Productivity value chain analysis of cassava in the Philippines

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Abstract. This paper evaluates the value chain of cassava through crop accounting and financial analysis in Partido district, Camarines Sur, the Philippines. Cassava (Manihot esculenta), locally known as “kamoteng kahoy” is well-known for its ability to produce a reasonable yield in poor soil conditions with less or no farm inputs. This is the reason why cassava is often grown by resource-limited farmers and is regarded as a good source of food security. To analyze its productivity, this study was conducted in 2019. Data gathering was primarily done through focus group discussions and key informant interviews. Results revealed that different gender roles exist where men are primarily responsible for farming while women are for marketing. It also discovered the reason why farmers, though provided with options, often choose the less profitable transaction path, due to perishability of crop. It also solved the mystery of low productivity in this locale as compared with the national and international production. Typhoons, government policies, and pricing mechanisms affect its overall productivity. Cost build-up, value-added, and cost and returns analyses are interesting. Farmers are less profitable yet have the highest opportunity for profitability when the constraints are addressed while sellers have a high degree of profitability due to fewer input costs. The existing entry barriers in each chain were also identified, along with the researcher’s recommendations on how to eliminate or mitigate them. The study can be useful to stakeholders of cassava in designing intervention mechanisms to tap its full potentials.

1. Introduction
Most of the studies related to cassava revolved around its biology, anatomy, and physiology. It is, therefore, necessary to conduct a full range of cassava value chain analyses through crop accounting and financial analysis. This study has taken into account the dynamics of the value chain outside the hands of the farmers by involving other chain actors such as the middlemen, processors, and sellers. In addition, research related to the cassava value chain in this specific locale has never been conducted, making this study more distinct and relevant.

Value chain refers to a chain of activities where products pass through in sequence and at each activity, the products gain value [6]. It can be defined as the whole spectrum of operations from production to consumption [5]. Cassava (Manihot esculenta) is a tropical root crop that serves as food for approximately 800 million people around the world [7]. This crop is usually grown by low-income farmers in tropical and sub-tropical regions [3]. Global production of cassava in 2014 was about 268,277,743 metric tons, 33.5% came from Asia, with the Philippines ranking 25th for producing 2,540,254 MT [3]. However, various risks are associated with cassava farming for commercial purposes which results in low agricultural productivity. Losses occur due to crop diseases and soil erosions.
Moreover, if cassava farming is not adequately managed, it could have devastating effects on the environment, such as habitat damage and soil deterioration [1,7,13].

In the year 2019, cassava production in the Philippines was 2,630,800 MT and valued at PhP 21,485,400.00 [12]. Camarines Sur contributes only 5% to the country’s cassava production, yet information that is attributable to specific districts is scarce. Thus, analysis of the dynamics of cassava is relevant in determining such information. This is the first comprehensive study of cassava in the district, and even to the rest of the region, that utilizes crop accounting, financial analysis, and value chain analysis.

2. Materials and methods

2.1. Materials

The study utilized a mixed-method and was conducted in 2019, before the outbreak of COVID-19 in the district and before the onslaught of three super typhoons that battered the region in 2020, which significantly destroyed cassava production. To gather primary data, key informant interviews (KII) were conducted, and focus group discussions (FGD) were also facilitated. In addition, document review was steered to collect substantial data which served as the basis for comparison of the research results and existing claims about a particular topic. Purposive method through snowball sampling was used to determine the respondents, because there are no existing records of cassava players in partido district.

All known major, active, and available entities of farmers, sellers, and middlemen were included in the study. Respondents were the 15 producers (planters/farmers), five traders and processors, and 12 sellers of the product. The study also considered other key informants such as Municipal Agriculturists, Local Government Unit (LGU) representatives, Department of Trade and Industry (DTI) personnel, and Department of Agriculture (DA) officers, who significantly contributed inputs in the realization of the study. The researcher used a structured questionnaire as the primary instrument in gathering data. The preliminary investigation was initially conducted by coordinating with the office of the municipal mayor in different municipalities of the Partido District. After determining possible barangays, the researcher coordinated with various officials to locate the respondents. Crop accounting worksheets through Stata and excel were employed to generate the summaries of relevant accounting figures.

