 2013). This policy covers how the practices and management techniques employed by the actors and members of the food industry were substantially aligned in securing the welfare of the consumers/public away from the risks posed by adulterated, unhygienic, and malpractices of the involved parties in production, manufacturing, and processing. Unfortunately, in spite of the presence of this act in the country, there were still underlying factors that questions its effectivity and proper implementation, in general. Retailers and other midstream actors answered that washing their vegetables at after harvest and before conducting MPVs would be one way of complying with it.

However, if it would be assessed even at the lens of the Philippine Good Agricultural Practices (PhilGAP), these practices are unsanitary and do not pass the requirements in ensuring food safety of consumers at all. Uniform results were found by Finger et al. (2023) where minimally processed vegetables in the market are prone to bacterial contamination such as *Escherichia coli*, *Salmonella* spp., and *Listeria monocytogenes*. These pathogens are the ones responsible for foodborne diseases which was mainly attributed by the authors to unhygienic practices of the processors or retailers doing the MPVs, or by means of contact to contaminated areas and water where the MPVs are displayed.

4.3.6. Summing up: leverages for innovation, internal and external drivers of change

Nonetheless, with the discussions above, the informants enumerated some recommendations to better improve the vegetable value chain in Kapatagan. In order to encourage the adoption of these chain actors in terms of the innovations introduced to them or the ones they already tried but did not sustain, the following are suggested:

Improvements in DFTC

They advised to relocate the institution or facilities in an area that is more accessible or convenient for both the midstream actors and the general public or consumers. Moreover, instead of only managing the vegetable chain, they must also incorporate the fruits as these commodities usually go together, similar with how the Bankerohan market was oriented. The dropping fee of having it in a per kilogram basis from being per sack/load must also be amended to at least initiate adoption of these chain actors with additional adjustment period at least in this case.

Construction of adequate farm-to-market roads

The focus of this project must be in connecting the vegetable farms in remote areas of the locality such as those located almost at the peak of Mt. Apo. Through this, it would be easier to adopt the innovative practices of using polyethylene plastic bags and cleaning the vegetables even at farm level to reduce post-harvest losses and ensure food safety measures implementation.

Better Access to Institutional Buyers

Currently, the wholesalers of vegetables in Bankerohan are incentivized to minimally process these vegetables (e.g., cleaning, peeling, and individually packing cabbages) because they have access to institutional buyers like the supermarkets within Davao City. Thus, when there is an increased market access among the other chain actors to these institutional buyers that require high quality and safe vegetables (e.g., PhilGAP certified), they will be more likely to adopt innovations.

Legislation

Another pathway to innovation adoption would be the strict implementation of legislation in terms of post-harvest losses reduction and food safety protocols in the agri-food system. These include the imposition of the Food Safety Act of 2013, and also the city ordinance that prohibits single-use of plastic packaging in the market. Also, to protect the informal sectors in this chain against the factors that pose risks to their operations (e.g., demolitions and confiscation of products), BMBEs Act of 2002 must be implemented as well by the city government.

Table 11. Roles of key players in addressing the objectives in Kapatagan vegetable chain (cabbage)

Objective	Roles of key players in addressing the objectives
Reduce postharvest losses	<ul style="list-style-type: none">○ Adoption of proper packaging for cabbage such as individually wrapping the cleaned cabbage balls with newspaper, pre-cooling practices through cold storage and refrigerated vehicles, and alum treatment to extend shelf life.○ Construction of farm-to-market roads○ Proper implementation and regulation in using the facilities of DFTC, dropping fee guidelines, and packaging materials requirements○ Inclusion of fruit chain in DFTC aside from purely vegetables to encourage consumers and retailers to adopt
Improve food safety	<ul style="list-style-type: none">○ Controlled and reduced use of chemicals during production stage, use of organic fertilizers (among sprayer-contractors) and at the wholesale node (use of calcium carbide)○ Monitoring and inspection of food safety guidelines among minimally processed vegetables (MPVs) in the market (especially in Bankerohan).

4.4. Conclusion

Mainly, this project aimed to assess the role of the informal sector, focusing on the midstream node of the vegetable and mango value chains in Southern Philippines. The central element that this project covered was to identify how to reduce the post-harvest losses, implement food safety protocols, and offer accessibility of safe and healthy foods to the consumers. This was achieved through determining both the internal and external factors affecting their operational decision in the chain, as well as their strategies in functioning informally. As indicated in the framework (Figure 1), there is an interplay occurring between the incentives and disincentives which also affect how they deal with the possible risks in informally operating, along with the external drivers which include the role of the enabling environment in attaining the goals.

Incentives include the chain actors' operations motivated by necessity, relationship with co-actors, low cost attributed to informality, and the trust and reciprocity they establish with co-actors in the chain. The disincentives, on the other hand, are the factors that are posing risks and challenges to these actors' general operations. These consist of actors who are risk averse, the seasonality in weather and production of vegetables, the impediments they may face, and transactions that are credit-based while operating informally. Also, given that the focus of this project is in the informal sector, the strategies employed and practices by the chain actors in Kapatagan are also important to be identified to counter the disincentives/risks in their operations. They cited that controlling the production and trading volumes, paying the daily market tax or locally known as "arkabala", parking vehicles or displaying of vegetables away from formal actors in the chain to ensure avoidance of causing traffic and be penalized, as well as charging lower market price for their vegetables to compete with formal chain actors in the market, provided that they incur lower costs than them since they are not paying for permits and stalls. Lastly, the external drivers are the interventions extended by the enabling environment stakeholders such as initiating and organizing vegetable associations, building of region-wide trading post, which was the Davao Food Terminal Complex, while dealing with high incidence of post-harvest losses that also affect the fulfillment of imposing food safety measures and consumers having access to affordable, safe and nutritious food in general.

Innovation is another influencing factor to the attainment of this project's objectives in reducing post-harvest losses, implementing the food safety measures, and how these could offer accessibility of safe and healthy foods to the consumers. As mentioned, some of the traders and dicers in Kapatagan and also members of KAVEFADTRA and KODA were given the opportunity to train and attend seminars on post-harvest handling and packaging in Benguet. They were taught of proper logistics practices and use of appropriate packaging materials depending on the vegetable type to reduce post-harvest losses while ensuring food safety and security of consumers. They were able to implement it for two months but due to issues and concerns raised the chain actors of these practices being labor intensive, incur additional costs, Benguet situation and vehicles are not the same with Kapatagan, and the major one is how the chain actors in the latter are not cooperative and adoptive to innovations in general.

The following are suggested to improve the contribution of informal actors particularly in the midstream node of the chain given the internal and external drivers and the bottlenecks in the vegetable chain of Kapatagan:

- Conduct consultation between the informal actors and the government to discuss proposed government programs at the local and national level to reduce post-harvest losses and improve food safety. Participants should include these informal actors such as traders, laborers, wholesalers and retailers including representative from two local government units of Davao City and Davao del Sur. At least two government programs relevant to post-harvest losses and food safety should be in the agenda. This is the unsettled issue in the implementation of Executive Order 42 which is a local issue that involves the local government units of Davao City and Davao del Sur. The other agendum is the implementation of PhilGAP or the Philippine Good Agricultural Practice.
- Review proposed programs given the results of the consultation to include assessment of various options that consider the motives, incentives and disincentives of informal sector that plays crucial role in effectively implementing the programs. The areas to consider in evaluating the various options should include the benefits to various actors in the chain, the likelihood of adoption by key actors and the costs involved to various stakeholders.
- Local government units of Davao City and Davao del Sur to strengthen implementation of existing policies such BMBEs Act of 2002 and Food Safety Act of 2013 in coordination of other national government agencies. The first policy could create an impetus for more organized and well facilitated chain actors in their locality through which they will be waived of the risks in operating within the informal sector (e.g., demolitions, penalties, and confiscation of products). Although there is a discretion given to LGUs whether they would charge administrative fees, the amount must not also exceed by PhP 1,000 which is already equivalent to the membership fee these chain actors are currently paying to their informal organizations. This could also control the entrance of potential and future chain actors that would regulate the level of competition within the vegetable industry which further affects prices, and post-harvest losses due to surpluses.

- Food Safety Act of 2013 must also start through the LGUs to ensure the security and welfare of vegetable consumers through strictly imposing the regulation paired with subsequent sanctions and penalties for any chain actors who will not comply. The leverage point can kick off with widespread implementation of proper packaging and handling practices of vegetables since the informal actors mentioned that they will be adopting these innovations provided that the government will force them to do so.
- Construct farm to market roads within Kapatagan that would connect the smallholder farmers from remote areas (e.g., those found almost at Mt. Apo's peak). This is critical in supporting implementation of these policies and innovations. Through this, farmers will be incentivized to initially wash and even impart in individually wrapping the cabbages, hence, it would be easier for the midstream actors to facilitate the succeeding processes. Consolidation of vegetables would also be more convenient and efficient with the FMRs since all suppliers can access the roads that would link them to the main trading and consolidation post situated at the center of barangay Kapatagan.
- Implement improvements in the Davao Food Terminal Complex. This was identified to be one of the key leverage points in enhancing adoption of innovation among chain actors in Kapatagan and Bankerohan. An informant reported that at present, the board of directors and heads of Davao region who are associated with establishment and utilization of DFTC are currently amending its implementing rules and regulations (IRRs). One of these amendments is to adjust the dropping fee from being on a per kilogram basis, it would be uniform with what was indicated in the City Revenue Code which was to charge it on a per load basis. However, this must also be complemented with two subsequent amendments as per the suggestions of the chain actors covered in this project - (1) fruits should be included in the operations and control of DFTC to encourage the buyers and consumers to adopt it like how Bankerohan is presently organized, (2) strict imposition of appropriate packaging materials per vegetable type for them to adopt. Therefore, the per load fee should be adjusted depending on the packaging of the vegetables (i.e., carton boxes, crates, or clear polyethylene bags). Also, the city government must initiate plans of diverting the routes of public utility vehicles through which passengers could easily access the facility despite being built in the inner part of Toril.
- Assess and compare cost and returns in implementing traditional and innovative practices of midstream actors in vegetable value chains. This was highlighted by how the informants discontinued their adoption of innovative practices introduced to them in Benguet (e.g., individual wrapping of cabbages and using polyethylene clear bags as packaging materials of vegetables). They mentioned that they incurred high losses in adopting these two because their vehicles are underloaded while additional investment is required by means of purchasing the packaging materials and hire more workers to wash, wrap, and pack the vegetables (especially cabbages) in these clear cellophane bags. However, one informant disagreed because he had seen significant differences such as: the minimization of discounts in the vegetables (from 25% to 30% per sack) to a maximum of 10% when clear plastic bags are used instead of sacks. This was accounted to the fact that on a per sack packaging, they are still gross weight while the clear plastic bags represent the net weight of the vegetables. Thus, future studies in assessing the losses, costs and returns on these nuances is a good way for the chain actors to be incentivized in adopting these innovative practices. More so, consumers and buyers will benefit as well through seeing the quality of the vegetables they are purchasing which also heightens their importance of food safety measures.

