Analysis of the Strawberry Value Chain in the Philippines

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ABSTRACT

With the challenges faced by the strawberry industry prior to the COVID-19 pandemic and its experiences during the pandemic, revisiting the strawberry industry is needed through a value chain approach. This study examined the strawberry value chain of the Philippines and recommends various interventions. The study proceeded in two major phases. The first phase mapped the strawberry value chain and determined the status, problems, and prospects for each node of the value chain: input, production, processing, and marketing. The second phase generated intervention models (blueprints) relating to product, market, resource, process and technology, and human capital development. Interviewed representatives of the potential implementing agencies found these intervention models, in the form of blueprints, workable and acceptable. Primary data were gathered through surveys and key informant interviews conducted online or via phone. Secondary data from journals and similar scholarly work supported the primary data gathered.

Keywords: strawberry, value chain analysis, value chain development
JEL codes: Q1, Q13, Q16

INTRODUCTION

The Philippine strawberry industry is primarily attributed to the Cordillera Administrative Region (CAR). According to the Philippine Statistics Authority (2020), CAR cultivates almost all (98%) of the country's strawberries. The region, especially in Benguet and Mountain Province, has become a popular destination among local and foreign tourists. Strawberry picking is their most common activity. Over time, the market for fresh and processed strawberry products in CAR has depended on

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tourists. Hence, travel restrictions and lockdowns brought about by the COVID-19 pandemic in the country greatly affected the industry. Market activity for fresh and processed strawberries at the height of the pandemic was minimal.

Prior to the COVID-19 pandemic, the challenges faced by the strawberry industry were supply chain inefficiencies, limited value creation, and sustainability concerns. Added to these are the pandemic impacts. Thus, the strawberry industry needed revisiting through a value chain approach.

Having resilience, inclusivity, food security, and sustainability in mind, this study examined the strawberry value chain of the country and recommends various interventions. First, the study mapped the strawberry value chain, analyzed the performance of the different components or participants in the chain, and determined the chain's strengths, weaknesses, opportunities, and threats (SWOT). Building upon the results, intervention models to improve the chain were developed and validated through a collaborative approach with stakeholders of the strawberry value chain.

LITERATURE REVIEW

Strawberry in the Philippines

Spanish colonizers introduced strawberries in La Trinidad, Benguet in the 19th century. The American period reintroduced strawberries to meet the demand for all-American salads. The crop adapted well to the local climate, and cultivation expanded to the Trinidad Farm School, now Benguet State University (BSU). La Trinidad became known as the "Salad Bowl of the Philippines" in the 1970s, with Baguio City as the primary market. Strawberry production became a vital source of livelihood, earning the town the nickname "Strawberry Fields of the Philippines" (Shaon 2015).

While the Philippines may not rank among the top strawberry-producing countries globally, PSA data (2020) indicate a positive trend in strawberry production. From 610 metric tons (MT) in 2010, strawberry production increased to 1,202 MT in 2020. Although the volume of strawberries produced is still much lower than leading producers like China and the US, this upward trajectory demonstrates the flourishing nature of strawberry production in the Philippines.

Strawberry production provides different livelihood forms, which benefit many individuals. In Benguet, 825 strawberry farmers earn from selling their harvested strawberries (Quitasol 2020). Agoot (2018) cited in her news article the municipality of La Trinidad in Benguet as one of the top tourist destinations in the country, especially in summer and December. The strawberry farms are tourists' top destination in Benguet, with 282,000 individuals recorded to have visited in 2019. Tourists venture into Benguet province not only for its strawberry production but also for the experience of picking strawberries and buying the harvest at farmgate prices averaging PHP[1] 350 (USD 6.29) to PHP 450 (USD 8.09) per kg, and other strawberry-based products popular in the province (Lapniten 2019). Aside from La Trinidad, Benguet, other major strawberry-producing areas in the region are Baguio City, Buguias and Kibungan in Benguet, and Bauko in the Mountain Province.

The strawberry harvesting season in La Trinidad, Benguet, spans from December to June. Prices of strawberries are influenced by the seasonality of the crop, with lower farmgate prices during the peak months (February to April) and higher prices during the lean months (May to January) (Cordona 2017). The seasonal supply also affects retail and wholesale prices, although specific data on these prices are unavailable for the country. According to PNA (2024), retail prices of fresh strawberries during peak season in the markets and stalls outside the farms ranged from PHP 400/kg (USD 6.83/kg) to PHP 500/kg (USD 8.53/kg). Strawberries picked by visitors themselves on the farm ranged from PHP 700/kg (USD 11.95) to PHP 1,000/kg (USD 17.07).

1 Philippine Peso

Reyes et al. (2017) observed that traders in La Trinidad have significantly influenced strawberry prices. They have set prices that often leave strawberry farmers with no choice but to sell at prices below their break-even point. This power imbalance gives traders an unfair advantage and may lead to price manipulation. The study also revealed that traders can manipulate prices by halting purchases until supply increases and prices fall or during natural disasters and climate shocks. When asked about government intervention to address these situations, the key informants did not respond clearly.

Based on the data on strawberries imported and exported by the Philippines (FAO 2020; UN Comtrade 2020), the demand for strawberries is high, especially among tourists and visitors that enter Baguio City and Benguet. In addition to this is the demand of local strawberry processors. However, local production falls below local demand for strawberries, hence the higher volume of strawberries imported to the country at an annual average of 590.4 MT. This suggests that more needs to be done to improve the local production of strawberries in the country, mainly in CAR, for local supply to meet the local market demand and help stabilize the fluctuating prices of strawberries, especially at the farmgate.

Value Chain Concept

The concept of "value chain" was introduced by Porter (1985) to describe the complete set of activities involved in bringing a product or service from its inception to disposal (Zamora 2016). It encompasses various stages, such as production, distribution, and consumption, with each participant in the chain contributing to the product's overall value (Hellin and Meijer 2006). By breaking down a business into its key activities, the value chain concept helps identify sources of competitive advantage (Abecassis-Moedas 2006).

Value chain analysis has expanded beyond individual firms and applies to industries, clusters, and global systems (Zamora 2016). It has been used to analyze activities that span multiple countries, known as "global value chains" (Sturgeon et al. 2015 as cited by Zamora 2016). Value chains can be categorized based on the dominant role-player: buyer-driven chains, where large retailers and trading companies establish production networks; and producer-driven chains, led by multinational corporations managing production networks (Abecassis-Moedas 2006). Regardless of the type, value chains should represent a natural flow of operations, with value added at each stage (Zamora 2016). According to Chivaka (2007) as cited by Zamora (2016), the ability to create and capture value determines the competitive success of a participant in the chain.

