International Journal of Multidisciplinary Research and Publications
ISSN (Online): 2581-6187

Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines

Gigi B. Calica[1], Katrina R. Sedillo[1], Genie Marie D. Galapon[1], Raymund Joseph P. Macaranas[2]

[1]Socio Economics and Policy Research Division, Philippine Center for Postharvest Development and Mechanization (PHilMech), CLSU, Cpd., Science City od Munoz, Nueva Ecija, Philippines 3120

[2]Agricultural Mechanization Division, Philippine Center for Postharvest Development and Mechanization (PHilMech), CLSU, Cpd., Science City od Munoz, Nueva Ecija, Philippines 3120

Email address: gbcalica@gmail.com; k16sedillo@gmail.com; geniemariegalapon@gmail.com; monchmac@gmail.com

***Abstract*—** *The Indigenous People (IP) of North Cotabato were engaged in the production of abaca fiber through manual hand stripping process resulting to low quality output and consequently low income. The government through the Local Government Unit (LGU) of Kidapawan City in collaboration with the Philippine Center for Postharvest Development and Mechanization (PHilMech) implemented a project on improving the manual hand stripping with 24-serration to mechanized with 0-serration. The processing system comprised of a stripping machine, an all-weather dryer and pallets for storage. The IPs supplied the raw materials by delivering abaca tuxy from the mountain to the processing center, where the fiber was stripped, dried and temporarily stored. Results showed that the average tuxy to wet fiber recovery rate was at 18% and wet to dried fiber at 29%. The first market deals recorded 61% and 78% of fiber sold were classified as excellent compared to the manual hand stripping of 44% of good fiber. The feasibility study established good financial indicators and farmers were willing to pay P5.20/kg for the stripping activity which was 29% higher than the actual cost. The net social benefits included cost reduction on labor, less processing time, ease of processing and additional income from the quality product output. However, hauling of tuxy from the upland farm to the processing center was very tedious thus, a tramline system for hauling would be needed.*

***Keywords*—** *Abaca fiber, all-weather dryer, net social benefits, probability to adopt, serration, stripping machine, tramline system, willingness-to-pay*

I. INTRODUCTION

A worldwide known fiber, Manila hemp is from abaca (*Musa textilis Nee*) which is indigenous in the Philippines. Currently, only two countries, the Philippines and Ecuador, produce abaca fiber commercially. The fiber is obtained from the leaf sheath of the acacia plant, similar to the banana plant. This resilient and flexible fiber is prized for its strength, durability and resistance to salt water damage. It is mainly used to make rope and yarn because it is used for specialty paper products such as tea bags, filter paper, cigarette paper and bags because of the fineness and durability of the fibers. Other uses include producing textiles such as carpets and bags and fiber crafts like baskets and wallets (Shahri et al. 2014 and https://www.techsciresearch.com/report/philippines-abaca-fiber-market/4290.html).

Abaca is grown practically all over the Philippines, except in the northernmost part of the country. As an agricultural country, farming is one of the major livelihoods in the Philippines with around 200,000 farming families depend on abaca farming (https://www.vancouverpcg.org/resources-listofrestaurants/yamang-pinoy/abaca/the-philippine-abaca-industry/). North Cotabato in Mindanao is one of the major abaca producing provinces along with the Bicol Region and Mindoro in Luzon; Leyte, Samar, Negros Oriental, Iloilo and Aklan in the Visayas.

At present, some 129,357 hectares are planted to abaca in the country involving around 64,678 farmers based on the average landholding of 2 ha/farmer (PSA, 2024). Compared to Ecuador where abaca production is in large scale industrial farms, Philippine production is through the efforts of the farmers who are doing all the processes such as farming, stripping and drying (Franck, 2005).

The Philippines dominated the global abaca production, supplying approximately 63.51% of the world's demand as of 2020 (Munar, 2024). The demand of the abaca fibers along with the other natural fibers are also predicted to continue to increase due to general growing demand among renewable material for environmentally friendly products (Lalusin et al. 2015). Moreover, in environmental conservation perspective, abaca plantation is not a negative intrusion of species because it does not harm natural species of flora and fauna, Generally, it can be placed under the forest floor without affecting native trees or other species (Lanaja, P.L. et al. undated).

