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Towards Boosting the Supply Chain of Soybeans for Food Security and Import Substitution in Caraga Region, Philippines

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A B S T R A C T

The supply chain of soybeans for food in the Caraga Region was assessed to determine the key actors and their critical functions to identify the issues along the chain. Investigative practice, a systematic review of published articles, key informant interviews, and a survey of 158 respondents in the production hubs (Tago and San Miguel, Surigao del Sur) were used to obtain information about the critical impediments of meeting the chain's requirements for development relative to food security and import substitution. The rising consciousness on health and wellness among the consumers is favorable for the soybean industry. However, the results show few published articles for soybeans in the Philippines. Also, the supply chain of the said commodity has been struggling to keep up with the volume and quality requirements of the various actors for soy food production, although it remains profitable among the chain actors. The problems are more concentrated in soybean production, where farmers need help in obtaining high-yielding varieties of soybean and resistant to pests and diseases and learning technologies aligned with the requirements of health-conscious consumers. This study suggests giving attention to the supply of quality planting materials for farmers to use and for government interventions to focus on empowering the farmers technologically and logistically for progress in developing the soybean industry in Caraga Region for food security and reduced soybean import dependence.

Keywords: *supply chain, soybean, food security, soy food, Caraga Region, Philippines*

1 Introduction

Soybean is an essential commodity for the food and feed industries in the Philippines. Yet, it is not vastly produced across the country because the Philippines remains a substantial net importer of the commodity up to the present day. Most of the country's soybean supply is obtained annually from the USA, Canada, China, and South America (Cain et al. 2014; Cejalvo and Mercado 2018). Agcopra and Piadozo (undated) and Dela Cruz and Neric (2016) estimate the import quantity for soybean to be around 99% of the entire volume consumed in the country or about 693 metric tons annually, specifically in the years 1995-2014. The soybean production in the country is yet relatively small, which Corpuz (2018) described as negligible and minimal, and Cejalvo and Mercado (2018) as significantly low. Although Agcopra and Piadozo (undated) had explored the possibility of import substitution through steadily increasing local soybean output and measuring the competitiveness of the local production areas for benchmarking purposes, there is still a vast demand-supply gap to reckon. Production of soybean in the country is still inconsistent in behavior, and apparently,

soybean has remained a less preferred commodity for large-scale production among many agricultural producers across the country.

Soybean is a commodity of bulk uses for its two forms as consumed in most cases by industries and humans worldwide: soybean meal and soybean oil (Pritchett et al. 2016). Borines et al. (2019) have pointed out the consumption of soybeans as food for humans and feed for animals, with the former using soybean as an ingredient of many food preparations and products such as soy sauce, soya, or soy milk, soy coffee, tofu, and tokwa. The latter is a "gold standard" for protein in animal diet formulation due to the amino acid content in soybean as able to "compliment with cereal grains" (Dozier and Hess 2011 and Stein et al. 2008 as cited by Buyoc et al. 2017). In the Philippines, soybean is consumed not mostly for food but rather for feed. Gerpen (2007) had pointed out another use of soybean, which is particularly promising given the myriad issues with fossil fuel use. Soybean had been among the oilseeds potentially poised to produce renewable clean energy, in which biodiesel production is an integral part (Gerpen 2007).

Recent developments have ushered in changes that placed soybean in the spotlight in the Philippines due to the surge of consciousness and pursuit of the national objectives of nutrition, health, and wellness as well as food security. There is a renewed interest for soybean to be particularly strengthened for those objectives since it is well-packed with protein, vitamins, and minerals and can be propagated easily as well (Dela Cruz and Neric 2016). This work tackles the scientific inquiry into the supply chain for soybean used as food in Caraga Region to produce the guide for future action. In doing so, straightforward information-gathering techniques with qualitative approaches (e.g., contextual synthesis and descriptive statistical analysis) are used to draw the needed information from the ground for understanding what needs to be done on soybean's supply chain for food in Caraga Region. Given the national objective of food security, this work aims to contribute to the search for strategies that will catalyze sustainable soybean development with increased opportunities in the light of food nutrition and security.

2 Materials and Methods

This work is a spinoff of the study of Dela Cruz and Neric (2016) in pursuit of improving the supply chain of soybeans for food in the Caraga Region. Tago and San Miguel, Surigao del Sur were the areas of focus from which the major chain players were traced. Caraga Region has been consistently producing soybeans for over three decades already. However, due to resource constraints, the tracing of chain players was limited to Caraga Region and its neighboring areas in Davao Region. Tracing was expedited by referrals. The traced individuals were interviewed and studied with their environs through key informant interviews and investigative practice. Synthesis of observation records and descriptive statistics (e.g., means, frequency counts, and percentages) were used to answer the information needs of understanding and determining the constraints and guide actions for the sustainable development of the soybean supply chain in the Caraga Region. One hundred fifty-eight (158) respondents of different roles across the soybean supply chain provided information. These respondents were selected purposively. The key informants significantly contributed to investigating and validating the supply chain, especially in the critical chain functions and associated issues for insights towards improving the soybean supply chain in the country. Also, for comparison of actions and establishing the point of this study, a systematic review of articles was undertaken. Twenty-eight literatures had been reviewed to provide insights into the current status of the Philippine soybean industry, the consumption of soybeans across the country, and the needs to be looked into across the soybean supply chain in Caraga Region that currently tops in its production.

