

## Current practices and challenges of pineapple smallholder growers in managing the pineapple waste in Samarahan, Sarawak Malaysia

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### Abstract

Malaysia's commitment to expanding its pineapple production has increased the amount of pineapple waste production in the country, especially in the state of Sarawak. This has raised the alarm regarding the proper management of pineapple waste among the local farmers. Therefore, the current study was carried out to investigate the current practices of pineapple waste management and to identify the challenges in managing the pineapple waste among pineapple smallholders in Samarahan, Sarawak. The data was collected from 123 pineapple farmers by employing a close-ended survey questionnaire. The pineapple smallholders were selected using the random sampling method and the data were analysed using descriptive analysis. The findings revealed that the pineapple smallholders in Samarahan employ several practices for managing the pineapple waste which include using the pineapple crown as new planting material, animal feed and compost material. Moreover, the study has also identified several challenges in managing the pineapple waste such as lack of time, high cost, difficulty in finding the buyer of the waste product, shortage of labour, the waste product attracts pests and diseases, and it produces foul smell which discourages them in managing the pineapple waste. Therefore, the relevant agencies should provide guidance to the local pineapple growers in managing pineapple waste through sustainable waste management practices.

## 1. Introduction

Sarawak has a very big potential in pineapple farming as it is the second-largest pineapple producing state in Malaysia, second to Johor with 8,429 hectares of pineapple farming land (David, 2019). Currently, there are several cultivars of pineapple that have been commercialized which are Nanas Sarawak, Maspine, Yankee, Gandul, Moris Gajah, Josapine, N36, MD2, and Moris pineapple (Malaysian Pineapple Industry Board, 2019). These types of pineapple can be consumed fresh, or it can be processed into canned, juiced, and are found in a wide array of food packaging- dessert, fruit salad, jam, yoghurt, ice cream, candy, and as a complement to meat dishes (Chaudhary *et al.*, 2019). According to the Malaysian Pineapple Industry Board (2019), canned pineapple productions contribute to 95% of the export

market and 5% of the domestic market, whereas fresh pineapple contributes to 3% of the export market and 70% to the domestic market. Moreover, large-scale pineapple producers have contributed 54.5% of pineapple production whereas the smallholders have contributed 47% to the total production of pineapple in the country (Ruslan *et al.*, 2017). A study conducted by Jaji *et al.* (2018) reported that the pineapple industry contributes significantly to the country's socio-economic development in terms of improving the livelihoods of smallholder farmers through income generation.

In the pineapple processing industry, there are only 52% of the pineapple fruit used for pineapple production while the remaining 48% form the waste materials which consists of fruit peel and leaves (Rabiu *et al.*, 2018). The pineapple waste consists of residual skin, peels, pulps,

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stems, and leaves which are the by-products of the pineapple processing industries and harvesting activities. The abundance of waste in the pineapple industry is mostly generated by poor management of fresh fruit, storage, and transportation system (Praveena and Estherlydia, 2014). The transformation of pineapple waste to wealth through value-added products by extraction of fibre from the pineapple leaves to produce commercial products such as string and rope is important to be emphasized as an income source for the smallholders as well as economic growth for the country (Ruslan *et al.*, 2017). According to Yusri *et al.* (2015), pineapple leaves which are a major part of pineapple plants are usually left to decay or burn. This happens in the field during harvesting time due to limited technology and ignorance from farmers and local communities about the existence of commercial uses of pineapple leaves. Furthermore, the stems, crown, and core are other sources of pineapple waste generated during pineapple processing because they are removed and cut before the peeling activities (Saravanan *et al.*, 2013). However, in Thailand, pineapple stems have become a significant agricultural waste as the source of starch (Nakthong *et al.*, 2017). Moreover, according to Wijayati *et al.* (2016), the pineapple peel that is usually thrown away and considered as a waste, contains vitamin C, carotenoids, and flavonoids. Ong *et al.* (2014) argued that waste disposal can be problematic because the waste material is high in moisture and sugar content which is prone to microbial spoilage.

The pineapple waste is usually eliminated through burning and decomposing. Transforming the pineapple waste especially pineapple leaves and stem into value-added products is important for economic development. However, to date, only a few studies on the management of pineapple waste have been conducted among smallholder growers in Malaysia. Also, with the concern of mismanagement of the pineapple waste production due to the increase of the pineapple farms in the country, more research is needed to explore the practices of pineapple waste management among the smallholders. Besides, it also helps in providing extra income to the pineapple growers due to agricultural diversification as well as minimizes field waste and reduces air pollution. Therefore, the current study was conducted to investigate the current practices of pineapple waste management and to identify the challenges in managing the pineapple waste among pineapple smallholders in Samarahan, Sarawak.

