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Status and impact of pineapple technology on mineral soil

(Status dan impak teknologi nanas di tanah mineral)

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Keywords: pineapple technology, impact, mineral soil, sustainable rural livelihood framework (SRLF)

Abstract

Status and impact assessment of pineapple technology on mineral soil was carried out using the adapted Sustainable Rural Livelihoods Framework (SRLF). Data were gathered by personal interview involving 52 respondents in 20 districts in Peninsular Malaysia. Results of the study revealed that the adoption of modern variety, crop and resource management, plant health management and postharvest technologies as recommended by MARDI/LPNM were low. Unlike pineapple cultivation on peat soil, the technology for pineapple cultivation on mineral soil had not given satisfactory impact on farmers' income. Uneconomic farm size, poor crop management, low price of the fruits arising from low quality produce contributed to the low net income. Without subsidy, pineapple cultivation on mineral soil would not be an attractive venture. The technology for pineapple cultivation generally had matured. Any intervention by policy makers should focus on stabilizing the fruit prices and increasing the farms to an economic size of ≥2 ha. This could be achieved through efficient contract farming and farm consolidation. Radical technology such as new varieties and efficient farm management via mechanization are needed to revitalise the pineapple industry to ensure its sustainability and competitiveness.

Introduction

Pineapple is a popular non-seasonal fruit and widely cultivated in Johor, Peninsular Malaysia.The pineapple industry in Malaysia is unique because 90% is planted on peat soil and the remainder is planted on mineral soil (Chan 2000). There is emerging interest of planting fresh fruit varieties on mineral soil as it is perceived as having better quality than those planted on peat soil.

An *ex post* impact assessment of pineapple technology on peat soil was carried out in 2009 to determine the status of technology adopted by farmers and its impact on farmers' incomes. Results of the study revealed that the adoption of new varieties, crop and resource management, plant health management and postharvest technologies as recommended by MARDI was low (Raziah 2009). However, generally the technology for pineapple cultivation on peat soil had given positive impact on farmers' incomes.

A study on the productivity and efficiency of the pineapple subsector in 2010 (Raziah et al. 2010) revealed that the average yield was 28,970 fruits per hectare. The average total productivity at 2.37 with a standard deviation of 1.09 was encouraging. For every RM1.00 invested, the net return was about RM1.37. The average technical efficiency at 72.26% with a standard

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deviation of 15.18% was considered as moderate. The elasticity of production factors at 0.94 indicates that manipulation of production factors to increase productivity and efficiency is limited. Pineapple is an old industry in this country and the pineapple technology had reached its maturity stage along the technology life cycle. Although it could still provide positive impact on farmers' incomes, radical technologies such as new varieties and labour saving production systems are needed to ensure the sustainability of the pineapple industry in the country.

This paper is aimed at identifying the status of pineapple technology adoption on mineral soil, determining the technology impacts on farmers' income and finally suggesting policies to ensure the sustainability and competitiveness of the pineapple industry in the country.

Methodology

Impact studies faced conceptual as well as empirical challenges due to the complexities of the relationships between agricultural technology and rural livelihoods. The goals of agricultural technology development change from increasing food production to the broader aims of reducing poverty both in less developed and developing countries. In Malaysia, agricultural technology development is aimed at increasing food production for food security reasons, increasing exports to reduce high deficit in balance of trade on food items and more importantly increasing farmers' income and make agriculture sector as competitive as the other sectors in the economy.

The sustainable rural livelihoods framework (SRLF) has been used by a growing number of researchers and development organizations in the world including the United Nations Development Program (UNDP), the Department for International Development (DFID) in the United Kingdom and non-governmental organizations (NGOs) such as CARE and Oxfam (DFID 1997) (Anon. 2001).