3 Results and Discussion

Review on the Supply Chain Studies of Soybeans

Over the last five years, studies that focus on issues across the soybean industry, particularly on the supply chain, are only a handful despite their relevance to policy formulation and any calculated step towards strengthening an industry/supply chain. For the case of soybeans, earlier efforts directed to develop the soybean industry can be seen in the work of Manuel et al. (1987). Such work has been pivotal in examining the uptake of soybean production among the farmers in the Philippines when it delved into lucrativeness and its potential issues. The attempt to curb the rising soybean importation in the 1980s

due to the increasing animal feed production was identified as the primary driver of studying soybean adoption, which had led to knowing the willingness of even the small farmers to take on soybeans as a secondary crop, particularly during fallow periods or dry months (Manuel et al. 1987). Such rising importation has been continued somehow to the present, which is relatively consistent based on the sizeable ratio of soybean for feed relative to food. With close observation on the study's respondents, apprehensions of the farmers were mainly on the water irrigation and the pest and disease infestation that are indeed damaging and disadvantageous to earning adequate incomes among the farming populace (Manuel et al. 1987).

The report of Dela Cruz and Neric (2016) is the most recent work that has probed into the supply chain of soybeans in the Philippines. It has noted the source of most raw soybean at Surigao del Sur and Agusan del Sur in Caraga Region, and Davao City and Compostela Valley in the Davao Region. All of the mentioned areas are involved in the bulk trade of soybeans in the Philippines. The soybean produce from these areas is processed into food and feed. Dela Cruz and Neric (2016) mapped out the supply chain from Mindanao to Cebu and Manila, taking into account the major players, their practices and behavior, their costs of operations and gains, and their problems constraints. They had pointed out the importance of responding to improving the quality of planting materials and soybean production, besides the logistics required for information dissemination and technology learning. Their work presented a basis to pursue improved services to educate the soybean farmers on efficient production and post-production handling methods, prices, and opportunities associated with value addition in soybean. Latency is the primary cause of failed government's attempt to expand the substitution of imported soybeans with the local ones because of the constraints mentioned above (Dela Cruz and Neric 2016; Domingo 2017).

Another work that had studied the soybean industry is that of Agcopra and Piadozo (undated). Their work has evaluated the competitiveness of the local soybean production in Isabela for import substitution implications. Cost and price competitiveness were analyzed, wherein the results yielded higher costs for local production than for importation. Extended analysis on price implied a level of competitiveness unfavorable for locally-produced soybeans, which suggests a much lower comparative advantage of soybean from Isabela than the imported ones. Agcopra and Piadozo (undated) have found similar constraints with those found by Dela Cruz and Neric (2016). Studies covering industry or supply chain context are wanted for soybean to plan out with reliable basis the actions to be taken in the short, medium, and long terms. Studies exhibited in the works of De Oliveira and Alvim (2016) on the logistical and competitiveness implications of an initiative (segregation) across a supply chain, Teuscher et al. (2006) on the risk management implications of a sustainable supply chain management, and Salah et al. (2019) on the traceability of agri-supply chains for responsibilities on quality and safety in consumption are important to be undertaken, as such works can guide the future actions of the Philippines towards building a sustainable industry for soybeans.

The Hub of Soybean in the Philippines (Caraga Region): Key Actors, Functions and Quality Requirements for the Soy Food Products

Caraga Region is the hub of soybean production in the country, with 350 hectares yielding an annual estimate of around 50% of the total volume of soybean produced in the country (Dela Cruz and Neric 2016; PSA 2017). It has three major soybean areas-the municipalities of Tago and San Miguel in Surigao del Sur and the municipality of Trento in Agusan del Sur. These areas are the primary source of soybean for food in Mindanao and the entire country (Dela Cruz and Neric 2016). The aforementioned municipalities of Surigao del Sur produce the light-colored (yellow) soybeans while the lone municipality of Agusan del Sur produces the dark-colored soybeans usually used for soy sauce and black beans. The light-colored soybeans are used for soymilk, tofu, and taho (a local dessert of white, soft, and creamy curd sweetened with syrup). These soybeans are the focus of this study, as the other is not the preferred ingredient for the ready-to-consume soy foods. To produce the soybean for food products and preparations, the supply chain of which has actors who perform the critical functions (e.g., input provision, production, aggregation, processing, and consumption) as indicated in Figure 1 and Table 1. The said supply chain has enablers that perform financial intermediation and facilitation services in general.

