

# The Supply Chain of Vegetable Production in the Philippines: The Case of Nueva Ecija Farmers

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## Abstract

This descriptive study looked at the supply chain of vegetable production in Nueva Ecija, Philippines. The researcher collected data from farmers using a validated survey questionnaire and discovered that inputs in vegetable production are determined by the crop's cultural requirements, with pre-harvest labor costs and other inputs accounting for most inputs. After harvesting, respondents claimed that a large quantity of vegetables means a higher profit for farmers, and eggplant could provide a reasonable cost of return. Almost all respondents do not have a place to store their produce. In practice, they deliver the vegetables directly to the market and, occasionally, to the middlemen. Farmers primarily use Kolong-Kolong to transport their vegetable products to market, which can be purchased per kilo or per bundle, with payment made in cash upon delivery. Regarding demand-supply, the availability of produce-vegetables was determined by the farmers' adherence to the vegetable calendar.

## Keywords

Farmers, Harvest, Kolong-Kolong, Philippines, Supply Chain, Vegetable Production

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## 1. Introduction

Nueva Ecija is one of the provinces in Central Luzon which produces a variety of agricultural products. It is known to be the rice granary of the Philippines and is famous for the big production of onion as its primary agricultural product. According to Guia (2012), "Nueva Ecija's agricultural production covers an area of about 298, 742 hectares of fertile lands that are nourished by the Great Pampan-

ga Rivers and its many auxiliaries”. “Nueva Ecija also offers boundless opportunities in agro-industry and agri-based trading activities to local and foreign investors. The province’s vast, arable and irrigated agricultural lands and support facilities optimize these opportunities. Various agricultural research and development institutions collaborate with the Provincial Government to achieve agricultural advancement. They secure the food supply not only in the province but in the whole country as well”.

Nueva Ecija has huge farmland where farmers can plant and produce not only high-value crops but also lowland vegetables or simply the “Bahay-Kubo” vegetables such as Jicama (*Pachyrrizus erosus*), eggplant (*Solanum melongena*), winged bean (*Psophocarpus tetragonolobus*), peanut (*Arachis hypogaea*), string beans (*Phaseolus vulgaris*), hyacinth bean (*Dolichos lablab*), lima bean (*Phaseolus lunatus*), winter melon (*Benincasa hispida*), angled luffa/Chinese okra (*Luffa acutangular*), bottle gourd (*Lagenaria siceraria*), squash (*Cucurbita maxima*), radish (*Raphanus sativus*), mustard (*Brassica juncea*), onion (*Allium cepa*), tomato (*Lycopersicon esculentum*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), sesame seed (*Sesamum indicum*).

However, according to Llorito (2020), “small farmers have difficulty accessing inputs and markets for their produce, while buyers such as agribusiness enterprises and wholesalers find it difficult to get the quantity and quality of products that they need for processing on a timely basis”. Because of these situations and various dilemmas that local farmers are currently facing, there is a possibility of a vegetable supply shortage in the province.

This study analysed the production of vegetables by farmers in Nueva Ecija using supply chain analysis. The supply chain can assist farmers in improving enterprise performance, achieving better supply chain integration, and successfully completing their period (Lin & Lin, 2018). Moreover, this study could help farmers attain acceptable returns with their farming activities to sustain their production to provide affordable food for every Filipino table. The researcher focused on the low-land vegetables or the “Bahay-Kubo vegetables”, which are the most common vegetable, planted by the Novo Ecijanos (Subia, Mangiduyos, & Turgano, 2020) and are mostly consumed by the households because of their cheaper price and the nutrients they provide to the Filipino meals.

Specifically, this research identified the supply chain in the production of vegetables in terms of inputs and growing (land preparation, seeds/seedlings, fertilizers, pest control, labor, other inputs), harvesting, handling and storage, transport vehicle, price/pricing, terms/modes of payment and marketing.

## 2. Literature Review

Firms today are attempting to implement innovations to ensure their survival, value creation, and success. In supply chain relationships, innovation is increasingly seen as the result of a collaborative process involving various stakeholders both within and outside the firms. Collaboration is gaining traction, and innova-

tion focus is shifting away from firms and their supply chain networks. This leads to the concept of supply chain innovation, which is widely recognized as an essential component for improving a firm organizational and supply chain performance (Krishnan et al., 2021).

