



Utilizing and Creating Added Value from Commercial Banana: Case Study in Phra Nakhon Si Ayutthaya Province, Thailand

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Abstract

Bananas are an interesting cash crop. The popular banana cultivars that tend to grow commercially in Thailand are Gros Michel banana, Lady Finger banana, Pisang Awak banana (Cultivated banana), and Lebmuernang banana. Banana fruit is a food source rich in nutrients and many important substances. In addition, different parts of the banana can be used and processed to create economic value. Therefore, the knowledge gained from gathering information on banana processing and the feasibility case study of the production of processed products from commercial bananas can be used as a guideline to support and extend the utilization of bananas in various aspects in order to take advantage of local resources as a method to uplift the basic economy to achieve stability, sustainability, increase careers, and income of banana growers and local enterprise.

Introduction

Banana is a tropical plant that is native to Asia. It is mainly found in Southeast Asia, such as Laos, Myanmar, Vietnam, Indonesia, Malaysia, Cambodia, and Thailand, and has continuously spread throughout the world as a cash crop (Department of Agriculture, 2018). Bananas are one of Thailand's most important economic crops. Due to the widespread utilization of different parts of bananas, 15,051,333 kg (equal to 374,388,936 Thai baht) of fresh bananas and processed bananas were

exported from Thailand in 2020 (Office of Agricultural Economics, 2020). In Thailand, there are commercially valuable banana varieties such as Pisang Awak banana (Cultivated banana), Gros Michel banana, Lady Finger banana, and Lebmuernang banana (Pengpoo & Jamjang, 2016). Bananas can be eaten either raw or ripe; the fruits are a nutritious food source, content high energy due to their high starch but low-fat content, vitamins included vitamin A, vitamin B6, vitamin C, and minerals included calcium, iron, and potassium, etc. (Phukasmas, 2017). Different parts of bananas can be used in many ways,

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including being used as raw materials in both savory and sweet dishes. Including processing into beverage products, banana juice, banana wine, concentrated banana juice, banana starch, utilization from stems, bracts, leaves, banana stalks, and banana rubber, and using banana waste as raw materials for biogas production. In addition, bananas have various medicinal properties such as constipation, diarrhea, gastritis, etc. (Sangseesod, 2000).

Therefore, this paper offers a collection of knowledge about the guidelines to use and create added value from commercial bananas in Thailand is necessary for community development. A case study on the possibility of adding value to bananas in Sai Noi Sub-district, Bang Ban District, Phra Nakhon Si Ayutthaya Province, was to disseminate preliminary information to those who are interested in a guideline for further utilization of bananas in various aspects.

Characteristics of commercial banana varieties in Thailand

Bananas belong to the family Musaceae, where bananas are grown or edible are classified in section Eumusa and originated from two species of wild bananas, the wild banana (*Musa accuminata* Colla) and the Tani banana (*M. balbisiana* Colla), which are Banana genomes A and B, respectively (Mohapatra et al., 2010; Deepthi, 2016). Planted or edible bananas have 2, 3, and 4 sets of chromosomes (2X, 3X, and 4X) (Valmayor et al., 2000). There are many varieties of bananas found in each region of Thailand. There are differences in the genomes, height, size, shape, and characteristics (Fig. 1 and Table 1). The bananas studied were edible banana groups with 2 sets of chromosomes and AA or 2X (AA) genomes, such as the Sugar banana (*Musa acuminata* 'Kluai Khai, AA Group) with artificial stems no more than 2.5 m tall, approximately 16 cm in diameter (diameter more than 15 cm), the blossom is oval, pointed tip, reddish-purple. Commercial harvest occurs when 70-80% of the fruit is completed and the fruits at 40-50 days after cutting the banana blossoms (Sangudom et al., 2014). There are 7 hands per bunch of bananas, and about 14 fruits per hand, the size is relatively small, 2-3 cm wide, 8-10 cm long, thin peel, bright yellow when ripe, Orange-cream-colored flesh, fragrant, sweet taste. Lebmuernang banana (*Musa acuminata* 'Kluai Lep Mu Nang', AA Group) is an edible banana 2X (AA), pseudostem not higher than 2.5 m, diameter less than 15