2.2. Methods

A value chain analysis was performed and value chain mapping was constructed to examine the actors, their roles, and relationship dynamics in the chain. Crop accounting techniques were employed to evaluate, account, and analyze the costs, value-added, and returns on production, logistics, and marketing. Return on Revenue (ROR) was applied to determine the profitability of overall activity in each chain. It measured the relationship of net income derived with the revenue generated for the activity. To analyze the relationship between the cost of sales and gross revenue in ascertaining the degree of business risk, the Gross Profit Rate (GPR) was computed.

To analyze the estimated income of each player involved in a particular transaction path, the Cost to Revenue Ratio (EC/R) was derived. Moreover, the profit to cost ratio was used to measure the relationship of the profit derived with the costs incurred in the activity and assess the overall attractiveness of the activity. The value-added in each chain was calculated to measure the liquidity of a particular activity. The following equations and formula were applied: sales = quantity x unit price; cost of goods sold = direct materials + direct labor + variable overhead costs + fixed overhead costs; gross margin (in pesos) = sales - cost of goods sold; and gross margin percentage = gross margin/sales x 100; value added (VA) = costs incurred – selling price; 

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ROR = \frac{\text{net income}}{\text{gross income}}; \quad \text{GPR} = \frac{\text{gross income}}{\text{gross revenue}}; \quad \text{EC} = \frac{\text{Total expenses}}{\text{gross revenue}}; \quad \text{and Profit to Cost Ratio} = \frac{\text{Profit}}{\text{Costs}}.
\]
3. Results and discussion
3.1 Socio-demographic profile of each player and level of involvement of farmers in the cassava value chain in Partido District, the Philippines

The average age of the players in the value chain is on the age bracket of 47-49 years old. As compared to the result of PSA’s study in 2019 which revealed an average age of 48, the results obtained can be interpreted that there exists no notable difference as far as the age is concerned [12].

Table 1 also shows that most farmers are male while the majority of middlemen and sellers are female. It appears that women are responsible for marketing, while men are responsible for farming, which matched the results of a study in southwest Nigeria [2]. It was also revealed that the level of farmers’ income is considered below the country’s poverty threshold (8 x PhP 1,275 = PhP 10,200.00), while middlemen and sellers’ income hovers above the threshold (6 x PhP 2,566.67 = PhP 15,400.00) and (7 x PhP 3,232.14 = PhP 22,625.00), respectively. Based on the 2013 analysis, it can be inferred that cassava farmers are resource-limited, which is a typical scenario since cassava can be grown with less or no farm inputs [3]. It can also be noted that the average number of family members for both players is far above the country’s average household size of 4.4 persons. All players also seem to have the same model class of civil status and educational attainment.

Table 1. Socio-demographic profile of cassava value chain players (Partido District, the Philippines).

| Profiles                                      | Cassava farmers | Cassava middlemen & processors | Cassava sellers |
|-----------------------------------------------|-----------------|--------------------------------|----------------|
| Number of entities                            | 15              | 5                              | 12             |
| Average age of respondents                    | 47              | 48                             | 39             |
| Gender                                        | Male            | Female                         | Female         |
| Civil Status                                  | Married         | Married                        | Married        |
| Average family monthly income (PhP)           | 13,800.00       | 15,400.00                      | 22,625.00      |
| Number of family members                      | 8               | 6                              | 7              |
| Highest educational attainment                | High School     | High School                    | High School    |

3.2 Value chain characteristics as to the relationship of players from the farmers to buyers using the farm to market analysis

The Cassava VC in Partido, Camarines Sur consists of farmers, middlemen/processors, and sellers. The middlemen usually offer lower prices than the sellers. It appears that most farmers sell their harvest to the middleman for the primary reason of profitability and perishability. Fresh cassava tubers rot within 2 to 3 days, so farmers have the tendency of selling it piece by piece at a lower price, even though it can be sold at a higher price if sold as wholesale. Unlike in the farmer-to-middleman value chain wherein only the middleman sets the price, the seller-to-market value chain has several factors that can affect the price determination of cassava. This was the first comprehensive value chain study of cassava in the district. In comparison with the cost and return analysis of cassava in the Philippines, the results of this study are more detailed yet significantly lower than provincial and national production [12]. As also compared to the cost and returns of cassava players in Indonesia, Ghana, and Nigeria, the results of this study are substantially lower on the average [4,8,10,11].