The Indigenous Peoples (IPs) of North Cotabato grows abaca mainly for their livelihood because it is one of the agricultural products most suitable to them. Abaca has a lot of advantages in the mountain areas such as inexpensive abaca planting and production cost, and high demand for its fiber in local and global markets. To support the abaca farmers, the government extends assistance to boost its production and thereby its supply in the local and global markets.

With the present manual fiber primary processing requiring long duration to complete a hectare and producing low quality fiber, the Local Government Unit (LGU) of Kidapawan City in North Cotabato in collaboration with the Philippine Center for Postharvest Development and Mechanization (PHilMech) initiated a project on enhancing the processing of abaca fiber output of the community by introducing to them tools and machine from manual to mechanized which are acceptable to the IPs.

Gigi B. Calica, Katrina R. Sedillo, Genie Marie D. Galapon, and Raymund Joseph P. Macaranas, "Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 2, pp. 202-208, 2024.

II. Materials and Methods

The identified abaca plantation study sites were in Kidapawan City and Magpet, North Cotabato. The Mt Apo Farmers Association was identified as cooperator in the project implementation and help the members in uplifting their livelihood.

The abaca processing system for the North Cotabato farmers was established through the collective effort of the Mt Apo Farmers' Association, the Kidapawan LGU and PHilMech. The farmers' association provided an area for the processing system and the raw materials to be processed, the LGU for technical assistance and PHilMech for the machines such as the stripping machine, dryer and pallet. PHilMech further showcased the complete system for 3 months and marketed its outputs. During the actual operation, data on fiber recoveries and fiber classifications along with their corresponding prices, as well as the costs and income incurred, were collected.

As per the technical feasibility of the technology/equipment in the system, its conversion rate, quality of raw materials, time, labor and fuel requirements, other inputs such as the grade classification of the final product were considered. Also, assessed were the products' competitiveness in terms of price and fiber quality as well as its marketing costs incurred.

For the project feasibility, parameters used were the investment as against the processing costs and its best level of scale of operation that income would be realized by the association. Feasibility studies with different scenarios were prepared for the reference of the potential users. Financial indicators such as the net present value (NPV), internal rate of return (IRR), benefit-cost ratio (BCR) and payback period (PBP) were determined as well as the breakeven point price (BEP) and volume (BEV) were considered for its project feasibility (NEDA and ADB, 2007).

In collaboration with the Philippine Fiber Industry Development Authority (PhilFIDA), a government agency catering the growth and development of the natural fiber industry in the country, briefings, trainings on good agricultural practices and fiber grading classification were conducted. On the other hand, the project team conducted hands-on training for the operators and to potential users of the stripping machine. More so, after the three-month processing operations in the area, survey on the feedbacks from the abaca farmers and other prospective users on the willingness-to-pay (WTP) for the technology was gathered. Assuming that the values of X are normally distributed, the histogram can easily be used to obtain an estimate of the mean WTP using a simple formula:

$$WTP = \sum_{k=0}^{N} [probability\ of\ acceptance\ at \frac{price}{kg}]$$

where N is the number of groups. To find the aggregate WTP for the entire population, multiply the mean for each group by the size of that group in the population with standing and sum across groups (Boardman et al 2006).

A comparative analysis on the costs and benefits derived from using manual stripping as against the stripping machine were evaluated.

III. Results and Discussion

1. Existing Abaca Fiber Processing Operations

The existing manual abaca fiber processing practices were tumbling, tuxying, manual stripping, drying, bundling and marketing (Fig. 1). Commonly, the farmers went up the mountains where the abaca plants were located to harvest and process the abaca fiber (tumbling, tuxying, manual stripping, drying and bundling). Tumbling was the process of cutting the abaca trunk using a bolo or scythe while tuxying was the separation of the leaf sheaths of abaca with a tuxying knife (Calica et al 2024). The farmers stayed there for about 15 days to 1 month to complete the processing and then went down to market the dried abaca fiber. It was their practice to put up the manual stripping device by using available materials in the field where they would harvest.