Value-creating activities occur both within the industry and within a company itself (Chivaka 2007 as cited by Zamora 2016). Companies must deliver high performance on customer benefits to create value and surpass costs (Porter 1985). According to Hellin and Meijer (2006), value chain analysis involves mapping the market to understand and analyze the contributions of different actors within the chain and their relationships. By understanding these interactions, it becomes possible to identify the factors that affect how the value chain functions. The resulting market map provides a framework for identifying the value chain actors, the enabling environment, and the service providers. The enabling environment encompasses critical elements such as infrastructure, policies, regulations, institutions, and processes that shape the operating conditions for the value chain.

Strawberry Value Chain and Related Studies

The strawberry industry in China, particularly in Jiangsu Province, has emerged as a sector with significant economic value. However, it faces more challenges than other regions due to limited varieties, lower quality, and lower yield. The strawberry value chain involves stakeholders, including input suppliers, producers, processors, wholesalers, retailers, and consumers. The industry encounters constraints such as limited investment in research and development (R&D), absence of collective action mechanisms, inadequate infrastructure, and unstable land property rights.

To address these challenges, strategies such as increased R&D investment, fostering partnerships, improving infrastructure, and implementing land use reforms are recommended (Wang 2021).

Gaskell's study (2015) examined strawberry production in Albania's Kafaraj area, led by experienced Greek growers. The paper discussed initial yields, market chains, domestic and export markets, postharvest challenges, market saturation, and consumer demand. It recommended interventions to improve production practices, postharvest handling, and marketing strategies. The findings emphasized the importance of research and interventions for Albania's successful and sustainable strawberry industry. Implementing these recommendations can overcome challenges, seize market opportunities, and drive industry growth and stability.

Chaulagain et al. (2022) analyzed strawberry farms' profitability and SWOT in Nepal's Nuwakot district. The study found that farmers in Kakani and Okharpauwa achieved net returns of NPR 159,870 and NPR175,180 (USD 1,199 and USD 1,314), respectively. The distance to the market influenced the difference in returns. The average benefit-cost ratio for both villages was 2.41, indicating profitability. Strengths included favorable climate and farmer interest in strawberry farming, while weaknesses included the farm-to-market distance. Limited access to technology and pest/disease risks were identified as threats. Strawberry cultivation supports job creation and allows the utilization of marginal lands in Nepal's economic development.

To reduce the gaps, Chaulagain et al. (2022) recommended that the government should provide financial and technical assistance to farmers to facilitate expanding market outlets for their products. The researchers also suggested providing high-yielding and disease-resistant runners (i.e., stolons as planting materials). To reduce losses incurred during transportation, the researchers advised establishing processing and cooling facilities near the market. They further urged developing market-oriented policies and programs to optimize production and effectively penetrate the markets.

METHODOLOGY

Analytical Framework

The Philippine government's Department of Science and Technology (DOST) Smart Food Value Chain Framework (Figure 1) guided this study. This framework was based on Michael Porter's Value Chain Model, a framework originally used at the firm level. The latter model has two broad categories: primary and secondary activities. The primary activities, or those that are basically immediate to the value addition process, include inbound, operation, outbound, marketing and sales, and services activities. The production, processing, distribution, and consumption activities in Figure 1 comprise these primary activities. Meanwhile, the secondary or support activities as defined by Porter (firm infrastructure, human resource management, technology development, and procurement) consist of those efforts related to food security, waste management and recovery, human resource development, and smart/innovative technologies, as well as the supply chain management systems.

To operationalize the DOST Smart Food Value Chain Framework, this study subscribed to the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) Operational Value Chain Framework (Figure 2). The framework followed two phases: value chain analysis (phase 1) and value chain development (phase 2).

The first phase involved tracing the value chain from input to consumption. The key players and their corresponding products or outputs and activities were discussed along the value chain. At the end of the chain, requirements and preferences from end consumers and institutional buyers were provided. The value chain was analyzed by discussing the strengths and weaknesses and the opportunities and threats surrounding the value chain players. Wherever possible, these attributes (SWOT) were presented as prepandemic or due to the "new normal" condition postpandemic.

Figure 1. DOST smart food value chain framework

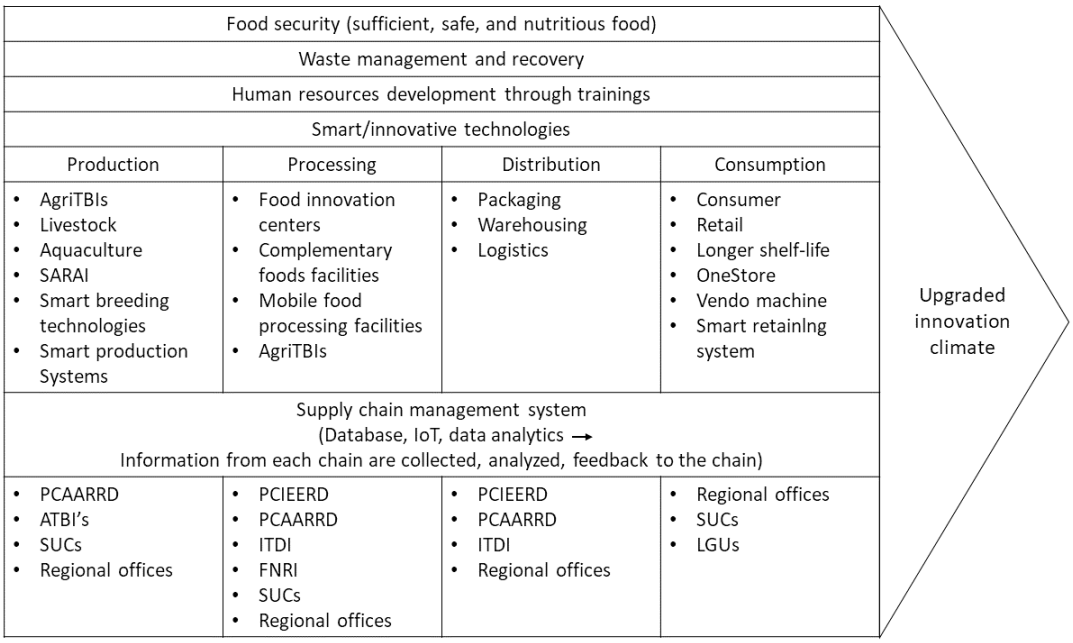
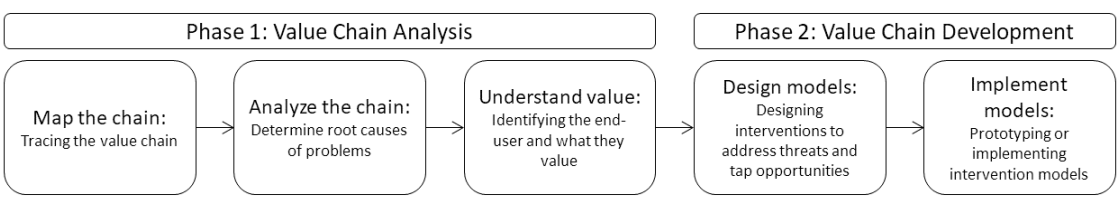


Figure 2. PCAARRD value chain operational framework



Building on the results of phase 2, various intervention models were presented. These interventions serve to rationalize the existing and pipeline efforts of PCAARRD, other government agencies, and those in the private sector. The intervention models reflected product, process, function, and general upgrading of the value chain. This study attempted to recommend toward (1) continuous, efficient, and inclusive value chain operation; (2) new, smart, and innovative ways of production, processing, distribution, and retail; and (3) food security, having an available and accessible healthy diet for Filipinos (Figure 3).