## 2. Materials and methods

The research was conducted in the Samarahan district of Sarawak, Malaysia. Samarahan was chosen

since it is the largest pineapple planting district with 357.95 ha or 37% of the total planted areas across Sarawak in 2016 (Veno, 2018). It is a district with an area of 593.9 km square coordinated at 1°45'99" North and longitude 110°48'83" East. In this study, the population of smallholders was provided by the Malaysian Pineapple Industry Board (Sarawak branch) with 180 smallholders. Hence, the identified sample size is 123 samples based on Krejcie and Morgan (1970). The primary data was collected from 123 smallholder pineapple growers using a survey instrument of the close-ended questionnaire. A simple random sampling method was employed to select the respondents for the survey. The data collection instrument was made up of two sections; A and B. Section A contained questions about the demographic profile of the pineapple growers, whereas Section B elicited their responses regarding the current practices of pineapple management and the challenges they faced in managing their pineapple waste. To ensure the instrument's validity, a preliminary test was done to detect design flaws and other potential issues with the instrument. The results were used to fine-tune the questionnaire before it was used to collect the final data. The reliability analysis using Cronbach's alpha was conducted to examine the internal consistency of items for each of the constructs in the instrument.

The descriptive analysis was used to analyze the data using the Statistical Package for Social Science (SPSS) software version 22. Moreover, descriptive analysis was used to describe the socio-demographic characteristics and the current practices and challenges faced by the pineapple growers in frequencies and percentages.

## 3. Results and discussion

### 3.1 Reliability analysis

The reliability statistics for the Likert scale were determined by using Cronbach's Alpha. Table 1 indicates that the Cronbach's alpha value for this study is 0.858 which indicates a very strong association with the range of consistency between  $0.8 > \alpha \geq 0.9$  (Sekaran and Bougie, 2013). This indicated that the reliability of the items measured in each of these indices is very good and the consistency is relatively high.

Table 1. Reliability statistics

Cronbach's Alpha	N of items
0.858	15

### 3.2 Socio-demographic profiles of smallholder pineapple growers

Table 2 reports the descriptive characteristics of the 123 respondents of pineapple growers in Samarahan, Sarawak. The results showed that the majority of the respondents (52%) are males while the rest (48%) are

females. This shows that there are more male pineapple growers than female pineapple growers in the study area. Whilst the age of the pineapple growers was in the age of 31–40 years old (50.4%) and only 8.1% of the growers were in the age bracket of 51–60 years. More than half of the respondents (72.4%) had secondary school education and only 17.1% attained tertiary level education. The results also indicated that the majority of the pineapple growers earned less than RM500 per month (50.4%) and only 14% of them have a monthly income above RM1,500. In terms of farm sizes, about 90.2% of the pineapple farmers cultivate on less than 2 acres of land and the majority of them (70.7%) had 3-5 years of pineapple farming experience.

Table 2. Socio-demographic data of pineapple smallholder growers (n = 123).

Socio-demographic profile	Frequency	Percent (%)
<b>Gender</b>		
Male	64	52.0
Female	59	48.0
<b>Age</b>		
20-30	25	20.3
31-40	62	50.4
41-50	26	21.1
51-60	10	8.1
<b>Level of education</b>		
Primary school	13	10.6
Secondary school	89	72.4
Tertiary education	21	17.1
<b>Monthly income</b>		
RM0-RM500	62	50.4
RM501-RM1000	44	35.8
RM1001-RM1500	9	7.3
RM1501-RM2000	3	2.4
RM2001-RM2500	2	1.6
RM2501-RM3000	3	2.4
<b>Farm size (acres)</b>		
0.5 - 2	111	90.2
3 - 5	12	9.8
<b>Planting experience</b>		
0-2 years	19	15.5
3-5 years	87	70.7
6-8 years	17	13.8

Based on the table above, it can be summarized that most of the smallholder pineapple growers in Samarahan Sarawak are young farmers who have less than five years of experience in pineapple farming and had undergone only secondary school education. Moreover, they are categorized in the lower income group who received less than RM500 per month and have less than 2 acres of pineapple cultivation areas. These findings are in line with a study conducted by Nahar *et al.* (2020) that found most of the pineapple growers in Samarahan were male, had less farming experience, and were categorized as lower-income group. Simpach and Pechrova (2015) in

their study on the projection of the age-and-sex structure of agricultural workers in the Czech Republic reveal that there will be changes in the proportions of male and female workers due to the changes in average ages and female longevity.