5. Case 3: Tomato

5.1. Introduction

Three vegetable value chain actors were interviewed in Maragusan which involved the farmer, farmer/financier/wholesaler, and trader/wholesaler. On the other hand, the vegetable chain actors in Bankerohan were also interviewed in this project to trace up their connections to Kapatagan and Maragusan chains. To better understand the roles, functions, issues faced, and opportunities found by these chain actors, in organizing their responses based on the key informant interviews four categories were formulated. First, the chain or operations which will discuss the position and profile of the actors in the entire chain, the services they offer to other actors in the chain, the volume of vegetables they supply and source out from their suppliers, the seasonality of their transactions, as well as their membership (if any) to any organization related to their role in the chain. Second, the informal sector category will tackle about the formal registration condition of the actor's business/role in the chain, the existing gender roles, the barriers to entry for new entrants in the chain, along with the risks, motivations, and strategies of these actors. In the third section, it includes the issues and roles played by the actors regarding the post-harvest losses and food safety measures in the vegetable value chains. Lastly, the innovation part is comprised of the existing technological innovations that are either practiced/adopted or have failed in the vegetable value chain, as well as their corresponding impacts, reasons for adoption/failure, and factors that would encourage them in adopting these innovations.

Meanwhile, the analysis of this project grounded by the aforementioned categories in the key informant instrument integrates the project's proposed framework (see Figure 1). It can be seen in the diagram that although the focus of this study was mainly on the midstream node of the chain, it still included the upstream and downstream nodes for the overall analysis. Both internal and external factors were assessed through which the former was further divided into two: (1) motivations, and (2) strategies and incentives.

5.2. Description of the food system in which the case study is located

Aside from cabbage chain in Kapatagan, Davao del Sur, tomato chain in the municipality of Maragusan, Davao de Oro (see Figure 17) was also studied. These two provinces belong to Davao Region which ranked 10th with a production of 2,200 metric tons during the second quarter of 2023 (see Figure 18). The municipality of Maragusan is referred to as the "Summer Capital of Davao Region" because of its Type II climate, similar to Baguio City in Benguet.

In terms of the innovation in this specific chain, there were several innovations introduced to the chain actors, some were successfully adopted, while others failed. To cite, the use of wooden crates was long adopted as a packaging for tomatoes as they have seen its benefits in addressing post-harvest losses as compared to traditional polypropylene sacks or carton boxes. Meanwhile, the innovative wooden crate packaging introduced by the project which is to incorporate newspaper lining on corners or all sides of the crate was still not practiced at present in this chain. Polyethylene bags on the other hand was also adopted but, not in tomatoes but in root crops and other fruit vegetables with thick exocarp (e.g., cucumber, okra, bell pepper, etc.). The innovations that have failed in Maragusan tomato value chain include their trading post that offered cold chain facilities like cold storage and airconditioned/refrigerated vehicle trucks for vegetable transport. Mismanagement, higher costs (operating and electricity), and chain actors' low adoption level were cited as the major reasons to its failure. As they perceived that cold chain facilities are unnecessary given their direct transactions (especially the midstream actors) and Maragusan's cooler temperature.

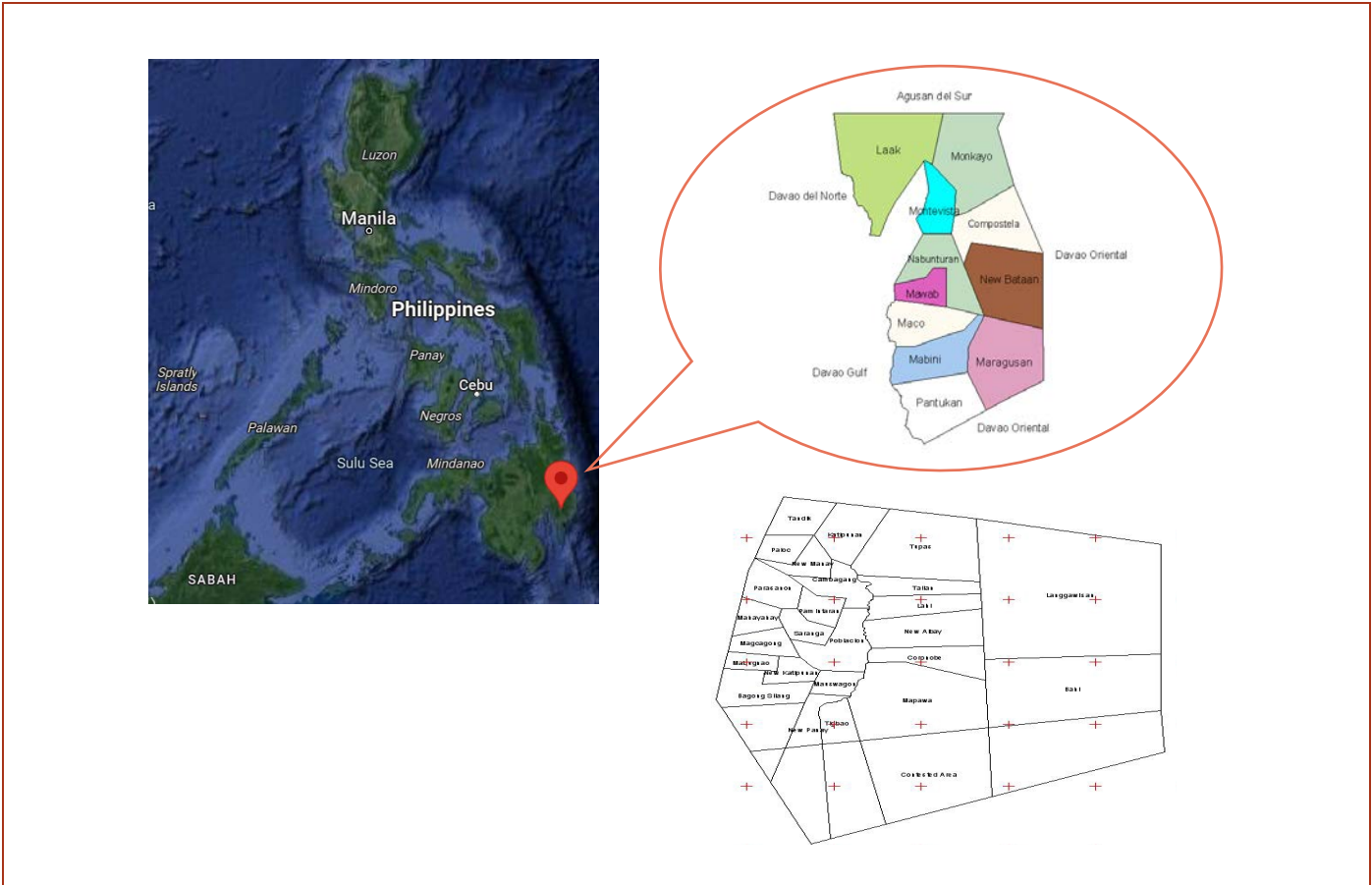


Figure 17. Municipality of Maragusan in the Philippine Map
 Source: Google Maps and Food and Agriculture Organisation (2006)

Although tomato is considered under the lowland vegetables which does not necessarily require cooler temperature but an even distribution of dry and wet seasons, Maragusan was still able to produce and trade an average of 5.7 tons weekly (based on informants’ responses). Therefore, about 0.2% of tomatoes in Davao region comes from Maragusan vegetable chain.

