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Financial and Technical Assessment of Kenaf Cultivation for Producing Fiber Utilized in Automotive Components

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Abstract

The kenaf plant is eco-friendly, renewable, low in cost and not meant to be a food source, owing to its potential commercial value in Malaysia, the government has allocated millions of ringgit for research to develop a viable kenaf-based industry. This study is an attempt to assess the financial and technical performance of kenaf cultivation to produce fiber usage in automotive components. The financial data were collected through interviews with kenaf growers and from group discussions as well as production data collected from CMPC (Kenaf Processing and Marketing Centre) Bachok-Kelantan. The financial data were analyzed using Microsoft Excel software while Eview8 was used to analyze the production data. Three scenarios of kenaf production per hectare were assumed which were 15, 12 and 10 ton. According to the data analysis; the results revealed when kenaf production was 15 ton/ha, the farmer made a maximum profit of 37% from the subsidy provided by the Lembaga Kenaf Dan Tembakau Negara (LKTN) or National Kenaf and Tobacco Board, which was more than double the profit margin without subsidy. The financial analysis illustrated that all the three scenarios were viable when using the Benefit Cost Ratio (BCR) as an indicator. However, the production of 15 ton per hectare was the best of the three scenarios due to the five-year payback period, which was equal to half the period run on the model of the financial analysis. Additionally, the analysis of the production input (labor and chemicals) showed a significant effect on kenaf production as indicated in the analysis of Ordinary Least Square (OLS).

Keywords: Financial analysis; BCR; OLS; LKTN; CMPC; Kenaf production; Profit margin

Introduction

Natural fiber composites appeared to be as replacements to glass-reinforced composites in several industrial usages. Natural fiber composites for example hemp fiber-epoxy, flax fiber-polypropylene (PP), and china reed fiber-PP are mostly used by the customers in automotive applications due to their lower price and lower density. Glass fibers used for composites have density of 2.6 g/cm^3 and cost between $1.30 and $2.00/kg. In comparison, flax fibers have a density of 1.5 g/cm^3 and cost between $0.22 and $1.10/kg [1]. Moreover, Al-Oqla et al. [2] conducted a study to evaluate and select the most appropriate non-woven natural reinforcement fibre/polypropylene-based composites for interior parts in the automotive industry. The study utilized a decision-making model with emphasis on analytical hierarchy process was used to assess 15 potential alternatives of different natural fiber/polypropylene composites (Treated coir 15 wt%/PP, Treated coir 20 wt%/PP, date palm 30 wt%/PP, treated date palm 30 wt%/PP, Flax 30 wt%/PP, Treated Flax 30 wt%/PP, Flax 50 wt%/PP, Treated Flax 50 wt%/PP, Jute 20 wt%/PP, treated Jute 20 wt%/PP, Treated Jute 30 wt%/PP, Treated Kenaf 30 wt%/PP, Kenaf 40 wt%/PP, Treated Kenaf 40 wt%/PP, and Sisal 15 wt%/PP treated). To evaluate these potential alternatives, Al-Oqla et al. [2] simultaneously considered six criteria which they purported will enhance the selection process of natural fiber reinforced polymer composites, which includes; tensile strength, tensile modulus, flexural strength, flexural modulus, impact strength and the maximum water absorption of the composites. The results from their finding revealed that, impact and flexural strengths were given more priority in the evaluation process where as for overall evaluation criteria, treated flax/polypropylene composite with 30 wt% fiber loading was found to be the best alternative, while date palm fiber/polypropylene composites were found to be a potential alternative. Thus they concluded that by determining the best type of fiber composites for automotive industry will not only enhance it sustainability and productivity but will also contribute to the environment by achieving more visible solution that can reduce the weight of products, thereby reducing CO_2 emission.

Kenaf 40 wt%/PP treated is found to be most potential non-woven natural reinforcement fiber/polypropylene with regards to flexural strength criterion, but has a weak potential with regards to tensile strength. On the other hand Kenaf 40 wt%/PP showed high potential with respect to tensile and flexural modulus.

