

Determinants of Profitability of Sweet Potato Production in Camarines Sur, Philippines

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Abstract— Sweet potato has found its niche in the global market and is now outpacing other primary staple foods not only because of its desirability for human consumption but as an immediate source of income as well. A study was conducted to examine the factors affecting the profitability of sweet potato production in Camarines Sur, Philippines. Purposive sampling technique was used to select the 108 farmer-respondents. A structured questionnaire and focused group discussion were used as main tools for gathering data. Frequency counts, weighted means and percentages were used to describing and analyzing the socio-demographic data. Cost and return analysis and return on investment were used to determine the profitability of sweet potato production. The factors affecting the profitability of sweet potato production were also evaluated using multiple regression analysis. Results revealed that sweet potato production is generally profitable with the high financial return of 144% to farmers, or a net income of Php 48,400.00 pesos per hectare. There exist a positive relationship between income and farm size, labor input cost, cost of other inputs and access to buyers but inverse relationship exist between income and years of experience and tenurial status. Furthermore, farm size and cost of other inputs are significant variables that contribute to the increase in income. Recommendations include stabilizing the pricing system for sweet potato through the formation of production clusters to improve their market opportunities; provision of seminars and workshops on product development; provision of subsidies on agricultural inputs to reduce the cost of production; provision of basic and high-technology infrastructure; and establishment of an information network on the agricultural market.

Keywords— sweet potato production; market channel; profitability; cost and return analysis; return on investment.

I. INTRODUCTION

Sweet potato has found its niche in the global market because of its potential to respond to the pressing needs of food security and poverty alleviation [1]–[4]. It is being promoted as part of the strategy to combat vitamin A deficiency in children and pregnant mothers, a good alternative food and a good source of carbohydrates and phenolic compounds [5]–[7]. Likewise, it is also considered as a critical staple food base for disaster-readiness and increases the resiliency of households in the face of adverse impact brought about by climate change [8], [9].

Asia is the largest sweet potato-producing region in the world, with figures showing over 90 million tons produced annually. China is the world's biggest producer and consumer of sweet potato, where it is used for food, animal feed, and processing as food, starch, and other products [10]. In the Philippines, a recent report showed that the volume of production for sweet potato is 536,000 metric tons covering a total area of 85,800 hectares. The value of production was estimated at Php7.75 million pesos [11]. For the first quarter of 2017, the Philippine Statistics Authority reported 21.41 thousand metric tons production in the Bicol region which

accounts for 19.1 percent of the total sweet potato production [12]. The huge annual volume of sweet potato is an indicator that more farmers are climate-resilient in this region because of the adaptation measures they undertake [13] and they are growing this crop not only for their consumption but to feed the entire nation as well. Likewise, it is a response to the call for resilient livelihoods to smallholder farmers. Indeed, the sweet potato industry plays a critical role to ensure sustainable development and economic viability not only of the farmers but of the whole country. It is in this light that sweet potato production, processing, and marketing activities, as well as factors influencing them, must be given attention; hence, this study. This study aims to identify the production and marketing practices of sweet potato growers and determine the factors affecting the profitability of sweet potato production. Also, this study also identifies the problems and constraints affecting the sweet potato production and recommend solutions to address these problems.

II. MATERIAL AND METHOD

The study was carried out in ten (10) barangays within the (3) three municipalities of Bula, Cabusao, and Nabua in

Camarines Sur, Philippines. The respondents were from barangays Barceloneta, Biong and San Pedro in Cabusao; Barangays Sto. Nino, Lubgan, Lanipga and Bagoladio in Bula; and Barangays Tandaay, Duran and Inapatan in Nabua, Camarines Sur, Philippines. Respondents are 108 farmers who are involved in growing sweet potato, with a minimum farm size of a ½ hectare. Purposive sampling was used with data taken from the Department of Agriculture.