Fig. 1. Current practice for hand strip abaca process

Considering the low cost required for the hand stripping equipment, the manual method was still used to strip 80 percent of the abaca fiber produced in the Philippines. A stripping serrated blade, a stripping block, a source of blade pressure, and a pedal lever were the essential components of hand stripping equipment. As a pulling aid, a small piece of wood was used. To strip, first push the pedal lever, then remove it until the strip was complete (Fig. 2). The serrations (number of teeth per inch) on the edge of most manual stripping knives were used for hand stripping (PNS).

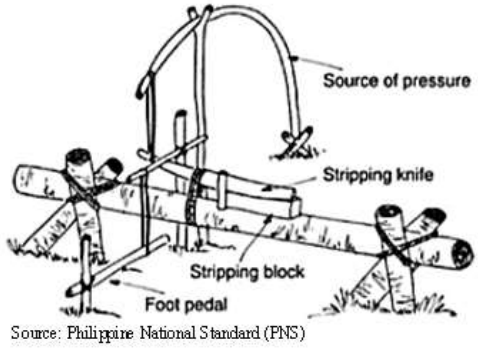
Manual stripping was time-consuming. The daily processing capacity ranges from 10 to 20 kg of dry fiber packages which is determined by the serration of the stripping knife used. Since some vascular and parenchymal cells remain attached to the fabric, hand stripping results in poor quality fiber bundles that demand a lower retail price and have little application.

2. Mechanized Abaca Fiber Primary Processing System and its Operation

The processing system comprises of a stripping machine, an all-weather dryer and pallet for handling and vertical or horizontal storage space efficiencies thereby maximizing warehouse capacity. The engine powered stripping machine has a capacity of around 70kg/hr with efficiency rate of 59 to 65 percent and fiber recovery of 17 to 21 percent. Meanwhile the all-weather dryer capacity is around 320 kg (Fig. 3).

Gigi B. Calica, Katrina R. Sedillo, Genie Marie D. Galapon, and Raymund Joseph P. Macaranas, "Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 2, pp. 202-208, 2024.

An existing multi-purpose building in the area was utilized to house the stripping machine, adjacent to it, the all-weather dryer was set up and pallets were provided for the temporary storage of dried fibers to complete the processing system. The processing plant was located half way between the farm location and the residential areas.



Source: Philippine National Standard (PNS)

Fig. 2. An illustration of a manual stripping device in North Cotabato, Philippines, 2020

Fig. 3. Abaca stripping machine, all-weather dryer and pallet equipment in the processing center in North Cotabato, 2021

A series of briefings and hands-on trainings on the technologies and the system to be implemented were conducted to the members of the cooperator-association for awareness and skills on the operation and maintenance of the technologies.

To operationalized the processing center, farmers had to do the harvesting and perform tuxying in the upland abaca farms then hauled down the tuxy to the processing plant (Fig. 4). The processing center received the tuxy followed by machine stripping and initial drying were done within the day. Drying the fiber took around 2-3 days depending on the weather condition. Temporary storage was practiced because farmers marketed fibers in bulk to maximize the truck capacity and thereby reduced transport cost (Fig. 5).

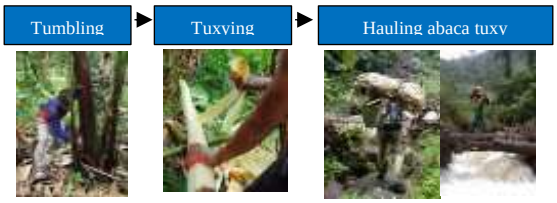


Fig. 4. Abaca handling from the farm to the processing center in North Cotabato, 2021

A total of 31 actual processing operations were done by the project team in cooperation with the cooperator during the 3-month processing in the center. Data showed that there was a monthly increase in the number of processing operations and volume of tuxy processed in the center which signified positive response of the farmers in the use of the PHilMech's stripping machine. The average recovery rate for the tuxy to wet fiber and wet to dried fiber were at 18% and 29%, respectively. On the other hand, the process incurred waste at 19% (Table 1).