In yet another study by [3], in which they noted that achieving an optimal reinforcement condition in the field Natural Fiber Composites (NFCs) to obtain desired properties is challenging, thus, they employed the decision making model to determine the most appropriate reinforcement condition of the date palm/eproxy composite to achieve the best recommended tensile properties. Eleven potential reinforcement conditions were evaluated regarding Maximum Tensile Strength (MTS),Maximum Shear Stress (MSS) and Elongation to Break (EL) criteria simultaneously for date palm, of which MSS was found

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to contribute the most to the in the evaluation process, with a weight of 39.0%, followed by MTS and EL with weights of 31.0% and 29.0% respectively. The authors concluded that, in addition to providing a road map for implementing proper decision making models in the field of natural fiber composites to optimize their desired characteristics, the study also noted that, selecting an appropriate reinforcement condition can dramatically enhance achieving better low-cost sustainable design possibilities.

A review by Al-Oqla, et al. [4], identified Polymers show tendency of surface resistivity to conduct electricity, however, the surface resistivity of thermoplastic polymers shows poor conductivity, hence its wide use as insulating wire coatings for several applications [5,6]. The poor conductivity according to (3-8) could results to startling shock or electrical spark resulting from building-up and retaining static electrical charges. As such attention has shifted to development and applications of electrically conductive polymeric composites particularly; the natural fiber reinforced conductive polymer composites for use different aspects of industrial applications as it demonstrates properties of effectiveness and high level of desirable mechanical strength that enables it to be excellent mechanical support for field carrying conductors.

A wide range of natural fibres has been used to reinforce different polymer matrices. Such fibres include wood, bamboo, cotton, coir, rice straw, wheat straw, rice husk, flax, hemp, bagasse, pineapple leaf, oil palm, date palm, curaua, ramie, jowar, kenaf, doum fruit, rapeseed waste, sisal, jute etc as showed in the work of Jawaid and Abdul [7] (Figure 1).

Growing environmental, social and economic awareness as well as governmental emphasis regarding environmental impact issues and sustainability concepts, [8] resulted in the growing encouragement of utilizing natural resources [9]. As a result of these growing concern and encouragement, natural fiber reinforced polymer composites (NFC), has presented a valuable alternative material for wide range of applications including; packaging, disposable accessories, furniture, building, insulation, and automotive industries applications [10]. NFC, includes: jute, hemp, sisal, oil palm, kenaf, and flax are utilized to be fillers or reinforcing material for polymer-based matrices. Kalia et al. [8] concluded that, utilization of the natural fibres lead to reduce the amount of waste disposal problems, thus, reducing in environmental pollution [8]. Furthermore, these materials can be substituted for the traditional glass/carbon polymer composites [8], given their several advantages in terms of low costs and density, acceptable specific strength and modulus low weight products, availability, CO_2 sequestration enhanced energy recovery, reduced tool wear in machining, and reduced dermal and respiratory irritation over the traditional glass/carbon polymer composites [10,11]. Thus, AL-Oqla [11] concluded that, widening the application of such materials can contribute to the human living standards as well as the green environmental indices

The usage of industrial application of natural Fibers for composite materials relies on economic and environmental characteristics in addition to technical ones, besides preferred physical and meta-physical properties [12].

The kenaf (*Hibiscus canavinus*) plant is eco-friendly, renewable, low in cost and not meant as a food source. However, in Malaysia, interest