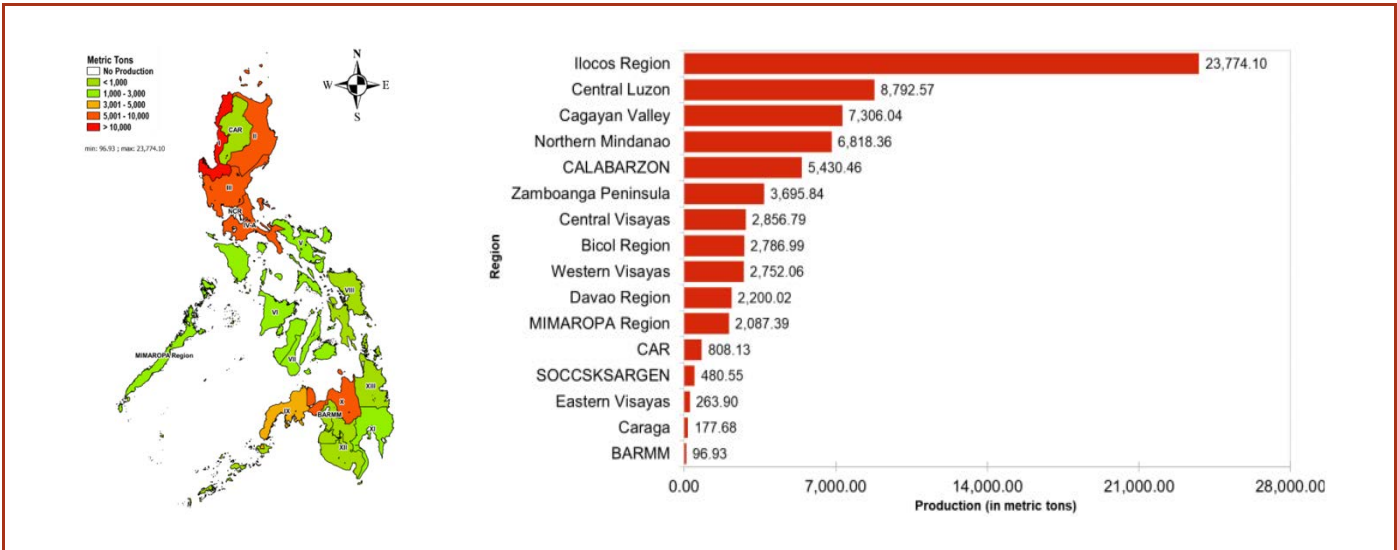


Figure 18. Volume of tomato production by region, April to June 2023
 Source: Philippine Statistics Authority (2023)

In Table 12 it can be seen how Davao de Oro where Maragusan was situated ranked first in terms of average annual productivity (9.84 metric tons per hectare) in the tomato industry of the entire country. It surpassed the record of Davao region (6.45 metric tons per hectare) itself. However, it is the only province in the said region that showed a negative average growth rate for 10 years (2012 to 2022) by -3.86% (PSA, 2023). This may signify that although the province is showing the highest productivity, the volume of tomatoes produced in the area declines over time on average. One angle associated with these contrasting records was the high level of post-harvest losses incidence in their tomato industry despite experiencing cooler temperature similar with Kapatagan in Davao del Sur than the rest of the areas in Davao region. The findings of this study suggested that this was due to the factors such as: the lack of farm-to-market roads connecting the highland vegetable growers to the nearest trading post, current logistics practices, and the failure of the formerly built trading post in Maragusan because of mismanagement issues.

Table 12. Volume, area, and productivity of tomato in Davao region and Philippines from 2012 to 2022

Region/ Province	Volume			Area (in ha)			Productivity (average metric tons per hectare)
	% Share in 2022	Average % share (2012-2022)	Average % Growth rate (2012-2022)	% Share in 2022	Average % share (2012-2022)	Average % Growth rate (2012-2022)	
Philippines	100	100	0.59	100	100	-0.88	13.08
Davao region	2.16	1.96	0.85	4.28	3.98	0.63	6.45
Davao de Oro	0.42	0.46	-3.86	0.65	0.61	-1.15	9.84
Davao del Norte	0.03	0.03	0.91	0.11	0.11	-0.55	4.20
Davao del Sur	1.11	1.00	1.65	1.92	1.90	-0.11	6.91
Davao Occidental	0.05	0.02	0.00	0.10	0.04	0.00	7.14
Davao Oriental	0.11	0.10	5.29	0.47	0.42	2.43	2.98
Davao City	0.44	0.35	4.03	1.04	0.90	2.17	5.06

Source: PSA (2023b)

5.3. Results

5.3.1. The value chain, its key actors, enablers, and its governance

The major supplier of vegetables in Maragusan, Davao de Oro are the smallholder farmers both from the lowland and upland regions of the municipality (see Figure 19). "Pinakbet" vegetables are usually grown in the lowland areas which include eggplant, bitter melon, squash, okra, string beans, and the focus crop in this project - the tomatoes. Meanwhile, upland farmers are producing vegetables which include cabbage, Chinese cabbage, carrots, snap beans, cauliflower, broccoli, chayote, and bell peppers. There are also a few of the large-scale vegetable growers who are usually extending other services such as financing and trading to their co-farmers.

In the logistics node of the chain, this is composed of several actors that are either competing or transacting with each other. Vegetable traders in Maragusan play the biggest function in sourcing out supplies of vegetables from the farmers, their own farms, their financed farms, and dicers while delivering them towards different actors such as the wholesalers within the locality, the secondary wholesalers and retailers found in other areas (but mostly in Bankerohan, Davao City), and some institutional buyers. The competitor of these traders is another chain actor

who can function as direct buyer of vegetable farmers in the area or be dicers or agents of other traders, especially outside Maragusan - the *warik-warik*. However, unlike the traders, *warik-warik* are sourcing out and delivering only smaller volumes of vegetables while also acting as wholesaler/retailer in the market by displaying their vegetables.

Also, aside from the mentioned Bankerohan wholesalers and/or retailers, the next destination where the vegetable supplies from Maragusan flows in the chain, there are also other buyers from other provinces or regions. These are comprised of wholesaler and/or retailers from Mindanao particularly found in Surigao del Sur, Tandag (a city in Surigao del Sur as well), Agusan del Sur, Butuan City (in Agusan del Norte), along with Tacloban City in the Visayas region. Institutional buyers can also be traced but most of them are transacting with the wholesalers in Bankerohan, Davao City as they are more accessible. Lastly, the vegetables grown from Maragusan will be consumed in either the local households situated within Maragusan, or by households from other market outlets where the vegetables can reach like the aforementioned cities and provinces.

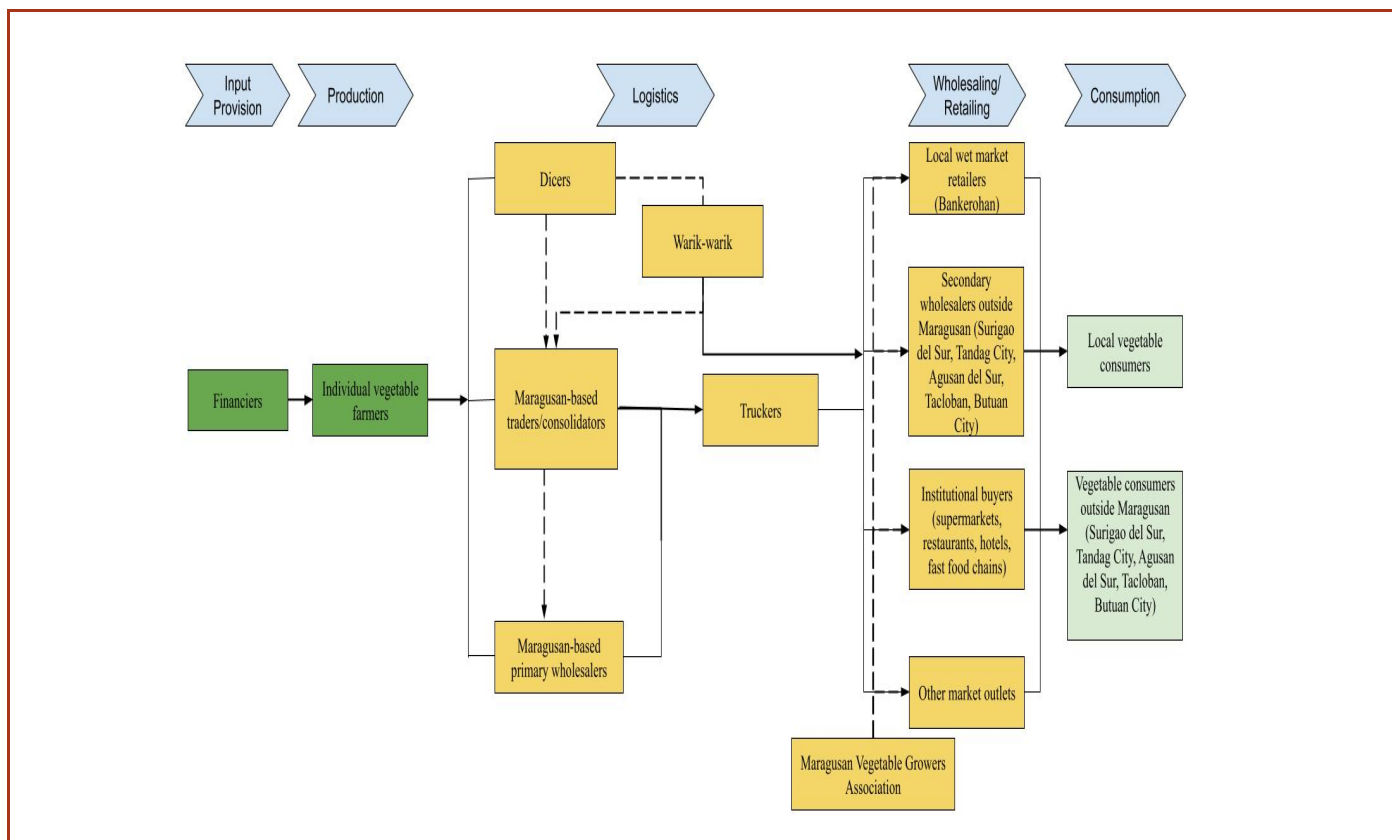


Figure 19. Value chain map of vegetables in Maragusan, Davao De Oro

Data Source: Key informant interview and World Bank (2019)

Farmer-financiers. These chain actors can either be smallholder or large-scale vegetable growers. Also, they are categorized based on the topographical orientation where they are planting: lowland and upland. Although in Maragusan, the majority of them are individual smallholder farmers as per the description of the informants, the few large-scale vegetable growers are the ones who are commonly acting as financiers to some of these smallholders. Their operations include provision of inputs which are composed of seeds, fertilizers, and agro-chemicals that are necessary for vegetable growth and development (JICA, 2022). Most of the financiers in tomato chain prefer to source out farm inputs from private companies rather than small local agrivet suppliers. According to the Commercial Crop Variety Database (2022), tomato financiers transact with 5 major accredited input suppliers which are: Ramgo International Corporation, East-West Seeds Inc., Allied Botanical Corporation, Pilipinas Kaneko Seeds, and UNIGEN Seeds Asia, Inc.