Fig. 5. Flow of abaca fiber primary processing in North Cotabato, 2021

TABLE 1. Actual Abaca Processing, Mt. Apo Association in North Cotabato, May to July, 2021

Month	No. of processing operations	Volume of tuxy processed	Wet fiber recovery		Dried fiber recovery		Waste	
		kg	kg	%	kg	%	kg	%
May	5	995	92	9	70	76	373	37
June	11	3,525	848	24	264	31	805	23
July	15	6,633	1,053	16	252.50	24	917	14
Total	**31**	**11,153**	**1,993**	**18**	**586.5**	**29**	**2,095**	**19**
Average	**10-13**	**3,717.67**	**664.33**	**18**	**195.50**	**29**	**698.33**	**19**

3. Abaca Fiber Classification and Marketing

Traditionally, it was the practice of abaca farmers to store dried fibers at home until all the farm area had been harvested and processed. They sell in bulk and accept the all-in pricing basis of the traders within the city. Sorting was only done in the Grading Baling Establishment (GBE).

The quality of abaca fiber is determined by the strength, purity, color, texture and length of the fiber. The stripping machine of knife used determine the fineness of the fiber, the spindle-stripped abaca fibers are indicated by the letter "S" before the official grade, i.e., S-S2, S-1 and so on (PRDP 2014). The different fiber grades and classification were established and released by the Philippine National Standards (PNS) and PhilFIDA listed the uses and indicated the required grades of abaca fiber (Table 2).

Excellent – S2, S3 Good – I, G, H
Fair - KJ, MI Residual- Y,OT

In the 3-month pilot operations, records show that the association produced dried fiber totaled to 586.5 kg or an average of 196 kg per month and registered around P52,785 total sales or an average of P17,595 per month. Previously, market transaction records of manual stripping (with 24 serration) outputs of the association showed that majority (44%) of the fiber product sold were classified as good fiber - G, I (18%) and fair fiber S3 (18%). However, using the PHilMech's stripping machine (with 0 serration), first two market deals showed that around 61% and 78% of the fiber products sold were graded as S-S2 or excellent fiber priced at P94/kg and P90/kg, respectively. Meanwhile, classified as good fiber S-I and S-G comprised around 24% and 16% and again S-S3 was graded as fair fiber (Table 3). The downgrading of S-S3 classification from excellent to fair could be attributed to the market demand that time. Further, these data showed that using stripping machine with 0 serration improved the abaca fiber output classifications of the association. Higher fiber grade commands good price resulting to a higher income for the farmers.

Gigi B. Calica, Katrina R. Sedillo, Genie Marie D. Galapon, and Raymund Joseph P. Macaranas, "Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 2, pp. 202-208, 2024.

TABLE 2. Grades and uses of abaca fiber, Philippines

USES	GRADES/TYPES
Cordages products - *ropes, twines, marine cordage, binders, cord*	S2, S3, I, G, JK, MI, Y
Pulp and paper manufactures - *Tea bags, filter paper, mimeograph stencil, base tissue, sausage skin, base paper* - *Cigarette paper, currency paper, chart file folders, envelopes, time cards, book binders and parchment paper* - *Micro glass air filters media, x-ray negative, optical lens wiper, vacuum filter, oil filter* Nonwovens - *Medical gas masks and gowns, diapers, hospital linens, bed sheets* Handmade paper - *Paper sheets, stationaries, all-purpose cords, lamp shades, balls, dividers, placemats, bags, photo frames and albums, flowers, table clock*	 S2, I, G G, JK, MI, Y, OT S2, I, G, JK S2, I, G, JK All grades including wastes
Fibercrafts - *Handbags, hammocks, placemats, rugs, carpets, purses and wallets, fishnets, door mats, table clock*	S2, G
Handwoven fabrics - *Sinamay, pinukpok, tinala, dagmay* - *Sacks, hotpads, hemp, coasters* - *Baskets* - *Wallpaper*	 High grades S3, H lupis *Bacbac* S2, G, KJ, Y
Furniture	S2, *Bacbac*
Fiberboards - *Roofing tiles, floor tiles, hallow blocks, boards, reinforcing fiber concrete and asphalt*	OT and other waste
Others – *wire insulator and cable, automobile, automobile components/composites*	JK, MI, Y, OT
Miscellaneous applications – *wigs, grass skirts*	All grades

Source: PhilFIDA

TABLE 3. Classification of abaca fiber produced and income by using manual vs mechanized stripping in North Cotabato, 2020 to 2021