As stated by Pechrova *et al.* (2018) the main purpose of young farmers involved in the agriculture sector is to continue the farming legacy inherited from the family or relatives and to work in nature and with animals. Also, the study stated that the difficulty to purchase the agricultural land, the administrative burden, and ensuring the finances for the development of a start-up have driven young farmers to get involved in the agriculture sector. The finding of this study that shows most of the farmers belong to the low-income group concurs with that of Prayoga *et al.* (2019) who reported that the small scale of production makes farmers with low income, have limited access to sell their crops, hence they are always on the poverty line.

### 3.3 Current practices of pineapple waste

Table 3 shows that only a handful of pineapple growers in Samarahan benefited from the pineapple waste products. The results have shown that only 22 smallholders (17.9%) claimed to have used the pineapple crown. Moreover, only 16 smallholders (13%) claimed to have used or recycled pineapple leaves. The number of smallholders utilizing the pineapple fruit waste is also similar to those utilizing the pineapple peels or skin by only 16 smallholders (13%). The pineapple crown is mostly used by the growers as the planting material, animal feed, or a plant decoration due to its adorable and unique shape of the pineapple crown. Furthermore, due to ignorance and a lack of technological application, pineapple leaves, cores, and peels or skin were only used on a small scale (Yusri *et al.*, 2015).

Table 3. Current practices on pineapple waste.

Practices	Frequency	Percentage (%)
<b>Utilization of pineapple leaves waste</b>		
Yes	16	13.0
No	107	87.0
<b>Utilization of pineapple crown</b>		
Yes	22	17.9
No	101	82.1
<b>Utilization of pineapple core waste</b>		
Yes	16	13.0
No	107	87.0
<b>Utilization of pineapple peels/skin waste</b>		
Yes	16	13.0
No	107	87.0

The findings from the survey also found that the pineapple growers' gained benefit from the pineapple leaves by recycling the leaves into animal feed, compost,

mulching, and selling them for extra cash. This finding expands on the findings by Zawawi *et al.* (2014) regarding the benefit of pineapple leaves in which the pineapple leaf fibre is more favourable as a potential substitute for wood fibre in paper production in comparison to fibre from corn stalk and Napier grass. The high cellulose content and low lignin content in pineapple leaf fibre could lead to high-quality pulp and paper production. Furthermore, the study also found that the pineapple core waste is commonly used as the compost material, animal feed, face maskers or is processed to produce pineapple juice. The pineapple core contains a high source of bromelain and can be processed further into value-added products. According to Misran *et al.* (2019), the production of bromelain can be obtained through the extraction of pineapple waste such as stem, core, crown, and peel. Bromelain has shown a diverse usage in pharmacology as an inflammatory agent, platelet aggregation inhibitor, and antitumor agent (Rabiu *et al.*, 2018). In highlighting the pineapple skin or peel waste, the smallholders claimed that they also utilized the pineapple peel or skin as animal feed, and some preferred to sell it for a profit if there is a market for it. This has shown that pineapple waste as a feedstock is a viable alternative to other animal meals. Moreover, this finding supports Tran (2006) that the outer peel or skin, core, and leaves are commonly used for ruminant feeding.

### 3.4 Challenges in managing the pineapple wastes

The next aim of the study is to explore the challenges faced by the pineapple smallholders in managing the pineapple waste in the study area. As shown in Table 4, most of the smallholders (39.84%) claimed that they did not have enough time to manage the pineapple waste (e.g., turning the waste into a profitable product). Moreover, 45 respondents (36.59%) in the survey perceived that managing the pineapple waste involves a high cost thus it presents difficulties, especially for the low-income smallholders. These two difficulties are identified as the most common difficulties faced by the smallholders in the study. However, several smallholders have also associated their difficulties in managing the pineapple waste with the difficulty in finding buyers of the waste product (8.13%), attracting pests and disease (5.7%), labour shortage to manage the waste (5.7%), and foul smell of the waste (4.1%).

