

## A Novel Approach Towards Sustainable Banana Farming Intercropped with Rubber by A Smallholder – A Profitable Source of Income Diversification

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**Abstract**— In the year 2009-2010, the Department of Agriculture, Malaysia introduced Abandoned Land Development Project (ACDA). Under this project, abandoned lands are replanted with crops of economic value. The cultivator of this case study was one of the participants of ACDA project. With the subsidies provided by the Government of Malaysia, the cultivator established a banana farm. Conventionally, the cultivator's main source of income should be generated from selling the banana fruit. However, we found this cultivator cum entrepreneur diversified his land productivity. The monthly income generated from selling banana fruits, suckers and rubber seedlings were 30.2 %, 39.9% and 29.9% of his total farm income, respectively. The cultivator provide a novel insight in managing banana farm by introducing new techniques of planting, fertilization regime and diversification of income in his banana farm intercropped with rubber seedlings.

**Keywords**— Banana; Fruits; Rubber; Intercropping; Fertilizers

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### I. INTRODUCTION

Banana as one of the popular fruits in Malaysia covers more than 11% of total fruit area with annual production about 180 000 tonnes and a balance of trade of more than US 8 million (RM 30 million)(Hassan, 2004). In the year 2009, the Government of Malaysia introduce Economic Stimulus Package 2009-2010. Under this package, the Department of Agriculture introduced Abandoned Land Development Project (ACDA). In the span of 2 years, an allocation of RM30 million was spent involving total rehabilitated area of 2215.7 hectares throughout Malaysia (Department of Agriculture, 2013). The cultivator in this study, is a participant of this program, received RM 200, 000 initial capital for the clearing and replanting the abandoned land with banana. The farm was established in September 2010 with plants banana (*Musa paradisiacal L.* variety berangan). Later the cultivator intercropped his farmland with rubber seedlings to increase farm returns, contributing to improved total land productivity. The bananas planted were used as shade plants (Robinson & Saucó, 2010) for the rubber seedlings. The aim of this paper is to highlight the novel farm practices practised by the cultivator cum entrepreneur to maximise his land productivity.

### II. MATERIALS AND METHODS

The farm is located at Sungai Long (5°38' N, 101°45'E), Jeli, Kelantan, Malaysia with total planted area of 3.2 hectares. Questionnaire was administered through face-to-face interviews with the farmer to capture data on banana management and production practices such as land preparation, establishment techniques, fertilizer management, pest and disease management and enterprise revenue. Additional information on rubber seedling intercropping was obtained through direct assessment with the cultivator.

Our study found, no tillage was done on the farm because of the presence of boulders in the farm. The landscape of the farm is gentle terrain and soil type is alluvial soil. There is a small river stream which provide water source to the banana farm. Sprinklers were installed throughout the farm aided by the force of gravity for field irrigation. The subsidies provided by the government was used for clearing, levelling and pre-planting land preparation, labour force, electric fencing against the wild boars, initial tissue culture planting materials, rubber seeds, fertilizers, and equipments' for farm maintenance (power sprayer, agriculture tools, pesticides, herbicides and sprinkler). The initial tissue culture planting materials (*Musa paradisiacal L.* variety berangan) were obtained from the Department of Agriculture at the cost of

RM1.70/plantlet. A total of 6,400 plantlets were used. The plantlets were planted at spacing of 3.0m x 3.0m, 3.0m x 2.4m and 2.4m x 3.6m depending on land surface condition. Rather than following the conventional method of planting one sucker in single hole, in this farm, the cultivator planted 2 suckers in single hole with dimension of 0.3m x 0.3m (wide) at the depth of 0.3m. This allows the farmer to maximise the plant density up to 2000 banana plant per hectare. In normal banana farming establishment, at the 2.5m x 2.5m and 3.0m x 3.0 m of spacing, the farmers can have plant density between 1100 to 1600 plant per hectare (Jabatan Pertanian Negeri Perak, 2012). Smallholders are usually ready to use fertilizers if they are easily accessible and, most importantly, if they are affordable and their use is profitable (FAO, 2004). An increase in use of fertilizer will increase the production cost and burden the smallholders. Thus, for smallholder cultivator, the compound fertilizers were subsidised by the Government of Malaysia to improve their crop productivity income, and therefore alleviate rural poverty. As the planting technique differs, the cultivators opt for a different fertilization regime. Rather than following the conventional regime of fertilization which used compound fertilizers (NPK;15:15:15), the cultivators develop his own fertilization regime (Table 1). Besides the use of compound fertilizers, there were 3 additional types of fertilizers (each cost USD71.6) applied depending on the stage of the banana plant (Table 1). On the 1st, 3rd, 5th and 9th month the compound fertilizer was applied. On the 2nd, 4th and 6th months, the fertilizers were applied as foliar fertilizer mixed with pesticides to reduce labour cost. Whenever the fertilization was done, the rubber seeding also benefited it.