In this study, the adapted SRLF (*Figure 1*) was used to assess the status and *ex post* impact of pineapple technologies on farmers' income with reference to four key technologies; modern variety (MV), crop and resource management (CRM), plant health management (PHM) and postharvest technology (PHT). The livelihood outcome to be assessed in this study is the farmers'

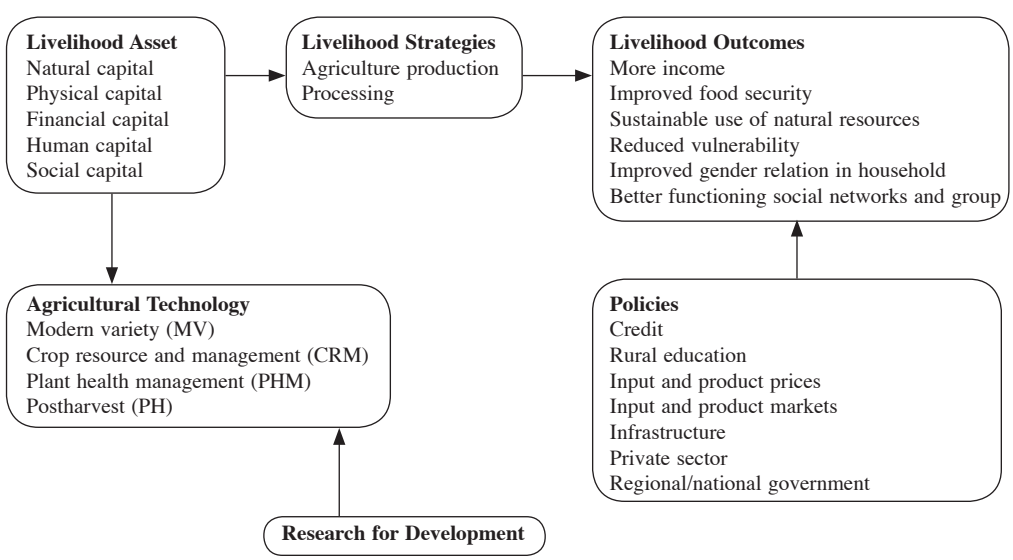

Figure 1. A sustainable livelihoods framework with agricultural technology

incomes. The targeted net income for members of the 'Taman Kekal Pengeluaran Makanan' (TKPM) was RM3,000/month (Anon. 2007) and this would be the bench mark for pineapple growers income in this study.

Primary survey was conducted in Perak, Pulau Pinang, Negeri Sembilan, Kedah, Kelantan and Terengganu involving 20 districts and 52 respondents. Structured questionnaire was used in data collection. The questionnaire was divided into four sections: 1) respondents and farms background, 2) agronomic practices, 3) farms' production costs, prices of output and revenues for one crop cycle, and 4) problems encountered by farmers in pineapple cultivation.

On the agronomic practices, farmers' practices were compared against the technology recommended by MARDI as bench marks. The lists of technology recommended were based on information gathered from *Panduan Penananan Nanas* (Mohammed Selamat et al. 1996) published by MARDI in 1996 and reprinted in 2009.

For each agronomic practice, starting from land preparation to harvesting and field transportation, a scale of 0–3 was assigned: 3 = practise technology recommended, 2 = practise some of the technology recommended, 1 = practise technology sourced from others and 0 = did not practise technology at all. A qualitative judgement was used to assign the scale for technology adoption.

Descriptive analysis and statistical tests were performed on the data and presented in the form of cross tabulation and column charts.

Results and discussion

Respondents' profile

The summary of the respondents' distribution by states and their background is presented in *Table 1*. The majority of farmers (>92%) were males. More than 40% were 41–50 years old and more than 26% were relatively older, 51–60 years old. The majority of pineapple growers (74%) had gone through primary and secondary levels of education. Those involved in pineapple cultivations as full time farmers were about 34%. The majority of pineapple growers (37%) earned less than RM1,000 per month followed by those who earned higher income of RM1,001–RM2,000 monthly (28%). Most of the respondents (70%) had been involved in pineapple cultivation between 1–5 years.

Background of farms

The average farm size in the area studied was about 7 ha with a standard deviation of 13.4 ha indicating high variations in the farm size. It ranged from a small plot of 0.4 ha to a bigger farm of 81 ha.