Dicers. Commonly known as the middlemen between the farmers and traders since they are the ones who are directly transacting with the former, add a mark-up price to be sold to the traders who can either be Maragusan-based or not. They are commonly the agents for consolidation of vegetables from different smallholder farmers in order to meet the required volume needed by the traders for a specific transaction. Sometimes, they are getting their marketing capital from these traders in order to pay the farmers in cash (to initiate sustainable transactions in the future).

Traders. They are usually known to be functioning as farmer-financiers as well in the chain as a strategy to ensure sustainable supplies of vegetables, in case there is a shortage of supply from their partner dicers or individual vegetable growers within Maragusan. The volume of vegetables that they are transporting to and from Maragusan ranges from 8 to 10 tons daily.

Primary wholesalers. These chain actors are wholesalers of vegetables found in the public market of Maragusan, in other words, are Maragusan-based wholesalers. They are sourcing out their supplies from individual farmers, dicers, or traders, depending on the volume and type of vegetables they needed for a particular day.

Warik-warik. Considered as the greatest competitor of traders and even dicers in the chain since they are directly purchasing smaller volumes of vegetables (from 20 kilograms to 100 kilograms per day) from individual farmers. Instead of displaying on the public market like how traders do, they prefer to sell to nearby or adjacent cities or municipalities so they could charge the vegetables higher than the prevailing market price in Maragusan. They incur lower costs by having a short cut in the flow of transactions in the chain but benefit from charging higher selling price. They usually own personal vehicles to function well in the chain instead of transacting with the next chain actors who are the truckers.

Truckers. In case the dicers, traders, or wholesalers do not personally own vehicles to deliver and transport vegetables from the farms to the trading post or toward their different buyers within and outside Maragusan, truckers are providing them transport vehicles. Depending on the agreements between the logistics actors and the truckers, the rental fee varies per transaction. Moreover, some of the traders are also playing this role in order to extend their functions and services offered in the entire chain.

Local retailers. The traders and some of the *warik-warik* and wholesalers who are sourcing out from Maragusan are supplying to local retailers in Bankerohan, given that it is the main wet market in Davao City. Most of them source out an average of 1 ton per day of assorted vegetables which can be on cash, credit, or consignment arrangements.

Secondary wholesalers. Apart from the wholesalers based in Maragusan and in Bankerohan, the buyers from other provinces or cities also supply to wholesaler-retailers based on their areas. These include those coming from Surigao del Sur, Tandag City, Agusan del Sur, Butuan City, and Tacloban City. There are also some wholesalers who own retail stalls within the market but are either managed by hired store vendor or by a family member to maximize profits and reduce operational costs.

Institutional buyers. These are composed mainly of high-end market outlets such as supermarkets, restaurants, fast food chains, and hotels within Davao region. Institutional buyers are the targeted buyers of Maragusan traders and wholesalers as they charge price premia, provided that the quality and volume requirements are met. In most cases, these buyers prefer Class B vegetables and will only improve their quality and appearance through minimally processing them. For instance, by cleaning them thoroughly removing the mud sticking to the fruit

vegetable in order to be charged higher. There are also some who are cutting these tomatoes to conveniently offer the consumers from these buyers (e.g., “sari-sari” or “all in one packaging” of vegetables for specific Filipino dishes, particularly “pinakbet,” or salad packages).

Ambulant vendors or “laray”. Similar with the vegetable retailers who are mainly operating in Bankerohan market but are either selling limited crops (in type and volume) than the regular retailers in the market. Although some of them are only selling their own produce directly to the market, to sustain their operations, they are also sourcing out few volumes of vegetables from Maragusan, Kapatagan, and other nearby vegetable-producing provinces. They can be found displaying their vegetables on top of sacks in the sidewalks of the main vegetable section of the Bankerohan market, different from the regular retailers who are renting commercial stalls at the public market’s center.

5.3.2. Focus on the midstream actors: who they are, how they are organized, their motivations, strategies and sensitivity to incentives

Midstream actors

In Figure 19, the actors that are mapped with color golden yellow are the ones who are considered as the midstream actors. They are mainly involved in logistics until retailing nodes of the chain or in other words, the part of the chain where input provision, production, and consumption are excluded. Similar with the cabbage value chain, the midstream informal sector in Davao region also plays a significant role which can be seen through its contribution to the total value added in the industry (see Table 13). Also, due to the margins accounted in between the chain nodes, the retail node showed the higher figures in the net added value of the chain (PhP 107,190), uniform with that of cabbage earlier. However, with relatively lower volume of tomatoes harvested and average prices from farm to retail, as well as the chain incurring the highest losses (30%), its net value was the lowest as well among the three.

Table 13. Total value generated of tomato in Davao region from 2012 to 2022

Chain Node	Average Price (in PhP)	Average Gross Volume (in MT)	Average Losses (%)	Average Net Volume (in MT)	Total Average Gross Value (in PhP)	Total Average Net Value (in PhP)
Farm level	17.95	4238.25	30	2966.78	76,076.59	53,253.70
Wholesale	30.73				130,241.42	91,169.15
Retail	36.13				153,127.97	107,189.76

Source: PSA (2023b, 2023c) and Secretaria et al. (2023)

The midstream actors in Maragusan are mostly operating informally (unregistered and unorganized individuals or group of individuals) but significantly offer services in the entire chain. In this section, the midstream actors and their level of informality will be discussed which include the dicers, traders, wholesalers, *warik-warik*, retailers, and ambulant vendors or *laray*.

Dicers

As previously defined, these chain actors act as the agents of big traders in Maragusan as they are the ones who directly visit and transact with the farmers, consolidate the volume required by the traders and charge as relatively

higher prices than the farm gate. As most of the middlemen and operating mostly on behalf of large-scale traders and wholesalers, they are operating informally. In Maragusan, these midstream actors are not required to be registered as their operation only covers smaller scale of activities, which is why almost all of them are informal actors as well.

Traders

Despite their large-scale operations, these midstream actors are also part of the informal sector. Interestingly, some of them have been registered and even had business permits before, one informant cited that she was legally and formally operating last 2020 but decided not to renew her permits and registration to the Bureau of Internal Revenues (BIR) and Department of Trade and Industry (DTI). She said that the majority of her co-traders have the same cases because from the pandemic period until now, their operations became limited and intermittent as compared before.

Wholesalers

Aside from their claim that they are not required to be registered and secure a business permit for their operations in the chain, there are other factors that influence their decisions to operate whether formally or informally. One factor is how they are directly related with other chain actors, such that the traders are either their spouse or parents which is commonly observed in Bankerohan and Maragusan markets. Also, only those wholesalers who have other income streams are more required to be registered and have business permits such as the informant involved in this project who happens to be a grocery store owner.

Warik-warik

Apart from being the major competitors of Maragusan-based traders, they are also referred to as “informal agents of Davao buyers” since they primarily supply vegetables to Davao traders and wholesalers, rarely in Maragusan public markets. Davao buyers were said to prefer these actors as they cut transaction cost in sourcing out from the trading post. As described earlier, they own private vehicles for their trading operations but only buy and sell at lower volumes of vegetables than the traders or some wholesalers do. One large-scale vegetable farmer identified warik-wariks as chain actors who operate in specific territorial locations in in area (e.g., Maragusan), while sharing market information on types of commodities and prices assigned per location.

Retailers

The retailers who are selling at the Farmers’ market section in Bankerohan are mostly registered and have their own business permits. In some cases, some of the retailers found in this section are only tasked to sell the displayed vegetables while the real owners are also extending trading services to other market outlets. However, in the private section (Marfori and Leonor Complex) of Bankerohan, this area is filled with informal retailers but are commonly found renting commercial stalls in the market.

Ambulant vendors or “laray”

Unlike the regular retailers in the market, they are usually found displaying their vegetables on the sidewalks with their parasols to avoid direct sunlight in damaging their vegetables given that they sell not on commercial stalls or tables. In Bankerohan, they are required to pay a daily market tax of PhP 20 in order to sell their vegetables. Since they are not renting any stall or table to display their vegetables with, and most of their stocks are directly sourced out from their own farms, they have lower capital investment than the retailers.

Motivations

Necessity and opportunity

For the vegetable farmers in Maragusan, their operations are mainly driven by necessity and opportunity. This pertains to how although they are financed by large-scale grower-traders in the chain, they can still side-sell their vegetables to other buyers because they badly need immediate cash to cover expenses and other necessities entailed in their daily lives and household demands. Their advantage lies on the fact that their role of providing the costs of their production was reduced while giving them stable and sure buyers (i.e., the trader-financiers and even other buyers in the chain). On the other hand, this would be a risk for trader-financiers because they invested not just in monetary basis but also entail trust and reciprocity among these farmers; expecting these farmers will be more loyal in solely delivering their produce toward them.

Low barriers to entry

This can be observed among farmers, warik-warik, and ambulant vendors in the chain. The first chain actors experience low barriers to entry since they could enter the industry by starting off on a smaller-scale operations while also ensuring the potential markets where to supply their produce after harvest. Another advantage would be to venture with the financing services offered by the trader-financiers in the chain, cutting the risks and challenges of worrying about the production costs. They only need to comply with the requirements set by the financiers while they have one option which is to side-sell to other buyers as well.

Meanwhile, warik-warik are motivated to enter the chain since similar with the other chain actors, they are not required to be formally and legally registered. This particular role as well requires low investment capital since they are only sourcing out 20 kilograms to 100 kilograms of vegetables daily, quite lower than the volume needed by the wholesalers in the market which reached to 1 ton per day. Their market is also highly advantageous than the locally-based traders/dicers/wholesalers because they are directing to Davao City and other cities within Davao region (Tagum City and Mati City), hence, another motivation to charge relatively higher price than supplying locally in Maragusan.