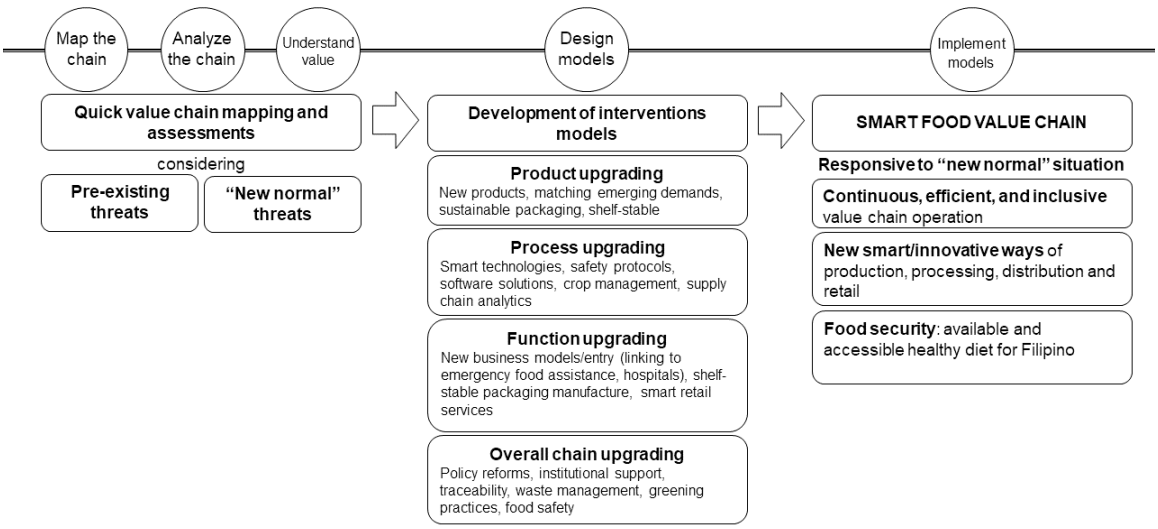
Data Collection and Analysis

Phase 1: Value chain analysis

For the value chain analysis phase, the first strategy was to thoroughly review the literature to have an overview of the strawberry industry or commodity system. This facilitated the surveys and key informant interviews (KIIs). These secondary data were from published and unpublished materials such as theses, special problem reports, and term papers of university students.

After gaining sufficient information about the commodity and industry, KIIs with technical experts, municipal agriculturists, and association

Figure 3. Detailed operational framework



officers were conducted from July to September 2021. These informants were selected based on their knowledge, expertise, and engagements with the players of the strawberry value chain, especially those in the production node. As provided earlier, answers to the guide questions in mapping and describing the value chain were elicited from these individuals. Information gathered include the activities, products, and players in the value chain, and customer preferences and requirements for strawberry products. Further, the researchers sought the informants' perceived strengths and weaknesses among players and opportunities and threats for the value chain. Insights from the KIIs supported and validated the results of the survey that was limited by the mobility restrictions brought about by the COVID-19 pandemic.

A survey with a few players in the value chain, such as farmers, wholesalers, consolidators, processors, and retailers followed. These players were identified through purposive and snowball sampling.

In summary (Table 1), the study engaged 26 individuals interviewed/surveyed, 13 of whom were value chain players (four farmers, three processors, two wholesalers, two consolidators, and two retailers). The rest were key informants.

Table 1. Summary of surveys and KIIs conducted

Sources	Number
Technical experts, municipal agriculturists (KII)	8
Value chain players (survey)	18
Farmers (including association officers)	9
Processors	3
Wholesalers	2
Consolidators	2
Retailers	2
Total individuals	26

After analyzing the key players and their activities within the value chain, the next step was determining their value additions. Value added is the quantity of wealth a player generates in the chain, measured by deducting the costs of goods bought in and services from their net sales. The computed value added was based on the key informants' estimated total cost of intermediate inputs (TCI), total volume produced or sold (TV), and total sales received (TS). Estimated values from strawberry farmers and processors were factored per production, while estimated values from retailers, wholesalers, and consolidators were considered per year.

Phase 2: Value chain development

For the value chain development phase, the strengths, weaknesses, opportunities, and threats (SWOT) of the players in the value chain were determined using the data collected from Phase 1 of the study. The study followed the SWOT matrix approach to systematically generate possible strategies or interventions to improve the Philippine strawberry value chain. However, to facilitate prioritizing and validating the intervention models, the strategies were classified into five clusters: (1) product development, (2) market development, (3) resource development, (4) process and technology development, and (5) human capital development.

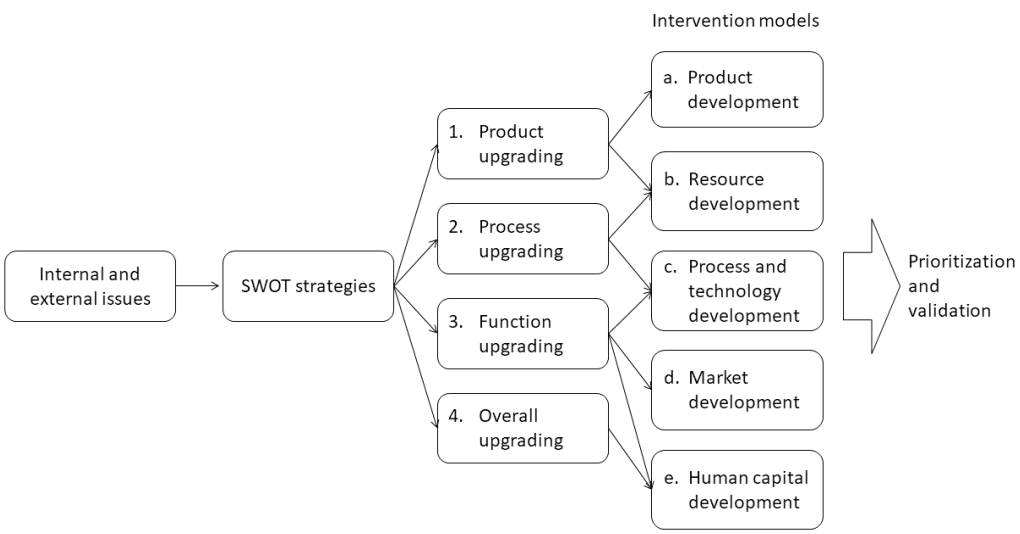
To make the strategies more specific, the study attempted to align various existing and planned strawberry programs and technology or policy initiatives of the regional offices of the Department of Agriculture-CAR (DA-CAR), the Department of Trade and Industry-CAR (DTI-CAR), and DOST-CAR, among others. Stakeholders were consulted to validate and prioritize these intervention models. They included those interviewed during Phase 1 and newly identified or referred individuals from stakeholder agencies. The stakeholder analysis took place through phone calls and online meetings. Figure 4 shows the flow of development of interventions.