This study has found that the major obstacles faced by the smallholders in managing their farm waste are lack of time (49 respondents) and a high cost of implementation (45 respondents). This finding corresponds with Ruslan *et al.* (2017), who found that time constraints, high costs, and outdated technology have affected pineapple waste utilization and

management. This is the case when the smallholders had to attend to other farming tasks, commitments and were focused on selling their farm products. Therefore, they were not able to resort to properly managing the pineapple waste product or turn it into a profitable waste product. Investment in technology, such as the processing of pineapple leaves into leaf fibre, is more costly, hence most smallholders cannot afford to use the waste owing to financial constraints. Furthermore, several respondents claimed that converting pineapple waste into animal feed was pointless without a buyer (of the waste product) due to the lack of livestock to be fed in their area. Therefore, several respondents felt reluctant to process the pineapple waste for animal feed. Furthermore, due to manpower shortages, they are unable to effectively utilize field waste such as pineapple leaves since collecting the leaves and composting other waste materials takes more energy and time, as well as adding to the cost of their farm operations. As a result, pineapple waste is typically burned or dumped after harvesting. The continuously increasing pineapple waste has a detrimental impact on health because it takes a long time to degrade and attracts pests and insects that can increase the risk of contracting several harmful diseases. Thus, to avoid attracting pests, disease and foul smells, the proper balance of carbon, nitrogen, and moisture must be achieved in the surrounding areas (Wee, 2017).

Table 4. Challenges in managing the pineapple waste

Challenges	Frequency	Percentage (%)
Lack of time	49	39.84
High cost	45	36.59
Finding buyer	10	8.13
Attract pest and disease	7	5.69
Labor shortage	7	5.69
Bad smell	5	4.07
Total	123	100

## 4. Conclusion

This study has highlighted the lack of utilization of pineapple waste among pineapple smallholder growers in Samarahan, Sarawak. The pineapple crown is mainly used as new planting material, while the leaves, core, peels, and skin are used as animal feed and compost material by the pineapple growers in the study area. At the same time, the smallholder growers faced several problems when managing the pineapple waste such as time constraints, high implementation costs, difficulty to find buyers of the waste product, lack of labour to manage the waste, pest and disease attraction, and foul odours generated by the pineapple waste, all of which discourage them from managing the waste. It is recommended that the responsible organizations must recognize the findings (e.g., the current practices of pineapple waste management and the difficulties faced in managing the pineapple waste) to improve the

management practices of pineapple growers in Samarahan. This can be done by conducting waste management programmes and training to increase the smallholders' interest, knowledge, and intention to fully utilize their pineapple waste while also conserving the environment.