Lastly, the ambulant vendors in Maragusan but mostly in Bankerohan bear the lowest capital requirements as they only need to produce their own vegetables on their small farms, harvest them, and directly sell them to the market. Also, unlike the other midstream actors, they do not need private vehicles to transport their vegetables as they could deliver them using public utility vehicles (PUVs) given that they sell lower volumes as well.

Risks and strategies

Lack of formal and legal documents of transactions

The major reason as to why side-selling happens is how the agreement was informally done with the absence of legal papers to prove the validity of the financing-supplying guidelines (e.g., contracts), indicating that the financed farmers are limited to be supplying their vegetables solely to the trader-financiers. Similarly, this happened with their trading transactions to wholesalers or buyers (e.g., in Surigao del Sur) where supplying vegetables are paid on credit terms. Delays in payments oftentimes happen, and worse, there were cases of unpaid debt from these buyers which ended up being uncollectible as these buyers can either be nowhere to be found or has already left their businesses. One informant reported that in Surigao del Sur, she still has uncollectible debts of buyers amounting to PhP 140,000. Given these conditions, trader-financiers are situated at the more disadvantaged platform in bearing the informality risks of engaging in such transactions since they could not file for lawsuits against these actors. So, to counter the effects, she decided to discontinue her financing services toward these chain actors and became more hands-on in visiting and monitoring the farms together with her husband to avoid repetition of such incident.

Passive perception of actors toward post-harvest losses

When asked regarding their current practices in reducing the post-harvest losses incurred from unsold vegetables that turned into spoilage, damages, and shrinkage, all of the informants have uniform perspective of throwing them away. For some, they have this mindset that due to high volumes of vegetables being produced in Maragusan, minimally processing them would not be suitable for them, so, even the class B vegetables will be deemed unmarketable, thus, must be disposed automatically. Despite being knowledgeable of the appropriate technologies and practices to help reduce PHL levels in all nodes of the chain, the actors in Maragusan are not applying them. Midstream actors are expected to play the crucial role in this goal however, even though they are aware that PHL mostly occur due to handling and logistics practices, they are more profit-driven than concerned in taking part with this goal. One trader mentioned that on average, 2 out of 10 midstream actors are employing practices to somehow reduce PHL cases for they know this will not only benefit them through improved quality of vegetable products but also for the welfare of their consumers.

Limited knowledge and particularity of buyers and consumers toward safe vegetables

As described by the midstream actors, consumers and local buyers are more price-sensitive than quality- and safety-sensitive when it comes to purchasing vegetables in the market. They also have little knowledge of distinguishing the difference between vegetables that are safe and with high chemical residues. A trader informant cited that in one of the localities she had supplied vegetables, the consumers are eating unwashed cabbages, which made her to reduce her heavy reliance on agro-chemicals to somehow safeguard the health of her buyers.

Volatility of prices

One reason as to why they stayed in informally operating within the chain, especially those traders who were formerly registered and had business permits is the volatility of prices in the market which started during the pandemic period. Also, the commodities they are handling and trading are highly perishable which make them more prone to sudden price changes due to quality deterioration from morning until the afternoon.

The chain actors are strategizing by means of income diversification schemes. Aside from financing services, some of them also covers the trucking services in the chain, manage their own farms and also have some grocery stores to sustain the necessity requirements both in household and business purposes. Moreover, given that the market is getting more competitive with new entrants and established actors in the chain, some are upscaling their marketing strategies by putting their contact numbers to the packaging (e.g., sacks) of the vegetables they are delivering in the market. This was done by a new consolidator in the chain which perceived high competition and

collusion occurring between and among the existing dicers, traders, and wholesalers in the market - limiting the influence of new entrants like him.

5.3.3. Power and influence: who plays the tunes in and around the value chain?

All of the interviewed chain actors in this project agreed that the middlemen or dicers mainly dominate the chain at present in Maragusan. This can be proved by the fact that even with the establishment of Maragusan Vegetable Growers Association that aims to remove the presence of these middlemen in reducing transaction and marketing costs of vegetables, they consider it as a huge challenge to attain. One reason is their vital role of acting as agents of large-scale chain actors, especially traders and wholesalers in order to ensure a stable and sustainable supply of vegetables. They also provide convenience toward these actors by minimizing their efforts and costs of personally transacting and consolidating vegetables from smallholder farmers from different areas to fill up the capacity of their vehicles or to meet the required volumes by their buyers. Second dominating chain actor would be the traders since they usually play various functions in the chain by being vegetable growers themselves, while being financiers, truckers, and traders to other chain actors as well.

Table 14 depicts how dicers in the tomato industry of Maragusan chain enjoy low bargaining powers of both suppliers and buyers. Through convenience, lesser transaction costs, offering of cash advances, higher volume transacted than *warik-wariks* and cash payments, their suppliers and buyers more likely to sell toward them. There is a low to moderate threat of new entrants provided that there is relatively lower capital investment involved in dicing than trading or wholesaling, trust and reciprocity among chain actors are dicers' greatest advantage among newbies. As mentioned previously that traders ranked second when it comes to market control in this chain, Table 14 supports it. Wherein they receive low risks potentially posed by new entrants, buyers and/or suppliers. The reasons consist of the high capital investment (some traders allow buffer funds in case of credit transactions with their buyers but to maintain trust with suppliers, they need to pay them on cash basis). Apart from marketing capital, they also need to acquire personal vehicles necessary for their operations, otherwise they will settle on higher charges imposed by a few truckers in the area. Also, similar with the case in cabbage chain, the ambulant vendors bear the highest risks. For they sell the lowest volume of tomatoes while dealing with the highest post-harvest losses due to mechanical damages and shrinkage caused by no proper stalls or tables to display them in the market.

Table 14. Competitive forces in tomato industry

Competitive forces	Dicer	Trader/ Consolidator	Warik-warik	Trucker	Institutional Buyer (Hotels, Restaurants, Supermarkets)	Wholesaler	Local Market Retailers	Ambulant vendors
Threat of new entrants	Low to Moderate	Low	Low to Moderate	Low to Moderate	Low	Moderate to High	Moderate to High	High
Bargaining power of suppliers	Low	Low	Moderate	Moderate	Low	Low to Moderate	Low to Moderate	Moderate
Bargaining power of buyers	Low	Low to Moderate	Low to Moderate	Moderate	Low to Moderate	Low to Moderate	Moderate	Moderate
Threat of substitute products	Low to Moderate	Low to Moderate	Moderate	Moderate	Moderate	Moderate	Moderate to High	High
Rivalry	Moderate	Moderate	High	Moderate to High	Moderate	High	High	High

Source: Key Informant Interview and ACIAR Project ABG/2012/109 (2016)

5.3.4. Midstream actors and innovation: incentives and disincentives for change

Incentives

Advantages of informal operations

Two angles were provided by the results of the key informant interviews among the chain actors in Maragusan as to why they are incentivized to remain operating informally. First, is their uniform perspective that chain actors involved in small-scale operations are not required to be registered and apply for a business permit. Large-scale chain actors like traders are supposedly the ones required to comply for these things since they cover multiple functions and transporting vegetables outside Maragusan entails travel permits in order to cross the borders, regulated by the checkpoint stations. Next would be the advantages of incurring lesser costs when they operate informally. Instead of paying for the necessary requirements in applying for registration or renewal of permits, they can re-allocate it in expanding their services or as additional capital investment to their business operations. This cost efficiency factor is mostly observed among the ambulant vendors since they can already sell their produce or vegetable products in wooden/bamboo tables in the public market (see Figures 20 and 21) by only paying the PhP 20 daily market tax. The amount is a very small portion of their income generated from their informal operations in the market.



Figure 20. Tomato ambulant vendor displaying on bamboo table in the public market



Figure 21. Tomatoes in Bankerohan market displayed on bamboo tables

Market-driven operations

One incentivizing factor for the chain actors is their consideration of the market demands of vegetables. This means that farmers are leveraging on the seasonality of vegetables before deciding what particular crops to grow for a specific cropping period, while also practicing crop rotation techniques. Traders and other midstream actors are also incentivized in the senses that they have stable supply of high-demand vegetables in the market since the farmers are also knowledgeable on this regard. In fact, one large-scale vegetable farmer is strictly following the biodynamic calendar in growing vegetables to ensure the quality and market demand of their produce all year round.

Also, they could acquire this significant information through the private technicians from the chemical companies who are conducting seminars and knowledge transfers toward them. Midstream actors on one hand also share market information to somehow gauge the market conditions such as exchanging price data (prevailing market price within and outside Maragusan) to regulate their trading transactions and properly charge reasonable prices as well.

Disincentives

Irregularities in operations

As aforementioned, due to the occurrence of the COVID-19 pandemic, the majority of the traders were disincentivized to renew their registration and permits to DTI and BIR. Besides price volatility, another factor to their decisions to remain operating in the informal sector would be the irregularities in their trading activities. This is also the same with the reason provided by the retailers and ambulant vendors wherein registration and securing business permits would cause them additional cost since their operations also face irregularities. It disincentivizes them to shift towards the formal sector since informal operations can offer them the autonomy to discontinue anytime, they want, especially when the market conditions are already unfavorable for them to operate. Unlike when they are registered, since they are paying for their permits and income taxes, they will be forced to operate despite challenging market conditions.

Limited access to market information and government interventions

Based on the sentiments shared by the informal chain actors in Maragusan, after operating under this sector for several years, one of their major challenges would be the accessibility of market information and programs extended by the government and other enabling environment stakeholders in the chain. The informal large-scale farmer-consolidator raised his concerns that informally operating in the chain he observed several disadvantages. These include the following: their local government unit's focus in creating and providing programs only for smallholder chain actors in Maragusan; and limited access to market information in term of subsidies, trainings, and registry system (RSBSA under the Department of Agriculture).