About 36% Moris farmers and 58% Sarawak farmers cultivated the varieties on small plots of 0.1–2 ha. Out of the small plot, the majority of Moris farms (55%) was less than 1 ha, and for Sarawak, the plot size was mostly 1.1–1.5 ha. (*Figure 2*). The average farm size for Moris and Sarawak were 9.5 ha and 3.6 ha respectively with standard deviations of 16.7 ha for Moris and 3.9 ha for Sarawak. The higher standard deviation in Moris plots was due to the farms heterogeneity with the involvement of highly commercialised farmers against small scale growers. As for Sarawak, the farms were considered as relatively homogenous.

Technology adoption

The pineapple technology practised by the farmers was compared against those recommended by MARDI in order to determine the status of technology adoption and dissemination. Generally, the technology for pineapple cultivation on mineral soil is equivalent to that of peat soil except that in mineral soil, plastic cover is recommended for controlling weed and to prevent soil erosion.

Modern varieties There were two main varieties of pineapple planted in the area studied. Moris variety was the main choice

Table 1. Distribution of respondents by states and their socio-economic scenario

Variables	Categories	Percentage (%)	Total respondent
States	Kedah	26.9	52
	Kelantan	21.2	
	Negeri Sembilan	11.5	
	Pulau Pinang	1.9	
	Perak	23.1	
	Terengganu	15.4	
Gender	Male	92.2	51
	Female	7.8	
Age (years)	20–30	4.1	49
	31–40	18.4	
	41–50	40.8	
	51–60	26.5	
	>61	10.2	
Education levels	Never been to school	2.0	50
	Primary	32.0	
	SRP/SPM	42.0	
	STP/Diploma	14.0	
	Others	10.0	
Main occupation	Farmer	34.6	52
	Pensioner	17.3	
	Business	1.9	
	Government	7.7	
	Private	3.8	
	Others	34.6	
Household income (RM/month)	<1,000	37.2	44
	1,001–2,000	27.9	
	2,001–3,000	20.9	
	3,001–4,000	7.0	
	>4,001	7.0	
Experience in pineapple cultivation (years)	1–5	70.6	51
	6–10	9.8	
	11–15	7.8	
	16–20	11.8	

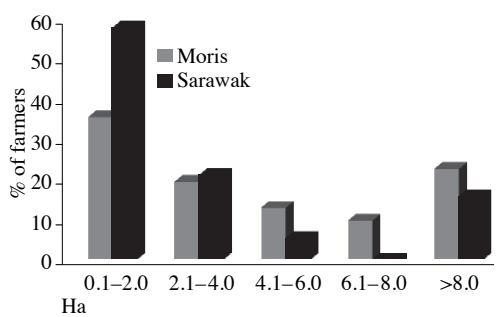

Figure 2. Area planted by varieties

among pineapple growers (62%) followed by Sarawak (38%).

The relatively new variety Josapine was not fully accepted by the farmers since its introduction in the 1990s. The high cost and not easily available planting materials, its susceptibility to bacterial heart rot (BHR) and the need for more intensive crop care and maintenance are reasons for this variety not being accepted by the farmers.

Table 2. Status of pineapple technology adoption on mineral soil

Variables	*3 (%)	*2 (%)	*1 (%)	*0 (%)	Number of respondents (n = 52)
Treatment of planting materials	9.30	0	19.20	71.20	52
Land clearing and preparation	38.50	19.20	1.90	40.40	31
Infrastructure preparation	96.00	0	4.00	0	25
Planting distance					
(i) Moris	71.00	3.20	0	25.80	31
(ii) Sarawak	10.00	5.00	85.00	0	19
Planting density (plant/ha)					
(i) Moris	22.60	22.60	54.80	0	31
3 : >35,800					
2 : 35,800					
1 : <35,800					
(ii) Sarawak	5.00	15.00	80.00	0	19
3 : >35,800					
2 : 35,800					
1 : <35,800					
Fertilizer application	30.80	9.60	46.20	13.50	52
3 : >3.7 t/ha					
2 : 3.7 t/ha					
1 : <3.7 t/ha					
Weed management	1.90	48.10	46.20	3.80	52
(i) Pre-emergence pesticides	51.90	0	13.50	34.60	52
(ii) Post emergence pesticides	1.90	0	75.00	23.10	52
Flower induction and fruit growth hormones	53.80	0	15.40	30.80	52
Pest and disease management	46.20	0	5.80	48.10	52
Fruit harvesting:fruit maturity index	11.50	71.20	0	17.30	52
Fruit transportation	19.20	32.70	0	48.10	52

3 = Practise technology recommended
2 = Practise partially the technology recommended
1 = Practise technology from other sources
0 = Did not practise technology

Treatment of planting materials Planting materials need to be treated with fungicide such as Benlate before planting to prevent fungal infection later on. The majority of farmers (71%) did not treat the planting materials as recommended, 19% followed the recommendation from other sources and only 9% followed the proper procedure as recommended by MARDI.