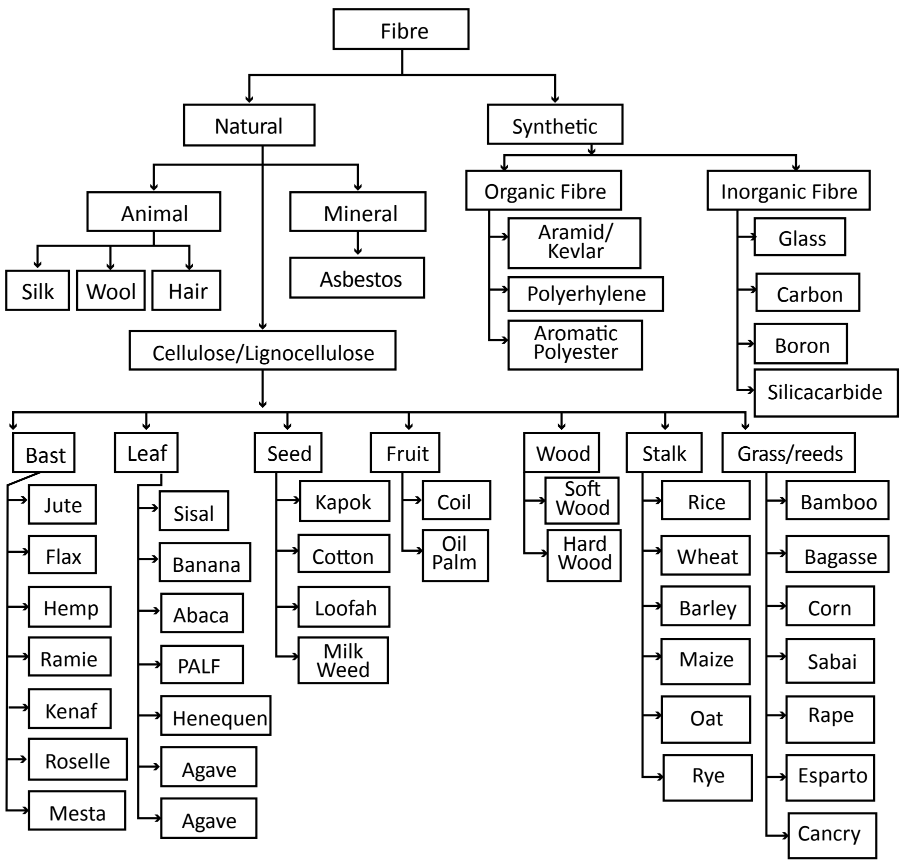

Figure 1: Classification of natural fibers.

and involvement in kenaf have significantly increased as indicated by the substantial increase of allowance for kenaf development programs under the 9th Malaysia Plan. This proves that kenaf has high-quality potential to be an industrial crop to be explored in Malaysia [13].

In Malaysia, kenaf was first used as a potential alternate fibrous material for the production of panel products such as fiberboard and particle board under the 7th Malaysian Plan (1996-2000) [7]. Owing to its commercial potential in Malaysia, the government has allocated RM 12 million to start research and for subsidies under the 9th Malaysian strategic plan [14]. In addition, kenaf is a relatively new crop in Malaysia and local knowledge and experience is inadequate but there is encouragement to create significant commercial processing and manufacturing capacities. There is a demand for non-wood renewable fiber for use in the industrial, construction, paper and automotive parts industries. Demand for Malaysian kenaf stem has increased substantially from both local and foreign companies, among them Panasonic Electric work kenaf Malaysia Sdn Bhd [15].

Investigations are ongoing to determine the immediate future of the kenaf fiber market and the kenaf fiber production industry which can stimulate discussion about other third world countries and the kenaf fiber market. The reason for such focus on kenaf in Malaysia is due to the country's favorable position to develop an industry which will have a positive impact on the environment worldwide and contribute to local development [16]. In Malaysia, for example, the kenaf industry is a significant contributor to the GDP (Gross Domestic Product) of the country. So, in order to increase the economic growth or per capita GDP of Malaysia, farmers, have to increase the output of kenaf plant cultivation. As reported by the Department Of Statistics Malaysia DMOS [17], the agricultural indicators contributed to Malaysia GDP in 2014 by 9.2% and the kenaf as one of agriculture indicators, the production weight of dry stem is increased in the year 2013 to 2014 from 7.1 (000 ton) to 7.6 (000 ton) which positively share in the country GDP.

In fact, recently the Malaysian government introduced and encouraged the use of bio-fuels to replace the use of petrol. This is because petrol price has been fluctuating dramatically and it has also been predicted that sources of petroleum will be depleted in the foreseeable future.

In line with the Malaysian government's encouragement of kenaf cultivation it is vital for us to identify the main determinants to boost the output of kenaf cultivation, especially on loamy and alluvial soil. The study which did by [18] concluded that when the kenaf cultivated for its fibre the plant population should vary from 200,000 to 500,000 plants/ha and the spacing between trees from 35 to 50 cm. In locations that the rainfall is inadequate, the irrigation is required in order for the kenaf to reach high biomass yields. It is a crop with sensitivity to nematodes, especially when it is cultivated in areas with sandy soil and this sensitivity should be taken into consideration in the rotation systems that will be applied. Harvesting time and methods should be adjusted according to the use of the crop (fibre, seeds, fibre and seeds, forage, etc.). To produce a variety with higher yields and improved resistance to drought as well as to nematodes and anthracnose is account as the main encounters for the future of the kenaf development [18]. Nevertheless, there are also problems in cultivation of kenaf on loamy soil, for the kenaf plant cultivation requires more input compared to other crops. However, in terms of the environment, the plantation of kenaf may potentially create a positive benefit for climate warming compared to other types of plants [16]. Additionally, Kenaf has high biomass output, a broad growth area, strong adaptability to environment, it has a very high carbon dioxide amalgamation rate and more than any other crop (1 ton kenaf biomass absorbs 1.5 tonnes of atmospheric CO_2), and is a noble plant to be grown for alleviating the global warming [19].