The status of the agricultural sector in Nueva Ecija was studied by Dilao and others (2019), and their findings revealed that farmers encountered several problems, such as pest attacks, seeding management, delivery and continuity of continuous supply of goods from the farms to the market, and the like.

To go in-depth with this claim and to assist the Novo Ecijano farmers with their concerns, the researcher conducted the current study on the supply chain of vegetable production in the province.

According to Rais and Sheoran (2015), “supply chain management is critical to keeping business costs low and profitability high. There are numerous factors involved in supply chain management, with flow being one of the most important. Flow encompasses product flow, information flow, and financial flow. The movement of goods from a supplier to a customer, as well as any customer returns or service needs, is included in the product flow”. Likewise, Hasan (2013) stated that another benefit of the supply chain is that it has “emerged as a key approach for enterprises aiming to become environmentally sustainable”.

Rais and Sheoran’s (2015) supply chain management study revealed that India produced approximately 81.285 MT of fruits and 162.187 MTs of vegetables, accounting for nearly 14.0% of the country’s share of global vegetable production.

In Alam & Khatun’s study (2021), a large number of farmers, primarily smallholder farmers who own or cultivate 0.05 - 2.49 acres of land, are producing vegetables commercially in Bangladesh. They can expand their supply chain from domestic to international markets. Rapid urbanization and rising income levels have also contributed to an increase in vegetable consumption in Bangladesh.

Another relevant finding about supply chain management came from the research of Allam et al. (2021); the results of their study showed that waste had a significant negative impact on the profitability measured by return on equity which implied that companies should strive to reduce their waste to be able to increase their profitability.

In Vietnam, a related study on supply chain was conducted by Bui et al. 2021, and their findings revealed that the two main actors in the survey sample’s short food supply chains in Vietnam were small farmers and distributors. Farmers could sell their products in various ways at the local market. There was some preliminary evidence that these chains helped to stabilize input, output, and revenue prices; created sustainable income; and increased farmer satisfaction and confidence.

From the different pieces of literature above, it was clear that the supply chain is vital in the delivery of goods and services and marketing of products, particularly agricultural products like vegetables. Hence, this study finds meaning and

substance.

### 3. Methodology

The descriptive research design was used in this study to describe the supply chain of vegetable production in Nueva Ecija, Philippines. “Descriptive research systematically describes a situation, problem, phenomenon, service or program, attitude toward an issue, or simply, it provides information on a subject,” according to Kumar (2014), as cited by Subia, Trinidad, Pascual, Medrano, and Manuzon (2019).

The 141 Novo Ecijano farmers were chosen purposively (Subia, 2018) due to their knowledge of the supply chain in the production of vegetables in Nueva Ecija in terms of inputs and growing (land preparation, seeds/seedlings, fertilizers, pest control, labor, other inputs), harvesting, handling and storage, transport vehicle, price/pricing, terms/modes of payment and marketing served as the respondents of this study. The face and content validity of the questionnaire was established through consultations with other five experts in the field who were knowledgeable on the topic of the study while the reliability was established through field testing to 10 non-respondent farmers. The questionnaire was found reliable with a Cronbach’s alpha coefficient of 0.877. The reliable and validated questionnaire was then answered by the respondents, and the collected data were then processed by computing the frequency and percentages using Microsoft Excel.

## 4. Results and Discussion

### 4.1. Number of Years in Vegetable Farming and Farm Ownership

Table 1 shows the number of years in vegetable farming by the farmers in the province.

Sixty-nine (69) vegetable farmers had been farming for 10 to 15 years. As a result, vegetable farming was their primary source of income. They also inherited their parents’ vegetable farming business and claimed that, unlike plain farming, vegetable farming had lower maintenance and cost than other crops. Six of the respondents had been in vegetable farming for 21 - 25 years, while the

**Table 1.** Number of years in farming.

Number of Years in Farming	Frequency	Percent
26 to 30 years	6	4
21 to 25 years	6	4
16 to 20 years	36	26
10 to 15 years	69	49
1 to 9 years	24	17
Total	141	100

remaining respondents had been in farming for 26 - 30 years. They claimed they were in this occupation because they lacked knowledge of other jobs or skills.