Meanwhile, the functions in the chain are

responsible for the production of soybeans characterized to be of comparable quality with those imported from the USA and Canada (Table 1). These quality attributes refer to the smooth beans without wrinkles, blemishes, impurities, or mottles. However, soybeans that are adequately dried and chemical-free among the local food processors are the added attributes (Balanay and Laureta 2019). Manchuria is the variety that has been chosen to produce the light-colored soybean because it easily meets those quality attributes, besides the uniformity of maturity, big bean size, and unlikeliness of having mottles on the beans when harvested (Balanay and Laureta 2019). The local processors are meticulous with the bean color because it affects the color of their soy food products—the lighter and more uniform the color, the better for the local food processors. Soybean of lighter color with the rest of the other desirable quality attributes usually command a relatively high price compared to the darker ones when sold. Soy foods produced from such beans are sold to food terminals, village markets, food stalls/canteens, stores, and hotels. The details on the practices involved in the critical functions of the chain are in the tables following this section.

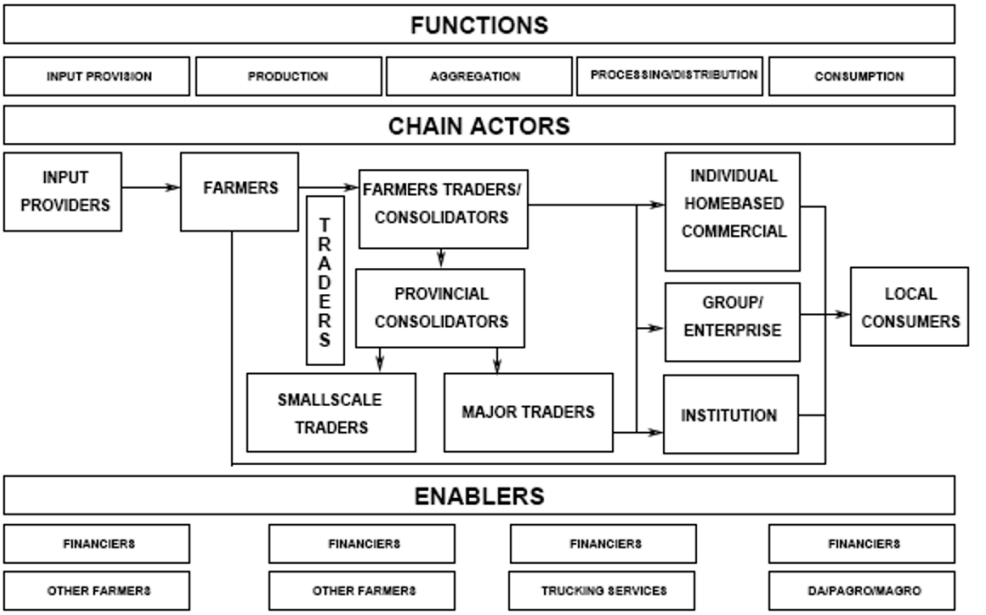

Figure 1. The Soybean Food Supply Chain in Caraga Region

Table 1. The Actors in the Supply Chain of Soybeans in Caraga

Actors	Function
Input suppliers and Enablers • Department of Agriculture and other farmers (seeds) • Input retailers (agri-chemicals and fertilizers) • Private moneylenders (financial capital)	Input provision-make available for purchase and for free access the necessary inputs such as seeds, agri-chemicals, fertilizers and financial capital for the production of soybean.
Farmers	Production-undergo the various farm operations such as land clearing/preparation, sowing, weeding, care and maintenance, and harvesting to produce the soybean from 3-4 months in quality that qualifies to the product attributes desired by the consequent buyers (traders and consolidators/aggregators).
Aggregators (canvasser, local and provincial consolidators)	Aggregation-consolidate the soybean produce from the local farmers to sell in big volumes to the much bigger consolidators or to transport to Cebu and Manila.
Processor (local)/ Distributors	Processing-convert the fresh and raw soybean into food products such as tofu, soymilk and taho usually for sale to consumers. Distribution-household members doing the distribution of the processed products in food terminals, food stalls, some stores and hotels.
Small-scale traders	Distribution-sell soy foods in food terminals, food stalls/canteens, village markets, some stores and hotels.