Land clearing and preparation The area identified for planting needs to be cleared by using herbicides such as Paraquat. Burning is recommended under suitable weather condition to enhance the soil fertility and at the same time to kill pathogens. In this study, about 39% from 31 farmers who answered the question followed the recommended procedure, 19% partially followed and 40% did not follow at all what were recommended (*Table 2*). In terms of infrastructure, based on 25 farmers who responded, the majority (96%) have the required infrastructure particularly farm road and drainage facility.

Planting distance and planting density The majority of farmers who planted Moris followed the recommended planting distance (71%). For those who planted Sarawak, the majority (85%) followed the recommendation from

other sources and only 10% followed the recommended planting density by MARDI. For the two varieties planted, generally the plant densities for the majority of farms were lower than the recommended density (*Table 2*).

Fertilizer application The estimated amount of fertilizer needed is 3.7 t/ha. Results of the study revealed that more than 30% farmers applied more than the recommended rate while about 10% farmers followed the exact rate of fertilizer. More than 46% farmers applied less fertilizer than the recommended rate while about 14% did not apply fertilizer at all (*Table 2*). Most of the farmers were provided with subsidized fertilizer at the rate of RM1,750/ha. Assuming that the farmers fully utilized the subsidized fertilizer, the amount of fertilizer applied still less than the recommended rate for the majority of farms.

Weed management A combination of both methods; mechanically using cangkul (or other tools) and using herbicides were recommended to control weeds in pineapple farms.

Based on the survey, only a small number of farmers (2%) adopted both methods to control weeds before planting. The majority of farmers (52%) did apply pre-emergence herbicides as recommended by MARDI while 35% did not apply pre-emergence at all. For post emergence herbicides, the majority of farmers (75%) applied them but using recommendation from other sources.

Flower induction and fruit growth hormone Inducing flower by using chemical is a normal practice adopted by pineapple growers. For the ratoon plants, flower induction is done to get an even harvest. For newly planted large scale area, flower induction is carried out to regulate or stagger the yield to avoid over supply at certain times.

In general, all farmers used the technology for flower induction and fruit growth hormones. About 54% farmers followed MARDI's recommendation while 31% did not undertake flowering and fruiting inductions (*Table 2*).

Pest and disease management Pests and diseases, if not properly controlled, tend to affect pineapple yield and quality. From this study, about 46% farmers followed MARDI's recommendation on ways to control pests and diseases while 48% did not do anything to treat pests and diseases in their farms (*Table 2*).

Pre and postharvest technology The maturity index for pineapples varies according to variety. From this study, about 12% farmers followed exactly what was recommended by MARDI while the rests (71%) followed partially.

After harvesting, the fruits are usually collected using bamboo rattan and transported to a collection centre. In this study, 19% farmers used the appropriate technology for on farm handling and transportation, 33% followed partially and 48% did not follow the recommendation (*Table 2*).

Technology impacts

The *ex post* impact of pineapple technology on mineral soil was analysed by assessing the livelihood outcome in terms of farmers' incomes. The net income as targeted for the members of TKPM at RM3,000 per month was made as a bench mark and compared against the net income received by the pineapple growers. Analysis on productivity, gross income and cost of production were done prior to the calculation of the net income.

Land productivity (yield) About 68% farmers who planted Moris variety managed to achieve the expected yield of 30 t/ha and above while the rests had achieved lower yield. The average yield of Moris variety

was higher than expected (32 t/ha) with a range of 20–40 t/ha and standard deviation of 5.30 t/ha. However, the average yield of Moris on peat soil was slightly higher at 34 t/ha (Raziah 2009).