cm, relatively long oval, pointed tip, reddish-purple color. Harvesting period occurs when the fruit is about 60 days and after the banana blossom cutting (Youryon & Supapvanich, 2017). There are 7-8 branches per cluster of bananas, one branch has 10-16 fruits, small fruits, 2-2.5 cm wide, 11-12 cm long, fruits curved, tapered at the end, thick peel, golden yellow when ripe, fragrant, yellow flesh, sweet taste. Gros Michael banana (*Musa acuminata* 'Kluai Hom Thong', AAA Group) is an edible banana 3X (AAA) with pseudostems not higher than 2.5-3 m, diameter more than 15 cm, the blossoms are oval, quite long, pointed, reddish-purple color. Harvesting period occurs when the fruit is about 90-110 days after a banana blossom cutting (Chunwijitra, 2015). There are 4-6 branches per cluster of bananas, one branch has 12-16 fruits, large fruit, 3-4 cm wide, 21-25 cm long, thin skin (peel), golden yellow when ripe, the flesh is light orange, fragrant, sweet taste. Pisang Awak banana (Cultivated banana) (*Musa x paradisiaca* 'Kluai Nam Wa', ABB Group) is an edible hybrid banana 3X (ABB) with pseudostem not higher than 3.5 m, more than 15 cm in diameter, the blossoms are oval, pointed, reddish-brown. Harvest time occurs when the fruit is about 110-120 days after a banana blossom cutting. There are 9-12 branches per cluster of bananas, one branch has 10-16 fruits, The fruit is larger than the Lady Finger banana, 3-4 cm wide, 11-13 cm long, the peel is thicker than Lady Finger banana when ripe yellow, white meat, yellow center filling, sweet taste (Suvittawat et al., 2014; Silayoi, 2015).

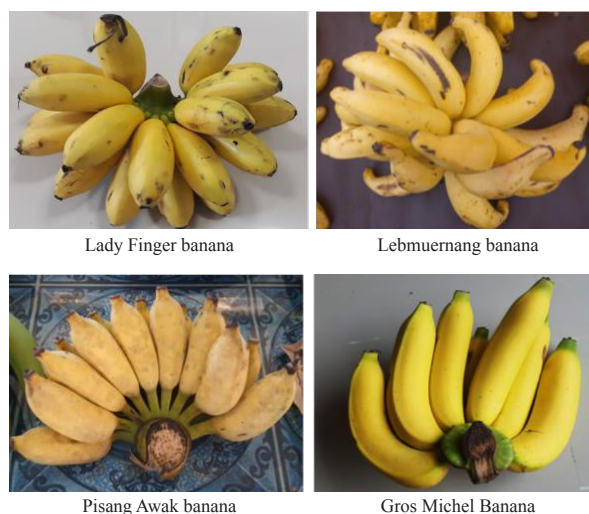


Fig. 1 Characteristics of the commercial banana varieties in Thailand

Table 1 Summarize characteristics of the commercial banana varieties in Thailand

Characteristics/ Varieties	Lady Finger banana 'Kluai Khai'	Lebmuernang banana 'Kluai Lep Mu Nang'	Pisang Awak banana 'Kluai Nam Wa'	Gros Michel banana 'Kluai Hom Thong'
Set of chromosomes, Genomes	2X (AA)	2X (AA)	3X (ABB)	3X (AAA)
Harvesting period (days after blossom cutting)	40-50	60	110-120	90-110
Pseudostem high (m.)	2.5	2.5	3.5	2.5-3.5
Pseudostem diameter (cm.)	>15	<15	>15	>15
Blossom shape	oval with pointed tip	oval with pointed tip	oval with pointed tip	oval with pointed tip
Blossom color	reddish-purple	reddish-purple	reddish-brown	reddish-purple
Branches per cluster	7	7-8	9-12	4-6
Fruit per branch	14	10-16	10-16	12-16
Fruit size	small	small	medium	large
Fruit wide (cm.)	2-3	2-2.5	3-4	3-4
Fruit long (cm.)	8-10	11-12	11-13	21-25
Peel (skin)	thin	thick	thick	thin
Peel color at ripe stage	bright yellow	golden yellow	yellow	golden yellow
Flesh color	orange-cream	yellow	white with yellow center	light orange
Fragrant	fragrant	fragrant	fragrant	fragrant
Taste	sweet	sweet	sweet	sweet
References	Sangudom et al. (2014)	Youryon & Supapvanich (2017)	Suvittawat et al. (2014); Silayoi (2015)	Chunwijitra (2015)