The Farmers: How They Grow the Soybean for Food

The farmers in Caraga Region have long been into soybean production with around 20-30 years in experience (Balanay and Laureta 2019). They grow soybean with Manchuria variety either by crop rotation or by intercropping that needs a financial capital of Php 6,000-Php 50,000 per cropping period (3-4 months) for around 2-5 hectares of production area (Balanay and Laureta 2019). Table 2 shows the cultural practices these farmers observe in producing soybeans, which suggest their choices to minimize cost. The farmers in the two major soybean areas prefer to manually do farm operations, particularly in land preparation and weed management. The farm practices of these farmers seem not to vary significantly, particularly in planting distance, fertilizer management, inoculation, replanting of missing hills, controlling weeds, and post-harvest management. The farmers do not pay particular attention to inoculation, fertilizer management, replanting of hills, and post-harvest management, as they do not practice them. Fresh soybeans are sold to traders and aggregators-thus, post-harvest management is not observed keenly among these farmers. The farms of these farmers are also dependent on rains and are applied with chemicals to control weeds, pests, and diseases. The preference of the local processors for obtaining chemical-free soybean is found an issue to address at this

Table 2. The Practices of the Farmers in Soybean Production

Cultural Management Practices	San Miguel, Surigao del Sur	Tago, Surigao del Sur
1. Land Preparation	Conventional	Conventional
2. Inoculation	None	None
a. Planting distance		
a.1. Between hills (cm)	12 inches/1 ruler/1 foot	12 inches, 30-60 cm, mostly 30
a.2. Between furrows (cm)	12 in/1 ruler/1 foot	12 inches, 30-60 cm
b. Number of seedlings per hill	3	2 to 3
b.1. Germination rate of seeds	Medium	Medium
c. Replanting of missing hills	No	No
3. Fertilizer management	None	None
4. Weed management		
d.1. Problem	Yes	Yes
d.2. Degree of Problem	Medium	medium to high
d.3. Common weeds (in local names)	agingay,dungi-dungi, cover crops mukatay nga sagbot, kulits,springamaranath	agingay, muti-muti, tayok, feildgrass, peldiras, agingay, kukamuti, kulitas, weed, kikamute, kabilaw, tagik-tagik, carote, mani-mani, bao-bao, carabao grass, bagon-bangon, halo-halo, dugi, payong-payong
d.4. Method of control	hand weeding and use of chemicals	hand weeding and use of chemicals
5. Pest management		
e.1. Problem	yes	Yes
e.2. Degree of Problem	Moderate	moderate to high
e.3. Common pests (in local names)	ulod and bunhok, bug, armyworm, piangaw, green bag, black hopper, small flying pests	bugs, armyworm, bunhok, piangaw, uod, stemborer, black bugs,tayangaw, buntok, tagamsao, payang-payang,
e.4. Method of control	use of chemicals	use of chemicals
6. Diseases		
f.1. Problem	yes	Yes
f.2. Degree of Problem	low to medium	medium to high
f.3. Common weeds	curly, yellow and dried leaves-believed to be caused by pests and intensive heat.	Yellowing/whitening/decaying of leaves, damaged tangkay, sudden death of plant
f.4. Method of control	None	only few use fungicide, mostly just pluck the damaged parts
7. Water management	Rainfed	Rainfed
8. Postharvest practices	None	None

point because such soybean is quite challenging to procure given that the preference of stopping weeds and pest infestation is through the use of chemicals. Despite the limitations/constraints, the other quality attributes of soybean for food can be easily met because most of the farmers in Tago and San Miguel, Surigao del Sur, are quite experienced in producing the said commodity.

The Aggregators: How They Make Available the Supply Of Soybean for Food

The aggregators are of three types: 1) the local collectors who are farmer-leaders or relatively big producers in the area and who also collect soybeans for sale, 2) the provincial consolidators who collect soybeans in larger volumes for delivery to another but much bigger consolidator in Davao who takes charge of distribution to Cebu and Manila, and 3) the independent traders who buy whatever quantities are available for distribution (sometimes called strikers) to local processors and other consolidators. They are just a few in number but are quite experienced in looking out for the supply of soybeans and in cinching deals for the volume acquisition of soybeans. Based on Table 3, the scale of operation among these aggregators is yet small and with a substantial risk in product handling because they buy by picking up and buying in fresh cash soybeans sensitive to humidity changes during transport. They see the products themselves in the farmer's area and transact for the product purchase in person. They also deal with the transportation of soybean to the much larger aggregator in Davao. With that, they are quite exposed to changes in soybean prices at the destination point and exposed to hazards and going to the remote places of Surigao del Sur for their buying activities. However, not all of them are properly registered business entities, which can pose a problem in the supply chain on traceability.