Validation meetings were also conducted to elicit the key players' and stakeholders' comments, recommendations, and acceptance (in principle) of the intervention models. After preparing the initial blueprint of each intervention model, three rounds of validation were conducted with representatives from stakeholders to elicit the comments, recommendations, and willingness of stakeholders to cooperate with the lead agencies upon implementation of the interventions.

Limitations

This study focused on analyzing the strawberry value chain in CAR by mapping its core processes, key players, interactions, product flows, and supporting functions. However, due to challenges such as refusals, time constraints, and COVID-19-related restrictions, the interviews were limited to two to nine representatives from each value chain segment. The study significantly relied on secondary data and KIIs. It explored the impact of the COVID-19 pandemic on the strawberry value chain in CAR from March 2020 to December 2020, highlighting vulnerabilities and government initiatives. Further

Figure 4. Development of intervention models



limitations encountered in the study are related to confidentiality and internet connectivity issues.

With the nonprobabilistic sampling employed and given the small sample sizes for each node in the value chain, the overall result of this study is not expected to statistically encompass the industry's diversity. However, the study addressed this limitation through KIIs conducted to verify or validate the findings obtained through the survey of the value chain players. Further, while majority of the surveys and KIIs were via phone calls or online meetings, care was taken to cross-validate the responses between and among various respondents and informants whenever possible and appropriate.

The study solely focused on the proposed intervention models and excluded their implementation. Further, while the final models were deemed workable and accepted in principle, such perceptions are limited only to those who participated in the validation meetings.

RESULTS AND DISCUSSION

Phase 1: Value Chain Analysis

Key customers and product requirements

The Philippine National Standard PNS/BAFS 1254:2014 establishes criteria for marketing fresh strawberries, emphasizing cleanliness, pest-free status, and a minimum of 75 percent red coloration for ripeness. Grading includes Extra, Class I, and Class II based on quality, with Extra denoting superior quality. Size classification depends on fruits per kilogram or weight.

Table 2. Size classification of strawberries

Size Classification	Number of Fruit/kg	Average Fruit Weight (g)
Small	>110	6 – 7
Medium	70 – 109	8 – 14
Large	50 – 69	15 –20
Extra Large	<50	>20

Uniform packaging is vital, especially for Extra Class strawberries, which require uniform ripeness, color, and size. Adequate packaging, cleanliness, and ventilation are stressed, with clear labeling for retail and nonretail containers (BAFS 2014).

CAR has no specific standard for marketable strawberries. Common practices involve removing damaged and undersized strawberries, with varieties such as King Berry and Sweet Charlie classified by size. Institutional buyers prefer Sweet Charlie for its sweeter taste, while restaurants and pastry shops favor King Berry for its larger size. Demand peaks from November to January, causing price increases, and prices rise from June to October due to low supply during the rainy season. Though national standards enhance market competitiveness, local practices, preferences, and seasonal dynamics play a significant role in the strawberry market in CAR.

Key players and their roles

Input provider

Agencies like the DA, through its Bureau of Plant and Industry (BPI); DOST; BSU; and local government units (LGUs) support strawberry farmers with inputs such as fertilizers, planting materials, pesticides, and tractors. They also introduce new technologies like greenhouses and hydroponics, with BSU and LGUs distributing planting materials produced through tissue culture technology.

Producers

Strawberry farms in CAR range from about 500 to 800 m^2 in size. Farmers manage tasks like input sourcing, land preparation, and maintenance with family or hired help. During postharvest, they sort, pack, and deliver strawberries to markets and processors. Farming methods range from conventional to organic, good agricultural practices (GAP), and hydroponics. La Trinidad and Baguio City are key locations due to favorable weather and elevation. Emerging farmers are found in areas like Bauko and Kibungan within CAR.

Processors

Aside from fresh strawberries, CAR is also known for the different processed strawberry products produced in the region, such as jams, preserves, and wine. Strawberry processors in CAR purchase their strawberries from the farmers. They usually prefer to use the Sweet Charlie variety in processing strawberries.

Market traders/distributors

The key players in marketing and trading fresh and processed strawberry products are wholesalers, consolidators, retailers, and strawberry processors.

Wholesalers act as intermediaries, buying fresh strawberries in bulk from farmers in La Trinidad and Baguio City and selling them in turn to retailers in smaller volumes. Wholesalers impose minimum order requirements and utilize online platforms for wider reach. They communicate through text messages or farm visits. They package the strawberries in boxes and sell them directly to retailers in CAR or through online platforms like Facebook and Shopee.

Consolidators are distributors who purchase strawberries from farmers at a fixed price and arrange their own transportation. They have established relationships with buyers like hotels, restaurants, and public markets. Consolidators may pick up strawberries directly from farms, pay based on the quantity sold, and set a minimum order requirement, usually five to 10 kg per order.

Strawberry processor wholesalers are the strawberry processors who distribute their products to retailers and have also established buyer-seller relationships with them. They also require a minimum purchase volume, usually five to 10 boxes sold wholesale. Strawberry processor wholesalers do not sell online, just like the consolidators. Their primary focus is processing strawberries and distributing them to retailers.

Retailers are essential in the strawberry value chain, buying from wholesalers or consolidators and selling to consumers. They work closely with wholesalers, repacking strawberries at smaller volumes with lower prices. Retailers accept cash, bank transfers, and online payments. They exist in CAR and other regions, with some selling processed strawberry products. Online retailers offer delivery services through local couriers to adapt to pandemic restrictions, while traditional retailers rely on in-store visits.

Activities and processes in the value chain

Input provision

BSU and DOST use tissue culture technology to produce strawberry runners sold to farmers through municipal or city agriculture offices. The process involves sterilization, excision, establishment, acclimatization, and runner production. Researchers identify suitable strawberry varieties in the region. Ongoing R&D can lead to the discovery of new strawberry varieties adapted to areas like Baguio City and La Trinidad.