TABLE I  
FERTILIZATION REGIME PRACTISED BY THE CULTIVATOR

Months	Fertilizers	Amounts
1	N:P:K (16:16:16)	150g
2	N:P:K: MgO: ME (18:18:18:3:ME) -foliar fertilizer	20g
3	N:P:K (15:15:15)	100g
4	N:P:K: ME (13:40:13:ME) -foliar fertilizer	20g
5	N:P:K (15:15:15)	100g
6	N:P:K: MgO: ME (15:15:30:3:ME) -foliar fertilizer	20g
7	No fertilizer application	-
8	No fertilizer application	-
9	N:P:K (15:15:15)	250g

ME - trace elements: B - 0,025%; Cu \* - 0,01%; Fe \* - 0,07%; Mn \* -0,04%; Mo-0,004%; Zn \* - 0,025%

Herbicide used in this farm is glyphosate. No specific time was scheduled for the maintenance of weeds. The spraying was done based on the growth of the weeds. During the initial planting stage, the cultivator use carbofuran (3% w/w) and place it into the planting hole to hinder nematodes and rhizome borer infestation. Bimonthly, the cultivator practice spraying mixture of foliar fertilizer (Table 1) with pesticides [depending upon types of infestation; fungicide-mancozeb 80% w/w; alternating the insecticide use (fipronil 5.0% w/w or deltamethrin 2.5% w/w) to control insect pests].

By mixing the fertilizer and pesticides, the cultivator is able to reduce the cost of labourer. In Malaysia, fusarium wilt of banana or Panama disease caused by *Fusarium oxysporum* f. sp. cubense is the most important disease of banana (Hassan, 2004). At the moment of this paper was written, there is no confirmed banana diseases in the farm. However, there was slight infestation of banana pseudostem borer, *Odoiporus longicollis* (Diptera: Coleoptera) detected.

In this farm, the plant density varies because of the uneven land surface and presence of boulders within the farm. This results in variation in emergence time of banana inflorescences and harvesting time which allow the cultivator to directly market the fruit to retailer in small-scale to the nearby town. By doing this, the cultivator maximise the profits by avoiding the traders or wholesaler who purchase the fruits at much lower price. For the suckers and rubber seedling, the market was determined by demand from new farm establishment in the surrounding areas. The cultivator constantly supplies the suckers to the Department of Agriculture which distribute the suckers to other farmers within the district. Meanwhile, the markets for the rubber seedling was sort out by the cultivators thorough networks of his friends. The monthly earning of the cultivator after 11-12 months of the establishment of the farm was described in Table 2.

TABLE III  
MONTHLY EARNING OF THE CULTIVATOR AFTER 11-12 MONTHS OF THE ESTABLISHMENT OF THE FARM.

Monthly income	Production volume	USD (%)
Banana fruits production	4,000kg	3,255.2 (30.2)
Sale of banana suckers	11,000 suckers	4,296.9 (39.9)
Sale of rubber seedlings	3300 seedling	3,222.7 (29.9)
<b>Monthly Expensive</b>		
Salary of labourers, electricity, fertilizers, pesticides and transportation	-	1,627.6
<b>Returns</b>		<b>9,147.2</b>

### III. CONCLUSIONS

The land rehabilitation project is a wise strategy to improve income of rural poor which is in line with the government's poverty eradication program. Progressive farmers create opportunities and increase revenue thorough farm diversification activities. In this case study, banana farming diversification activities indulged include supplying suckers planting materials to new growers and row intercropping with rubber seedlings to provide planting material for small-scale rubber growers. It was believed banana farm can only be sustained by selling the banana fruit. Based from the cultivator's experience, the income generated thorough direct selling the banana sucker and rubber seedling is more than income from selling the banana fruit.

### ACKNOWLEDGMENT

We would like to thank Mr. Hashim and his family for his generosity and willingness for us to conduct our study in his farm. We also would like to thank Universiti Malaysia

Kelantan for the funding provided under Skim Penyelidikan Jangka Pendek (R/SGJP/A07.00/00760A).

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