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# Cost Benefit Analysis of Kenaf Cultivation for Producing Fiber in Malaysia

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## Abstract

The main objective of this work to assess the cost benefit of kenaf cultivation in Malaysia. The data were collected through the focus group discussion with kenaf farmers as well as from National Company of Kenaf and Tobacco board (NKTB) administrative staff, the production data collected from Kenaf Processing and Marketing Centre Bachok-Kelantan. The cost benefit analysis model was developed using Microsoft Excel software. Three scenarios of kenaf production per hectare were considered which were 15, 12 and 10 ton. According to the data analysis; the investigation of the three scenarios revealed that when the farmers in Kelantan state cultivated kenaf for producing fiber the production of 15 tons per hectare was found to be viable and maximizes their profit. The results suggest that farmers need to increase the productivity and alternate the current cultivated variety V36 with the tested varieties in Malaysian soils.

**Keywords:** Kenaf cultivation; Kenaf variety; Cost benefit analysis

## Introduction

Kenaf is fibrous crop adapted to a temperate and tropical environment, not harmful to the environment, biodegradable and inexpensive. It entails two sorts of outer and interior fiber; they were bast and core, their characteristics are comparable to tree wood. The bast, core fiber, and leaves have numerous uses, encompassed manufacturing of paper products, building materials, absorbents, automobile parts, textiles, and livestock feed [1]. Also, the manufacturing of kenaf products has been evaluated for textiles and identified as additional prospective uses. Therefore kenaf may be an alternative to other crops to be cultivated. However, incentives should be given to farmers to substitute corn and cotton with kenaf as there is a very slow adaptation by farmers due to the lack of enterprise financial plan to grow kenaf [2].

### Factors influencing kenaf cultivation and fiber production

There are several factors affecting kenaf components yields; they were kenaf cultivars, sowing date, photosynthesis, and length of the growing season, plant population, and crop maturity. Hence, when investigating about kenaf yields and plant composition, it is necessary to realize the production factors that affect the cultivation of these plant components and their composition as well as the moisture content of kenaf stalks [3]. Also, Webber et al. [4] clarified that the length of the period of kenaf planting season, the average day, as well as night temperatures and suit soil moisture content, are the primary key factors affecting kenaf fiber yields. Additionally, kenaf stalk yields normally range from 11 to 18 ton/hectare and this depends on previously identified production factors. The main factors that can influence kenaf cultivation and fiber yield are summarized in Table 1 [3-6].

### Kenaf cultivation and fiber production

Tahery et al. [7] compared the kenaf varieties such as Guatemala 4 (G4), Kohn-kaen 60 (KK60) and V36; the parameters of gas exchange characteristics were measured. They found that KK60 was the most desirable choice of kenaf variety to be cultivated for fiber production. Moreover, to achieve a high yield of productivity the important factors that affected crop production such as environmental factors need to be addressed.

The demand for kenaf locally and internationally has rapidly increased. Cultivation of it in Malaysia faced many challenges when grown in sandy soil. The investigation which was conducted by Basri et al. [8] gave a solution of adding chicken manure to the soil which will provide the best production instead of fertilizer which has environmental and health consequences. Malaysia is located in a temperate climate, for that, much fertilizers need to be added for the cultivation of kenaf. The results of the mixture of biochar and organic and inorganic fertilizers which is attained by Basri et al. [9] provided an efficient method for the cultivation of kenaf in a tropical climate with less impact on the environment. Carlsson-Kanyama and González [10] in their research on non-$CO_2$ gas emission associated with food production, they clarify that the poultry meat production shows very low emissions. However, Sampanpanish studied the effect of organic fertilizer use in the rice to reduce greenhouse. They stated that the usage of manure fertilizer has the lowest emission of greenhouse gasses, this will indicate that the production of kenaf fiber used the organic fertilizer will enhance the productivity as well as mitigate the environmental effects.