The majority of farmers (62%) who planted Sarawak variety managed to achieve the expected yield of 35 t/ha and more. The average yield of Sarawak at 38 t/ha was higher than expected with a range of 20–50 t/ha and standard deviation of 9.90 t/ha. A t-test statistics performed on the data revealed that the average yield of Sarawak variety was significantly higher than Moris variety ($F = 15.59$ and $\alpha = 0.000$).

The lower standard deviation in Moris and Sarawak productivity was generally attributed to homogeneity in cultural practices. Based on random verification survey on mineral soil, five out of ten farmers (50%) followed exactly the technology recommended while on peat soil 14 out of 25 farmers (56%) followed exactly the technology recommended by the Lembaga Perindustrian Nanas Malaysia (LPNM). Although some of the farmers did not practise the technology recommended by MARDI or LPNM, generally the average farms productivity was higher than expected, indicating that the pineapple technology was matured.

Price and gross income Based on the survey, the prices of Moris and Sarawak varieties were determined based on grades. The prices of Moris were RM1.45/kg, RM1.03/kg and RM0.65/kg for Gred A, Gred B and Gred C respectively. The prices for Sarawak variety were lower, RM1.13/kg for Gred A, RM0.79/kg for Gred B and RM0.59/kg for Gred C.

Based on the above prices, the average gross income for pineapple farms based on this study was about RM27,980/ha. The average gross income for Moris variety was about RM27,940/ha while for Sarawak variety the average gross income was about RM28,040/ha.

Production costs The production costs included in this study were the variable costs or direct costs. Infrastructure and development costs were not included in the calculation as they involved a long-term life-span. The average cost of production for pineapple as a whole based on this study was about RM11,580/ha. The average cost of production for Moris variety was about RM12,550/ha and RM10,370/ha for Sarawak variety.

In general, the major input cost components were planting materials, fertilizers and herbicides. The other important cost components were labour (especially during harvesting) and transportation.

Fertilizers were subsidized by the government at the rate of RM1,750/ha for replanting schemes. In this study, all farmers received the fertilizer subsidy. Without subsidy, the cost of production for pineapple would be much higher.

Net income Net income was calculated by subtracting the production costs from the gross revenue. The average net income for pineapple cultivation on mineral soil was about RM16,390/ha. The average net income for Moris variety was RM15,390/ha and RM17,670/ha for Sarawak variety. Without subsidy, the average net income of pineapple growers reduced to RM10,390/ha. The average net income for Moris variety and Sarawak variety were RM9,390/ha and RM11,670/ha respectively.

The distribution of the pineapple growers' gross net income is shown in *Figure 3*. About 23% farmers managed to generate monthly gross net income of ≥RM3,000 per month as targeted for the members of TKPM, Department of Agriculture (DOA). However, 36% received gross net income less than RM1,000 per month. Further analysis on the distribution of the gross net income by varieties revealed that about 30% Moris farmers and 12% Sarawak farmers managed to generate gross net income ≥RM3,000 as targeted. The

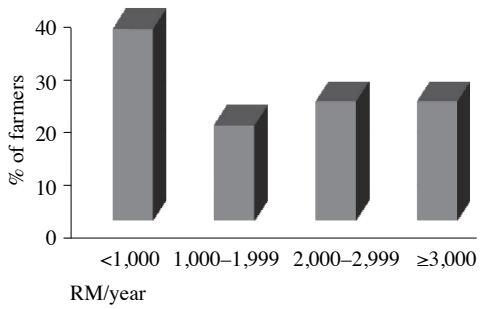

Figure 3. Distribution of pineapple farmers estimated monthly net income

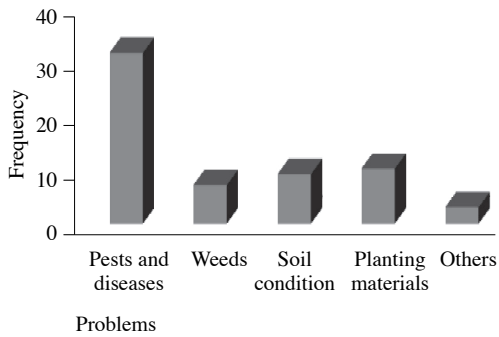

Figure 4. Problems encountered by pineapple farmers

lower gross net income received by the farmers were attributed mainly by the small farm size since the majority of farmers was operating on small plot of land less than one ha for Moris and less than 1.5 ha for Sarawak.