In contrast an investigation by [20] showed that, kenaf cultivation is not feasible in competition with other crops and its production can be a very risky endeavor.

There are benefits and costs from the cultivating, processing and industrializing of kenaf plant especially in terms of technical and financial feasibility which this study attempts to find out. Hereafter, it is necessary to estimate the direct benefits and costs for farmers in Kelantan. The aim of this research is to assess the technical and financial feasibility and farmer's profitability with regard to kenaf production.

Methodology

Financial valuation techniques and cost-benefit analysis

The main purpose of economic analysis and benefit cost analysis is to provide technical, marketing, financial and economic information to assist in decision making for a project under examination, in weighing the existing constraints and preferences [21]. Hence, the purpose of cost analysis is not only to estimate total cost per unit of product, but also to categorize cost reduction opportunities and support profit maximization strategies. In addition, product selling prices are in most cases determined by the market where the product is sold and bought at the level of existing competition, but they should at the same time persuade the investor to continue in the project by covering the cost [22].

In the kenaf production industry in Malaysia, many efforts are being initiated to achieve better quality and environmental conservation by maintaining and implementing cleaner technology. Consequently, assessing the cost and benefit of this industrial plant is urgently needed to ensure the continuing producing of kenaf fiber, and this investigation will apply a cost and benefit analysis to evaluate the net benefits of kenaf following the method in Table 1, [22,23].In this table the profit and loss calculated using all the inputs and outputs used by the farmers to produce kenaf fiber, the sales revenue of kenaf with the subsidies which provided from LKTN subtracted by the costs such as seeds, fertilizers pesticides and mechanized, land rent and labour used to plant kenaf.

Data collection

The field survey conducted by the researchers of LRGS (Kenaf Long Research Grant Scheme) in Kota Baharu, Kelantan state and Kampong Mercong, Pahang State. The researchers observed that, a few of the farmers or small holders had chosen to cultivate kenaf rather than other crops possibly because planting the other crops didn't entitle them to subsidies and other incentives from the government as in the case of planting kenaf [24].

Field survey

The objectives of the field survey in this study was to help the researcher to obtain comprehensive knowledge about the study area, updating the secondary data and collecting new data related to the research problem [25]. The field survey was carried out during the period of 2014. The data were collected through the qualitative focus group discussions (FGD) with the kenaf farmers and LKTN directorial staff as well as the leader of the kenaf farmers for briefing and explanation of the input used to produce kenaf as well as the machinery and labors costs [26] and some of data such as subsidies received through an email

Variable Expenses	**Sales revenue (kenaf stalk wt./ton x price)**	**=Net Sales+Subsidies from LKTN**
	Minus	
	Cost of Material:	Seeds. Fertilizer, pesticide, water, etc.
	Minus	
	Cost of Temporary .Labor	=Gross profit or gross margin (Return above variables Expenses)
	Minus	
Fixed expenses	Cost of permanent labor	Salaries if found
	Minus	
	Land rent etc.	=Net profit before interest and tax
	Minus	
	Interest on Capital Employed or invested	=Net profit before tax
Financial Expenses	Minus	
Conversion elements related to kenaf fiber financial analysis		
1 RM=0.25USD I Ha=2.47 acre 1 gallon=3.97 liters 1 working day=8 hours Kenaf price/ton=500 RM		

Table 1: Financial layout of kenaf cultivation profit and loss (Soldatos, 2013) and (Monti and Alexopoulou, 2013).

from LKTN inspector. The data of kenaf cultivated area and number of farmers in Kelantan state 2014 were obtained from the LKTN (National Company for Kenaf and Tobacco) website shown in Table 2.