Table 3. The Aggregators of the Soybean Supply Chain in Caraga Region

	TYPES OF TRADER		
Particulars	**Farmer leaders/traders Local collector**	**Traders with Dicers Provincial consolidator**	**Independent Buy and sell trader**
Respondent count	2	3	1
Average age	45	46	56
Gender	100% male	100% female	100% male
Household head	Yes	No	Yes
Household size	4-5	4-5	3
Educational Attainment	50% HS grad 50%Vocational	100% College level	HS grad
Business Enterprise	100 % Homebased not registered, informal	100% Registered with own store/ stall	100% Registered with own store/stall
Experience in the trading soybeans	10-20	30-40 and 5-10	5-10
Experience in soybean farming	100 % Yes, presently Soybean farmers	100% Yes, previously Soybean farmers	100% No, not at all Purely businessman
Soybean products handled	Fresh and dried whole soybeans	Fresh and dried whole soybeans	Fresh whole soybeans only
Pricing	23-25 (dried)	22-25 (fresh)	20 (fresh)
Total No. of sacks bought	(1) 200 sacks (dried)	1600 to 2000 sacks	100 sacks
Trading period	1. May 2. August/October	1.April-August	July
Source of Commodity	Trento, ADS	San Miguel and Tago, SDS	San Miguel, ADS
Type of Transportation	Owned	Owned	Owned
Mode of purchase	Picked up	Picked up	Picked up
Mode of payment	Cash	Cash	Cash
Buyer of Commodity	Davao Caraga, Bukidnon	Davao, Cotabato, Digos	Davao
Mode of purchase	Picked up/ Delivered	Delivered	Delivered
Mode of payment	Cash	Cash	Cash

The Processors: What is Preferred by the Local Processors for Their Soy Foods in Caraga Region

Local processors obtain their raw materials or ingredients from the distribution outlets or the local consolidators. They are keen on the quality of soybeans to be processed into tofu/tokwa (soy cake), soy polvoron (sweetened cooked soybean flour), hotcake, iced candy, and soymilk for local distribution (within Caraga Region) and distribution to the neighboring provinces in Mindanao. Most of their customers in those areas are health-conscious individuals and from the Seventh-Day Adventist Church. Chemical-free and light-colored soybeans are preferred as the main ingredients for the soy foods of the local processors because the result of the process usually has soyfoods of clean and healthy appeal. Colored soybeans produce soy foods with much darker colors than that lighter beans, which may leave questions in the customers' minds as to the sanitation of the processing area and the quality of soybeans being used in the process probably of poor quality. Darker soybean results in a less appealing soy food appearance and eventually lower soy food prices. This is especially true for tofu/tokwa and soymilk, but not for soy coffee (another soy food product), where dark-colored soybeans are no problem at all. In the local distribution of these products, open, wet, and street markets that are very common in rural areas are the usual places to be accessed for, besides those consigned in government offices' canteens, the malls, grocery stores, and some establishments (restaurants and small hotels).

The processors are of three types: individual, enterprise, and institutional. The individual processors manage their processing business themselves, including the distribution of their products. They are not keen on the regularity of their operations and sometimes process soybean for their consumption. Thus, soybean processing is not necessarily for business all the time. Their operations are intermittent and only process when they can buy soybeans because of orders received and availability. Some of them who are quite enterprising accept orders without limits and allow purchase on credit by customers. These are the individual processors who opt to deliver customer orders to collect payments for the previous orders purchased on credit.

On the other hand, the enterprise processors are larger in terms of the scale of operations. They are the ones with order-based operations and the production of soy coffee and soy milk mainly, which are sold in these processors' stores and in rural food terminals. The last type refers to the institutional processor that is an establishment for the large-scale production of soy milk, tofu/tokwa, and veggie meat for distribution to the Seventh Day Adventist members, hotels, and college students. It operates as regularly as daily except for Saturday and Sunday. In the distribution of their products, household members take over the responsibility to facilitate the work. Stalls in food terminals and open, wet, and street markets owned by these processors are often used for the sale of their products. Specific details on the practices of these processors in the chain are provided in Table 4.

Key Customers and Their Product Requirements in the Soybean Supply Chain

Table 5 presents the key requirements of the various customers of soybeans along the chain, which shows the high standard of quality held for the soybean used as food. The desired quality of the soybean to be processed into foods is distinguished with a visual examination based on the physical appearance of the soybeans as smooth, clean, with no spots/mottles and blemishes, and dried properly. The prices of soybeans with impurities and mottles can easily get classified as "reject," which can abruptly drive down the soybean prices. Thus, the production process for soybeans used as food is painstaking to attain the required quality characteristics; otherwise, the farmers will have reduced profits from the process. However, there is a particular requirement that is intriguing because all do not practice it at the farmer's level, which is that of having the soybeans produced without the application of agri-chemicals. Because soybeans are associated as a healthy source of vitamins and minerals, having the soybeans grown organically (without agri-chemicals) would further boost the image of soybeans as a healthy food choice, which would eventually have a stronger appeal to the populace seeking nutritious and affordable food items. Meeting the production of soybeans without using such chemicals to attain the requirement of the consumers for soybeans (to have organically produced soybeans safe for consumption) may be an arduous task to do among the farmers. Pest and disease infestation is among the critical parts of the production process, which must be adequately