Production

Strawberry farmers engage in activities to ensure plant growth and high-quality production. This includes procuring input materials, hiring helpers, and implementing pest and disease control measures. Farmers communicate with buyers during the growing season. After harvest, they sort, pack, and deliver the strawberries in containers like styrofoam crates or baskets.

Processing

Processing strawberries typically entails employing workers to clean the berries and transform them into desired products such as jams, wines, and jellies. This involves various steps, including slicing, mashing, blending the strawberries with other ingredients, simmering or boiling, and allowing them to cool. The process may need to hire workers, use fuel for heating, and ingredients such as sugar and water. Larger-scale operations may require machinery for mixing and processing strawberries. Packaging the processed strawberry products involves using containers such as bottles and jars, applying labels, and sealing the final products.

Marketing/trading

Wholesalers and consolidators perform crucial tasks to market their strawberries. These include cleaning the strawberries to ensure food safety and prevent spoilage or microbial contamination. Additionally, they sort the strawberries, distinguishing between first-class and second-class quality while organizing them by variety and size. Before delivery, they meticulously pack fresh strawberries in boxes using straw ropes and packing tape.

The activities of strawberry processor-wholesalers include packaging the bottled processed strawberry products into boxes and sealing them with packing tapes and labels. Distributing bulk amounts of their products to retailers follows.

Retailers sell fresh strawberries and processed products like jams, preserves, and wines. They clean and sort again the fresh strawberries received from wholesalers or consolidators based on quality, size, and variety. Repacking allows for smaller volumes with lower prices. They sort processed products by size and properly seal and label them before offering to consumers.

Flow of product, information, and payment in the chain

Fresh strawberry is the most common product in the strawberry value chain in CAR. The chain involves input providers, farmers, distributors (wholesalers and consolidators), retailers, and the local market. Strawberry farmers in La Trinidad usually buy their planting materials (runners) from BSU, DA-CAR, and DOST-CAR for PHP 10 (USD 0.18) to PHP 25 (USD 0.45) per runner. Farmers obtain planting materials and prepare the land for growing strawberries. They apply compost, fertilizers, and pesticides while weeding and watering. Farmers or strawberry-picking tourists harvest the strawberries. When harvested, the strawberries are sorted, packed in crates or boxes, and sold to wholesalers and consolidators. The distributor pays the farmer on a semimonthly or monthly basis. This arrangement depends on the weight in kilograms the farmer delivers in a given period. Processors usually pay upon delivery or upon picking up the strawberries.

When consolidators deliver fresh strawberries to their buyers, they usually have their own vehicles or avail themselves of sea transportation for buyers from the Visayan region. Consolidators do not follow a payment-first policy since they have already established buyer-seller relationships. They usually collect payments from their buyers semimonthly or monthly through bank transfers and online payments.

On the other hand, wholesalers avail themselves of couriers such as taxis, vans, and buses when delivering fresh strawberries purchased by buyers from CAR, the National Capital Region (NCR), and other provinces in Luzon. Fresh strawberry wholesalers in CAR follow a payment-first policy before shipping out the ordered strawberries. The modes of payment they accept include cash, bank transfer, and online wallet transfers like GCash and PayMaya.

Meanwhile, retailers sell fresh strawberries and processed products like jams, preserves, and wines. Retailers commonly have their own physical stores, while those who offer delivery of their products commonly hire local couriers for transportation. The mode of payment is cash upon pick-up from their retail stores or stalls and online payment or bank transfers when an order is made online. Retailers do not have a required minimum purchase per order.

On the other hand, the value chains for processed strawberry products involve input providers, farmers, and processors. Farmers deliver their harvested strawberries to processors through contracts or direct sales. Processors then prepare the products, place them in sterilized bottles or jars, and chill them for improved shelf life. They distribute the processed products to retailers or sell them directly to consumers.

Small-scale processors, often operating from home, manually produce limited quantities of products and sell them at their own stalls, online, or locally. Large-scale processors have dedicated facilities and machinery and employ more workers. They distribute products to retailers, *pasalubong*

(take-home goodies) stores, supermarkets, and hotels. They receive payment upon delivery or purchase, with online orders using bank transfers or online payment platforms. They distribute processed products to retailers in CAR, the NCR, Luzon, and Visayas.

Figure 6 presents an overview of the strawberry value chain in CAR. The strawberry value chain starts from the input providers who provide planting and other materials to the strawberry farmers, who then sell their harvest to the distributors and strawberry processors. The distributors and strawberry processors are the ones who will market the strawberry products to the end consumers.

External influences

Government and nongovernmental organizations engaged in developing technologies and policies support the strawberry industry in CAR. They include the DA, BSU, LGUs, DOST, BPI, DTI, Department of Labor and Employment, state universities and colleges, and other strawberry-based organizations. These institutions ensure the continuous operations of each key player within the value chain by providing financial aid, training, seminars, skill enhancement, and marketing support.

Value added

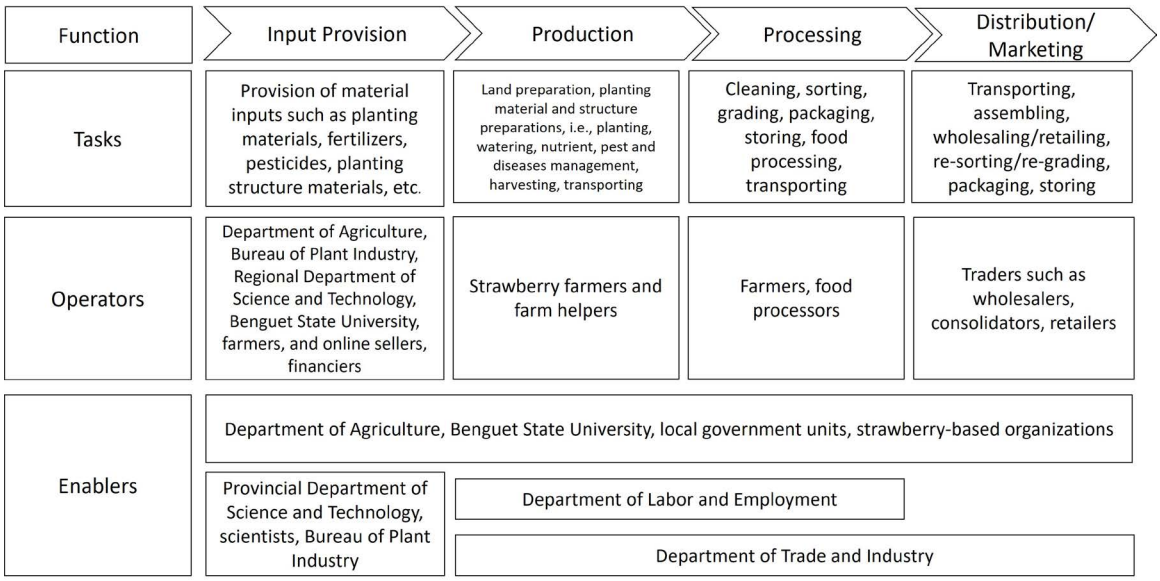
Figure 7 shows the estimates for value added across the two subchains considered in this study. The first subchain involves farmers, wholesalers/consolidators, and retailers; while the second subchain consists of farmers and processors.