Chemical composition from different parts of bananas

Raw bananas contain starch as the main constituent and resistant starch, which is beneficial for the digestive and circulatory systems (Table 2). The resistant starch is not digested by enzymes in the small intestine. Instead, they reach the large intestine and are fermented by microorganisms into short-chain fatty acids such as acetate, propionate, and butyrate, which are beneficial to probiotic microorganisms (Boonkong et al., 2015). Raw banana flour has important biological properties such as antioxidant activity. The analysis of the antioxidant activity of 4 types of raw banana starch,

namely, Gros Michel banana, Lady Finger banana, Pisang Awak banana (Cultivated banana), and Lebmuernang banana, found that Lebmuernang banana has the most antioxidant activity, which is 38.63%. When all 4 types of bananas were processed into banana flour, it was found that the raw sugar banana flour had the highest antioxidant activity, at 31.71%. Processing resulted in a decrease in the antioxidant activity of banana starch (Pengpoo & Jamjang, 2016). The chemical composition and antioxidant activity changing when the fruits begin to ripen. The trace chemical composition of ripe Lady Finger bananas and ripe Gros Michel bananas were investigated and found that total soluble solids, the phenolic compounds, sugars, vitamin C, and antioxidant activity tended to increase as the bananas began to ripen at full maturity. After that, it tends to decrease when the bananas enter the maturity stage. A ripe Lady Finger banana has higher antioxidant activity than a ripe Gros Michel banana (Fernando et al., 2014). Other parts of bananas, including banana sheath, banana blossom, banana leaves, and stem, are primarily dietary fiber, which is not digested in the gastrointestinal tract. Therefore, does not give energy. The moisture content of fresh banana plants is 96%. Dietary fibers found in dried banana plants include cellulose, hemicellulose, lignin, and pectin (Li et al., 2010).

Methods for processing and utilizing different parts of bananas

Table 3 shows the methods for processing and utilizing different parts of bananas. Both raw and ripe bananas can be processed into a variety of food products such as fried bananas, banana chips, and sweet bananas in coconut cream. Banana flour, which can be used as a raw material in food production (Nimsung et al., 2007)

Table 2 Chemical composition from different parts of bananas

Bananas	Chemical composition (%)						References
	Moisture	Protein	Fat	Ash	Carbohydrate	Fiber	
Unripe banana flour	6.90	3.60	0.89	3.14	76.77	7.2	Menezes et al. (2011)
Ripe banana flour	9.57-8.17	4.78-4.11	0.42-0.30	4.44-4.65	80.80-82.72	NI	Alkarkhi et al. (2009)
Unripe banana peel	NI	8.6	13.1	15.25	12.78	50.25	Wachirasiri et al. (2009)
Ripe banana peel	NI	7.51	12.44	15.13	14.18	50.74	Weeragul et al. (2015)
Banana blossom	1.76-1.89	1.98-1.29	0.41-0.46	4.19-3.08	93.42-95.17	15.48-15.32	Arya & Sinija (2016)
Banana leaf	NI	11.70	9.60	31.30	NI	21.70	Yeekaew et al. (2015)
Banana pseudo stem	Cellulose 39.12%, holocellulose 72.71%, klason lignin 8.88%, acid-soluble lignin 1.90%, ash 8.20%, pectin 0.27%						Li et al. (2010)