Furthermore, they revealed that vegetable farming was a good source of income, particularly if market prices were stable. They made money when supply was scarce, or when there was an opportunity due to high demand and fewer available vegetables in the market, causing prices to skyrocket. Furthermore, crop rotation or planting vegetables in between rice crops could maximize farmland for additional crops.

## 4.2. Farm Ownership

**Table 2** shows the farm ownership of the vegetable farmers-respondents interviewed.

**Table 2** shows that 108 respondents owned farmland. They claimed they inherited the property from their parents. Some were also bought. The latter asserted that owning farmland was an excellent investment. Others who responded pawned their tilled land because they needed money, and a few claimed to have lost money from vegetable farming in the past.

## 4.3. Supply Chain in the Production of Vegetables

The following tables present the supply chain in the production of vegetables in terms of inputs and growing (land preparation, seedlings, fertilizers, pest control, labor and other inputs); harvesting; handling and storage; carriage vehicle; selling practices; mode of payment; market and demand-supply.

### 4.3.1. Inputs and Growing

The input requirements for vegetable farming are shown in **Table 3**. It is made up of labor, material, and other input requirements.

**Table 3** depicts the various input components used in vegetable farming. It is divided into three categories: labor cost, material cost, and other inputs. The majority of the inputs were confirmed by farmer respondents to be common requirements in vegetable farming. It differed in material costs required because the severity of pest, insect, and fungi attack varied. Similarly, the use of other inputs varied depending on the type of vegetable planted; for example, the farming method for hot peppers may differ from that of the ampalaya (bitter gourd) plant. The same is true for eggplant, tomato, kalabasa (squash), and sitao, which may necessitate additional inputs such as seedling trays, plastic mulch,

**Table 2.** Farm ownership.

Farm Ownership	Frequency	Percent
Owned	108	77
Pawned (Sangla)	12	9
Percentage/Land Rental	21	15
TOTAL	141	100

**Table 3.** Inputs in vegetable farming.

Labor Cost	Material Cost	Other Inputs
Plowing	Seeds	Seedling Trays
Harrowing	Fertilizer	Plastic Mulch
Plot Construction	Pesticides	Poles
Planting		Wood post
Fertilizer Application		Wire
Insecticide Application		Strings
Spraying and Weeding		Gasoline/Fuel (water pump)
Irrigation		
Harvesting and Hauling		
Packaging		

poles, wood posts, wire, strings, and gasoline or fuel for the water pump. It should be noted that the costs of planting and growing vegetables vary. The respondents stated that they were satisfied with the quantity of yields if the planting and growing processes were carried out in accordance with farming requirements. Enough funds were required. Borrowing was used by some farmer respondents, particularly those who relied solely on vegetable farming for income. This does not include any interest on the borrowed funds. When typhoons or floods struck the area, the farmers were further burdened by their obligation to repay the loan. The findings above indicate that inputs in vegetable production are dependent on the crop's cultural requirements, and that the majority of inputs go to pre-harvest labor costs and other inputs.

#### 4.3.2. Harvesting

**Table 4** displays the total harvest or yield of vegetables in MT per ha.

The table shows the yield of vegetables per hectare. All respondents claimed that if yields were large in quantity, farmers would profit whether the price per kilo was low, average, or high since their selling price is higher than their puhunan (investment price). They also stated that there was a lot of opportunity in vegetable farming, particularly if they were well-experienced and given a good education. It denotes that those various vegetables have different total yields per ha and that comparing them is impractical due to differences in characteristics and cultural management. Furthermore, when asked what vegetables could yield a reasonable cost return, the farmer respondents said eggplant, aside from being a year-round vegetable because the production cost is lower than other vegetables.