Value added by farmers and processors is expected to be the least among the key players due to their higher production costs. In contrast, wholesalers and consolidators are expected to have the highest value added within the chain.

Value added along the strawberry value chain was computed. For the traditional fresh strawberry subchain, consolidators had the highest value added at PHP 433.33/kg (USD 7.79/kg) in the prepandemic period and PHP 284/kg (USD 5.10/kg) during the pandemic. Meanwhile, farmers had the lowest value added along the chain at PHP 41.75/kg (USD 0.75/kg) in the prepandemic period, which further decreased to PHP 19.82/kg (USD 0.36/kg) during the pandemic.

The BSU Agri-based Technology Business Incubator (BSU-ATBI) experts concurrently

Figure 6 . Overview of the strawberry value chain in CAR



conducting a strawberry value chain study in CAR validated the computed value added at each node of the strawberry value chain in CAR. While values may vary due to different respondents, BSU-ATBI mentioned that the trends in value added aligned with expectations for their research project. Farmers and processors were anticipated to contribute the least value, whereas wholesalers and consolidators were expected to generate the highest value within the chain.

Strengths and opportunities in the strawberry value chain (prepandemic)

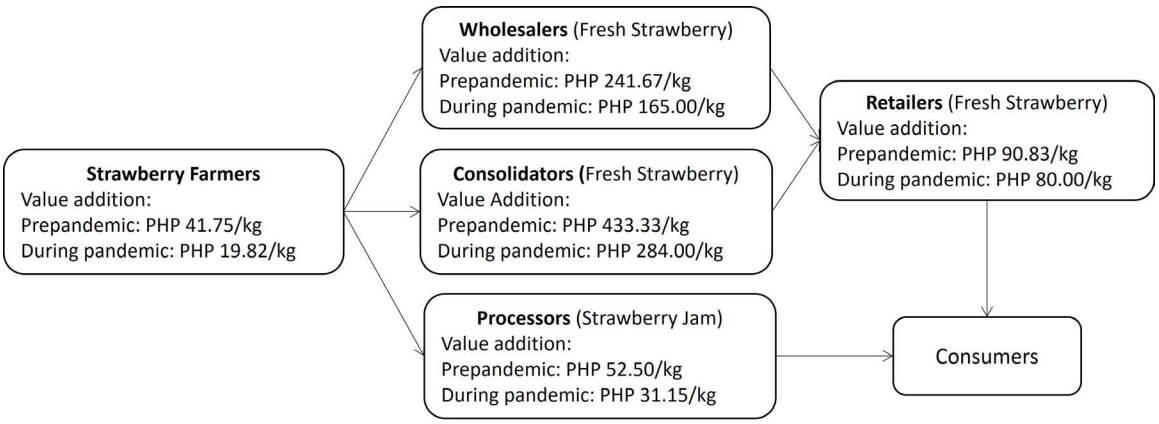
Input providers such as BPI-Baguio, DA-CAR, and BSU possess strengths such as access to disease-free planting materials, use of tissue culture, consistent engagement in R&D, and strategic collaborative relationships. Strawberry farmers in La Trinidad use quality planting materials, adopt new technologies, and benefit from their membership in farmer associations. Processors in Baguio City and La Trinidad gain advantages from their proximity to farmers, ensuring fresh, high-quality products, and maintaining stringent processing standards. Retailers near tourist spots benefit from established buyer-seller relationships, effectively attracting consumers. Wholesalers and consolidators contribute to the value chain by influencing farmgate prices through information exchange.

Key players in the strawberry value chain in CAR also have various opportunities. Input providers can capitalize on the increasing presence of foreign stakeholders by researching new strawberry varieties through tissue culture. Strawberry farmers can enhance production through elevated farming, financial support from associations, and addressing the growing demand for raw strawberries, especially during holidays. Festivals and trade fairs provide a platform for farmers to showcase and sell products to tourists. Research institutions and government support enable the adoption of new technologies in farming. In processing, opportunities arise from R&D, government programs for skills enhancement, and the accessibility of Food Innovation Centers. Marketing and distribution players benefit from local festivals, attracting tourists and investors, and expanding their market presence.

Weaknesses and threats in the strawberry value chain (prepandemic)

Lack of skilled manpower intensified the labor requirement for using tissue culture. Strawberry farmers noted that this limitation leads to the degradation of planting material quality and its limited supply. Tissue culture technology is labor-intensive and time-consuming. Materials need proper handling and preparation to provide

Figure 7. Value added for fresh strawberries and strawberry jams



the right environment for culture and initiating plantlet growth, which require close monitoring.

Small-sized farms averaging 500–800 m^2 limit the revenue from strawberry production, which is further constrained by the cost of labor required. Hence, they lack the capital to adopt technology.

The lack of a postharvest facility for the strawberry farmers is another weakness that leads to their weak price negotiating power. They are forced to sell their strawberries at any buying price offered to them given the highly perishable nature of their produce. Buyers set prices for fresh strawberries, and farmers observed a significant markup in prices passed on, with distributors selling at nearly double the buying price or a markup of almost 100 percent.

The lack of marketing strategies among the strawberry processors led to other weaknesses, such as the market being dependent on the presence of tourists; limited product offering and differentiation; and lack of standards in processing. These weaknesses resulted in low brand awareness among consumers, low market share, and poor market reach, which prevented them from acquiring their maximum potential revenue, thus not having enough capital to avail themselves of processing technology.

Strawberry distributors manually sort and grade the fresh strawberries they purchase from the farmers, which is a weakness that increases labor cost and time consumed. Also, wholesalers do not have their own means of transportation, a weakness resulting in high transportation cost and high postharvest losses. These two weaknesses indicate that strawberry distributors have poor postharvest handling, constraining their capability to reach maximum profit due to postharvest losses.

Threats and opportunities in the strawberry value chain (during pandemic)

The COVID-19 pandemic presented logistical challenges in the strawberry value chain in CAR. Mobility restrictions impeded input provision, affecting suppliers of planting materials. The decrease in tourist visits impacted La Trinidad's strawberry farmers, resulting in low demand and prices for fresh strawberries. Processors also experienced reduced sales, prompting the need for business continuity plans. The economic crisis also resulted in higher input materials and gasoline prices, weakening the strawberry distributors' purchasing power and increasing input costs.