## Methodology

### Cost benefit analysis of kenaf cultivation

This section clarifies the financial and profitability analysis of kenaf cultivation for producing fiber in Malaysia. And there are many reasons of why we selected the Kelantan state. A review by Roslan et al. [11] noted that, Malaysian government has the plan to replace kenaf with tobacco and Kelantan state is one of the strategic state that was considered in this investigation due to its economic importance. Also as reported in the New Strait Times [12] as listed below highlighted the strategic importance of Kelantan state in the present study:

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| The factors | The advantages |
|---|---|
| Cultivars | Early and medium maturing cultivars, classified as short-day plants grown if the purpose for producing fibre, the growing cultivars suitable to soils type and environmental factors will gave fibre yield ranges from 11ton/hectare to 21 ton/hectare |
| Plant Maturity | Plants were harvested at either 90, 120, or 150 days after planting |
| Plant Populations | The recommended plant populations of 185,000 to 370,000 plants/ha are desirable for increasing stalk yields and the production of single stalk kenaf plants, the plant populations needs about 8 kg/ha of seed (100% germination). |
| Soil Fertility | The application of nitrogen rates (0, 56, 112, 168, and 224 kg N/ha) on a fine sandy loam soil, it was determined that stalk yield tended to increase as nitrogen rates increased up to 168 kg N/ha |
| moisture content | Will increase the weight and the accepted by the factory is 0% |
| average day and night | The cultivars in needs to germinate, growth and well established when the day length approximately 12.5 hours. |
| The length of kenaf planting season | the delaying of kenaf harvesting in the grown season has a significant effect on stalk yields, the stalk yields ranged from 3.8 t/ha for 60 day to 19.3 t/ha for 150 days |

**Table 1:** The major factors influencing kenaf cultivation and fibre yield.

1. Kelantan people are known as most successful business communities in the country;

2. It has one of the poorest districts in the state as most of the people are involved in the agricultural and fishing sectors;

3. Tobacco farming was the first introduced in Kelantan in the 1960s by the Malayan Tobacco Company and although lowered upon by the conservative and religious tradition;

4. The introduction of the Asean Free Trade Agreement (AFTA, 2010), reduced tobacco farming, among which, Kelantan was the most affected;

5. Also increased kenaf cultivation in Kelantan has resulted in the reduction in the cultivated areas of tobacco.

Moreover, Kelantan state is the first state that the researcher had an interactive session with farmers that cultivated kenaf to produce fiber as well as the state where kenaf processing factory is located.

The main aim of conducting a financial analysis and benefit-cost analysis helps in providing; marketing, financial and economic information that can assist decision-makers for project consideration as well as provide insight to current constraints and preferences [13]. Therefore, cost analysis does not only estimate total cost per unit of output, but also helps to identify cost reduction opportunities and profit maximization strategies. Furthermore, the market where a product is transacted upon determines its selling price, however, it should be able to cover the cost of the project so as to encourage more investment [14].

The costs and returns of the kenaf crop cultivation by farmers were assessed by enterprise budgeting methods applied for each data that was collected from the farmers. The values estimated in this investigation were revenue, costs and returns [15] as follows:

1. **Revenue:** Gross income (GI), is known as the value of the total output produced by the planted land. GI was calculated by multiplying average yield by average price at the farm level. GI contains the only kenaf fiber produced during the year, which was sold by the farmers as the stem to LKTN.

2. **Operating cost:** It is defined as the total input cost including: traction contract cost, hired labor cost, seeds, fertilizer, insecticides, fungicides, and herbicides cost. The traction value consists of the opportunity cost or the hire cost for using machinery for land ploughing.

3. **Total enterprise cost (TEC):** It is the value of all inputs used in kenaf stem production. It is the sum of the operating cost, the opportunity cost of equity capital and the opportunity cost of family or hired labor. TEC is divided into the total variable cost and total fixed cost. However, in this analysis, total fixed costs are excluded. This study focused on evaluating farm profitability on a short-term basis (in the 2014 kenaf crop season). Since fixed costs is ignored in the short term, net returns were defined as gross income per unit of activity and expressed in Malaysian Ringgit per hectare equivalent to USD.

4. **Returns**: Enterprise gross margin (EGM) is defined as the difference between Gross income (GI) and operating cost. In the kenaf production industry in Malaysia, many efforts are being initiated to achieve better quality and environmental conservation by maintaining and implementing the cleaner technology. Consequently, assessing the cost and benefit of this industrial plant is urgently needed to ensure the continuing producing of kenaf fiber. This investigation will apply financial cost and benefit analysis to evaluate the net benefits of kenaf cultivation and its fiber production following the method adopted from Soldatos [14], Monti and Alexopoulou [2]. In their evaluations the profit and loss is calculated using all the inputs and outputs utilized by the farmers to produce kenaf fiber, the sales revenue of kenaf with the subsidies which is provided by LKTN is subtracted from the costs such as seeds, fertilizers pesticides and mechanized, land rent and labor used to plant kenaf. Kenaf price is RM 500 as predetermined by LKTN, the projection period is 10 years. Moreover as reviewed by Webber III et al., Webber III et al., Dempsey, and Cook et al. [3-6] kenaf production per hectare is 13-18 ton per hectare, in this attempt the production scenario is (10,12 and15) ton/hectare as showed in Table 2.