Remark: NI means no information

including the use of bananas to produce both savory and sweet food. In addition to being consumed ripe bananas can also be used as a face mask to add moisture to the peel and reduce roughness on the peel (Hengsawadi, 2014). Banana blossoms can be processed into banana beverages, which contain phenolic compounds and have high antioxidant activity (Amornlerdpison et al., 2016). Fresh and dried banana leaves can be molded into food packaging. Fresh banana leaves are used to make a Baisri or inventions in various worship ceremonies. Factors affecting the quality of fresh banana leaves are temperature and season for harvesting banana leaves (Kwanhong et al., 2017). Banana stems are used as a raw material for both human food preparation and as an ingredient in animal feed as well as in the production of banana rope, paper, bags, or various packaging. Other waste can be used as raw materials in the production of fertilizers, bio-fermented water, and briquette fuels, etc. (Sutthiwilairatana et al., 2017).

Case study of the possibility of creating added value from commercial banana

Economic feasibility study is a study that evaluates returns and costs (Pricing of Benefit and Cost) based on the goal of efficiency of resource utilization for production. The applied price is called “efficiency price” and the collective analysis is called “Economic Cost-Benefit Analysis” (Field & Nancy, 2005).

In studying the economic suitability of a project, the expected benefits from the project are compared with the project’s investment cost over the period of analysis, which is calculated in the form of the main economic index, which is discussed as follows Dellarosawati (2020).

Net Present Value (NPV) is a calculation comparing the value of Economic investment in different years with expected economic benefits during the project analysis period using the discount rate converted to the current currency.

Table 3 Example of methods for processing and utilizing different parts of bananas

Bananas	Methods for processing and utilizing different parts of bananas	References
Unripe banana flour/ Ripe banana flour	<ol style="list-style-type: none"> 1) Unripe banana or ripe banana was washed with clean water 2) Dipped in hot water at 65-75°C for 10 mins until tender (for unripe banana) 3) Cooling banana fingers under clean water (23°C) 4) Peeling of the banana 5) Slicing (3-4 mm thick unripe and 2 mm thick ripe slices) 6) Steeping the slices in 0.2% citric acid solution for 10 min and draining of solution 7) Drying the slices in tray dryer at 60°C until the final moisture content 8-10% (wet basis) 8) Grinding and sieving (250 μ) before packaging 	Pragati & Ravish (2014)
Extracted pectin from unripe banana peel	<ol style="list-style-type: none"> 1) The unripe banana peel powder was mixed with hydrochloric acid 2) Heated (90\pm5°C) and stirred before filtration 3) A precipitate of pectin with ethanol and then it was recovered by centrifuge at 5000 rpm for 10 mins 4) The pectin substance was dried in a conventional oven at 65°C until a constant weight 	Kamble et al. (2017)
Extraction ripe banana peel for jelly drink	<ol style="list-style-type: none"> 1) Banana peel was cut into small pieces 2) Dried by using tray dryer at 50°C for 24 hours and crushed to make a coarse powder 3) The dried powder was extracted with water (Ratio 1:20) at 25°C for 18 hours 4) The extracts obtained were evaporated to dryness by rotary evaporator, packed and stored at 4°C 5) Jelly drink: extracted banana, milk, sugar, gelling agent, and salt were blended by blender until the mixture was homogeneous. 6) Banana jelly drink were pasteurized at 73°C for 15 second and stored in sterile containers at 4°C. 	Rattanatavon et al. (2020)
Dehydrated blossom	<ol style="list-style-type: none"> 1) Collect banana blossoms and remove the bracts 2) Cut banana blossoms and soak 0.2% lactic acid (30 mins) 3) Drain the liquid and place in trays in hot air oven 4) Dry at 60°C for 4 hours and collect dehydrated blossoms 	Acharya et al. (2020)
Extracted cellulose from banana pseudo stem	<ol style="list-style-type: none"> 1) The banana stems were cut into small pieces and left to dry in the sun. 2) The dried stems were mashed and sieved with a sieve size of 70 mesh, to obtain a 70 mesh stem powder. 3) The isolation of cellulose involved the following processes, which include liquefaction, delignification, and bleaching 	Iliyin et al. (2020)
Banana leaf for food packaging	Banana Leaves are one of the most used materials for natural food packaging with its natural properties of foldable structure and its ability to hold water.	Pratama & Junianto (2021)

Benefit-Cost Ratio (B/C Ratio) is an economic index that shows the ratio of the present value of the benefit to the present value of the project investment. B/C greater than 1 means the project will provide a return that is worth the investment.

