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Feasibility of Adopting Kenaf on the Eastern Shore of Virginia*

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Since the 1940s, kenaf (*Hibiscus cannabinus* L., Malvaceae) has been viewed as a potentially attractive source of fiber, mainly for newsprint and high quality paper. Kenaf research has drawn increased interest due to the establishment of the Kenaf Demonstration Project in 1986 and the involvement of numerous researchers of the Agricultural Research Service Stations in Mississippi, Oklahoma, and Texas.

Much of the kenaf research, however, has focused on the establishment of breeding, genetics, and agronomy programs (Kugler 1996) and less attention has been given to the economic and environmental issues related to the adoption of this crop. This paper seeks to address the void in the current literature by discussing the economic and environmental impact of growing kenaf on the Eastern Shore of Virginia. This research is part of a more comprehensive study that focuses on the adoption of alternative crops in order to provide local producers with more sustainable farming strategies. To prove successful, potential alternatives need to have an economic or environmental record that is equal or superior to that of traditional crops in the area. Only after these new crops pass this test, can we then decide to address the numerous barriers that accompany their commercial production.

Kenaf is no exception. Initially, it seemed that kenaf could be a feasible addition to the current crop mix on the Eastern Shore. Closer scrutiny, however, revealed that our assumption was not correct. Currently, kenaf fails to be an economically viable alternative and it offers only marginal environmental benefits. The value of this computer model approach is two-fold. This project was able to effectively investigate many options for incorporating kenaf into existing whole farm plans on the Eastern Shore of Virginia without the growers actually risking their economic investment of inputs, land, and labor. The model is also available for investigating other crops, which may be of interest for consideration by local growers.

METHODOLOGY

Project Development

An integrated systems approach was developed at the request of growers on the Eastern Shore of Virginia to evaluate potential new or non-traditional crops. This approach examines the production, economic, and marketing feasibility and the potential environmental impact of both traditional crops and proposed alternatives. Agriculture is a major source of income and employment opportunities for the population of this predominately rural area (Center for Public Service 1995). This environmentally sensitive growing area is located on the southern end of the Delmarva Peninsula, between the Atlantic Ocean and the Chesapeake Bay.

Economic Analysis

A linear programming model was designed to perform the economic analysis (Kalo et al. 1997). The model evaluated the economic performance of two representative farms with distinct cropping systems, grain or vegetable production, typical of the region. Both farms were assumed to be commercial operations with 255 ha of arable land available and limited machinery and labor resources. The grain farm had no irrigation and it could grow a combination of full season soybeans or winter wheat, double-cropped with soybeans. The vegetable farm had limited water resources and irrigation equipment but could grow various crops. The economic performance of kenaf was evaluated under each cropping system. Rotational constraints were established in order to prevent planting the same crop in a field in two consecutive years.

The model identified the optimum grain and vegetable farm plans by maximizing net returns to land,

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management, and fixed capital. Local farm management agents and extension specialists developed detailed calendars of resource utilization and budget estimates for production costs. Table 1 summarizes the kenaf cost of production budget estimates for the Eastern Shore.

The lack of an established market for kenaf makes it impossible to collect historical price data for kenaf. Instead, we used prices specified in the proposed contracts for kenaf in the mid-Atlantic region. Table 2 summarizes the profit ha for kenaf given various yield and price estimates. Kenaf was profitable only if price exceeded $75/t and/or yield was more than 12 t/ha.

Environmental Analysis

The computer program PLANETOR (Center for Farm Financial Management 1995) was used to measure environmental parameters regarding soil erosion, pesticide leaching and runoff, pesticide toxicity, and nitrogen leaching. This program was customized for the study area in order to evaluate the environmental performance of the optimal farm plans generated by the economic model.

ECONOMIC ANALYSIS

The results of the initial economic model showed that kenaf could not compete with the alternatives available in either cropping system. Simply stated, kenaf did not provide the same returns to investment given the limited resources of each farm plan. To understand what it would take to make kenaf a viable alternative, we evaluated three important variables: (1) an increase in price; (2) an increase in yield; and (3) a decrease in transportation costs (marketing).

The results of the sensitivity analysis indicate that kenaf becomes economically feasible if we could institute the following changes:

1. Kenaf enters the optimal solution for the representative grain farm when its price increases to $120/t. This represents a 42% increase in the price of kenaf from the $75/t assumption used in the base farm models. Net returns for the grain farm, however, increase only 13.5%, from $72,910 to $102,110. For the representative vegetable farm, the price of kenaf has to increase to $100 in order to grow 81 ha of the crop. However, at $100/t of kenaf, net returns increase by only 1%.
2. The yield of the kenaf crop needs to increase from around 12 t/ha to 19 t/ha in the grain farm model and to 17 t/ha in the vegetable farm model. This change increases net returns by 24% for the grain farm and 9% for the vegetable farm.
3. Kenaf enters the optimal solution if the transportation distance is cut from 241 to 80 km, in both models.