Table 4. The Processors of the Soybean Supply Chain in Caraga Region

	PROCESSORS			
Particulars	**Individual** Own Consumption Commercial	Commercial Production Own Consumption	**Enterprise**	**Institutional**
No. of Respondents	2	3	2	1
Key Informant	Processor	Owner	President/Treasurer	Manager
Average age	46	48	30 and above	47 (respondent)
Gender	100 % male	100 % female	100 % Female	Male
Civil Status	100 % Married	100 % Married	100 % Married (Respondent and members)	Married
Educational Attainment	50 % HS level 50 % HS grad members)	33.333 % HS level 33.333 % HS grad 33.333 % College grad	100 % HS grad (respondents) Mostly HS level/grad (members)	College grad
Years in soybean processing	11-20 years	5-10 years	2-3	2
Experience in soybean farming	Yes, Also farmers	33.33 % yes 66.66 % None	All None	All None
Soybean products handled	Fresh and Dried	Dried	Dried	Dried
Types of Soybeans Used	Local	Local/ Imported	Local	Local/ Imported
Source of Commodity	Own Produced	L: Caraga, Davao I:Davao	Caraga, Davao	L:Caraga, Bukidnon Davao
Processing period	Depending on supply	Year-round (Weekly)	Depending on order	Every weekday
Price of soybeans (raw material; in pesos)	None, Own produced	33.33% free (own produce) 66.66 % L: 18-25, I : 50	50 % free (own produce) 50% 24	38-42
Mode of purchase	Own produced	Picked-up	Delivery	Delivery
Mode of payment	None	cash	Cash	Cash
Finished Products	Soyamilk, coffee, tokwa	Soyamilk,coffee, polvoron, tokwa, hotcake, ice candy	Soyamilk, coffee	Soyamilk, tokwa, veggie-meat
Pricing of Finished Products	S= 75-80 per L 25 per 350 ml C=100-120/kg T=150/kl	S :20-30/350 ml 60-65 ½ gal C:40-50 ½ kl, T:140/kl, P:1-2/pc, H:5/piece, I:2-3/pc	S=15-20/350 ml C: 120/kl	S=25/350 ml T:100/kl VM:135/kl
Buyer of Commodity	Neighbors LGU	Neighbors, LGU, Students, Grocery Stores	Rural food terminal Own store	College Students, Hotel SDAs nearby
Mode of selling	Picked up	Delivery	Delivery/ picked up	Delivery
Mode of payment	Cash	Cash and credit	Cash (consignment)	Cash

addressed to harness the selling potential of soybeans as a competitive and healthy food choice.

Products to be bought are usually picked up along the chain, except major wholesalers/retailers because large delivery trucks (wing vans) are used. "Pick up" as the mode of making the products available in markets or to aggregators is helpful, particularly among the small chain players (e.g., farmers and small-scale traders) with the small savings, they incurred for skipping the transportation expenses for their soybeans. Cash is always involved in almost all transactions in the chain, which implies the importance of financial resources to sustainably do the tasks in the chain. However, besides meeting the quality requirements of the chain, another equally critical factor for the chain's proper functioning and sustainability is the quantity of soybeans being transported and processed. The seasonality of producing the commodity is a factor, but the efficiency of production due to the quality of planting materials and the cost of the technology is another. Thus, strengthening the forward and backward linkages of the farmers is essential to be undertaken for these farmers to be aided in building further their capability to sustain good production levels. Addressing such areas properly will likely improve the profitability of soybean production and resolve other problems on price stability and

Table 5. The Key Product Requirements of the Various Chain Actors

Key Customers	Quality	Volume/ Buying Price	Schedule of Delivery	Mode of Delivery	Mode and Term of Payment	Awareness on Requirements of Customers	Problems and Constraints
Provincial consolidator (PC)	Fresh, all classes/varieties of yellow soybeans, smooth and clean	No limit in volume (available local quantity not much)/18-23 per kg	From farmers to PC: picked up right after harvest	Pick-up (truck)	Cash upon pick up to farmers plus incentives to merchandisers	yes	Decreasing soybean supply, profitability and market share
Major wholesaler/ retailer (MWR)	Dried, classes A-B/all varieties of yellow soybeans, smooth, clean, no impurities, no wrinkles, no blemishes, no dark spots	No limit in volume (available local quantity not much)/27-30 per kg	From PC to MWR: delivered if supply reaches a truckload	Delivered (truck: 1-5 MT; wing van: 10k-15k MT)	Cash on delivery from PC	yes	Stringency in terms of soybean quality and in choosing supplier, stagnated price
Collectors/ consolidators /wholesalers	Fresh and dried, all classes/ varieties of yellow soybeans	No limit in volume (available local quantity not much)/18-23 per kg	Fresh after harvest for Surigao del Sur; after drying for Agusan del Sur	Pick-up (truck)	Cash upon pick up from farmers	yes	Decreasing soybean supply, profitability and market share
Local processor	Classes A-B/ Any variety of yellow soybeans, chemical-free, dried properly, smooth and clean	Depends on existing orders, 28-34 kg per processing period	Depends on existing order	Pick-up or delivered (own vehicle)	Cash upon pick up/ delivery from traders	yes	Stringency in terms of quality, limited demand
Local collectors	Dried	No limit, 20-22 per kg	After farmers have dried their products	Pick-up (truck)	Cash upon pick up from farmers	yes	Decreasing soybean supply, no other buyer option
Small-scale trader/ buyer	Dried	No limit, 23-24 per kg	After collectors have consolidated all produce	Pick-up (Truck)	Cash upon pick up from local collectors	yes	Low production volume of black soybeans, rough condition and far distance of production areas

quality requirements. Logistics is mainly important to be examined for its critical role in this case. Apparently, logistics is part of the problems in the chain, given the location of the production areas as rural, remote, and with security hazards.