Conversely, in the perspective of smallholder chain actors, they are disincentivized in the opportunities offered by these large-scale midstream actors. For them, although it paves the way for better opportunities of more stable volume requirement from the buyers and also the possibility of receiving a price premium, the capital investment in complying with the requirements set by these buyers would also be higher than usual. Since some of the large-scale buyers, especially the institutional buyers from other cities or provinces are requiring them to shift into formal operations and have their business permits before allowing them to supply or transact with them.

Lack of farm to market roads

This is more concerned with the post-harvest losses and food safety sections of the project. In remote areas of Maragusan, those farms located at the peak of the mountains (e.g., Langgawisan and Saranga), the only mode of transportation available is a single motorcycle with side carriers or locally known as "katig". With this, it is a huge challenge to impose post-harvest losses reduction practices along with the food safety measures since the vegetables can only be transported in this sense which greatly contributes to physical damages of vegetables, especially the focus crop in Maragusan case - the tomatoes - as it is more prone to bruises and spoilage contamination. Additionally, the charging rate for the labor and transport of vegetables from these areas has been PhP 80 per sack which make the "katig" drivers to strategize in maximizing their income and efficiency through carrying 4 to 5 sacks per motorcycle. The third concerning practice is how the laborers and traders/wholesalers/viajedors overload the sacks with vegetables and tying them tightly in order to maximize the space of the transport vehicles used. Henceforth, increasing the risks of post-harvest losses since vegetables were compacted and are tightly packed in a manner that results into physical damages and spoilage. The combination of these three further disincentivizes the chain actors to follow the post-harvest handling and food safety standards as it would only cost them more in comparison to their traditional practices.

On one hand, the midstream actors in Maragusan, particularly involved in tomato value chain also face both incentives and disincentives in adopting the introduced innovations. These innovations pertain to the use of wooden crate with and without lining, the previously offered cold storage and airconditioned transport vehicles in the area from the non-operational trading post.

Table 15. Summary of incentives and disincentives per midstream actor (tomato)

Key player	Incentives	Disincentives
Dicer	Longer shelf life	Additional cost and labor in using cold chain facilities; Perceived unnecessary of innovations provided the direct transaction or delivery to traders/consolidators/wholesalers; lack of farm to market roads connecting vegetable growers to trading post
Trader/Consolidator	Longer shelf life; improved quality; and reduction of post-harvest losses	Putting newspaper lining in wooden crates require additional capital and labor; Utilizing cold chain facilities require additional charge/fee and high electricity consumption; lack of farm to market roads and available vehicle to transport vegetables from remote areas to trading post (use of motorcycles with carrier or "katig")
Trucker	Longer shelf life; improved quality; reduction of post-harvest losses	Cooler temperature in Maragusan leads to actors' perception of cold chain facilities' unimportance; perceived cost of innovation (especially converting into airconditioned vehicles)
Warik-warik	Improved quality and longer shelf life	Additional cost and perceived unnecessary of innovations by directly transacting with traders/wholesalers from Davao City and in smaller quantities
Wholesaler	Improved quality, reduced post-harvest losses, and longer shelf life	Perceived higher cost and labor requirement of innovations; additional waste and cost of disposing lined newspaper per crate; lower demand for safe vegetables; lack of demand from institutional buyers
Retailer	Improved quality, reduced post-harvest losses, and longer shelf life	They can sell different grades of tomatoes at varying prices depending on freshness, appearance, and quality; low demand for safe and premium quality vegetables in the market
Ambulant Vendors	Improved quality, reduced post-harvest losses, and longer shelf life	Lack of permanent stalls in selling vegetables; high risks to demolitions and confiscation; perceived unnecessary of adopting innovations in selling vegetables in smaller quantities unlike wholesalers; current practices of selling in the sidewalks of the market heightens post-harvest losses
Laborer	More volume of mangoes delivered entails higher profit; lesser health risks in loading/unloading vegetables due to reduced weight (from gross to net by 25 kilogram-polyethylene bags)	Lack of perceived benefits from the innovations offered in the chain; additional costs; lesser income due to delivery fee being charged at per load/sack basis

5.3.5. Innovation

The midstream actors which composed of the traders, wholesalers, and retailers reported that innovations in terms of storing, logistics, and packaging were already introduced in the chain. According to the trader/wholesaler, these past innovations were once offered and proposed in the previously established "bagsakan" or trading post in Maragusan. Some of them include: the cold storage that was aimed to extend the shelf life of vegetables produced in the area, the airconditioned transport vehicle that could hold the good quality of vegetables delivered from farm to market, and the use of innovative packaging depending on the types of vegetables.

Similar with the case of DFTC in Kapatagan chain, the facilities in the previously built Maragusan trading post were considered as one of the government's white elephant interventions. The chain actors reasoned out that there is no demand for the use of cold chain technologies in the area. This is due to the cooler temperature perceived as

enough to sustain the freshness and quality of vegetables grown and traded. Also, with Bankerohan as the main wet market where the midstream actors dispose their products, it remained congested despite the attempt of the regional government through DFTC establishment. The purpose was supposedly to regulate storing, handling, and packaging guidelines to reduce post-harvest losses in the chain. Another factor to the failure of this innovation was the lack of policy regulation in Maragusan to reinforce and strictly implement the rules and regulations in utilizing these cold chain technologies.

At present, the traders/wholesalers/viajedors/retailers in the area use wooden crates for tomatoes, carton boxes for bell peppers, and some vegetables such as chayote remained to be packed in sacks. Although they are aware of "vacuum" or polyethylene bags as vegetable packaging, they are still apprehensive in personally adopting them. However, the recommended innovative packaging for tomatoes which is to incorporate newspaper lining in all of the sides of the wooden crates is still not widely used in this chain. They perceive that the use of wooden crates (see Figure 22) as packaging was already innovative enough with little willingness to adopt the lining system. The tomato wholesalers, retailers, and ambulant vendors, especially in Bankerohan mentioned that paper lining in these crates would only cause them additional cost - both in procuring newspaper linings, and fee in disposing the lined newspapers after delivery.



Figure 22. Tomatoes in a wooden crate

5.3.6. Summing up: leverages for innovation, internal and external drivers of change

Adoption Benefits are Greater than Adoption Costs

The interviewed chain actors cited that they will be incentivized to adopt the technologies and innovative practices when the benefits cover the additional costs. Their encouragement will also be influenced greatly by the benefits experienced by their fellow chain actors who already adopted these innovations.

Strong Support from the Enabling Environment

Another pathway would be to offer these innovations as subsidies by the enabling environment. The local government unit in Maragusan through their municipal agriculture office (MAO) play a crucial part in coordinating and encouraging these chain actors to adopt the innovations. This can also be done by channelling the subsidies, support, and assistance in reducing PHL and improve food safety implementation through the proposed Maragusan Vegetable Growers Association.

Improved market access

Buyers and market outlets requiring proper packaging materials and handling practices could create higher adoption level toward these upstream and midstream actors. For instance, vegetables, especially tomatoes from Maragusan packaged in lined wooden crates or be sold in wholesale/retail through polyethylene clear bags entail access to institutional buyers, the chain actors showed high willingness to adopt these innovations. The proposed software application of one of the large-scale farmer-consolidators in the chain could also be used in attaining this goal. This is because the application could potentially monitor the volume and type of vegetables needed in different market channels Maragusan chain actors are supplying to.

Leveraging over the socio-demographic factors in the chain

It was observed that in the vegetable chain of Maragusan, there is a distinction of gender roles. Since most of the labor-intensive activities are played by men, and women are assisting or assigned to management and marketing roles, it would be better to use their chain function in adopting the innovations. Female chain actors could act as information drivers of the benefits the innovation to their operations. This could also pave a way for additional employment opportunities for them (e.g., be assigned to put newspaper lining to the wooden crates of tomatoes). Meanwhile, male chain actors who directly visit the supplying farms can act as inspectors of food safety protocols (e.g., GAP) at production and post-harvest stages. However, this can still depend on how effective and efficient the market access and enabling environment's support are in implementing these gender roles in the chain.

Table 16. Roles of key players in addressing the objectives in Maragusan vegetable chain - tomato

Objective	Roles of key players in addressing the objectives
Reduce postharvest losses	<ul style="list-style-type: none">○ Adoption of proper packaging for tomatoes such as wooden crates with newspaper lining (all corners and/or on two sides)○ Construction of farm-to-market roads○ Proper implementation and regulation in using cold storage proposed through Maragusan Vegetable Growers Association
Improve food safety	<ul style="list-style-type: none">○ Reduced use of chemicals at farm level (individual farmers, farmer-financiers) and at the logistics node (proper handling and packaging practices - e.g., GAP-adoption).○ MAO should intensify promotional efforts of PhilGAP adoption and application among chain actors.

5.4. Conclusions

The vegetable industry in Maragusan is mainly composed of informal chain actors (formally/legally unregistered and unorganized), from upstream to midstream. Even the dominating actors in the chain - the middlemen or dicers - are also operating informally. For the large-scale consolidators and traders, most of them were previously registered but disincentivized to renew due to irregularities in operations and price volatility of vegetables in the market. The factors that influence their decision to remain operating informally in the chain include: the necessity and opportunity, low barriers to entry, cost efficiency and autonomy in operations.

Unfortunately, they were faced with high risks in their operations under the informal sector such as the lack of legal documents to prove validity of uncollected debts in credit-based transactions, passive perception on post-harvest losses reduction, and limited access to market information and government assistance programs. Also, the lack of farm-to-market roads is another disincentive for them to adopt the introduced innovations in the chain.

However, this project was able to capture the opportunities for these chain actors to potentially adopt these innovations, particularly in reducing post-harvest losses and implement food safety measures. These include the following: their perceived benefits are higher than costs incurred associated with adoption, the strong support of the enabling environment, improved market access to institutional buyers, and leveraging over the gender roles of chain actors.