Table 1. Kenaf cost of production budget*.

Costs	Quantity	Price	Cost/ha
Variable			
Seeding costs:	15.71 kg	$6.61	$103.82
Fertilizer:	109.92 kg	$0.70	$76.94
Fertilizer application costs:	1.00 ha	$14.83	$14.83
Lime	0.82 t	$38.00	$30.99
Spray materials:			
Herbicides	0.35 L	$23.62	$8.17
Insecticides	0.00 L	0.00	$0.00
Fungicides	0.00 L	0.00	$0.00
Irrigation:			$0.00
Machinery			
Production, repairs			$30.36
Production, fuel			$19.44
Harvest, repairs			$0.00
Harvest, fuel			$0.00
Miscellaneous:			$70.00
Interest:	$354.53	8.00%	$28.36
Custom rate harvest			$86.45
Marketing:	241.40 km	$3.07	$741.00
Labor charges:	7.41 hr	$6.00	$44.46
Fixed			
Machinery cost:			
Production			$58.02
Harvest			$0.00
Total			$1,312.83
Cost per sale unit	12.35 t		$106.30

*No land cost included, return is calculated as net returns to land and management.

Given that the cost of transporting a trailer load of kenaf is calculated at $3 per loaded km, transportation costs fall from $741/ha (destination being 241 km away) to $245.6/ha (destination only 80 km away). This change has a more pronounced effect than the previous changes, as it results in a 33% increase of net returns for the grain farm and a 12% increase of returns for the vegetable farm.

Challenges and Reality

The price, yield, or transportation cost adjustments required to include kenaf in the model's profit maximizing solutions pose a number of problems. The most difficult to overcome is the increase of average yield from 12 to 17 or 19 t/ha. Agronomic research (Hallmark et al. 1994; Hovermale 1995, 1994a,b; Kurtz 1996) demonstrated that yields of 17 or 19 t/ha are difficult to achieve. Such yields become even harder to attain with the inexperience of kenaf producers. Finally, most of the data on kenaf yields is provided via experiments conducted at experiment stations in the Deep South. Realizing that farmers are unlikely to replicate the results achieved by controlled experiments, it is prudent to assume even lower yields. Hence, the attainment of economic feasibility based on higher yield expectations would be difficult at best.

Price and transportation requirements are also problematic. Economic feasibility studies (Zhang and Dicks 1992) suggest that the best way to sell kenaf would be through processor forward contract agreements. Each contract would have built-in specific conditions relating to price and transportation agreements. Initially, some of the farmers on the Eastern Shore entered into negotiations with a kenaf processing company and developed one such contract. The contract specified that farmers would receive $75/t (dry) delivered to the processor. Furthermore, they would also receive $25/t towards their harvesting and storage costs. This increased the potential farm price to $100/t, which makes it economically feasible even when transportation costs are estimated at $3 per loaded km. Considering that the contract also offered to subsidize transportation costs by almost 50%, the agreement seemed quite attractive.

However, the contract has not yet been implemented. The processor was unable to reimburse farmers $25/t in harvest costs or the 50% transportation subsidy. This is reflected in the present kenaf production budget that now a price of $75/t and charges full transportation costs at $3 per loaded km for the 241 km that it is necessary to move the product to the processing facility (Table 1).

The relationship between processors and potential kenaf growers has deteriorated over the last year. Farmers are fearful of the dangers inherent in dealing with a single buyer and they suspect that they will be used by processors until the latter establish themselves in the market and develop more profitable partnerships with raw product supply sources closer to their plant. Farmers realize that there is nothing to prevent the processing company from changing the terms of the contract or even discontinuing their Eastern Shore activity. On the other hand, the processors are suspicious that the farmers are only using their company as a risk minimization tool to field test the economic feasibility of the crop. They fear that once the farmers gain some experience and expertise in growing kenaf they will seek to built their own processing plant, given the simplicity of the technology required.

The feasibility analysis for kenaf illustrates some of the problems in introducing a new crop alternative. In this section we only focused on three potential barriers to the production of kenaf: prices, yield, and transportation costs. However, other issues may pose difficulties. The acquisition of specific machinery for harvesting the product is a case in point. The production budgets assume a lump-sum custom harvesting cost of $86.45/ha. This assumption may be valid if an individual farmer could rent the machinery. Production costs would be much higher, however, if farmers had to purchase specialized equipment to harvest 81 ha, especially considering the fact that it cannot be used for harvesting either wheat or soybeans.

It is not economically feasible to ship the product over a long distance. Thus, the Eastern Shore is at a significant disadvantage in this regard. Because of its peninsular geographic location, growers

Table 2. Net return to land and management for various yield and price assumptions*.