The absence of tourists led to a huge volume of unsold raw strawberries, incurring significant loss and low demand, which resulted in low strawberry prices in the region. The farmers decided to venture into strawberry processing to prevent spoilage of unsold harvested raw strawberries. They processed strawberries into jams and preserves, which they sold to their neighbors or communities. Also, since the demand for strawberries was down, some farmers shifted to vegetable production as they had experience growing other crops, either monocropping or intercropping, aside from strawberries using the free vegetable seeds provided by the LGUs. This increased the variety of crops they could produce and improved their knowledge of vegetable production.

The marketing and trading sector faced difficulties in operations and increased costs due to mobility restrictions. Overall, the pandemic significantly disrupted the entire strawberry value chain in the region, influencing input supply, production, processing, and marketing.

Amid the COVID-19 challenges, opportunities existed for key players. Input providers had potential engagements in R&D initiatives. Strawberry farmers could diversify into work-from home processing, taking advantage of local support and rolling markets. Processors benefited from the presence of "food pass" and new processing facilities. Distributors especially enjoyed opportunities, including being allowed "food passes," embracing e-commerce, using local couriers, collaborating with shipping firms, and expanding their online presence.

Phase 2: Value Chain Development

Intervention models

The results of the stakeholder analysis revealed resource development as an intervention model that frequently ranked first. Hence, the highest priority would be resource development. This is followed by market, product, process, technology, and human capital development.

Resource development

For strawberry cultivation, resource development involves enhancing planting materials, reinforcing related efforts, and exploring innovative techniques. A collaboration between DOST-PCAARRD and BSU-ATBI focuses on providing tissue-cultured strawberry planting materials, along with farmer training in runner production. Another intervention strengthens agencies like DA-CAR, BPI-Baguio, and BSU's Horticulture Training and Research Institute to supply planting materials.

Exploring new propagation techniques is also an intervention to gather information about tissue culture. The final intervention centers on R&D for warm-weather strawberry varieties, aiming for resilient planting materials adaptable to diverse weather conditions. This initiative extends to investigating farms beyond CAR, driven by the need for adaptability.

In summary, the resource development cluster interventions can be categorized into two groups. The first group strengthens input providers, ensuring a steady supply of strawberry planting materials for farmers. The second group focuses on enhancing the quality and variety of propagated planting materials.

Market development

Market development for locally produced strawberries and processed products involves a multifaceted approach to enhance market presence. The first intervention focuses on establishing market linkages and distribution agreements to ensure a sustainable supply chain, fortifying marketability in the face of disruptions like the COVID-19 pandemic.

The second intervention involves coordinating with supermarkets, malls, and online platforms (e-commerce) to address limited access to broader markets. The proposed integration of e-commerce into the strawberry value chain represents a strategic plan to address limited market access. This digital shift could facilitate coordination with supermarkets and malls, providing opportunities for future collaboration with online platforms. The potential adoption of such technologies holds promise for revolutionizing marketing strategies and enhancing the overall organization of the strawberry value chain, both globally and specifically in the Philippines. On the other hand, the third intervention introduces innovative technology, such as DOST Region II's One Store smart vending machines, promising opportunities for small processors to market their products within and outside CAR.

In essence, the market development interventions aim to expand the market reach for key players in the strawberry value chain. These interventions aim to guide players in tapping into new marketing partners or channels, facilitating broader access to fresh and processed strawberry products, and reaching a larger consumer base.

Product development

Product development interventions target expanding and diversifying strawberry processed products to combat market saturation and enhance traditional product quality. The ongoing project of BSU-ATBI introduces products like dehydrated strawberries and strawberry-root crop ice cream. To combat saturation, the next intervention proposes the development of novel products such as strawberry syrup, juice, Korean-style strawberry milk, and strawberry honey.

Another crucial intervention focuses on improving traditional strawberry processed products by enhancing quality, packaging, and labeling for increased consumer appeal. Collectively, these initiatives aim to rejuvenate

the market, offering diverse, high-quality options while addressing existing challenges.

The two product development interventions essentially aim to create new processed strawberry products, addressing market saturation dominated by traditional items. This diversification may attract consumers and encourage the development of new products.

Process and technology development

The process and technology development interventions target improving the strawberry value chain by introducing innovative technologies and practices. The first initiative, led by BSU-ATBI, provides a technology package encompassing protected farming with low tunnels, walk-in tunnels, and greenhouses to enhance productivity and ensure quality through freeze-drying and advanced packaging methods.

The second intervention focuses on a smart food supply chain and resource management system, offering real-time price monitoring through an online application for effective raw product tracing. Additional strategies include promoting polytunnels for weather resilience, establishing toll processing facilities to increase profits, and developing a strawberry sorting and grading machine to reduce labor and time for farmers.

To summarize, the first process and technology development interventions focus on promoting existing technologies and facilities, while the second group of interventions aims to develop new technologies to enhance key players' operations.

Human capital development

Human capital development interventions in the strawberry value chain enhance performance through DOST's Partnership Establishment and Management Support, integrating data via DOST-CAR's One Expert platform. Initiatives include boosting GAP certification for farmers, supporting emerging farmers in CAR with research and LGU aid, and capacity building through DTI-CAR's Negosyo Centers. Additional efforts focus on training processors, encouraging youth in strawberry farming, and ensuring food safety management for quality assurance.

Another recommended intervention, considering the small average farm sizes owned by strawberry farmers, is to promote and support cooperatives as a strategy for advancement. This is crucial for facilitating the proposed interventions and empowering farmers to engage in higher value-adding activities. By encouraging cooperation among farmers, this intervention ensures that initiatives can be more effectively implemented and sustained.

The last proposed intervention is the establishment of partnerships with shipping firms to ensure consistent transportation even during community quarantines, preventing logistics disruptions in the future.

In short, the first set of interventions manages the strawberry value chain in CAR, leveraging the second set to upskill key players. The third set aids key players' operations, creating a cohesive approach for training and support.

SUMMARY AND FINAL REMARKS

This study examined the strawberry value chain in CAR before and during the COVID-19 pandemic, aiming to create a resilient and sustainable smart food value chain. The analytical framework followed two phases: value chain analysis (phase 1) and value chain development (phase 2). Twenty-six individuals served as sources of primary data for the study in the form of KIIs and surveys. The key players in the strawberry value chain are the input providers, strawberry farmers, processors, and distributors (wholesalers, consolidators, and retailers).

Due to fluctuating strawberry prices and study limitations, the computed value-added considered strawberries in general. In the traditional fresh strawberry subchain, consolidators had the highest value added at PHP 433.33/kg (USD 7.79/kg) prepandemic and PHP 284.00/kg (USD 5.10/kg) during the pandemic. Farmers

had the lowest value added, starting at PHP 41.75/kg (USD 0.75/kg) prepandemic and decreasing to PHP 19.82/kg (USD 0.36/kg) during the pandemic.