3.3. Profitability and liquidity of the players through crop accounting and financial analysis
3.3.1 Costs and returns of cassava farmers. Switching transactions from farmer, middleman, to seller will yield substantially low to lower, then to high profit; that is, from 6.259, 0.542, to 2.029 of profit-to-cost ratio, ideally. However, other factors such as bulkiness of harvest are present, which make it likely that a great portion of the harvest may be set aside to rot and not be sold. Thus, on average, the net return of farmers is only PhP 6.214 per kilogram. The resulting loss to farmers can likely outweigh the benefit of a higher price. This provides little to no option to the farmers but to sell it to middlemen even though it will result to, if not loss, lesser profit.
Table 2. Average production costs and returns of cassava farmers (Partido District, the Philippines).

| Items                        | Quantity       | Unit | Value (PhP) | Per farm | Per kg | Cost per kg | Percentage |
|------------------------------|----------------|------|-------------|----------|--------|-------------|------------|
| PRODUCTION                   |                |      |             |          |        |             |            |
| Area harvested = 2.137 ha    | 6,062.402      | kg   | 43,689.714  | 93,350.356 | 7.207  |             |            |
| EXPENSES                      |                |      |             |          |        |             |            |
| Materials (input stage)      |                |      |             |          |        |             |            |
| Planting materials           | 619.345        |      | 1,323.333   | 0.102    |        |             |            |
| Fertilizers                  | 386.895        |      | 826.667     | 0.064    | 0.166  |             | 17%        |
| Labor (production stage)     |                |      |             |          |        |             |            |
| Hired labor                  | 2,895.476      |      | 6,186.667   | 0.478    |        |             |            |
| Rentals - machinery          | 942.278        |      | 2,013.333   | 0.155    |        |             |            |
| Rentals - animals            | 302.652        |      | 646.667     | 0.050    | 0.683  |             | 69%        |
| Others (production stage)    |                |      |             |          |        |             |            |
| Land rentals                  | 499.220        |      | 1,066.667   | 0.082    |        |             | 8%         |
| Transportation (logistics stage) |            |      |             |          |        |             |            |
| Transportation of materials (to buyer) | 275.819       |      | 589.333     | 0.045    | 0.045  |             | 5%         |
| Transportation of harvest (to farm) | 19.969        |      | 42.667      | 0.003    | 0.003  |             | 0%         |
| Depreciation cost            | 77.379         |      | 165.333     | 0.013    |        |             | 1%         |
| Total expenses               | 6,019.033      |      | 12,860.667  | 0.993    | 0.993  |             | 100%       |
| Gross returns                | 43,689.714     |      | 93,350.356  | 7.207    | 7.207  |             | 726%       |
| Net returns                  | 37,670.681     |      | 80,489.689  | 6.214    |        |             |            |
| Net profit to cost ratio     | 6.259          |      | 6.259       | 6.259    |        |             |            |

As seen in figure 2, it can be asserted that transaction paths 2, 3, and 4 are more profitable to farmers, yet they often choose transaction path 1. The study also revealed that farm production averages 6,062.402 kilogram per hectare, which is lower or could be at par with the result of the study conducted by PSA if estimation per district of Camarines Sur will be made by PSA [12]. However, the lesser production of cassava is attributed to the non-application of organic fertilizer [3]. The 3 respondents with the highest production per hectare were the ones using fertilizer. It is followed by the two respondents having the highest time spent per week in cassava farming.

3.3.2 Costs and returns of cassava middlemen and processors. Cassava middlemen exhibit an unreasonable returns of PhP 14.30 per kilogram of cassava root crop or a 0.542 margin-to-cost ratio. It can also be noted in the figure that logistics, a non-value-adding activity, takes up much of the portion of the total cost. This may be due to the bulkiness and low value of cassava, which cannot take substantial expenses without suffering a net loss.