Cost and benefit analysis

This paper will apply the cost and benefit analysis and estimate the profitability of kenaf production in Kelantan to measure the following components.

The total initial cost which invested in kenaf production for all farmers is RM 8052000; this amount includes the cost of Machines and working capital.

The profitability of kenaf production to the farmers. This is calculated by using a time frame of 10 years, which will be suitable and equivalent to one commercial cycle for kenaf plant.The formula used for Cost benefit analysis CBA is as follows:

$$1\text{-}\ NPV = \sum_{k=0}^{N} R_k(P/F, i'\%, k) - \sum_{k=0}^{N} E_k(P/F, i'\%, k)$$

Where R_k is the revenues for k years, E_k is expenses for k years, $i\%$ is the discount rate and P/F is the discount factor used.

If the NPV is positive, then one should proceed with it; if it is negative, one should note as this indicates that the business management is inefficient.

In order to review the overall performance of a business, Net Present Value (NPV) is computed in this study. The annual income and returns are estimated for 10 years and then discounted to present values. The total discounted income and costs then show the business earns more benefits or costs. If NPV is positive, the business will potentially create a net return (profit) to the investor. On top of that, the NPV's magnitude indicates the expected profit of the business. In addition the calculation of Internal Rate of Return relies on the equation of NPV [27].

Benefit-cost ratio (BCR)

Benefit-Cost Ratio (BCR) is to estimate the benefit received per unit cost of the kenaf production project. It is thus an indicator of the efficiency of project investment. If BCR value is greater than 1, the business is justified taking into account economic grounds and the higher the BCR value, the higher the effectiveness of this business [28,29].

Kelantan	Number of farmers	planted area in hectare
Bachok	113	180
Pasir Mass	157	240
Pasir Puteh	96	160
Total	366	580

Table 2: Kenaf plantation Areas and number of farmers in Kelantan 2014.

Assumption for CBA is as follows

1. Price and total production are constant, the kenaf price determined by LKTN, the Malaysian company which gave the subsidies to the farmers in a way of fertilizers, pesticides and seeds to encourage them to cultivate kenaf in order to develop and process it for industrial products in Malaysia.
2. Farmers earn constant total revenue and total cost for the ten years, the period of the projection.
3. Average of 10 years real discount rate is used in calculating the discount value.

Initially, the cost and benefit analysis of plantation parts calculated with each type of grower.

The CBA scenarios: The Cost Benefit Analysis will include 'inflows' (revenue) and 'outflows' (costs) [30]. Nevertheless, at the commencement of a project some investment costs have to be included such as working capital. All the inputs and processes used to produce kenaf fibers) as well as adding the subsidies provided by LKTN for kenaf cultivation. In addition, the input data provided such as labor, fertilizer, herbicide, pesticides and machinery, parameters and their ranges for sensitivity analysis are based on the tone of dry stalk per hectare per year; which is relevant to the present study. The production of kenaf in ranged from five to 25 ton/ha as informed by the farmer's leader, so the three scenarios of kenaf production per hectare were assumed to be the average kenaf production to evaluate the financial assessment as follows:

(C=10: the worst scenario, B=12: the medium scenario, and A: the high scenario=15 ton/ha).

These scenarios were chosen based on the following reasons; 1) in the study, kenaf was planted after the paddy (rice) harvest, so the remaining fertilizer added by the farmers would enhance the production of kenaf.; 2) the weight of kenaf stem depends on the moisture content and other climatic factors, and therefore any increase in the stem weight will contribute to increase in the overall production. 3) Kenaf production per hectare in the study area ranged from five to 25 ton/ha, so the assumed scenarios depended on the average weight of kenaf per ha.

Discount rate: The discount rate is relevant in measuring financial performance that gives values to biodiversity and ecosystems. Moreover, Industrial capital is a production of inputs which use land and labor, This investigation adopted average interest rates of saving rates for the past 24 years as the benchmark of investment, and used 5% of interest rate to undertake the financial analysis [28].

A sensitivity analysis for kenaf production: A sensitivity analysis has be considered to determine how robust the financial analysis results under changed condition such as:

1. Increasing the discount rate from 5% to 8%
2. Reducing kenaf stem price by 10%.

Technical models for kenaf production

Since the objective is to estimate or measure the production or output of kenaf cultivation of the targeted number of farmers the method which was used by Noormahayu [31] was adopted in this study and the equation that has been formulated as follows which is in its stochastic form [32].