The Economic Internal Rate of Return (EIRR) is the discount rate that brings the net present value of a project to zero. This rate represents the percentage return received on the project investment as a percentage of return. It is an application of Economic Feasibility analysis theory concepts such as ENPV, EBCR, EIRR by creating added value from waste materials from upstream banana processing (banana trees, turtle-foot bananas) leading to downstream processing. Processed products from bananas to add value from waste materials. The investment period is approximately 5-6 years (determined by the age of the constant factors). The main production costs consist of fixed costs such as gas stoves, pans, kitchen utensils, basket blocks, and variable costs such as raw materials, water, electricity, labor costs, research methodology. This is in line with the literature review of articles related to banana processing such as Puengpho & Boonmeephithit (2021); Chunud et al. (2020) have chosen to use the project analysis theory as a decision-making tool and assess the worthiness of the investment.

Project sensitivity analysis is the best method for analyzing future outcomes of related events. By evaluating the rate of return-on-investment projects under risk and uncertainty, but also estimating the probability that it will occur (Probability or Expected value) which risk occurrences and economic uncertainty may affect investment decisions. For example, the production models are worthwhile. The changing of the production cost this may result in the unworthiness of production in the future that is economically unstable. Consequently, the sensitivity analysis helps in analyzing production patterns that have the potential to resist price sensitivity and the price of factors of production. Therefore, the sensitivity of the project must be analyzed as follows: 1) Costs increased by 5%, 10%, and 15%, while fixed income 2) Income decreased by 5%, 10%, and 15% while fixed costs, and 3) Income decreased by 5%, 10%, and 15% while costs increased by 5, 10 and 15% (Dellarosawati, 2020). The benefits of sensitivity analysis are to identify variables that cause volatility, net return of a project to help evaluate projects more efficiently, and that assessment should consider whether the return or benefit derived from the decision is worth

enough to offset any potential risks.

Sai Noi Community, Bang Ban District, Phra Nakhon Si Ayutthaya Province is a community that has received support from government agencies in using abandoned rice fields for banana cultivation and supporting the value-adding of bananas to processed products of the community, maximizing the use of local resources, creating a career, increasing income, helping to raise the basic economy of the community. "Banana" is a native plant that has a long history within the Sai Noi Community as well as the ability to be used to add value throughout the plant from leaves, blossoms, fruits, and stems.

General information of banana farmers in Sai Noi Community, Bang Ban District

This research is an Area Based Development Research, collection of data with a structured questionnaire with a population of 53 banana farmers in Sai Noi Community. The community has a total banana plantation area of 132.71 rai, covering the area of villages 1-10, with a total of 4 banana varieties, namely Gros Michel banana 80.86 rai, accounting for 60.93%. Followed by Pisang Awak banana (Cultivated banana), 45.15 rai, accounting for 34.02%, Lady Finger banana and Lebmuernang banana, 5.70 rai and 2 rai for 4.30% and 0.75%, respectively as Fig. 2.



Fig. 2 Basic information on banana cultivation in Sai Noi Sub district, Bang Ban District

The majority of banana farmers were female (72.73%), average age of 61 years, primary education (49.09%), 74.55% of them use personal funds for banana business, most of them do not have any loans, the others were burdened (47.27%), liabilities between 10,000-50,000 baht. The most popular banana varieties cultivated were Gros Michel banana (76.36%), followed by Pisang Awak banana (43.63%). Most of the area was owned by

farmers 83.64%, with an average banana plantation area of 1.56 rai per household (400 plants per rai). Popular to employ 2 workers during the banana planting period, average wage 300 baht per day, 8-day average wage labor, total average wage 3,500 baht per person per production cycle. The Hom Thong banana has an average production cycle of 8 months with an average cultivation cost of 6,585.65 baht per production cycle. The average annual income is 36,352 baht, while the Pisang Awak banana has an average production cycle of 10 months with an average cultivation cost of 7,477.37 baht per production cycle. Average annual income of 72,175 baht.