Descriptive method was employed in discussing the secondary data gathered on sweet potato in Camarines Sur. A structured questionnaire with open-ended questions was developed and used as the main tool for gathering the needed data. Likewise, focused group discussion was also undertaken to elicit more information from the farmers. Document review and analysis of data was also undertaken to confirm and validate the data gathered from the survey. Frequency counts, weighted means and percentages were used to describing the profile of respondents and analyze the production and marketing data collected from the respondents. The cost and return analysis and return on investment were used to determine the profitability of sweet potato production using the formula:

$$ROI = \frac{NetIncome}{TotalCost} \times 100 \quad (1)$$

The determinants of profitability of sweet potato production were evaluated using multiple regression analysis. The model used was explicitly expressed as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \quad (2)$$

where:

- Y_i: represents the average income per hectare of sweet potato produced
- β₀: constant
- β_i: estimated coefficients of the explanatory variables
- X_i: explanatory variables

III. RESULTS AND DISCUSSION

A. Respondent's Profile

Table 1 shows the socio-demographic profile of the respondents. A total of 108 respondents were taken for this study. In terms of gender, there are more males (52%) than females (48%), the oldest at 81 years old and the youngest at 24 years old. In terms of the age range, most of the respondents' age clustered at middle age (between 36-65 years old) with only 1% at 25 years old and below and 4% at 76 years old and above. On educational attainment, 57% of the respondents belong to high school level and 26% and 17% at the college and elementary levels, respectively. Majority of the respondents (95%) are farmers, and the rest are into labor and business. Minor sources of income include pig raising, copra, and fishing. Growing of sweet potato is the main source in Cabusao but secondary only for Nabua farmers.

TABLE I
SOCIO-DEMOGRAPHIC PROFILE OF RESPONDENTS AND FARMING CHARACTERISTICS

Socio-Demographic			Farming Characteristics		
	Frequency	%		Frequency	%
I. Gender	108	100%	I. Tenurial Status	108	100
Male	56	52%	Owner	60	56
Female	52	48%	Tenant	38	35
			Leasehold	10	9
II. Age	108	100%	II. Years in Farming	108	100
76 and above	4	4%	51 – 60	1	1
66 – 75	8	7%	41 – 50	3	3
56 – 65	35	32%	31 – 40	2	2
46 – 55	32	30%	21 – 30	17	16
36 – 45	24	22%	11 – 20	34	31
26 – 35	4	4%	1 – 10	51	47
25 and below	1	1%	III. Farm Size	108	100
III. Educational Attainment	108	100%	4.1 - 5.0	3	3
College Level	28	26%	3.1 - 4.0	9	8
High School Level	62	57%	2.1 - 3.0	7	6
Elem Level	18	17%	1.1 - 2.0	12	11
IV. Source of Income	108	100%	0.5 -1.0	77	71
Farming	103	95%			
Labour	2	2%			
Business	3	3%			

Table 1 above also presents the tenurial status, most of the farmers are owners (56%), and the rest are tenants and leaseholders with 35% and 9%, respectively. Most of them

are into farming for 30 years or so, with 47%, 31% and 16% doing farming for 1-10 years, 11-20 years and 21-30 years, respectively. Likewise, the majority of these farmers (71%)

have a farm size of 0.5-1.0 hectare while a few (3%) have a farm size between 4.1-5.0 hectares.

B. Production Practices

The cultural management practices for sweet potato are the following:

- Land preparation - the area is prepared by removing all weeds. It is thoroughly ploughed and harrowed twice to encourage better root penetration, proper aeration and to control immediate growth of weeds.
- Preparation of planting materials - terminal cuttings of sweet potato with 30 cm long is used. But some of the farmers use all parts of the vines from the terminal until one inch away from the roots.
- Fertilizer Application - farmers with small farm sizes seldom apply fertilizer, and only those farmers with more than one hectare are using inorganic fertilizer. They use urea as the basal application with a minimum of 2 bags per hectare.
- Planting - farmers use 2 to 3 cuttings of sweet potato planted at a distance of 80 cm between rows and 35 cm between hills. Each cutting is slipped on the ridges using a sharpened stick.
- Weeding Control – this is done manually by pulling the grass or by using a bolo.
- Hilling up - farmers harrow the spaces between hills of the plants to lift the soil and cover the roots of the plants. It is also done to remove weeds and promote proper aeration.
- Harvesting - there are two (2) ways by which harvesting is done: 1) By lifting all the vines or sometimes all the vines are first harvested and then the field is harrowed, and all the tubers are picked up from the ground 2) Farmers harvest only tubers using bolo and they wait for at least 1 week to let some tubers become bigger. Farmers then, harvest 2 to 3 times before the vines are removed from the field.