2- $Q = a\, CI^{\alpha} L^{\beta 1}$

1-$\text{LnQ} = \ln a + \alpha \ln CI + \beta \ln L + \mu^{2}$

Where:

Q = Output

CI = chemical input and

L = Labor

The output 'Q' shows the total earnings from kenaf cultivation of farmers and fiber processed for a year which is computed based on the size of the kenaf crop area (1hectare), quantity of kenaf fiber received annually and kenaf raw material/tones. The chemical input 'CI' describes the total fertilizer, insecticide, and weedicide inputs in a year to cultivate one hectare. The labor 'L' illustrates the annual labor to cultivate one hectare.

The definition of the equation is as follows:

1. α and β are the (partial) elasticity of output with respect to the chemical input, and labor input.
2. The sum ($\alpha + \beta$) provides information regarding the returns to scale, that is, the response of output to equivalent change in the inputs.
3. μ is an error term or stochastic disturbance term or residual which cannot be explained by all explanatory variables and explained variable.

Data analysis

The data which were collected from Kelantan farmers as well as LKTN staff were analyzed using Excel MS software and the results were tabulated and discussed. The technical data (Input-Output) were analyzed using Eview8 software and then tabulated according to OLS.

Results and Discussion

The results of the profitability analysis of kenaf production presented in Tables 3-5, illustrate the scenario of kenaf production per hectare (15, 12 and 10 tons) respectively; the investigation revealed that when kenaf produced 15 tons per hectare as mentioned in this study and the assumption of the analysis, the farmer enjoyed a profit margin of 16% even without the subsidies provided by LKTN, but when the farmer received the subsidies from the LKTN, the margin profit maximized to 37%, which is more than double the profit margin received without subsidies. However, when production was 12 tons/ha as indicated in Table 6, the farmer enjoyed a profit margin of 21% after adding the subsidies provided by LKTN. There was no profit without the subsidy. Additionally, the production of 10 tons/ha as indicated in Table 5 showed the worst scenario, with the farmer receiving a marginal profit estimated at five percent after including the subsidy.

Description	2014-2023
Revenue	4350000
Direct Production cost	3233500
Farm supervision	329400
Subtotal	3562900
Others	71258
Total cost	3634158
Farmers' profit before subsidies	715842
Subsidy Farmers' profit after subsidies	1588752
Profit per farmer	4341
Subsidy	16%
Profit Margin with Subsidy	37%

Table 3: Profitability Analysis of Kenaf Production – Scenario A.

Description	2014-2023
Revenue	3480000
Direct Production cost	3233500
Farm supervision	329400
Subtotal	3562900
Others	71258
Total cost	3634158
Farmers' profit before subsidies	(154158.00)
Subsidies	872910
Farmers' profit after subsidies	718752
Profit per farmer	1964
Profit Margin Without Sub	-4%
Profit Margin with Subsidy	21%

Table 4: Profitability Analysis of Kenaf Production Scenario B.

Description	2014-2023
Revenue	2900000
Direct Production cost	3233500
Farm supervision	329400
Subtotal	3562900
Others	71258
Total cost	3634158
Farmers' profit before subsidies	(734158.00)
Subsidy	872910
Farmers' profit after subsidies	138752
Profit per farmer	379
Profit Margin Without Sub	-25%
Profit Margin Subsidy	5%

Table 5: Profitability Analysis of Kenaf Production Scenario C.

From this investigation we can conclude that kenaf will be more profitable to the farmer if the production per hectare is 15 tons or more. The study revealed that the main reason for kenaf to be profitable is the production level as well as the subsidies from LKTN. As mentioned by the farmers' leader, the price of kenaf stem is determined by LKTN and there appears to be a lack of understanding among the farmers as to how the price of kenaf is determined. Consequently, some farmers think of increasing the production per hectare, by increasing the density of kenaf plants per hectare to as many as 666000 plants in the belief that would increase high weight yield per hectare. However, such an approach instead produced very weak kenaf stem diameter due to the high planting density that negatively affected the production of the commercial parts (core and fibre). According to findings of [22] kenaf production faces several challenges due to marginal profitability for European farmers who are reluctant to cultivate kenaf. This negatively affects the industrial chain which leads them to think of either increasing the yield per ha or reducing the cost through the agro-industrial chain.