#### 4.3.3. Handling and Storage

**Table 5** depicts how farmers handle and store their vegetables.

**Table 4.** Total harvest of vegetables in 1 ha.

Vegetable	Total Yield (MT)
Ampalaya	27,000
Eggplant	36,000
Tomato	40,000
Sitao	45,000
Okra	36,000
Hot pepper	30,000
Squash	15,000
Pechay	35,000

**Table 5.** Handling/Storage.

Handling/Storage	Frequency	Percent
Without Storage	132	94
With Storage	9	6
Total	141	100

It should be noted that 132 farmer respondents had no produce storage facility. They usually bring the vegetables directly to the market and sometimes to the middlemen. Vegetables are perishable goods that should be discarded as soon as possible after harvesting. It is not necessary to keep a warehouse for this purpose. Furthermore, whether the price is low or high, profit or loss, the cash that could be realized from the sale was already intended to pay some of the farmer's obligations and their children's education while nine respondents had a place to store their produce.

They stated that some vegetables may be stored for a few days to await a better market price. They also mentioned that some vegetables remained fresh even after three days of harvesting. It implies that other farmers do not prioritize storage facilities because some vegetables must be sold immediately after harvesting while still fresh.

#### 4.3.4. Transport Vehicle

**Table 6** shows the transport vehicle utilized by vegetable farmers in the transport or delivery of their produce.

**Table 6** shows the vegetable carriage vehicles used by farmer respondents to transport their products. Kolong-Kolong (A utility vehicle. A motorcycle attached to a flat style side car and can be used to move goods). This was used by 72 farmers to transport their produce. Fifty-three prefer tricycles, while 14 have a jeep that transports the produce to market. Two farmer respondents claimed to have extensive farmland, and that purchasing a mini truck was more cost effective. Furthermore, the money they spent on trucks was earned through profits or savings from previous years of vegetable farming.

**Table 6.** Transport vehicle.

Vehicle	Frequency	Percent
Kolong Kolong	72	51
Tricycle	53	38
Jeep	14	10
Mini-Truck	2	1
Total	141	100

#### 4.3.5. Price/Pricing

**Table 7** displays the price/price of the product when purchased by the buyers.

According to 102 farmer respondents, their products were sold in bundles. They added that sakadoras chose to buy in bulk to save time packaging the vegetables. They also stated that the majority of sakadora buyers were travelers and retailers who also purchased vegetables in bulk. This had a lower price and was based on quality, which could be considered good or bad. This was sometimes already done and agreed upon during harvesting. There was also the practice of including packaging in the agreement before harvesting. The buyer was then in charge of sorting the produce. It means that buying and selling in bundles is the most convenient because it allows for easy inventory, transaction, and tracking.

#### 4.3.6. Terms/Mode of Payment

**Table 8** shows the payment terms and modes for products sold to middlemen and sakadora.

In this industry, cash payment is the most common method of exchange. When the product is delivered to the market or trading post, this is usually done. Sakadoras (selling agent) and middlemen frequently hand over the agreed-upon cash. They rarely come across non-cash payments or non-payment of goods. Only a few people use consignment as a payment method. This implies that both farmers and sakadoras prefer cash payments. That cash on delivery (COD) motivates farmers to spend their hard-earned money on other inputs and family needs.

#### 4.3.7. Markets

**Table 9** depicts the marketplace where the viajeros (vegetable travelers) bring their vegetable produce.

114 of the 141 respondents said they brought their produce at Nueva Ecija's public markets, particularly the two well-known bagsakan centers in Sangitan and Gapan. Respondents also stated that selling their produce in nearby towns saved them money on transportation. Twenty-seven respondents stated that they brought or sold their produce outside of the province and used middlemen to do so. These middlemen then transported the vegetable produce to Manila. Other vegetables were brought as far as Pangasinan and Pampanga, where they were in high demand. This suggests that Nueva Ecija vegetables are in plentiful supply on the market. This means that the distance between the market and the farm is



**Table 7.** Price/Pricing.

Price/Pricing	Frequency	Percent
Pakyaw (in-bulk)	3	2
Per bundle (per bag)	102	72
Per kilo	36	26
Total	141	100

**Table 8.** Terms/Mode of payment.

Mode of Payment	Frequency	Percent
Cash on Delivery	96	68
Consignments, other terms	45	32
Total	141	100

**Table 9.** Markets.

Marketplace	Frequency	Percent
Within Nueva Ecija	114	81
Outside Nueva Ecija	27	19
Total	141	100

taken into account, as selling nearby can save time and transportation costs when compared to long-distance markets like those in Manila and other provinces.