Cost and Benefit Analysis for the Critical Actors of the Supply Chain

The chain actors with their estimated costs and benefits relative to a unit price are presented in Table 6, where the net benefits are estimated to be the residual amount after total operational cost is deducted in proportion to a peso of income or the unit price. Due to the variety of factors affecting the computation (e.g., distance covered, the scale of operation, the decision to accommodate other functions, and labor used), most of the actors are represented here in more than one case. As shown, the farmers, in general, are found not at the losing end. These actors are not at the bottom in terms of the size of the net margin/net benefit earned. The small-scale traders/local collectors make the lowest amount of net benefit rather. The ones with the most significant net margin/net benefit are the home-based soy food processors. These processors save costs by doing their operations at home most of the time and producing soy foods only when there are orders received from clients. Concerning the collectors and the consolidators/traders, other processors (non-home-based/commercial, group, and institutions) do well also in their operations. However, the farmers incur costs due to labor, material inputs (seeds, organic and inorganic fertilizers, seed inoculants, farm chemicals, fuel, utilities, and other materials), and other expenses (land tax, landlord's share, output shared, and capital interest) to produce an average yield (per hectare) of 2.096-2.357 metric tons per cropping.

Among the farmers, labor constitutes the largest expense item at around 65% of the total cost, followed by other expenses at 21% and material inputs at 14%. Among the other chain actors, the cost of the soybean produce sold by the farmers constitutes the highest in the amount that is around 95%, particularly among the traders, collectors, and consolidators. Among the processors, the home-

Table 6. The Costs and Benefits per Peso of the Chain Actors

Chain Actors	Total Cost	Selling Price/ Kila	Net Margin	Lead Time
Producers				3-4 months
Soybean Farmers	58%	18-23	42%	
Small-scale Traders / Local Collectors				1 day (from farmers)
FT1	98%	1	2%	
FT2	92%	2	8%	
Collectors				Around 1 day (from farmers)
D1	15%	0.5	35%	
D2	11%	0.2	9%	
Consolidators/ Traders				1-4 weeks (from small collectors)
C1	80%	30	20%	
C2	82%	30	18%	
C3	90%	28	10%	
C4	90%	25	10%	
C5	92%	32	8%	
Processors				1 week (from traders including distribution)
Individual (Homebased)	9%	25-180	61%	
Individual (Commercial)	84%	1-150	16%	
Group	67%	20-50	33%	
Institution	62%	25-180	38%	

based ones have around that much cost for their soybeans, while the rest comprises other expenses such as utilities and family labor. Unfortunately, the other much bigger processors have not disclosed much about the details of their costs for this section. With respect to the time involved in producing and passing the soybean product on to the next chain actor, the lead time information is provided (Table 6). As shown, the farmers have the longest lead time as soybean production takes 3-4 months to do. The shortest is with the small-scale/ local traders since the product transfer only takes around a day. The bigger consolidators may take 1-4 weeks to wait for the output volume adequate to be transported. The processors may take one (1) week to produce the soybean-based foods up to their delivery to the processors' clients. The lead time information also gives speculation about the time duration involved in earning their respective incomes along the soybean supply chain.

Critical Issues in the Supply Chain of Soybeans

Costliness due to inefficiency is implied in Table 7 for the actors' tasks and responsibilities in the chain. The farmers, in particular, have many production issues cascaded to other actors as irregularity of soybean supply, since apparently soybean is produced with marked seasonality in the production areas of Surigao del Sur (Balanay and Laureta 2019). The high seasonality of soybean production affects the operations of the local processors with the intermittent production of soy foods because, during the offseason, these processors have none to process. To remedy the situation, the local processors resort to using the imported soybeans to deliver products to their customers. Meanwhile, the farmers have an apparent need to be exposed to technology updates that will feature less costly procedures, especially in controlling insects and pests. Financial capital is one of their problems, on which their operations are most dependent. The farmers can hardly proceed with less financial capital, or else their production will be compromised. They are hard-pressed in providing capital, which will worsen with their other problems (e.g. insect and pest infestation, lack of technology updating, lack of government support, and lack of quality planting materials). However, because the farmers are the primary source of the local soybeans, building their competitiveness to increase the sources of soybeans as a substitute to the imported one may not progress significantly without much support from the government and other stakeholders. Strong partnerships that immensely help farmers get equipped in technologies and get aggressive in their production ventures are necessary to overcome such a difficult situation.