## Results and Discussion

The results of cost benefit analysis of kenaf cultivation for producing fiber obtained in Tables 3a-3c illustrate the scenario of kenaf production per hectare (15, 12 and 10 tons), respectively. The analysis showed that when kenaf is produced 15 tons per hectare as mentioned in this study and the assumption of the analysis, the farmer received a reasonable profit margin even without the subsidies and the IRR is very high and the payback period is half of the projection period. From this investigation, we can conclude that kenaf fiber will be more profitable to the farmer if the production per hectare is 15 tons or more. However, such an approach instead produced feeble kenaf stem diameter due to the high planting density that negatively affected the production of the commercial parts (core and fiber). According to findings of Soldatos [14], kenaf production faces several challenges due to marginal profitability for European farmers who are reluctant to cultivate kenaf; this will negatively affect the industrial chain which leads them to think of either increasing the yield per ha or reducing the cost through the agro-industrial chain. Also, the production of 12 tons per hectare showed reasonable performance, which can be considered as well-suited as well in this analysis. Thus the study concluded that kenaf production of 15 ton/ha assumed in this analysis is one of the most

| | RM | | WC | MC | Ideal C |
|---|---|---|---|---|---|
| **Sales** | 500 | | 10 | 12 | 15 |
| Production Budget | | | | | |
| **Kelantan** | **Number of farmers** | **Planted Area in Hectare** | **WC Production** | **Moderate Case Production** | **Ideal Production** |
| Pachok | 113 | 180 | 1800 | 2160 | 2700 |
| Pasir mass | 157 | 240 | 2400 | 2880 | 3600 |
| Pasir poteh | 96 | 160 | 1600 | 1920 | 2400 |
| Total | 366 | 580 | 5800 | 6960 | 8700 |
| Subsidy | | 2385 | | | |

**Table 2:** Kenaf budgeting.

| Description | Year 0 | 2014-2023 | Salvage |
|---|---|---|---|
| Cash Inflows | 8052000 | 4350000 | 4392000 |
| Cash out Flows | | 2761248 | |
| **Net Cash Flows** | **-8052000** | **1588752** | **9158256** |
| Present Value of Cash inflows | | $4,142,857 | $8,722,149 |
| Present Value of Cash outflows | | $2,629,760 | |
| BCR | | 1.58 | |
| **IRR** | **20%** | | |
| **NPV** | **$9,114,823** | | |
| **Pay Back Period** | **5 years** | | |
| **BCR** | **1.58** | | |

**Table 3a:** Cost benefit analysis of kenaf cultivation scenario of production 15 ton/ha.

| Description | Year 0 | 2014 | Salvage |
|---|---|---|---|
| Cash Inflows | 8052000 | 3480000 | 4392000 |
| Cash out Flows | | 2761248 | |
| **Net Cash Flows** | **-8052000** | **718752** | **6548256** |
| Present Value of Cash inflows | | $3,314,286 | $6,236,434 |
| Present Value of Cash outflows | | $2,629,760 | |
| BCR | | 1.26 | |
| **IRR** | **7%** | | |
| **NPV** | **$1,263,469** | | |
| **Pay Back Period** | **11.2 years** | | |
| **BCR** | **1.26** | | |

**Table 3b:** Cost benefit analysis of kenaf cultivation scenario of production 12 ton/ha.

| Description | Year 0 | 2014-2023 | Salvage |
|---|---|---|---|
| Cash Inflows | 8052000 | 2900000 | 4392000 |
| Cash out Flows | | 2761248 | |
| **Net Cash Flows** | **-8052000** | **138752** | **4808256** |
| Present Value of Cash inflows | | $2,761,905 | $4,579,291 |
| Present Value of Cash outflows | | $2,629,760 | |
| BCR | | 1.05 | |
| **IRR** | **-3%** | | |
| **NPV** | **($3,970,768)** | | |
| **Pay Back Period** | **58 years** | | |
| **BCR** | **1.05** | | |