To further analyze the value chain, a SWOT analysis identified prepandemic constraints such as insufficient planting materials, capital limitations for technology adoption, weak price negotiation, and processing technology constraints. During the pandemic, key players encountered challenges like low strawberry prices due to reduced demand and limited capacity to operate amid mobility restrictions.

The study advanced to the value chain development phase, cross-examining SWOT analysis results using the SWOT matrix to derive general strategies. These strategies were then categorized into five intervention models, aiding in prioritizing stakeholder actions and addressing key issues within the value chain.

Based on a comprehensive evaluation and ranking of strategies involving stakeholders and agencies, prioritizing resource development and market development is essential. Validation meetings with stakeholders and enabling agencies produced final intervention blueprints under each intervention model.

The interventions generated under resource development include providing tissue-cultured planting materials, strengthening agencies that provide planting materials, collecting updates or information on tissue culture and other techniques to propagate strawberry planting materials, and conducting R&D on warm-weather strawberry planting materials.

For market development, the interventions will provide linkages, establish marketing and distribution agreements with the key value chain players, and introduce a smart vending machine to help market processed strawberry products. Meanwhile, the interventions under product development include developing new processed strawberry products and conducting product improvement on traditional processed products like jams, wines, and strawberry ice cream.

The interventions under the process and technology development model encompass the provision and promotion of technologies, practices, and toll processing facilities, alongside the development of supply and price monitoring systems. Lastly, the human capital development model includes interventions aimed at upskilling and aiding key players in the value chain. Among them are establishing an overall management support system to monitor and manage the strawberry value chain in the region; providing training on value addition, entrepreneurship, and food safety; as well as establishing partnerships with shipping firms.

Hopefully, the interventions generated by the study reflect enough the three levels of value chain responsiveness. These interventions directly or indirectly contribute to a continuous, efficient, and inclusive value chain operation; provide new, smart, and innovative ways to conduct the activities within the value chain; and address food security.

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REFERENCES

Abecassis-Moedas, C. 2006. "Integrating Design and Retail in the Clothing Value Chain: An Empirical Study of the Organisation of Design." *International Journal of Operations & Production Management* 26(4): 412–428. DOI: 10.1108/01443570610650567

Agoot, L. 2018. "PH's Prime Strawberry Producer Holds Wine Fair." *Philippine News Agency*, 20 March 2018. https://www.pna.gov.ph/articles/1029414

BAFS (Bureau of Agriculture and Fisheries Standards). 2014. Philippine National Standard: Fresh Fruits - Strawberry Classification and Grading (PNS/BAFS 125:2014 ICS 67.080.10). http://www.bafs.da.gov.ph

Chaulagain, M., A. Dhakal, A. Adhikari, and D. Oli. 2022. "Value Chain Analysis of Strawberry in Nuwakot District." *Reviews in Food and Agriculture* 3(1): 1–5. DOI: 10.26480/rfna.01.2022.01.05

Chivaka, R. 2007. "Strategic Cost Management: Value Chain Analysis Approach." *Accountancy SA* August 2007: 24–27. https://www.proquest.com/docview/215230013?pq-origsite=primo&sourcetype=Trade%20Journals

Cordona, R.A. 2017. "Technical Efficiency of Strawberry Farmers in La Trinidad, Benguet, 2016." Undergraduate thesis, University of the Philippines Los Baños.

FAO (Food and Agriculture Organization of the United Nations). 2020. "Crops and Livestock Production." *FAOSTAT.* http://www.fao.org/faostat/en/#data/QCL

Gaskell, M. 2015. *Strawberry Value Chain Analysis for Albania*. Report for the Albanian Agriculture Competitiveness Lushnja SAVS Project. https://pdf.usaid.gov/pdf_docs/PA00SV41.pdf

Hellin, J., and M. Meijer. 2006. *Guidelines for Value Chain Analysis.* http://agroecoarm.com/wp-content/uploads/2016/07/FAO-2006-Guideline-for-VCA.pdf

Lapniten, K. 2019. "In Benguet, Seedling Shortage Hurts Strawberry Production." *Philippine Daily Inquirer, Headlines*, 12 July 2019. https://newsinfo.inquirer.net/1140838/in-benguet-seedling-shortage-hurts-strawberry-production#ixzz6aTBC1Koy

PNA (Philippine News Agency). 2024. "Strawberries Remain Top La Trinidad Tourist Magnet." *SunStar Philippines*, 20 March 2024. https://www.sunstar.com.ph/baguio/strawberries-remain-top-la-trinidad-tourist-magnet

Porter, M.E. 1985. *The Competitive Advantage: Creating and Sustaining Superior Performance.* NY: Free Press.

PSA (Philippine Statistics Authority). 2020. "Fruit Vegetables: Farm Gate Prices by Geolocation, Commodity, Year and Period." *OpenSTAT: Prices.* https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2M__NFG/0032M4AFN05.px/?rxid=dcc44fad-2a84-46a2-be14-150355358e68

Quitasol, K. 2020. "Benguet's Strawberry Farmers Look for Other Crops." *Philippine Daily Inquirer, Headlines,* 7 September 2020. https://newsinfo.inquirer.net/1332046/benguets-strawberry-farmers-look-for-other-crops

Reyes, C.M., S.N. Domingo, A.D. Agbon, and M.D.C. Olaguera. 2017. "Climate-Sensitive Decisions and Use of Climate Information: Insights from Selected La Trinidad and Atok, Benguet Agricultural Producers." *PIDS Discussion Paper Series* No. 2017-47. Quezon City: Philippine Institute for Development Studies (PIDS). https://www.econstor.eu/bitstream/10419/211007/1/1019150726.pdf

Shaon, R. 2015. "History of the Strawberry." *LGU La Trinidad Benguet*.

Sturgeon, J., G. Linden, M. Mashayekhi, and L. Zhang. 2015. "Chapter II: Improving International Trade Statistics Based on Product-Level GVC Studies." In *Tracing the Value Added in Global Value Chains: Product-Level Case Studies in China*. New York and Geneva: United Nations Conference on Trade and Development (UNCTAD). https://unctad.org/system/files/official-document/ditctncd2015d1_en.pdf

UN Comtrade. 2022. "Export and Imports of Strawberries by Philippines." *UN Comtrade Database*. https://comtrade.un.org/data

Wang, J. 2021. "The Strawberry Value Chain in Jiangsu Province, China." *Australasian Agribusiness Perspectives* 24(2): 27–42. https://bpb-ap-se2.wpmucdn.com/blog.une.edu.au/dist/4/1340/files/2021/03/AAP-Vol-24-Paper-2-Wang.pdf

Zamora, E. 2016. "Value Chain Analysis: A Brief Review." *Asian Journal of Innovation and Policy* 5(2): 116–128. DOI: 10.7545/ajip.2016.5.2.116