#### 4.3.8. Demand-Supply

**Table 10** depicts the availability of vegetables throughout the year. The supply changes in response to market demand.

According to the farmer respondents, a greater supply of vegetables in the market was based on the planting season. They claimed that pechay (bok choy), ampalaya, and eggplant, for example, could be grown all year to meet market demand. Other vegetables, such as squash and okra, may be available in January, February, and April to June, resulting in a large supply during these months. They also claimed that, in their experience, if there was an oversupply of goods, the price fell, and if there was a limited supply, the price rose due to demand. The farmer respondents stated that they were sometimes fortunate, or “tumama” in Tagalog, if the market price was high. Another reason for this phenomenon was when there was a good harvest and few rejects.

## 5. Conclusion and Recommendations

The supply chain is critical to the province’s vegetable production. To maintain the vegetables, inputs and growing (land preparation, seedlings, fertilizer, pest control, labor and other inputs), harvesting, handling and storage, transport

**Table 10.** Demand-Supply.

Vegetable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Pechay	[Solid brown bar]											
Hot Pepper	[Solid red bar]											
Ampalaya	[Solid orange bar]											
Eggplant	[Solid purple bar]											
Tomato	[Solid dark red bar]											
Squash	[Solid reddish-brown bar]											
Okra	[Solid light orange bar]											
Sitao	[Solid orange-brown bar]											

\*\*\*Source Putakputak.com. Agriculture and livestock guide (applicable to the entire country).

vehicle, selling practices, mode of payment, market and demand-supply must all be considered and prioritized.

Labor, materials, and other inputs in production were the main requirements to plant a vegetable. After applying other inputs like fertilizers, pesticides, and the like, harvesting followed, where the total yields were computed to analyze the return or net income from the plants. After the harvest, the next step was the handling and storing of the harvest crops would be sold or stored for a few days until the price went higher. To make the produce available not only in one place, but transport vehicles might also be required to distribute or bring the produce to the market. From the time the produce would be sold, there were selling practices in the market; it could be bought per kilo or per bundle, while the mode of payment could be paid in cash or would be paid after a day or two. For the markets, the produce could be directly sold to an agent to bring the produce in the market place, to sakadora, the buyer with big storage in the market would sell the produce into viajeros.

In terms of demand-supply, the availability of the produce-vegetables depended upon the vegetable calendar if followed by the farmers. It happened to be that sometimes, the supply was limited because the produce before its harvest was being attacked by pests, insects, and fungus. On the contrary, there was sometimes an oversupply because other products were being transported in the same location from other regions and towns. In addition, farmers from different cities planted the same vegetables, so during the harvest season, the supply was overflowing, causing the price to decrease.

Based on the conclusion, it is recommended that vegetable farmers must be aware of the factors to consider in vegetable production, such as inputs and growing (land preparation, seeds/seedlings, fertilizers, pest control, labor, other inputs), harvesting, handling and storage, transport vehicle, price/pricing, terms/modes of payment, and market/marketing for them to plan their preparation for the next season and can possibly strategize to reduce the cost of production. Also, vegetable farmers should be aware of their enormous role in the

supply chain and the roles of intermediaries in the bagsakan centers. They may have a common agreement regarding the marketing and pricing of the vegetable-produce. And lastly, vegetable farmers should be equipped with financial literacy and marketing strategies to prevent problems in costing, pricing, and distribution of their produce. The higher education professors teaching in Agricultural and Business Administration courses could be tapped by the Local Government Units to be the trainers of the farmers. Other problems such as demand and supply and the establishment of bagsakan centers may be addressed by concerned authorities like the Department of Agriculture and Local Government Units of the province of Nueva Ecija.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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