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### References

- Chaudhary, V., Kumar, V., Sunil, Vaishali, Singh, K., Kumar, R. and Kumar, V. (2019). Pineapple (*Ananas cosmosus*) product processing: A review. *Journal of Pharmacognosy and Phytochemistry*, 8(3), 4642-4652.
- David, J. (2019). Big potential for pineapple farming in Sarawak. The Borneo Post Online. Retrieved on May 2, 2020 from <https://www.theborneopost.com/2019/01/31/big-potential-for-pineapple-farming-in-swak/>.
- Jaji, K., Man, N. and Nawi, N.M. (2018). Factors affecting pineapple market supply in Johor, Malaysia. *International Food Research Journal*, 25 (1), 366-375.
- Krejcie, R.V. and Morgan, D.W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30, 607-610. <https://doi.org/10.1177/001316447003000308>
- Malaysian Pineapple Industry Board (MPIB). (2019). Marketing of pineapple. Retrieved on January 12, 2019 from Malaysian Pineapple Industry Board Website: <http://www.mpib.gov.my/en/marketing/?lang=en>.
- Misran, E., Indris A., Sarip, S.H.M. and Ya'akob, H. (2019). Properties of bromelain extract from different parts of the pineapple variety Morris. *Biocatalysis and Agricultural Biotechnology*, 18, 101095. <https://doi.org/10.1016/j.bcab.2019.101095>
- Nahar, A., Saili, A.R., Hamzah, N.M., Abdul Fatah, F., Yusop, Z. and Kamarul Zaman, N.B. (2020). Challenges in marketing channel selection by smallholder pineapple growers in Samarahan, Sarawak. *Malaysia Food Research*, 4(5), 77-85. [https://doi.org/10.26656/fr.2017.4\(S5\).020](https://doi.org/10.26656/fr.2017.4(S5).020)
- Nakthong, N., Wongsagonsup, R. and Amornsakchai, T. (2017). Characteristics and potential utilizations of starch from pineapple stem waste. *Industrial Crops and Products*, 105, 74-82. <https://doi.org/10.1016/j.indcrop.2017.04.048>.
- Ong, K.L., Wai, T.B. and Ling, L.W. (2014). Pineapple cannery waste as a potential substrate for microbial biotransformation to produce vanillic acid and vanillin. *International Food Research Journal*, 21 (3), 953-958.
- Pechrova, S.M., Simpach, O., Medonos, T., Spesna, D. and Delín, M. (2018). What are the motivation and barriers of young farmers to enter the sector? *AGRIS on-line Papers in Economics and Informatics*, 10, 79-87. <https://doi.org/10.7160/aol.2018.100409>
- Praveena, J.R. and Estherlydia, D. (2014). Comparative study of phytochemical screening and antioxidant capacities of vinegar made from peel and fruit of pineapple (*Ananas cosmosus* l.) *International Journal of Pharma. Biology Science*, 5(4), 394-403.
- Prayoga, K., Subejo and Raya, A.B. (2019). Shifting the meaning of farmers from the young farmers perspective. IOP Conference Series: *Earth and Environmental Science*, 518, 012074. <https://doi.org/10.1088/1755-1315/518/1/012074>
- Rabiu, Z., Maigari, M.U., Lawan, U. and Mukhtar, Z.G. (2018). Pineapple waste utilization as a sustainable means of waste management. In Zakaria Z. (eds) *Sustainable Technologies for the Management of Agricultural Wastes. Applied Environmental Science and Engineering for a Sustainable Future*, p. 143-154. Singapore: Springer. [https://doi.org/10.1007/978-981-10-5062-6\\_11](https://doi.org/10.1007/978-981-10-5062-6_11)
- Ruslan, N.A., Aris, N.F.M., Othman, N., Saili, A.R., Muhamad, M.Z. and Aziz, N.B. (2017). A preliminary study on sustainable management of pineapple waste: perspective of smallholders. *International Journal of Academic Research in Business and Social Sciences*, 7(6), 2937. <https://doi.org/10.6007/IJARBS/v7-i6/2937>
- Saravanan, P., Muthuvelayudham, R. and Viruthagiri, T. (2013). Enhanced production of cellulose from pineapple waste by response surface methodology. *Journal of Engineering*, 2013, 979547. <https://doi.org/10.1155/2013/979547>
- Sekaran, U. and Bougie, R. (2013). *Research method for business: A skill building approach*, 6th ed. New York: John Wiley and Sons.
- Simpach, O. and Pechrova, M. (2015). Projection of Czech agricultural workers' gender structure. *Agrarian Perspective Conference XXIV*, p. 447-455. Prague.
- Tran, A.V. (2006). Chemical analysis and pulping study of pineapple crown leaves. *Industrial Crops and Products*, 24(1), 66-74. <https://doi.org/10.1016/j.indcrop.2006.03.003>
- Veno, J. (2018). *The Goodness of Pineapples*. The

Borneo Post Online. Retrieved on Mar 18, 2020 from <https://www.theborneopost.com/2018/08/19/the-goodness-of-pineapples/>.

Wee, L. (2017). More composting to turn food scraps into fertilizer. The Straits Times Online. Retrieved on January, 21 2021 from: <https://www.straitstimes.com/lifestyle/homedesign/composting-gains-fans#main-content>.

Wijayati, N., Rini, A.R.S. and Supartono. (2016). Hand sanitizer with pineapple peel extract as antibacterial against *Staphylococcus aureus* and *Escherichia coli*. International Conference on Mathematics, Science and Education. Bandung, Indonesia: Universitas Pendidikan Indonesia.

Yusri, Y., Siti Asia, Y. and Adam, A. (2015). Novel technology for sustainable pineapple leaf fibers productions. *Procedia CIRP*, 26, 756–760. <https://doi.org/10.1016/j.procir.2014.07.160>

Zawawi, D., Mohd Zainuri, M.H., Angzzas Sari. M.K., Halizah. A. and Ashuvila, M.A. (2014). Exploring of agro waste (pineapple leaf, corn stalk, and napier grass) by chemical composition and morphological study. *BioResources*, 9(1), 872-880. <https://doi.org/10.15376/biores.9.1.872-880>