Grade	Manual stripping (24 serration)				Grade	Mechanized stripping (0 serration)							
	Market Outlet					Market Outlet 1				Market Outlet 2			
	kg	P/kg	%	Sales, P		kg	P/kg	%	Sales, P	kg	P/kg	%	Sales, P
I	8	89.00	18	712.00	S-S2	73	94.00	61	6,862.00	90	90.00	78	8,100.00
G	20	79.00	44	1,580.00	S-I	29	88.00	24	2,552.00	-	-	-	-
JK	5	73.00	11	365.00	S-G	6	83.00	5	498.00	18	79.00	16	1,422.00
S3	8	60.00	18	480.00	S-S3	8	58.00	7	464.00	6	54.00	5	324.00
H	3	36.00	7	108.00	S-O	1	1.00	1	1.00	1	1.00	1	1.00
T	1	1.00	2	1.00	S-T	2	1.00	2	2.00	-	-	-	-
Total	**45**		**100**	**3,246.00**	**Total**	**119**		**100**	**10,379.00**	**115**		**100**	**9, 847.00**

TABLE 4. Investment analysis on mechanized abaca fiber primary processing system in North Cotabato, 2021

Item	*Scenario 1*		*Scenario 2*	
	Abaca Stripping Custom servicing	**Percentage**	**Buy tuxy, Stripping to Drying fiber**	**Percentage**
Investment	**690,000.00**	**100.00**	**1,279,000.00**	**100.00**
Facility cost	690,000.00	100.00	279,000	21.81
Working capital	-		1,000,000	78.19
Fixed cost, P/year	**47,250.00**	**17.95**	**226,375.00**	**4.37**
Depreciation	26,100.00	55.24	46,110.00	20.37
Repair & Maintenance	7,350.00	15.55	14,685.00	6.49
Registration & Licenses	13,800.00	29.21	25,580.00	11.30
Loan	-		140,000.00	61.84
Variable costs, P/year	**215,952.00**	**82.05**	**4,948,499.04**	**95.62**
Salaries and wages	144,024.00	66.69	427,200.00	8.63
Fuel and oil	71,928.00	33.31	431,568.00	8.72
Labor and handling	-		201,600.00	4.08
Delivery	-		288,000.00	5.82
Stock cost	-		3,456,000.00	69.84
Miscellaneous (3%)	-		144,131.04	2.91
Total operating cost	**263,202.00**	**100.00**	**5,174,874.04**	**100.00**
Volume of dried fiber processed, kg	**7,756.80**		**66,816.00**	
Price/kg	90		90	
Gross income, P/yr	**698,112.00**		**6,013,440.00**	
Net income for the 1st yr, P/yr	**434,910.00**		**838,565.96**	
Payback period, year	***1.46***		***2.09***	
Internal Rate of Return, %	***54.09***		***57.86***	
Benefit cost Ratio, P	***3.33***		***3.52***	
Net present value, P	***1,606,413.56***		***3,230,316.89***	
Breakeven price				
Stripping fee, P/kg	1.48		-	
Dried fiber, P/kg	-		77.36	
Breakeven volume				

Gigi B. Calica, Katrina R. Sedillo, Genie Marie D. Galapon, and Raymund Joseph P. Macaranas, "Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 2, pp. 202-208, 2024.

Stripping , kg	16,687.10		-	
Dried fiber, kg	-		13,826.68	

Note: USD=P55

4. Feasibility Study

Based on the gathered data during the 3-month operation of the abaca primary fiber processing system in North Cotabato, two scenarios of feasibility study were developed. The first scenario was a custom servicing for the stripping of abaca fiber. The cooperator would impose a stripping fee of P4.04 per kg. The investment is around P690,000 and in its first year of operation, a net income would be at P434,910. It would be recouped in 1.46 years, with an IRR of 54.09%, BCR of P3.33 and NPV of P1,606,413.56. The breakeven price for the stripping fee was at P1.48/kg while the volume at 16,687.10 kg.

The second scenario with an investment of P1.279 million would buy tuxy from the farmers at P15/kg then stripped it and dry the fiber in the all-weather dryer, temporary storage and then market in bulk at P90/kg. In its first year of operations, it would have a net income of P838,565.96. The financial indicators were: payback period at 2.09 years; IRR of 57.86%, BCR of P3.52 and NPV of P3,230,316.89. The BEP for the dried fiber was at P77.36/kg and BEV was at 13,826.68 kg of dried fiber. The two scenarios were feasible with good financial indicators (Table 4).