Table 3. Average production costs and returns of middlemen (Partido District, the Philippines).

| Items                        | Sales (PhP) | Per kg | Cost/kg | Percentage |
|------------------------------|-------------|--------|---------|------------|
| PRODUCTION                   | 44,044.000  | 629,829.200 | 14.300 |            |
| Average sale per quarter: kg |             |        |         |            |
| EXPENSES                      |             |        |         |            |
| Direct materials (input stage) |             |        |         |            |
| Cost of sales                | 316,959.500 | 7.196  | 7.196   | 78%        |
| Marketing costs (marketing stage) |             |        |         |            |
| Rentals - place of operation | 10,010.000  | 0.227  |         |            |
| Pasada                       | 11,640.200  | 0.264  |         |            |
| Payment to Municipal Office  | 20,020.000  | 0.455  |         |            |
| Rentals-transportation equipment | 4,290.000  | 0.097  | 1.044   | 11%        |
| Transportation (logistics stage) |             |        |         |            |
| Drivers' fee                 | 12,870.000  | 0.292  |         |            |
| Transportation of harvest (middlemen to seller) | 24,310.000  | 0.552  | 0.844   | 9%         |
| Depreciation                 | 8,437.000   | 0.192  | 0.192   | 2%         |
| Total expenses               | 408,536.700 | 9.276  | 9.276   | 100%       |
| Gross returns                | 629,829.200 | 14.300 |         |            |
| Net returns                  | 221,292.500 | 5.024  |         |            |
| Net profit to cost ratio     | 0.542       |        |         |            |
3.3.3. Costs and returns of cassava sellers. Cassava sellers, on the other hand, are shown to have the highest profit of PhP 24.38 per kilogram of cassava crop or 303% gross returns. It can also be noted, based on the preceding and succeeding financial statements, that farmers have the highest gross returns, followed by sellers, and processors and middlemen. It also appears that the middlemen of cassava do not necessarily progress in the district, thus the players are primarily composed of farmers and sellers. Since middlemen derived lower profits, they have to outsource and transact other root crops or agricultural products apart from cassava.

Table 4. Average production costs and returns of sellers (Partido District, the Philippines).

| Items                      | Sales (PhP) | Per kg | Cost/kg | Percentage |
|----------------------------|-------------|--------|---------|------------|
| PRODUCTION                 |             |        |         |            |
| Average sale per quarter: kg | 3,951,030.720 | 36.400 |         |            |
| EXPENSES                   |             |        |         |            |
| Direct materials (input stage) | 1,107,943.200 | 10.207 | 10.207  | 85%        |
| Marketing costs (marketing stage) |             |        |         |            |
| Rentals - place of operation | 42,224.000  | 0.389  |         |            |
| Pasada                     | 5,314.400   | 0.049  |         |            |
| Payment to Municipal Office | 87,360.000  | 0.805  |         |            |
| Rentals-transportation equipment | 37,783.200  | 0.348  | 1.591   | 13%        |
| Transportation (logistics stage) |         |        |         |            |
| Drivers’ fee               | 9,609.600   | 0.089  |         |            |
| Transportation (seller to buyer) | 4,368.000  | 0.040  | 0.129   | 1%         |
| Depreciation               | 9,828.000   | 0.091  | 0.091   | 1%         |
| Total expenses             | 1,304,430.400 | 12.017 | 12.017  | 100%       |
| Gross returns              | 3,951,030.720 | 36.400 |         | 303%       |
| Net returns                | 2,646,600.320 | 24.383 |         |            |
| Net profit to cost ratio   | 2.029       | 2.029  |         |            |

3.4. Value chain map for cassava

Based on the value chain map in Figure 1, farmers primarily deal with two actors – sellers, and processors & middlemen. There were cases, however, where they directly sell it to consumers; however, if it seldom happens, it usually involves very low volume or quantity. Sellers, on the other hand, can sell it directly to consumers or food processors, whoever may agree to the price. This is most common in the markets of downtown Goa, Sagñay, San Jose, Tigaon, and Lagonoy, where marketing activities take place twice a week on average. When cassava is sold to either consumer or food processor, at some point, the processing immediately begins, as indicated by a dark green portion of the map.