Most of the sweet potato varieties grown are *Inubi* or *Ubi Violet*, *Durat*, *Tinarlac* or *Tinapayas*, *Tres kolores*, *Tinuring*, *Taiwan orange*, *Inaswang*, *Paryados*, *Maligaya*, and *Tinirung*. Some of the reasons given by respondents as to why they grow sweet potato are the following: as an additional source of income, the crop is not difficult to grow, typhoon-resistant, does not need irrigation and fertilizer and entails less production cost. Harvest is usually between 80 to 100 sacks with an average of 80 kilos per sack. The selling cost depends on the size and quality of the sweet potatoes. The biggest or 1st class usually cost between Php 10-15 per kilo; second class at Php8-10/kilo; third class at Php 6-8/kilo; fourth class at Php4.00/kilo and the smallest at Php100-150/sack. After harvesting, farmers noted that they could not store sweet potato for a long time because of the disease called '*atutang*' (sweet potato weevil). Likewise, there is no postharvest facilities or storage room available hence; they can only store sweet potatoes up to a maximum of 5 days on the farm.

C. Marketing Practices

There are two ways by which farmers market their produce. They either sell their products directly to the consumers or through local traders which they have initially

contacted. This marketing channel is illustrated in Figure 1. Farmers usually sell their products direct to their consumers to minimize transportation cost since their products are picked up from the farm gate. Transportation cost, to some extent, eats up a big slice of their income. However, farmers get the lowest profit with a huge sacrifice compared to other players in the business in this case. Agricultural products purchased at farms are usually cheaper than those sold on the regular market [14]. Another way is to market their produce individually via local traders. Before reaching the market, they usually go through one to three intermediaries and each intermediary takes more profit [14]. In this study, traders sell their products in nearby municipalities in Sipocot, Libmanan, Calabanga and the province of Camarines Norte. This practice aligns with the result of the study wherein smallholder farmers either sell to local traders or directly to consumers at the farm gate [15].

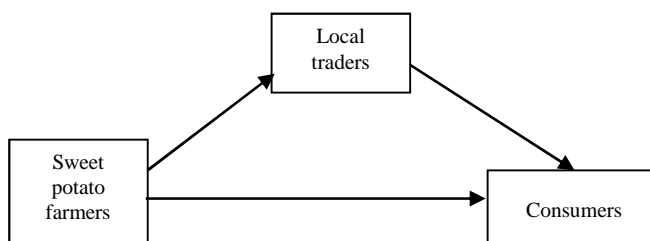


Fig.1. Marketing Channel for produce from sweet potato farms, Camarines Sur, Philippines.

Previous year's report also showed that across the provinces surveyed, bigger portion of sweet potato production at 83.29 percent was sold to a trader. Only 3.90 percent were sold to co-farmers and given away accounted for 3.71 percent while those for home consumption were 4.13 percent. Minimal proportion went to other dispositions [16].

When they sell in the local markets, the transactions are done informally. Farm gate sales usually result in lower revenues for the farmer since the prices offered to the farmers are lower and variable. Variable prices result from the unavailability of scales for weighing produce and lack of market price knowledge. Likewise, at the farm gate, farmers are often obliged to sell to their neighbors even when the latter cannot pay immediately for the produce [15]. Even then, farmers still opt to sell directly to the nearby buyers because they receive direct, immediate payments without thinking about transportation cost. Given this scenario, a previous research study also posited that households that did not sell their products and those that sold to their neighbors recorded losses while those that sold to private traders within the district, within the village and those that sold to consumers outside the district recorded profits [17].

Farmers noted that the price of sweet potato is not stable in the market. Some of the reasons given by farmers are the occurrence of the typhoon, the use of banana instead of sweet potato, unstable supply and price variability and control by buyers. In 2014, the Philippine Statistics Authority reported that price instability was the major marketing problem of 55.78 percent of all sample sweet potato farmers [16]. The low price of produce was the constraint of 36 percent. There was 28 percent whose problem was on rough roads/high transport cost and 14

percent on limited buyer/ market outlets. Farmers who cited problem on lack of marketing information were 10.89 percent. Market information and its availability play a critical role for farmers. Its limitation hurts the marketing of agricultural products. It may be noted that smallholder farmers remain uninformed on market prices and trends despite the technological progress brought about by the Internet and mobile phones. Thus, farmers generally do not have the required information due to poor production-market linkage resulting in the inability to locate better markets [18]. In the process, farmers do not have strong bargaining power and are forced to sell products through intermediaries [14].

This further corroborates with the report that farmers are in a disadvantaged situation about the flow of the market, pricing, and technological information as a result of severe constraints in information distribution and resources. Access to real-time information on changing demands in the market, the quality of the crops, and fluctuations in market prices as well as the accuracy of the information is vital. There are very few reliable alternative sources of market information that farmers can access, with 90 percent of them having to rely on the information provided by the buyers [19]. This is further supported by a study which stressed that intensified dissemination campaign, use of broadcast and print media and the conduct of fora/symposia are good venue for information access and exchange [20].