5. Willingness-to-Pay

This is the farmers' option price for the policy but for an individual who is risk averse and whose utility function depends only in income, expected surplus will underestimate option price for policies that reduce income risk and overestimate option price for policies that increase income risk (Boardman et al 2006).

Since the abaca farmers in the area had no experience and idea on mechanized stripping operation, the project team conducted a survey on the willingness-to-pay (WTP) on the use of the technology. Respondents were members and non-members of the association who live nearby the processing center and had observed the stripping operations using the PHilMech technology. Results show that majority (43.55%) were willing to pay a stripping fee of about 10% of their total sales or P5.50 per kg while around 25.47% said 5% of their total sales or P2.75 per kg dried fiber. The highest amount they would like to pay for the stripping was around P18.15 per kg and the lowest was P2.75 per kg. Considering the normal distribution of the responses, the weighted average WTP was P5.20 per kg. This could be plotted near the majority who signified P5.50 per kg WTP. Thus, farmers who stated to pay more than P5.20/kg (P5.50-18.15/kg or 62.5%) would probably adopt the technology (Tables 5 and 6).

On the other side, the actual stripping machine operating costs plus margin was at P4.04/kg. This was 29% lower than the weighted average WTP implied by the farmers. According to them using the machine, would result to fast and efficient stripping process that produced high quality fiber receiving higher price thereby redound to higher income for them.

However, though they were willing to adopt the system, their concern was the tedious tuxy hauling activity from the upland to the processing center as well as the corresponding additional costs.

TABLE 5. Willingness-to-pay for the abaca stripping in North Cotabato, Philippines 2021

Willingness-to-Pay for stripping abaca fiber	**Responses in percentage**	**Declared Share from sales as stripping fee, PhP[1]**	**Computed WTP for stripping fee per kg, PhP[2]**	**Weighted value P/kg[3]**
5% of total sales	25.47	1,650	2.75	0.70
10% of total sales	43.55	3.300	**5.50**	2.40
15% of total sales	1.50	4,950	**8.25**	0.12
20% of total sales	3.01	6,600	**11.00**	0.33
P10/kg	12.98	-	**10.00**	1.30
33% of total sales	1.50	10,890	**18.15**	0.27
P5/kg	1.50	-	5.00	0.08
No idea	10.49	-	-	-
Weighted Average WTP, P/kg				**5.20**

[1] 600 kgs/ha x P55/kg x % of total sales declared Note: USD=P55
[2] Column 4÷ 600kg/ha
[3] Column 3 x Column 5

TABLE 6. Probability to adopt the abaca stripping machine based on the willingness-to-pay of the farmers in North Cotabato, Philippines 2021

Willingness-to-Pay for stripping abaca fiber	**Responses in percentage**	**Probability to adopt the technology[1]**	**Cumulative Percentage**
10% of total sales	43.55	0.435	**43.5**
15% of total sales	1.50	0.015	**45.0**
20% of total sales	3.01	0.030	**48.0**
33% of total sales	1.50	0.015	**49.5**
P10/kg	12.98	0.130	**62.5**
P5/kg	1.50	0.015	64.0
5% of total sales	25.47	0.255	89.5
No idea	10.49	0.105	100.0
Total	**100.00**	**1.000**	

[1]Column 2/100

6. Net Social Benefits

Social benefits are goods and services received in addition to salary. They are designed to improve the quality of life of the community. This is a service or product that improves your life and is important. In the business side, it is the business activities that have a beneficial or favorable impact on people or places.

In the area, a sharing arrangement was being practiced between the farmer/owner and the laborer. The common agreement was at 60:40 sharing basis of the total sales; 60% for the laborer and 40% for the farmer/owner. The laborer performed all the activities from tumbling, tuxying, stripping, drying and baling for 60 days to finish the 600 kg dried fiber production/hectare up to marketing. If the dried fiber was sold at P55/kg, total sales recorded at P33,000 then the laborer was entitled to his share of P19,800 for the 60-days work rendered.