Total productivity Total productivity (TP) is the ratio of total output to total input. It measures the return for each ringgit invested. The TP analysis performs on the data revealed that the average TP for Sarawak variety at 3.44 was higher than Moris variety at 2.55. The t-test statistics performed on the data indicated that the TP for Sarawak variety was significantly higher than that for Moris variety ($F = 4.367$, $\alpha = 0.042$). However, both Sarawak and Moris varieties were considered as productive crops on mineral soil and should continue be recommended for planting.

Problems in pineapple cultivation
An open-ended question given to the respondents required them to state down the problems encountered in pineapple cultivation. The problems they listed were summarized into six categories: pests and diseases, weeds, soil, planting materials and others.

The main problem as indicated by the farmers was pests. Mature fruits were easily attracted by mammals such as monkeys, wild pig, rat, cow and squirrel. There was no easy way out of this traditional problem. Other problems included shortage, non-uniform and low quality supply of planting materials or suckers, poor soil quality and prolong dry season. Minor problems were weed, diseases, markets during glut and small land area (*Figure 4*).

Conclusion and recommendation
The average farm productivity for Moris and Sarawak varieties were higher than expected, nevertheless only a minority of farmers were able to generate average net monthly income of RM3,000 and more as targeted. The lower net income received by the majority of farmers was attributed mainly by the small and uneconomic farm size, poor crop management practices resulting in low quality produce and ultimately low price of fruits.

The technology for pineapple cultivation generally had matured. Any intervention by policy makers should focus on stabilizing the fruit prices and increasing the farms to an economic size of ≥2 ha. This could be achieved through efficient contract farming and farm consolidation. Radical technology such as new varieties and efficient farm management via mechanization are needed to revitalise the pineapple industry to ensure its sustainability and competitiveness.

Pineapple cultivation on mineral soil could provide a viable option for pineapple industry expansions only with subsidy. Without the subsidy, pineapple cultivation

on mineral soil would not be an attractive venture.

Based on the problems encountered by the farmers, further R&D should focus on three main areas: determining the most efficient way of controlling pests and diseases, supplying sufficient and standard planting materials with reasonable prices and improving soil quality after prolong usage.

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Abstrak

Penilaian status dan impak teknologi penanaman nanas di tanah mineral telah dilaksanakan menggunakan 'Sustainable Rural Livelihoods Framework' (SRLF) yang diubah suai. Data dikumpul melalui temu bual bersemuka dengan 52 penanam nanas dari 20 daerah di Semenanjung Malaysia. Keputusan kajian menunjukkan penerimaan penanaman varieti moden, pengurusan tanaman dan sumber, pengurusan perosak dan pengendalian lepas tuai seperti yang disyorkan oleh MARDI/LPNM adalah rendah. Berbanding dengan penanaman nanas di tanah gambut, teknologi penanaman nanas di tanah mineral tidak memberi impak yang memuaskan terhadap pendapatan petani. Saiz ladang yang tidak ekonomik, pengurusan tanaman yang kurang cekap, harga buah nanas yang rendah disebabkan oleh kualiti hasil yang rendah menyumbang kepada pendapatan bersih yang rendah. Tanpa subsidi, penanaman nanas di tanah mineral bukan suatu pelaburan yang menarik. Pada amnya, teknologi penanaman nanas telah matang. Sebarang intervensi oleh pembuat dasar perlu fokus kepada penstabilan harga dan meningkatkan keluasan ladang ke aras lebih ekonomik iaitu ≥2 ha. Ini boleh dicapai melalui sistem perladangan kontrak yang efisien dan pengelompokan ladang. Teknologi radikal seperti varieti baru dan pengurusan ladang yang cekap dengan menggunakan mekanisasi adalah perlu bagi merancakkan industri nanas seterusnya menjamin kelestarian dan daya saing.