Aside from poor marketing system, sweet potato farmers are faced with several constraints that significantly affected their efficiency of production at optimal levels. This also includes inadequate storage facilities, high cost of production and poor transportation system which also tends to increase the rate of post-harvest spoilage [21].

D. Profitability

Table 2 provides the detailed cost and return for growing sweet potato for a one-hectare farm. Cash sales and non-cash sales amounted to Php 72,000.00 and Php 10,000.00, respectively giving a total return of Php 82,000.00. Cash cost includes land preparation, hired labor, fertilizer & pesticide cost while non-cash cost consists of planting materials/cuttings, fixed cost, and unpaid family labor giving a total cost of Php 33,600.00. The computed net income is Php 48,400.00. Return on investment is 144% which is computed as follows:

$$ROI = \frac{48,400}{33,600} \times 100 = 144\% \quad (3)$$

Previous reports revealed that the production of sweet potato in Camarines Sur averaged P3,961 kilograms per hectare. Also, planting materials harvested were 655 kilograms. Together, gross earnings of sweet potato farmers amounted to P57,759 per hectare. In Camarines Sur, the average cost of production of sweet potato per hectare was P30,057. On a per kilogram basis, production cost was P7.59 [16]. In this study, the gross earnings are Php 45,000.0, and the production cost is Php 33,600.00. Most recently, however, the Philippine Statistics Authority reported that production of sweet potato dropped to 112.24 thousand metric tons, from 113.37 thousand metric tons in 2016 or by 1.0 percent. Among the factors that caused the decline was

decreased in yield due to root rot caused by continuous rains during root formation and poor quality of tubers harvested due to the effect of weevils caused by frequent rainfall.

TABLE II
COST AND RETURN ANALYSIS

ITEM	AMOUNT
I. Return	
Cash Sales	Php 72,000
Total Cash Sales	72,000
Non-Cash Return	
Consumed at Home	10,000
Total non-cash return	10,000
TOTAL RETURN	Php 82,000
II. Cost	
Cash Cost	
Land Preparation	7,000
Hired Labour	15,450
Fertilizer (Urea)	3,800
Pesticide	550
Total Cash Cost	26,800
Non-cash Cost	
Planting Materials	3,200
Fixed Cost	1,500
Unpaid Family Labour	2,100
Total Non-cash Cost	6,800
TOTAL COST	33,600
Net Cash Income	45,200
Net non-cash income	3,200
NET INCOME	48,400
RETURN ON INVESTMENT	144%

Multiple linear regression was employed to investigate factors affecting the quantity and income of sweet potato production per hectare (Table 3).

TABLE III
DETERMINANTS OF PROFITABILITY OF SWEET POTATO PRODUCTION

	Variable	Coefficients	P-value
Intercept		-7376.381885	0.003000623
years of experience	X1	-29.12512691	0.480936984
Tenurial status	X2	-278.2459918	0.570960933
Area for Sweet Potato	X3	55851.26525	5.61983E-23
Labour input cost	X4	0.468493294	0.070458959
Cost of other inputs	X5	1.299156038	0.017211924
Mode of Sale	X6	1132.139181	0.302960739

Results revealed that a positive relationship exists between income and farm size, labor input cost, cost of other inputs and mode of sale. This implies that as more of these variables are employed, there will be an increase in income on sweet potato production. On the other hand, results showed an inverse relationship between income and years of experience and tenurial status. The negative sign for the years of experience may be because farmers with long years of experience are used to obsolete methods of farming, traditional tools and varieties which do not encourage high-income return. For the tenurial status, the inverse relationship may be explained by the fact that majority of the farmer-respondents are tenants and leaseholders and their

desire to have high sweet potato production may not be as much as when you are the owner of the farm.

The coefficient on farm size was significant ($p < 0.05$) and positively related to the income of sweet potato produced. The results suggest that for every hectare increase in farm size, all else equal, the income on sweet potato would increase by Php 55,851. Also, a 1-peso unit increase in the cost of other inputs will increase the income by Php 1.29. Furthermore, the value of R^2 suggests that the independent variables used in the model accounted for about 98% of the variation in profitability (Table 4).