Gigi B. Calica, Katrina R. Sedillo, Genie Marie D. Galapon, and Raymund Joseph P. Macaranas, "Enhancing the Abaca Fiber Primary Processing System in North Cotabato, Philippines," *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 7, Issue 2, pp. 202-208, 2024.

Since no daily wage rate was imposed in this agreement, the P19,800 share was divided by the 60-days work per hectare to compute for the daily labor rate at P330. For the stripping rate, we divide the daily wage rate of P330 by 10 kg dried fiber/day output, divide it by the 8-hour work a day to get the hourly rate and multiply it with the 5-hour stripping per day giving us P20.62 per kg.

The social benefits from this project would be from the cost reduction on labor, reduction on the processing time, ease of processing and additional income from the quality product output. Benefits were identified from the income difference, reduced stripping cost, reduced number of person-days and less processing time. The saved person-days and processing time were valued based on the computed P330 daily rate. Costs were from the proceeds of the low-quality fiber, hauling costs and depreciation of the stripping machine. Subtracting the total costs from the total benefits gave us the net social benefits of P44,463/ha/cycle or P133,389/ha/year (Table 7).

TABLE 7. Net social benefits from using abaca stripping machine in North Cotabato, 2021

Item	Manual Stripping	Stripping Machine	Savings/ hectare*	Rate, P	Benefits, PhP/ha**	Costs, PhP/ha***
Volume of dried fiber/ha	600 kg		-	P55/kg	-	33,000.00
		600 kg	-	P90/kg	54,000.00	-
Person-days/ha	37.5[1] person-days	6 person-days	31.5 person-days	P330/ person -day[2]	10,395.00	-
Hauling costs, P/kg	600 kg	-	-	P10/kg	-	6,000.00
Stripping costs/kg	P20.62/kg[3]	P4.04/kg[4]	P16.58/kg	600 kg	9,948.00	-
Processing time/ha	60 days	6 days	54 days	P330/day	17,820.00	-
Depreciation[5]	-	P26,100/yr	-	P14.50/kg	-	8,700.00
TOTAL/ha/cycle					**P92,163.00**	**P47,700.00**
TOTAL/ha/year[6]					**P276,489.00**	**P143,100.00**
NET SOCIAL BENEFITS[7]					**P44,463/ha/cycle or P133,389/ha/yr**	

[1] (5 hours/8 hours) x 60 days
[2] (600kgs x P55/kg) x 60%÷60 days
[3] [(600kg/ha x P55/kg x 60% share/60days) ÷ (10 kg/day/8hrs/day)] x 5hrs/day stripping
[4] Actual stripping expenses such as fuel, labor and maintenance plus margin
[5] (Column 3/1800kg) x 600
[6] 3 cycles in a year
[7] Total Benefits – Total Costs

* Column 2 - Column 3
** Column 4 x Column 5
*** Column 2 x Column 5

Note: USD=P55

IV. Conclusion

The use of the stripping machine with 0 serration improved the productivity and the quality of fiber produced that commands a higher price thereby additional income to the farmers. Farmers were willing to use the technology because they signified a higher WTP than the actual stripping cost. More so, using the technology resulted to social benefits such as labor reduction and time saved for the farmers and laborers that could be devoted to some other productive activities to increase their family income and somehow uplift their quality of life. However, with the tedious hauling of tuxy from the upland farm to the processing center, a hauling system for mountainous areas such as tramline system would be of great help for the farmers.

Acknowledgment

The authors would like to thank Mr. Roderic O. Verena for the guidance and Ms. Harriet Jane C. Torena who helped us gather data, the LGU of Kidapawan City for initiating the project and PHilMech for funding the study.