Yield	Profit ($/ha)		
	Kenaf price/t		
(t/ha)	$65.00	$75.00	$85.00
7.4	482	556	630
12.4	803	826	1,050
17.3	1,124	1,297	1,480

*Total cost/ha = $1,312.83 (see Table 1) face the risk of dealing with monopsonistic partners or building the needed infrastructure. Having a processing plant on the Eastern Shore would greatly reduce transportation costs, at or below the 80-km constraint discussed above. The investment, however, would only shift the marketing problems from the farmer to the kenaf processors. They would now have to deal with the few paper mills using kenaf and it is not clear whether the processing activity offers enough value-added to the profit margins to make the entire operation economically feasible. The region, on its part, has neither the land or water resources to accommodate a paper mill. Given these barriers, kenaf appears to have no near-term potential for the Eastern Shore.

Environmental Sustainability

Despite the lack of economic viability, one main question needs to be addressed. Does kenaf offer sufficient environmental benefits to warrant any intervention into eliminating the barriers discussed above? Our conclusion, based on the environmental analysis, is that kenaf offers only marginal environmental improvement, mainly because it uses fewer pesticides than wheat and soybean, the main crops with which it would compete. The effect of including 81 ha of kenaf in the optimal solution of the representative grain farm. Net returns under this scenario fall by almost 30%, while the weighted average of soil erosion from 255 ha increases from 1.9 to 4.2 t/ha. Consequently, kenaf fails to provide the economic or environmental incentives to justify its adoption in a wheat and soybean operation.

Including kenaf in the crop mix of the representative vegetable farm provides similar results. The introduction of kenaf increases the weighted average soil erosion from 6.3 to 7.7 t/ha on the 255 ha farm. Net returns also decrease from about $625,000 to $530,000.

When the economic model was forced to incorporate 81 ha of kenaf in its farm plan, the two crops that were eliminated were wheat and soybeans. While kenaf has higher soil erosion parameters than wheat and soybeans, it could provide some relief in terms of potential pesticide leaching and runoff compared to the grain crops. On the other hand, kenaf offers little relief in terms of potential nitrate leaching. The potential for nitrate leaching is 319 kg/ha for kenaf compared to 291 kg/ha for romaine lettuce. These results and the results for soil erosion show that kenaf is no magic bullet that can solve the potential risk of environmental pollution from agricultural production on the Eastern Shore. Moreover, these results show that there are few incentives to justify research into eliminating the barriers for the production and marketing of kenaf.

CONCLUSIONS

Our analysis indicates that presently kenaf is not a viable crop for the Eastern Shore and its future commercialization faces serious constraints. Current knowledge of the economic and environmental impacts of this crop shows that it lacks both the economic and environmental incentives to justify further research. Kenaf cannot compete with other crops available to producers because it does not provide competitive profit margins and it lacks an established marketing infrastructure for delivering the product. Unattainable yields, low expected price levels, and dealing with a monopsonistic buyer make the production of kenaf on the Eastern Shore of Virginia a very risky venture. Furthermore, its mixed environmental record removes any justification for subsidizing further efforts for its commercialization.

REFERENCES

Center for Farm Financial Management. 1995. PLANETOR: Users manual. Dept. Agr. and Applied Economics, Minnesota Ext. Service, Univ. Minnesota, St. Paul.

Center for Public Service. 1995. Economic profile of the Accomac-Northampton Counties. Univ. Virginia, Charlottesville.

Goforth, C. and E.J.M. Fuller. 1994. A summary of kenaf production and product development research 1989–1993. Mississippi Agr. Forestry Expt. Sta., Res. Rep. 19(10).

Hallmark W.B., L.P. Brown, H.P. Viator, R.J. Habetz, W.D. Caldwell, and C.G. Cook. 1994. Kenaf: A new crop for Louisiana. Louisiana Agr. 37(2).

Hovermale, C.H. 1994a. The effect of nitrogen rate on kenaf planted at three row widths. Mississippi Agr. Forestry Expt. Sta., Res. Rep. 19(13).

Hovermale, C.H. 1994b. Effect of tillage method, cover crop, and nitrogen rate on yield of kenaf. Mississippi Agr. Forestry Expt. Sta., Res. Rep. 19(11).

Hovermale, C.H. 1995. Effect of date of planting on four varieties of kenaf. Mississippi Agr. Forestry Expt. Sta., Res. Rep. 20(9).

Kalo, A. 1997 Analyzing the economic and environmental impacts of agricultural alternatives: The case of the Eastern Shore. MS Thesis. Dept. Agr. and Applied Economics, Virginia Tech., Blacksburg VA.

Kugler, D.E. 1996. Kenaf commercialization: 1986–1995. p. 129–133. In: J. Janick (ed.), Progress in new crops. ASHS Press, Alexandria, VA.

Kurtz, M.E. 1996. Pre-emergence herbicide trials in kenaf. Mississipi Agr. Forestry Expt. Sta. Bul. 1053, August.