TABLE IV
REGRESSION STATISTICS

Multiple R	0.993450518
R Square	0.986943932
Adjusted R Square	0.986168324
Standard Error	4748.49047
Observations	108

The result of this study in terms of cost and return analysis for sweet potato production is very encouraging. As mentioned earlier, sweet potato is a very important staple crop and valuable marketed commodity for Filipinos. There is wide latitude for generating income. Thus, this crop should be given priority attention. With more farmers producing sweet potato, they will become more self-reliant and financially-secured. It is a good food crop for Filipinos because it can survive with fewer inputs and less management. Towards this end, the role of the local government units, research institutions, and other stakeholders are very crucial. For instance, the Crop Science Cluster-Institute of Plant Breeding is into various research initiatives on sweet potato and had reported that the return on investment (ROI) for sweet potato could range from 8% to 117% [22]. Indeed, the proactive roles and strategic partnership of the different institutions in providing necessary technical know-how to respond to location-specific needs of farmers is imperative to stimulate and drive farmers to continue raising basic and potential crops in their areas [23].

Additionally, it is a potential climate change adaptation crop given its moderate drought tolerance, requiring little labor and fertilizers for the development of tuber. It is a reliable food source even in times of adverse weathers because tubers are underground and not exposed to destructive winds of tropical cyclones [9]. This is further corroborated by the report of the International Potato Center wherein they cited the critical role the sweet potato played in disaster recovery [8].

E. Problems and Challenges

Some of the problems encountered by the sweet potato farmers are the following:

- Pest infestation such as the presence of mice and worms (ulod) makes the farm area less productive. Mice feed on the sweet potatoes causing leaves to curl and results in the production of inferior/small sweet potatoes. On the processing of sweet potatoes, knowledge of farmers is very limited, and training is

essential. The only processed products developed from sweet potato are *camote que*, *kalingking* and *Buchi*.

- Harvest is only done once a year. Hence, farmers find difficulty in sustaining their income for their families for the whole year.
- On marketing, there are no permanent buyers of sweet potatoes and or if ever there is, these buyers are very limited resulting to low price. Farmers also go to the main of the municipality to canvass for the price before bringing the product in the market.
- In terms of transport, farmers noted the high cost in '*paghihilada*' or the transfer of the produce from the farm site to the highway.
- Sweet potato is an undervalued crop for some farmers and is not given priority attention in the farm.

IV. CONCLUSION

The study examined the factors affecting the profitability of sweet potato production. Sweet potato production is generally profitable with the high financial return of 144% to farmers, or a net income of Php 48,400.00 per hectare. The study also revealed that positive relationship exists between income and farm size, labor input cost, cost of other inputs and mode of sale but inverse relationship exist between income and years of experience and tenurial status. Furthermore, farm size and cost of other input are significant variables that contribute to the increase in income of sweet potato farmers. Various problems affect the sweet potato farmers. One major difficulty is unavailability of market and high transaction costs which are significant hurdles to realizing the aims of agricultural development for farmers. Likewise, farmers lack training and have limited information on value-adding especially on food processing and product development. Pest infestation is also a problem and needs to be addressed to increase the volume of sweet potato production.

Looking at the high profit or return on investment, there is a bright prospect for the sweet potato industry in Camarines Sur. This is a positive response to the government's policy direction on poverty reduction and empowerment of the poor and vulnerable and Integrity of the environment and climate change adaption and mitigation. Likewise, sweet potato has a potential contribution towards developing interventions and solutions for climate change adaptation and mitigation and disaster risk reduction.

This study recommends some issues as follow: Policies should be developed to enhance the productivity of sweet potato farmers through the provision of seminars and workshops where farmers would acquire more training on sweet potato production, pest management, marketing, and product development. This can result in the mass growing of sweet potato which can also serve as buffer food during adverse and extreme climate conditions.

Provision of subsidies/financial support on agricultural inputs such as fertilizers, seeds, and agro-chemicals is essential to reduce the cost of production and increase the income of farmers.

Stabilize the pricing system for sweet potato through the formation/creation of producer groups/cooperatives to

improve their market opportunities. This will encourage farmers to venture into sweet potato production, processing and business which will provide them more income and make them more resilient to natural and economic vulnerabilities.

Provision of modern technologies and extension services, basic and high-tech infrastructure, having agencies teaching good agricultural practices, establishment of an information network on the agricultural market, appropriate institutions, and credit market development.

Strengthen social marketing and promote sweet potato diversity to change the mindset of farmers and communities that it is just one of those 'ordinary' crops growing on the farm. Sweet potato is a critical staple food base for disaster-readiness and recovery, nutrition and food security.

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