Cost and return of banana cultivation

1. Gros Michel banana: The production cycle is approximately 8 months, the average cost per plant is 114.5 baht, classified as variable cost; land preparation/ planting and sapling cost 25.5 baht per tree, harvesting cost 20 baht per plant, and maintenance cost 5.59 baht per plant and Fixed cost; depreciation of agricultural tools and equipment (pumps, hoses, knives, etc.) 9.5 baht per tree (Fig. 3).

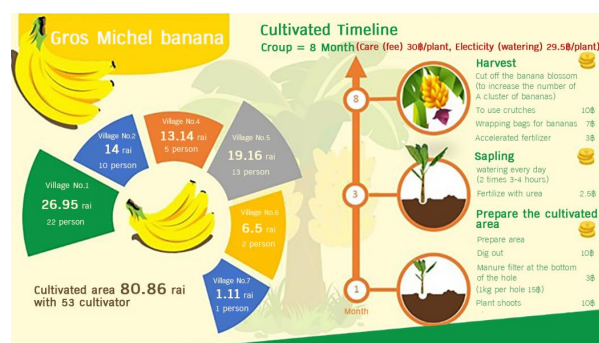


Fig. 3 Information on cultivation of Gros Michel banana in Sai Noi Sub-district, Bang Ban District

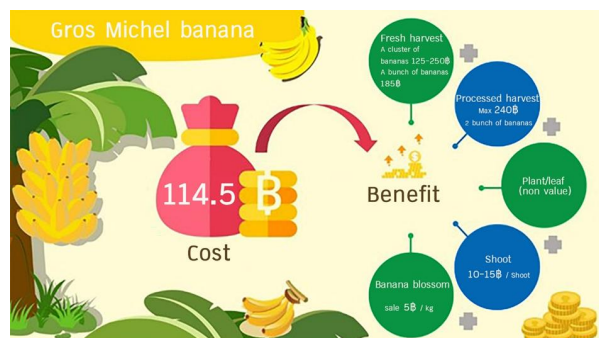


Fig. 4 Cost-benefit of Gros Michel banana production

The tree was classified as fresh fruit and can be sold as a whole tree, approximately 125-250 baht, if processed, can generate an additional 240 baht processed into crispy bananas for sale. Banana shoots can be sold at 15-10 baht per shoot, and banana heads at a selling price of 5 baht per kilogram (Fig. 4).

2. Pisang Awak banana (Cultivated banana): The production cycle is about 10 months, the average cost per plant is 122.5 baht, classified as variable cost; land preparation/ planting and sapling cost 28 baht per tree, harvesting cost 17 baht per plant, and maintenance costs 65 baht per plant and Fixed cost; Depreciation of agricultural tools and equipment (pumps, hoses, knives, etc.) 2.5 baht per tree (Fig. 5).

The tree was classified as fresh fruit. It can be sold for around 120-200 baht. If processed, it can generate an additional income of 260 baht. The trunk can be processed into a basket and artificial flowers earning additional income of 120 and 15 baht per tree, respectively. Banana leaves can be sold for an average of 20 baht per plant, banana blossom, selling price of 6 baht per kilogram, and banana shoots selling price of 10-15 baht per shoot (Fig. 6).

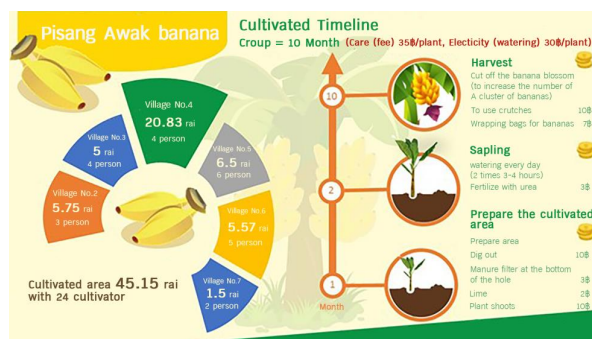


Fig. 5 Information on cultivation of Pisang Awak banana (Cultivated banana) in the study area