The summary of Profitability and Benefit Cost Analysis of the three scenarios is provided in Table 6, where the analysis of the projection illustrates that all the scenarios are viable when the BCR as taken as a financial indicator which equals more than 1. But when the kenaf stem production is 15 tons per hectare the NPV is very high and the payback period is five years, which is half of the budgeted time run in these models, which approved the choice of 15 tons per hectare production assumed in these attempts. The production of 12 tons per hectare showed reasonable performance but the payback period is more than 10 years, which is why it was not considered as compatible in this analysis. However, the scenario c is the worst scenario to be selected as an alternative in this attempt. Thus the analysis concluded that kenaf production of 15 ton/ha assumed in this analysis is one of the most viable production outcomes that famers can aim for to be profitable. The work which conducted by [33] illustrated that, the net return of cultivation kenaf was higher and maximized the profit of the farmers when grow the local cultivar instead of improved varieties under the farmers' practice.

Sensitivity analysis

Raising the discount rate from 5% to 8% and reducing the prices of kenaf stem by 10% from RM 500 to RM 450 per tonne and providing subsidy by the LKTN of RM 2385 don't negatively affect the feasibility of planting and manually harvesting kenaf for all farmers of Kelantan state, the work which conducted by Othman and Norfaryanti [34] to evaluate Kenaf production in alluvial and bris soil illustrate that the changes didn't have adversely affect the feasibility and profitability of kenaf cultivation (Table 7).

Ordinary Least square (OLS) analysis

The ordinary least square analysis of kenaf input (chemicals and labour) has been examined to investigate how much they affect the productivity of kenaf stem in Kelantan state using the model adopted by Noormahayu [31].

Description	Case Scenario A	Case Scenario B	Case Scenario C
Production/ha	15	12	10
Profit Per Farmer	4,341	1,964	379
Profit Margin without Subsidy	16%	-4%	-25%
Profit Margin with Subsidy	37%	21%	5%
IRR	20%	7%	-3%
NPV	9,114,823	3,263,469	(1,970,768)
Pay Back Period	5 years	11.2 years	58 years
BCR	1.58	1.26	1.05

Table 6: Summary of Profitability and BCA for the three Scenarios of Kenaf Project for Kelantan Farmers.

Description	Case A 15 ton/Ha	Case B 12ton/Ha	Case C 10 ton/Ha
Present value of benefit	11443356	9154392	7628904
Present value of cost	5405820	5405820	5405820
Discount rate	8%	8%	8%
IRR	111.54%	68.91	39.61
NPV	6037536	3748572	2223084
BCR	2.11	1.7	1.4

Table 7: Sensitivity analysis on planting and manual harvesting of kenaf stem.

Dependent Variable: LKENAF Method: Least Squares				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LCHEM	0.443193	0.060788	7.290732	0.0000
LLABOUR	0.493927	0.059213	8.341550	0.0000
C	5.808288	0.079149	73.38409	0.0000
R-squared	0.907	Mean dependent var		2.383888
Adjusted R-squared	0.907	S.D. dependent var		0.580153
S.E. of regression	0.0928	Akaike info criterion		-1.862756
Sum squared resid	0.439	Schwarz criterion		-1.752257
Log likelihood	1010.171	Hannan-Quinn criter.		-1.820141
F-statistic	53.29	Durbin-Watson stat		2.217498
Prob(F-statistic)	0.000000			

Table 8: Ordinary Least Square analysis of kenaf production dependent variables.

Cobb-Douglas production function

The Cobb-Douglas function is one of the most widely used forms of production function in economics [35]. The Cobb-Douglas function has also been applied to many other issues besides production [36]. The function which is summarises the relationship between production inputs and out in a mathematical economic model has been extensively used to analyse the driving force behind financial analysis [31]. Examine the applicability of the use of the cobb-Douglas production function in estimating the benefit of oil palm cultivation, the concluded that, the main factors influencing the production as input were the chemicals and labours.

The results shown in Table 7 indicate the estimation of the input-output (production) model using the OLS method. In this analysis the Ordinary Least Square (OLS) results indicate that, all the coefficients of the independent variables where the chemical input (LCI) is 0.443, the labor (LCI) is 0.493, and the constant is 5.808. All these coefficients are in positive values. The values of t-statistics of both independent variables are greater than 2 and it is painstaking as reasonable values in this analysis and also as good values.