At the beginning of the supply chain, the problem is because the volume and the quality of soybean produced depend on the farmers' performance. Similarly, the sustainability of the current programs on gradually reducing the country's import dependence on soybeans depends on the farmers. The consistency of the soybean farmers in producing increases in production volume sustainably with the desired quality intact will eventually establish and strengthen the downstream industry, making

Table 7. The Critical Issues of the Actors in the Supply Chain of Soybeans in Caraga

Actors	Key Issues and Concerns
Farmers	• Cannot afford the financial capital and risk in delivering a product as perishable as soybean because of price fluctuation, especially that buyers dictate usually the price • Problem on pest, insects, diseases and weeds in production • Government support is hardly felt because of distance • Production not yet efficient because of high operating cost • Inevitable use of agri-chemicals because of the pest and disease infestation • Lack of technology updating • Lack of quality planting materials that result to low output • Limited number of bulk buyers in the area
Merchandisers	• Issues on security and distance of the area
Consolidators	• Repetitive field visits to pick up fresh soybeans quite costly especially in labor and transport (gasoline) • Far distance and rough road condition-resulting to costly maintenance of vehicles
Major wholesaler/retailer	• Issues on security and distance of the area-thus, the reliance on the information given by the provincial consolidators and by how much they can deliver
Small-scale trader	• Trucking services costly with the limited supply of soybeans in the area
Processors	• High price of soybeans • Unstable supply of local soybeans (none during off season) • Had to go to Davao to get local soybeans to be processed; as a result, imported soybeans are procured

the entire soybean industry more defined than ever. Thus, maintaining farmers' capability to do so is an essential matter for the regularity of soybean supply and for any consequent chain improvements to gain traction. The government action has to be directed to these farmers' concerns for the strategic approach of sustaining the efforts to develop the soybean industry even more. The Department of Agriculture, as currently functioning as the source of good seeds for planting, is in the right direction, which has to be strengthened to obtain a sustainable supply of such seeds. Although seed saving has been practiced among the farmers (Balanay and Laureta 2019) and has somehow worked to provide supplementation, provision of high-yielding seeds and resistant varieties to insect and disease infestation is still wanting. It needs to be developed as soon as possible to strengthen the supply of quality planting materials in time that will translate to products of high quality. The other area to be developed has something to do with logistics, especially postharvest. The facilities, people, and other resources that can improve value addition to soybean production for sustainable soy food production are important to be assembled to pursue the interest of building a competitive soybean supply chain for industry competitiveness and food security. This qualitative research has identified the need to focus on farmers as a source of sustainable high-quality produce for development interventions. It will serve as the window of opportunity on what to work on in the future for soybean to be competitive and capable of pursuing the aforementioned national objectives of the country.

4 Conclusion and Recommendations

This research has identified the key actors and functions of these actors in the supply chain of soybeans for food in the Caraga Region. These actors have been earning profits from their engagements, although not much in some of them. They have been responsible for the yearly production of soybeans in the country, even with or without significant government intervention. With this, Caraga Region has been the hub of soybean production for several decades. The quality requirements for soy foods have reverberated the exigency of ensuring the sources of raw materials or ingredients to be consistent with food safety and security to harness the opportunities of providing the foods aligning to the health- or nutrition-conscious populace of the country. While these requirements of clean and chemical-free ingredients are wanted for the soy foods to be organic and nutritious, they are a bit tedious to the farmers, with the insect pest and disease infestation as a critical problem among them. The convenient way to control the infestation through agri-chemicals is the farmers' shortfall in providing the desired ingredients demanded by the local processor. Such needs to be addressed appropriately for the soybean raw material/ ingredient to comply with the quality requirements of the local processors to be consistent with food safety and nutrition. The fad on organic foods has an excellent opportunity for the soybean in Caraga Region to unravel also.

However, it is important to expand the focus on the other disturbing issues of the chain,

including the volume consistency and costliness of transactions. The regularity of production volume is an important consideration to build the soybean industry's competitiveness to wean local users from import dependence. A comprehensive program to improve soybean productivity by lowering production and transport costs can solve the supply chain issues. The bulk of the problems in the soybean supply chain for food in the Caraga Region is concentrated on the production point, which means production-centered interventions are yet necessary to be in place for the potentials of the said chain. This may entail expediting the R&D on improving the current soybean varieties in terms of yield and resistance to pests and diseases and ensuring the sustainability of the supply of which to the farmers, besides the improvement on logistics. In doing so, the rest of the supply chain issues will be resolved gradually for the competitiveness of the current supply chain and soybeans to have a significant role in the pursuit of food security in the country.

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Statement of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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