References

[1]. Abamo, A. P., & Aragon, C. T. 2007. Economic Modeling of Technology Differences and Global Competitiveness of the Abaca Fiber Industry in the Philippines. *Philippine Journal of Crop Science (Philippines)*.
[2]. Abgona, Remedios V., Hilario, Celerina T., Abriol, Edgar A., Josol, Fidel S., Barcelona, Ramil B., De Vera, Romeo P.2008. Improved Handstripping (Hagotan) Device. Patent No. 2-2008-000293Fiber Technology and Utilization Division. Fiber Industry Development Authority. 2008
[3]. Agricultural Process and Technology. n.d.. Retrieved from https://www.chingbee.com/process-and-technology/
[4]. Boardman, A., Greenberg, D., Vining, A and Weimer, D. 2006. Cost-Benefit Analysis: Concepts and Practice, Third Edition, Pearson Prentice Hill, New Jersey
[5]. Calica, G. B., Galapon, G.M.D. and Macaranas, R.J.P. 2024. Postproduction practices and marketing of abaca in North Cotabato, Philippines, International Journal of Scientific Research and Management (IJSRM), Volume 12 issue 01, pages 5727-5734, January 2024.
[6]. Design and Development of an Improved Manual Extraction Process of Abaca Fiber in Northern Samar. Fiber Industry Development Authority (FIDA), Agricultural Machinery Testing and Evaluation Center (AMTEC) and Northern Samar Integrated Rural Development Project (NSIRDP)
[7]. Franck, R. R. 2005. Abaca. In Bast and Other Plant Fibres; Franck, R. E., Ed.; Woodhead Publishing, 2005; pp 315–321. https://doi.org/10.1533/9781845690618.315.
[8]. Göltenboth, F., & Mühlbauer, W. 2010. Abacá-cultivation, extraction and processing. *Industrial applications of natural fibres*, 163-179.
[9]. https://www.vancouverpcg.org/resources-listofrestaurants/yamang-pinoy/abaca/the-philippine-abaca-industry/
[10]. Lalusin, A. G.; Villavicencio, M. L. H. Abaca (Musa Textilis Nee) Breeding in the Philippines. In Industrial Crops: Breeding for BioEnergy and Bioproducts; Cruz, V. M. V., Dierig, D. A., Eds.; Springer New York: New York, NY, 2015; pp 265–289. https://doi.org/10.1007/978-1 4939-1447-0_12.
[11]. Munar, Jenni. Revitalizing the abaca industry. Manila Chronicle, May 28, 2024
[12]. National Economic and Development Authority (NEDA) and Asian Development Bank (ADB). 2007. Project Evaluation and Development, Volume 5, Published by National Economic and Development Authority and Asian Development Bank, Quezon City, Philippines
[13]. Philippine Fiber Industry Development Authority (PhilFIDA). Grading and Classification
[14]. Philippine National Standard/Bureau of Agriculture and Fisheries Standards (PNS/BAFS 180:2016) – Abaca Fiber – Grading and Classification – Hand Stripped and Spindled Machine Stripped,

Department of Agriculture, Bureau of Agriculture and Fisheries Standards, Diliman, Quezon City, 1101 Philippines
[15]. Philippine National Standard/Philippine Agricultural Engineering Standards (PNS/PAES 254:2011) – Agricultural Machinery – Abaca Stripper – Specifications, PAES published 2011, Department of Trade and Industry, Bureau of Product Standards, Makati City, 1200 Philippines
[16]. Philippine Rural Development Program (PRDP). 2014. Abaca Value Chain Analysis Region V- Bicol Region. Department of Agriculture, Region V
[17]. Shahri, W.; Tahir, I.; Ahad, B. Abaca Fiber: A Renewable Bio-Resource for Industrial Uses and Other Applications. In Biomass and Bioenergy: Processing and Properties; Hakeem, K. R., Jawaid, M., Rashid, U., Eds.; Springer International Publishing: Cham, 2014; pp 47–61. https://doi.org/10.1007/978-3-319-07641-6_3.
[18]. Sudaria, E.E., Vinh, T.N., de Ramos, J.D. 1986. Design and Development of a Low Cost Abaca Stripper. Agricultural Machinery Testing and Evaluation Center, University of the Philippines Los Baños. March 1986
[19]. The Editors of Encyclopaedia Britannica. 2014, July 07. Abaca. Retrieved from https://www.britannica.com/plant/abaca
[20]. Valenzuela, Adriano C., Catbagan, Warrior D., Jabay, Petronilo B., De Vera, Romeo P., Josol, Fidel S., Abriol, Edgar A. 2008. Mobile Abaca Spindle Stripping Machine. Patent No. 2-2006-00034. Fiber Technology and Utilization Division. Fiber Industry Development Authority. 2008