Given the above conditions in Maragusan vegetable chain, the following are recommended to help improve the operations of the chain actors, and the entire chain as a whole:

- There should be an external regulating body to strictly impose the rules and regulations - this is suggested to the plan of launching the Maragusan Vegetable Growers Association by means of having control over the equitable access of the actors to the innovation offered by the organization (e.g., cold storage, and other facilities), and appropriate utilization and maintenance practices of such facilities in the area. Sanctions and penalties must also be incorporated in implementing these rules to further push the users of the innovative facilities to properly handle and operate them with utmost care. By doing so, this will prevent the re-occurrence of the mismanagement and other possible reasons as to why the former trading post failed to sustain its role in the chain.
- The implementing rules and regulations (IRRs) must be accompanied with the incentives from the enabling environment which are but not limited to lower dropping fee, lower transaction/transportation costs, and higher buying prices than in the traditional setting - this would also entail the implementation of appropriate packaging materials for each type of vegetables (e.g., lined wooden crates for tomatoes). Through it, the association in collaboration with the LGU and MAO in Maragusan will serve as an impetus for the reduction of post-harvest losses and providing safer and more accessible vegetables to the consumers.
- Construction of farm to market roads - given that Maragusan's topographic features include mountainous areas, it would indeed be appropriate if the LGU would help in building farm to market roads that would connect these far-flung vegetable farms to the nearest trading post or towards the proposed association. Subsequently, with better roads, the vehicles that could access these areas will also be improved, hence, reducing transaction costs as well as the high incidence of post-harvest losses through the use motorcycles with carriers or *katig*. Potentially, with reduction happening in these two, the market price would then be lessened, thus, slowly contributing to the attainment of the goal in providing accessible, affordable, and safe food for the consumers involved in this chain.

6. Integration of the Three Cases: Mango, Cabbage, and Tomato

6.1. Key findings

Based on the results and findings in the three cases: mango, cabbage, and tomato value chains in the Southern Philippines, the integrated summary in relation to the framework of this study is indicated below. The succeeding sections would be composed of the major components in the framework such as: internal and external drivers, the incentives and disincentives. These components affect the chain actors' decision and behavior in operating informally, roles in reducing post-harvest losses and implementing the food safety measures. and the innovation. On the latter part would be the innovation section containing the level of adoption at present and willingness to adopt of the chain actors in the three chains. Also, it would discuss about the past (introduced and practiced) and the future innovations (to be introduced by the project or practiced in other areas) in these chains.

Table 17. Internal drivers of the three chains

Internal Drivers	Chain/Case Findings
Motivations	
Necessity and opportunity	Operating in informal sector due to immediate need of cash; convenient access to inputs, credit and financing assistance from informal actors in the chain; autonomy in operations; ability to sustain operations and profits; multiple chain activities/roles played by single informal chain actor;
Low cost of operations	Paying a daily market tax of PhP 10 to PhP 20 instead of formal and legal registration from DTI or BIR; small-scale chain actors could transact with truckers or commute with PUVs to transport lower volume of mangoes or vegetables;
Trust and reciprocity	Ensuring trust through transparent and on-time payment and transactions among buyers and co-midstream actors; relational system of operations where functions and roles are also played by their family members or relatives to capture higher trust and reciprocity benefits;
Limited formality requirement from the market	10 percent of the buyers require formal registration and business permits from their suppliers in the chains (e.g., exporters, processors, and institutional buyers), the rest are already transacting with informal chain actors
Risks	
Seasonality	The demand for fresh fruits and vegetables start to heighten during November until December due to the holiday season; June to September is also the season of harvest to other fruit and vegetable producing regions (e.g., Cordillera and Leyte) dropping Mindanao prices <i>Strategies:</i> Control production schedules and volume with regard to seasonality and market demand; Grow all year round by planting to ensure monthly harvest (mangoes), or through crop diversification and rotation (vegetables); supplying to processors within Davao region
Credit-based and delayed payments	Some buyers transact on credit or consignment terms but issue delayed payments, or worse uncollectible debts <i>Strategies:</i> Control or totally discontinue financing and credit-based transactions to untrusted growers/buyers; traders/wholesaler allot buffer funds to be paid to growers or other midstream actors when buyers issue delayed payments

Post-harvest losses passive perception	Collective agreed that it is inevitable for fresh fruits and vegetables to incur high post-harvest losses than other commodities <i>Strategies:</i> charge lower prices for low quality produce; minimally processing;
Health and safety risks	Growers' heavy reliance and application of chemicals; laborers' risks in handling and carrying heavy loads of mangoes and vegetables to be delivered (logistics to consumption nodes) <i>Strategies:</i> Minimizing the use of yellow-labeled chemicals; careful handling and carrying of loads

Table 18. External drivers of the three chains

External Drivers	Chain/Case Findings
Legislation	Daily market tax collection of PhP 10 to PhP 20 in Bankerohan wet market; poor implementation of BMBEs Act of 2002 and Food Safety Act of 2013; and DFTC turning to be the white elephant project of Davao region
Information and technology transfer	Conduct seminars and trainings for chain actors to be well aware and knowledgeable of innovation benefits and advantages; private chemical companies' technicians doing knowledge and technology transfer to remote areas; inadequate efforts of MAO to inform the chain actors of government programs and registration guidelines (e.g., RSBSA and association creation)
Better market access	One major pathway to adoption of innovation in storage, handling, and packaging would be better access to institutional buyers requiring these standards; this can be done through leveraging on established associations and cooperatives to initiate clustering programs, as well as private and public partnerships;
Support from the enabling environment	Coordination and encouragement through MAO and LGU efforts in innovation adoption; linking with established associations and cooperatives in these chains to channel government and private programs and assistance; improvements in the facilities, accessibility, and implementing rules and regulations of DFTC; and construction of farm-to-market roads in these three major fresh fruit and vegetable producing areas of the project

Table 19. Incentives of the actors in the three chains

Incentives	Chain/Case Findings
Quality improvement	Another pathway to adoption of innovation would be to see there are improvements in the quality of mangoes and vegetables after adoption than traditional practices; lower chemical residue, higher volumes of premium or Class A produce sold in the market; free of mechanical, microbial, and physical damages;
Longer shelf life	Due to seasonality of fruits and vegetables, extension of shelf life to meet high demands during off-season is another pathway to adoption of innovation; preservation of fruit and vegetables' quality and freshness after logistics - result to higher volume of good quality mangoes and vegetables traded in the chain, generating higher profits for the midstream actors and better quality for the end-consumers
Market-driven operations	When more buyers require appropriate storage, handling, and packaging standards, the chain actors would be forced to adopt innovations; following biodynamic calendar of production anchored to the highly demanded crops in the market at varying periods or seasonality;

Informal organizations' existence	The existing organizations for growers, dicers, traders, truckers, wholesalers, retailers, and ambulant vendors in these chains are also operating informally; very low lifetime membership fee (PhP 1,000) but benefits do not directly improve chain operations Benefits: low membership fee, collective action, emergency and burial assistance, gathering and fellowship among chain actors
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Table 20. Disincentives of the actors in the three chains

Disincentives	Chain/Case Findings
Risk aversion	High perceived costs in adopting innovation in the chains and high perceived benefits from traditional practices; DFTC facilities are still not operational due to chain actors' negative perception and limited knowledge of the innovations' benefits
Current practices	Use of polypropylene sack packaging; overloading of transport vehicles; use of Calcium carbide; sitting on top of loads of fruits and vegetables; using refrigerated vehicles but occasionally use air condition to minimize cost - all significantly contribute to high incidence of post-harvest losses and food safety issues
Operational irregularities	After the pandemic period, chain actors experience volatility in prices and operation irregularities - pushed the previously registered chain actors not to renew and remain in informal sector; this also incentivized the small-scale chain stakeholders to operate informally due to the sense of autonomy whether to continue or impede operations during unfavorable market conditions
Limited demand for "safe" fresh fruits and vegetables	Buyers and consumers are less particular with safe fruits and vegetables in the market as they are more price-sensitive and quality-sensitive based on appearance and taste
Lack of market information and government interventions	Operating informally in these chains entail limited market information and government programs and subsidies unlike those chain actors in the formal sector (e.g., RSBSA-registered growers; traders with business and travel permits can expand services rendered in the chain)

6.2. Innovation

In this section, the past and new innovations (technology of practices) in the three covered chains will be discussed. The integrated post-harvest practices in these chains are summarized below (see Table 21) based on the assessment done by Secretaria et al. (2023) in various fruit and vegetable markets in Mindanao. These practices are observed from the wholesalers and retailers, mostly found in Bankerohan market in Davao City sourcing mainly from Kapatagan and Maragusan).

Table 21. Post-harvest practices and losses of chain actors in cabbage, tomato, and mango

Chain/ Commodity	Current Practices	Losses (%)	Cause(s) of Losses
Cabbage	<p><i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle</p> <p><i>Packaging:</i> polypropylene sack, recycled carton box</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> Damages leaves and butt-end</p> <p><i>Repacking:</i> polyethylene/plastic bags</p> <p><i>Sorting:</i> YES</p> <p><i>Minimal processing:</i> YES</p> <p><i>Display arrangement:</i> Bamboo/wooden rack, plastic tray</p>	13	Soft rot, insect damage, wilting, trimming loss
Tomato	<p><i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle</p> <p><i>Packaging:</i> wooden crate</p> <p><i>Washing/Cleaning:</i> water/water with detergent in Agdao market</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags</p> <p><i>Sorting:</i> YES (separating/removing damaged and overripe, then, charge for lower prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic trays, wooden crate (unlined)</p>	30	Soft rot, physical bruises, decay, overripe, skin blemishes, mechanical injuries
Mango (ripe)	<p><i>Transportation:</i> bongo trucks</p> <p><i>Packaging:</i> recycled carton box, bamboo mesh basket "bukag"</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags, bamboo mesh baskets "bukag" for Calcium carbide application</p> <p><i>Sorting:</i> YES (different quality grade charged for varying prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic rays, wooden crate</p>	5	Decay, bruises, fruit fly damage, overripe, shrinkage

Mango (green)	<i>Transportation:</i> bongo trucks <i>Packaging:</i> polypropylene sack <i>Washing/Cleaning:</i> NO <i>Trimming:</i> NO <i>Repacking:</i> NO <i>Sorting:</i> YES (damaged and downgraded quality charged at low prices) <i>Minimal processing:</i> YES (sliced street mangoes) <i>Display arrangement:</i> wooden table, carton box, bamboo mesh	5	Decay, bruises, fruit fly damage, overripe, shrinkage
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Source: Key Informant Interviews and Secretaria et al. (2023)

6.3. Impact pathways for the informal sector in the food system

The achievement of the food system outcomes heavily relies on the opportunities and constraints provided by the chain actors and the corresponding enabling environment stakeholders (IFAD, 2016). This includes the huge contribution of the informal sector in the fresh fruit and vegetables industry. As revealed in this study's findings, the total net value per node provided by mango, cabbage, and tomato alone in Davao region speak volumes. Despite the losses of 5% to 30% in these chains, the average net total value in the three nodes (farm, wholesaler, retail) still range from PHP 53,000 to PHP 2.9 million for 10 years (2012 to 2022). Thus, identifying the significant impact pathways in attaining these goals is crucial to maximize the role of the agri-food system to the regional and even national scales.