**Table 3c:** Cost benefit analysis of kenaf cultivation scenario of production 15 ton/ha.

viable production outcomes that farmers can aim for to be profitable. The work which was conducted by Agbaje et al. [16] illustrated that the net return of cultivation kenaf was higher and maximized the profit of the farmers when growing the local cultivar instead of improved varieties under the farmers' practice. As concluded by Rahman et al. [17] the intervention and support of the government policy is needed for the crop to determine a market condition for encouraging farmers to cultivate such crop. But when the kenaf stem production is 15 tons per hectare the NPV is more profitable; that means if the farmers cultivated kenaf produced any weight above this production relying on this analysis they will enjoy better income when growing kenaf for providing fiber. However, in this analysis we did not include any benefit of other products from kenaf cultivation, so if the other products such as seeds, leaves, and residues which can be used for animal feedings are included that will maximize the profit of the farmers. Thus the analysis concluded that kenaf cultivation would be viable if the farmer cultivated kenaf more than twice a year or intercropping with legume crop for enhancing the productivity. The research of intercropping kenaf with yam bean showed a significant effect on kenaf fiber productivity [18], this will positively increase the net income of kenaf fiber. Molla et al. [19] assessed the financial and economic profitability of jute in Bangladesh, they concluded that, jute production was more profitable than other crop and they recommended that to assure the continuity of the fiber crop, government should undertake policy for supporting the existence of this crop in a market economy condition.

## Conclusion

The investigation of the three scenarios revealed that when the farmers in Kelantan state cultivated kenaf for producing fiber the production of 15 tons per hectare was found to be financially viable and maximizes their profit. The three scenarios for fiber production were found to be profitable when the farmers used tractors for planting and harvesting kenaf, when BCR is used as an indicator. Moreover, when NKTB continues providing subsidies in the form of chemical, fertilizers and seeds for the farmers for the cultivation of kenaf, this is believed to serve as an incentive for continued kenaf cultivation. The findings from this research is hoped to provide information to decision makers, manufactures and farmers towards investment in kenaf cultivation. Additionally, the results of survey revealed that there are quite a number of challenges faced by kenaf farmers which needs immediate attention as stated by farmers' leader which includes:

- V36 variety with low seeds germination percentage decreased kenaf productivity. To increase the kenaf productivity, the kenaf variety KK60 which is recommended by Tahery et al. [7] as a better alternative to V36 and a favorite choice for kenaf cultivation for the production of fiber.

- There is need to reconsider the amount of subsidies provided by NKTB due to the high cost of labour, likewise, the predetermine price of kenaf stem by NKTB is RM 500 per ton is low thereby leading to low productivity and subsequent decline in returns which negatively affects the income of the famers.

- Though presently kenaf is produced once in a year which is considered not so profitable, thus the need to enlighten the famers' cultivations at intervals. Therefore, to increase productivity, there will be need for continuous training so as to gain more experience. More so, there is need to educated them not just on kenaf profitability but also its contribution to socioeconomic and environmental benefits.

## Recommendations for Further Future Research

The financial assessment of this work only considered the normal CBA for kenaf cultivation which used the financial indicators NPV, IRR and BCR, while the externalities were not measured. However, CBA which is adopted in this study did not include the externality due to the unavailability or lack of data, and the farmers did not consider the value of other products from kenaf plantation; they only produced kenaf fiber to be sold to LKTN. Moreover, due to insufficient data there is no estimation of the externalities. Therefore, the investigation recommended that the economic CBA with its indicators will be included in the future to assess kenaf cultivation in all Malaysian states.

## Suggestions and Policy Implications

- In the kenaf farming the scientific method of cultivation to be followed by the farmers and for LKTN has to provide the machinery instead of using the manual labors to get the high fiber yield.
- To find a mechanism to provide a high quality of seed to the farmers for better fiber production.
- To develop the local and global markets for promoting kenaf fiber and products marketing.
- Kenaf has numerous industrial applications and significant usefulness as forage and seeds used for oil production. Well, a strategic plan should follow with specific goals on all the mentioned aspects and should be tackled for kenaf cultivation to enhance its existence.
- Since kenaf has been established well in Malaysia, it will be good for the decision makers to offer a reasonable proportion of land areas to cultivate kenaf to increase its current production instead of supplementing the needs of the fiber by importing kenaf from another country such as Bangladesh, Myanmar, and Indonesia.
- Also, more efforts must be taken to evaluate the targeted products which are produced by the country using kenaf fiber and investigate their capabilities and interests, strengths and weaknesses compared to the other peer countries.

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