Fig. 6 Cost-benefit of Pisang Awak banana production

Possibility of adding value to banana products

Sai Noi Community prefers to bring products from Gros Michel banana (product size is not standard) and Pisang Awak banana (Cultivated banana) to add value. Including the processing of bananas into crispy banana chips with the production process as shown in Fig. 7. Undeveloped banana hand or Turtle Feet bananas are the 7-8th banana (a group of bananas will have about 8 to combs). Usually, farmers eat Turtle Feet bananas for their own consumption within the household or distribute to neighbors or relatives. These bananas do not generate income or cash inflows. The cost of producing crispy banana chips is classified as fixed costs such as gas stoves, pans, stainless steel trays, oven cabinets, kitchen utensils,

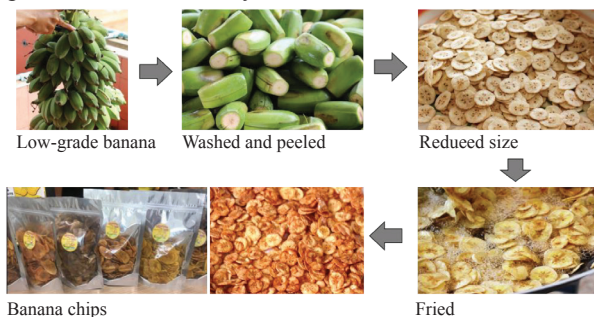


Fig. 7 Banana chip production line

Table 4 Results of banana processing cash flow

Banana Processing Crispy Banana (year)	Cash inflow	Cash outflow	Net cash flow
0		17,199.00	- 17,199.00
1	38,400.00	39,625.51	- 1,225.51
2	38,400.00	38,178.31	221.69
3	46,080.00	41,003.52	5,076.48
4	48,000.00	41,464.85	6,535.15
5	49,920.00	42,318.13	7,601.87
6	51,840.00	42,779.46	9,060.54
present value (7%)	213,797.32	197,533.67	16,263.65
Artificial Flowers (year)			
0		60.30	- 60.30
1	60,000.00	45,186.75	14,813.25
2	60,000.00	65,286.75	- 5,286.75
3	60,000.00	65,286.75	- 5,286.75
4	60,000.00	65,286.75	- 5,286.75
5	60,000.00	65,286.75	- 5,286.75
present value (7%)	246,011.85	232,676.47	13,335.38
Basket Weave (year)			
0		1,206.00	- 1,206.00
1	24,000.00	14,350.50	9,649.50
2	24,000.00	14,350.50	9,649.50
3	24,000.00	14,350.50	9,649.50
4	24,000.00	14,350.50	9,649.50
5	24,000.00	14,350.50	9,649.50
present value (7%)	98,404.74	56,117.65	42,287.09

amounting to 17,199 baht in the year 0, with a useful life of approximately 6. The years and variable costs such as water, electricity, gas, palm oil, seasoning powder, butter, sugar, oil absorbing paper, and labor cost details are shown in the Table 4.

The banana stems were then processed into artificial flowers and basket weave. If banana stems were not used to add value such as Artificial Flowers or Basket Weave they would end up agricultural waste. Banana stems means 1 plant contains about 10-12 bracts (6 outer bracts, can be used to produce Basket Weave get 1 piece) and (6 inner cladding used for production Artificial Flowers get 100-200 flowers). Fixed factors such as dryers and irons (costs are not actually paid in the 0th year) worth about 100,000 baht, with a lifespan of 5 years. By using banana stems and not allowing them to become agricultural waste helps promote career building reduces methane emissions (mitigation) which is the cause of global warming and add value of agricultural waste. The details of banana processing is presented in Table 4.