Table 22. Six impact pathway questions for informal sectors in the food system

Impact Pathway	Chain/Case Findings
1. What food system outcomes need to be improved?	<p>Post-harvest losses reduction: improvements in current chain practice especially in the logistics node, proper use of packaging materials, adequate legislation enforcement, adoption of innovation to improve quality and shelf-life of fresh fruits and vegetables</p> <p>Food Safety: strict implementation of Food Safety Act of 2013 by government agencies and LGUs, inclusion of proper handling and packaging practices by buyers' requirements, promotion of PhilGAP adoption</p> <p>Access to Healthy Foods: reduction of post-harvest losses, increased demand for safer fresh fruits and vegetables, prevalence of market information and benefits of consuming safer food products, lowered prices and better accessibility of safer and nutritious food products in the market</p>
2. Which actors in the informal sectors of the food system are important to achieve this goal?	Farmers, financiers/contractors, traders, truckers, wholesalers, retailers, processors, institutional buyers, ambulant vendors, laborers
3. What are the principal motives of these actors?	Necessity and opportunity, low-cost operations, trust and reciprocity, limited market formality requirements

4. What are the business strategies of these actors?	Production control, buffer funding, control financing services, lower pricing strategy, minimal processing, judicious chemical usage
5. Which other actors in the food system can influence the behavior of these actors in informal sectors?	Private input suppliers, formal traders (exporters and processors), supermarkets, hypermarkets, government agencies, informal associations, policymakers, private sectors, non-government organizations, consumers
6. Which incentives can be deployed by these other actors?	Legislation (BMBEs and Food Safety Act), market information, technology transfer, training, organization, disrupting bureaucracies, financing services, other incentives

Source: de Steenhuijsen et al. (2023) with modifications

In summary, it can then be inferred that in recognizing the critical contributions of the commonly “hidden middle” chain actors, it also entails subsequent support in terms of improving their current productivity and innovative competence. Moreover, it is also important to incorporate and assess whether they are equally contributing to the attainment of food system outcomes, especially that most of them operate in an informal setting.

Nevertheless, it was determined that in order to achieve the food system outcomes of reducing post-harvest losses, increasing food safety, and providing better consumers’ access to healthy foods, there must be improvements done in the current practices in the chain. In Table 22, innovation adoption also depends on the legislation enforcement by the stakeholders and policymakers. Also, knowledge and information transfer through seminars and trainings must be incorporated in these efforts of the enabling environment’s role toward the chain actors to fulfil these outcomes. The necessary incentives and motivations influencing the adoption and compliance of the informal chain actors to the innovations and legislations must also be highlighted. These include their positive response toward necessity and opportunities provided, low cost of operations in the informal sector, trust and reciprocity among chain actors, and improvements in the quality and shelf-life of fresh fruits and vegetables flowing in the chains. How the informal and formal associations and organizations exist in the chain serves as a vital chunk in incentivizing these informal chain actors to respond favorably to the set outcomes.

References and websites

- ACIAR. (2016). Regional Market Analysis for Mango in the Southern Philippines Market of Davao. Davao City: Australian Center for International Agricultural Research.
- ACIAR. (2016). Regional Market Analysis for Selected Vegetables (tomato, sweet pepper, bitter gourd, and eggplant) in the Southern Philippines Markets of Davao, Cebu, and Ormoc. Australian Capital Territory: Australian Centre for International Agricultural Research.
- DA - Region VII. (2016). VALUE CHAIN ANALYSIS: Highland Vegetables in Central Visayas. Cebu City: Philippine Rural Development Project (PRDP).
- Finger, D.F.J., Santos, I., Silva, G. A., Bernardino, M. C., Pinto, U. M., & Maffei, D. F. (2023). Minimally Processed vegetables in Brazil: An overview of marketing, processing, and microbiological aspects. *Foods*, 12(11), 2259. <https://doi.org/10.3390/foods12112259>
- IFAD (International Fund for Agricultural Development) (2016). The Fisheries Resources Management Programme (FRMP), <https://www.ifad.org/en/web/operations/-/project/2000001144>.
- JICA. (2022). Survey on Issue Analysis of Food Value Chain in the Philippines. Japan International Cooperation Agency (JICA)
- Llemit, R.L.G. (2022, September 21). Davao Food Terminal declared as Davao City's official "bagsakan" for fruits, vegetables. SunStar Publishing Inc. <https://www.sunstar.com.ph/davao/business/davao-food-terminal-declared-as-davao-citys-official-bagsakan-for-fruits-vegetables>
- Official Gazette (2002, November 13). Republic Act No. 9178. <https://www.officialgazette.gov.ph/2002/11/13/republic-act-no-9178/>
- Philippine Statistics Authority (2023a). Major Vegetables and Root Crops Quarterly Bulletin. <https://psa.gov.ph/system/files/csd/Major%20Vegetables%20and%20Root%20Crops%20Quarterly%20Bulletin%2C%20April-June%202023.pdf>
- Philippine Statistics Authority (2023b). Other crops: Volume of production, by region and by province, by quarter and semester, 2010-2023-PX-Web. PX-Web. https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2E__CS/0062E4EVCP1.px/?rxid=17311bfe-fa31-421f-8155-c3e6ca1ed38a
- Philippine statistics Authority (2023c). PX-Web - Select table. (n.d.). https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2E__CS/?tablelist=true&rxid=bdf9d8da-96f1-4100-ae09-18cb3eae313
- Reardon, T., Chen, K. Z., Minten, B., and Adriano, L. (2012), The Quiet Revolution in Staple Food Value Chains in Asia: Enter the Dragon, the Elephant, and the Tiger, Asian Development Bank and IFPRI, December.
- Reardon, T. (2015). The hidden middle: the quiet revolution in the midstream of agrifood value chains in developing countries. *Oxford Review of Economic Policy*, 31(1), 45-63. <https://doi.org/10.1093/oxrep/grv011>
- World Bank (2019). Improving Mindanao Agro-Industrial Competitiveness through better Logistics and Connectivity. <https://documents1.worldbank.org/curated/en/229931588609408993/pdf/Improving-Mindanao-Agro-Industrial-Competitiveness-through-better-Logistics-and-Connectivity.pdf>

Appendix 1

Post-harvest practices and losses of midstream informal chain actors in cabbage, tomato, and mango

Chain/ Commodity	Current Practices	Losses (%)	Cause(s) of Losses
Cabbage	<p><i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle</p> <p><i>Packaging:</i> polypropylene sack, recycled carton box</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> Damages leaves and butt-end</p> <p><i>Repacking:</i> polyethylene/plastic bags</p> <p><i>Sorting:</i> YES</p> <p><i>Minimal processing:</i> YES</p> <p><i>Display arrangement:</i> Bamboo/wooden rack, plastic tray</p>	13	Soft rot, insect damage, wilting, trimming loss
Tomato	<p><i>Transportation:</i> forward trucks, jeep, taxi cab, pedicab, tricycle, motorcycle</p> <p><i>Packaging:</i> wooden crate</p> <p><i>Washing/Cleaning:</i> water/water with detergent in Agdao market</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags</p> <p><i>Sorting:</i> YES (separating/removing damaged and overripe, then, charge for lower prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic trays, wooden crate (unlined)</p>	30	Soft rot, physical bruises, decay, overripe, skin blemishes, mechanical injuries
Mango (ripe)	<p><i>Transportation:</i> bongo trucks</p> <p><i>Packaging:</i> recycled carton box, bamboo mesh basket "bukag"</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> Polyethylene/plastic bags, bamboo mesh baskets "bukag" for Calcium carbide application</p> <p><i>Sorting:</i> YES (different quality grade charged for varying prices)</p> <p><i>Minimal processing:</i> NO</p> <p><i>Display arrangement:</i> bamboo/wooden rack, plastic rays, wooden crate</p>	5	Decay, bruises, fruit fly damage, overripe, shrinkage
Mango (green)	<p><i>Transportation:</i> bongo trucks</p> <p><i>Packaging:</i> polypropylene sack</p> <p><i>Washing/Cleaning:</i> NO</p> <p><i>Trimming:</i> NO</p> <p><i>Repacking:</i> NO</p> <p><i>Sorting:</i> YES (damaged and downgraded quality charged at low prices)</p> <p><i>Minimal processing:</i> YES (sliced street mangoes)</p> <p><i>Display arrangement:</i> wooden table, carton box, bamboo mesh</p>	5	Decay, bruises, fruit fly damage, overripe, shrinkage

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Cover photo

Tomatoes in Bankerohan market displayed on bamboo tables; Alessa Keith Carbonell.

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