Figure 1. Cassava value chain map, partido district, the Philippines.
The middleman was found to be playing two different roles; that is, as an assembler and a processor. Raw cassava is bought from the farmers to be processed into food and/or food ingredients. The middleman’s truck is usually used to transport cassava from the farm to the storage facilities. The cassava, then, undergoes granulation, wherein the crops are cut into small pieces using a granulating machine. It is, then, dried for 2 to 7 days using a drying pavement or drying facility. After processing, it is sold to feed processors who operate within or outside the Partido District, as indicated by the gray portion on the map. Figure 1 also shows the flow of Cassava in Goa, Camarines Sur in a form of transaction paths. Transaction path 1 is the mainstream of the local value chain which offers a low return to farmers. Transaction paths 2, 3, and 4 are the most profitable to farmers. On the other hand, sellers can choose among three paths, transactions 2, 3, and 4, which may provide reasonable and equal returns.

![Figure 1. Different transaction path of the cassava value chain in partido district, the Philippines.](image)

### 3.5. Assets, liabilities, interest, income, and expenses associated with the cassava value chain
The players confirmed that the only accounts they recognize for the asset section are cash, receivables, machinery and equipment, loan receivables, supplies, and furniture and fixture. For the liability section, they only recognize accounts payable and notes payable. For the equity section, they have unrestricted funds which they used in farming operations or in selling activities. It has also been reported that they also recognize expenses (outflows) such as logistics, rentals, registration, fertilizers, and planting expenses. For income/revenues (inflow), they only have sales income. They do not, however, recognize non-cash expenses, thus the depreciation was objectively estimated through the straight-line & declining balance method. All accounts involved were examined through crop accounting analysis.

### 3.6. Existing entry barriers in the cassava value chain
Typhoons are the natural entry barriers because the area is located in the Philippines' super typhoon capital zone. Most of the farmers claimed that they have lower production than that of the previous harvest. They attributed it to the poor soil condition, which is typical to the cassava farmlands when the soils are not properly managed or used. All of the respondents employ conventional tillage which is not a sustainable farming practice and which can even adversely affect the cassava. This practice can increase the farm production in its initial year; however, such practice can also destroy the soil composition and kill microorganisms, which help nourish cassava in times of nutrient depletion, by exposing it under the scorching sun [3].

Most of the farmers also identified a lack of capital as their major difficulty in farming cassava while sellers complained that the instability of prices is their major difficulty. Most of farmers are not applying fertilizers, which also lead to lower production. It is due to the fact that, in addition to its ability to produce a reasonable yield on low-fertility soils, cassava responds very well to fertilization. This finding is in consonance with the study conducted by PSA [12].

### 4. Conclusions
Cassava farming is usually undertaken by those who live below the poverty line, while marketing is usually undertaken by those who live slightly above the poverty threshold. Gender roles exist, men are associated with production while women are linked with marketing. Due to the perishability of the crop, farmers often chose the less profitable transaction path. Technology on farming and processing is
lacking and unavailable. It is therefore recommended to shift the focus of the government and NGOs’ efforts and initiatives for farmers to attain higher production. The cassava industry in the Partido district is not utilized to its full potential as evidenced by low production. Thus, financial support from government agencies should be provided to acquire the farm inputs necessary to boost production. Aside from this, it can be concluded that logistics, a non-value-adding element, has lowered the returns without giving benefits. Hence, a technological mechanism can reduce or eliminate non-value adding expenses.

Crop accounting relies on historical costs, but the effects of imputed costs were not considered. It is, therefore, recommended to conduct a study taking into account family labor. Another recommendation is the provision of transportation facilities and infrastructures since inefficiency in logistics can hardly be afforded by the players in the chain. The farmers recommended the provision of financial support, provision of machineries for processors, while the sellers recommended the provision of a proper place of operation, and training-workshops. Entry barriers should be taken into consideration in the formulation and implementation of the government’s policies, and NGOs’ programs.

Financial accounts of players are not being maintained. Thus, it is highly recommended for the players to maintain financial records through simple bookkeeping. An accounting enhancement program could be proposed by the university to assist the players in recordkeeping practices.

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