The feasibility and sensitivity analysis of banana products' added value revealed that all three products were feasible to produce (ENPV was greater than 0, EBCR greater than 1, and EIRR greater than financial return (7%)), but economically sensitive. If the cost of production changes by at least 5% in case of value added of banana chips (Fig. 7) and artificial flowers because the cost per unit is 6.91 and 1.5 baht per unit, the selling price is 8 and 2 baht per unit, while the basket weave was able to resist economic vulnerability. In the case of production costs increased by 5% (ENPV = 39,481.21 baht, EBCR = 1.67 times and EIRR 45%). It shows that adding value to banana products is economically feasible (Table 5). There is a need for development in terms of branding and packaging to create added value for the product, resulting in more cost-effective pricing and creating better awareness or recognition of the product as noted in the study of Phetsrithong et al. (2021). They found that beautiful and distinctive packaging attracted consumers to make purchasing decisions. However, the possibility of adding product value to take advantage of local resources to raise the level of career and income of farmers need to rely on the development process "Fundamentals Economy" is the economic system of local communities which can be self-reliant under the philosophy of sufficiency economy with mutual assistance. There is a moral and economic system that encourages development

in other areas, including economy, society, people, community, culture, environment, natural resources strongly and sustainably. It is a horizontal economy system that affects and builds socio-economic relations between people in the local community. It is not only an individual vertical economy but can bring about cooperation. There is an opportunity and a good relationship between the community's collective economy and the individual economy. It is an economic system characterized by cooperation, partnership, building relationships, both in the local community and at other broader levels, and outside The Community Organizations Development Institute (2021). It shows the importance of an economic work base and community capital because it is a solid foundation that will enable community organizations to have a better quality of life and be able to sustain themselves. The key elements of a foundation economy are the integration, the management of the community's financial system, the integration of joint capital, and have a strong community fund which can be a financial mechanism for the community to develop the economy, society, occupation, culture, the environment of the community, and people in the community. The Sai Noi Community has been grouped as a tourist attraction to conserve community resources and this approach is considered an appropriate framework to continue the horizontal level to create sustainability in careers and incomes.

Table 5 Results of the economic feasibility analysis of banana processing

List	Crispy Banana	Artificial Flowers	Basket Weave
Economic Net Present Value (baht)	16,263.65	13,335.38	42,287.09
Economic Benefit Cost Ratio (Times)	1.08	1.06	1.75
Economic Internal Rate of Return (%)	10	16	51
Sensitivity analysis (cost increased 5%) :EIRR	N.A.	N.A.	45

Remark: N.A. is not worth the investment

Conclusion

Banana is an important economic crop, rich in nutrients and useful substances. All parts of a banana can be used both as food and non-food. Banana farmers or entrepreneurs should have a good and appropriate planting management process (upstream) as well as quality control of raw materials after harvesting, systematic production, and processing planning (mid-water). They should have knowledge of marketing mechanisms, including feasibility analysis in economics,

transportation, and distribution to the consumer (downstream) which will result in quality products that meet the needs of consumers. The primary product is the banana fruit, and the secondary product is from different parts of the banana and by-products that can be processed to create added value. Research and development of banana products are an interesting way to improve the quality of life, livelihood, build a career and income for banana farmers. In addition, the integration of basic economic development builds community capital, extending the community towards "Local communities have a stable economic system and community capital that can be self-reliant and manage themselves sustainably". This is in line with the guidelines that the government has continuously tried to promote. For example the existing community capital is banana cultivation, extending the wisdom of the community to products and learning about the way of the community such as processing banana leaves into containers, bringing fibers from bananas to weave into bags, basket weaves, and artificial flowers, and continue to be a learning center and a source of tourism for the community, promoting community development under the base of natural resource and environmental conservation, including grouping into community enterprises to strengthen and reduce limitations. Some limitations from farmers are found including most of them are elderly people (average age 61 years), still lacking incentives to encourage the new generation to help develop and carry on. From the study finding, some farmers still have investment liabilities 47.27% have debts between 10,000 –50,000 baht. The farmer's cost of fertilizers accounted for 5% of the banana cultivation cost, 4.80% of Gros Michel banana cost plant and 5.33% of Pisang Awak banana cost plant can be shown in Fig. 3, Fig. 5 which can be reduced by using self-reliant or organic agriculture as part of the community's way of life. This study, therefore, contributes to confirming that bringing the existing community funds through the development process can create careers, incomes, and well-being, and self-reliance where communities coexist with ecosystems nature, and the environment.

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