From the above result, we can include the coefficient obtained, so the equation becomes:

$$Q = 5.808 + 0.443CI^{***} + 0.493L^{***}$$

To be noted that *** in the equation indicates significant level at 1%.

From the above we can see that the results illustrate the chemical Input and labor statistically and significantly determine the output or both exogenous variables (CI and L) can affect or have relationships with endogenous variable kenaf production (Q). Additionally, the result portrays that one percent increase in chemical input will lead to change of 0.44% in kenaf production and with the labor (L) unchanged, whereas one percent boost in labor will lead to change of 0.49% in kenaf production only and countenance the chemical input (CI) as constant. Both independent variables have positive relationship with kenaf production. In sum, the change in chemical and labor input can affect the output (kenaf production) by greatest percentage or have a good performance to enhance kenaf biomass production.

Meanwhile the result of regression (Table 8) showed the F-statistics value (53.29) and prob-value (0.00), thereby we can reject the null hypothesis which describes that the usage of the inputs didn't enhance kenaf cultivation and accept the alternative hypothesis due to the significant relationship between the independent variables (CI and L) and dependent variable (Q). From the result it can be concluded that this model is valid.

Moreover, in order to measure the regression's goodness of fit (how well the independent variables describe the dependent variables), we look at the R^2 value for the analysis which is depicted in Table 8. As shown in Table 7, the R^2 is 0.907, which means that the 90.7 of exogenous variables (chemical input and labor) determined the endogenous variable (kenaf stem). In general, the R^2 of this study is not close to 1 due to use of the collected data and many other factors which affect the output (kenaf stem) which were not considered or included in this investigation.

To check if the model used in this investigation follows the Cobb-Douglass production function rules or not, we have to sum up the coefficients for each independent variable. Since the coefficient for chemical input is 0.443, while labor's coefficient is 0.493, thus, when we sum up both coefficients, it gives us a value of 0.936, which is less than 1. It means that there are decreasing returns to scale experienced by the average farmer in Kelantan state, whereby replicating twice the use of chemical inputs and labors will lead to less than twice the output of kenaf stem. The investigation conduct by Noormahayu [31] concluded that, the usage of labor and chemicals as input was enhanced the production of the output.

Conclusions

Finally, the investigation of the three scenarios revealed that, kenaf production analysis is financially viable and maximizes the profit of the farmer in Kelantan state when the production is 12 and 15 tons per hectare and this will encourage the farmers to increase their kenaf production per hectare by following good agricultural land management practices. Also, the result of the effect of inputs such as chemicals and labors in kenaf production showed significant effect; this recommended that, there are other inputs such as seeds, soils and diseases and other climatic factors which affect kenaf production and need to be studied. Moreover, when the farmers own the tractor for mechanized operations for planting kenaf the three scenarios of kenaf production are profitable when BCR used as indicator, while the sensitivity analysis when LKTN continue in subsidizing the farmers to plant kenaf in term of chemical, fertilizers and seeds this will encourage the farmers to continue cultivation kenaf due to the maximization of the profit if kenaf production per tonne achieved the best production scenarios. In addition, the results of this work can help the planner, decision makers, industrializer as well as farmers to invest in kenaf cultivation for producing fibre.

The results of survey and investigations illustrated that there are some challenges encountered kenaf planting and farmers in Kampong Mercong as tackled by farmers leader in need to overcome, they were:

1. The low yield of kenaf seeds, the V36 variety continuously being sowing to produce kenaf plant, this will decrease the seed viability which has an adversely effect in seeds germination and kenaf productivity.
2. The high cost of inputs such as labour hiring compare to subsidies gave by LKTN and kenaf production per hectare which determines the return of the farmers in need to be considered.
3. The determined price of kenaf stem by LKTN will affect negatively the income of the farmer if the productivity of kenaf per hectare is low.
4. The cultivation of kenaf one time a year isn't much profitable, however, the awareness of the farmers by the importance of the kenaf cultivation is very crucial due to the environmental and economic benefits.
5. For increasing the productivity, the farmer in need to gain much experience and continue training as well as awareness to enhance the kenaf production to be used as industrial products in Malaysia.

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