Financial Analysis of Selected Shelterbelts Systems in Pakistan

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Abstract

Financial analyses of shelterbelt agroforestry system are compared for some regions in Pakistan. The study reveals that shelterbelts, though they may be competitive in biological terms, are supplementary in financial terms. The net present value analyses found wheat and sugarcane fields with poplar windbreaks to be financially sound in the Peshawar valley of N.W.F.P. Similarly, the agroforestry options of wheat sheltered by rows of shisham in the Mianwali region of Punjab and of wheat sheltered with eucalyptus in Tharparkar, Sindh were financially superior , to wheat monocropping. The study suggests positive financial incentives to land owner and tenant farmers for establishing shelterbelt agroforestry in these regions of Pakistan.

Introduction

The current status of agriculture in Pakistan emphasizes the need to develop efficient production system. For these systems to be successful and sustainable they must optimize the balance between input and output. Shelterbelts are considered to be one of the effective methods for increasing crop production efficiency.

Because the demand for fuel wood in the country is substantially greater than forest land can produce, privately owned farm and marginal lands must be put into production. The planting of shelterbelts/windbreaks, tree groves or individual trees in such areas is highly important since they are an integral part of the farming system. However, information regarding the economic benefits of tree rows/shelterbelts with respect to agricultural crops is scarce. The study will evaluate the economic benefits of selected shelterbelt systems.

Although the financial profitability of a shelterbelt varies with relative productivity, profitability also depends on the perspective. From the farmer's perspective, profitability is often measured in the broader economic terms of fuelwood, fodder, shade and shelter, control of land degradation, and provision of commercially valuable trees for timber, poles, and other purposes. All of these increase the value of the farm. From the government's or society's perspective, profitability incorporates not only these factor but also possible social benefits such as soil conservation, reduce wind erosion, alleviation of unemployment, improved rural economy, improved productivity, and decreased dependence on distant markets, both regional and international. The farmer is interested primarily in private agroforestry alternatives that are financially feasible for his own farm, while the government is interested in broader societal benefits and the possibility of increasing incentives to the private landowners to achieve them. In view of the current shortage in food supplies, it would not be possible for a farmer to raise block tree plantations on agricultural land. Trees could only be grown systematically around boundaries of agricultural fields.

This study looks at the information gathered to understand the cash flow for small farmers. The sensitivity of this information was also tested to present a range of comparisons of traditional crop oriented land uses with those proposed by tree oriented extension agents. Financial analysis serves as an important tool in extension in presenting to the farmers the financial difference between clear "with" and "without" alternatives.

Methodology

Data collection and analysis

The study was a part of thesis submittted by the author to the University of Idaho (U.S.A.). Three sites namely, Peshawar valley in NWFP, Mianwali region in Punjab and Tharparkar in Sind were studied in the analysis.

Data used in this analysis were collected by Pakistan Forest Institute personnel. The yield data were taken from a PFI publication on a shelterbelt windbreak project. This publication contains yield impacts but does not contain statistical or financial analysis (6). Economic data for food and tree crops were collected by students of the PFI, Peshawar in 1989 (1,8). The data obtained from farmers and market were summarized by the students and vary by crop and region.

A capital budgeting approach was used to determine the additional net cash revenue flows generated by the

shelterbelt investment over its economic life. More specifically, a net present value (NPV) analysis was employed indentifying the net value of the income stream. A common technique to incorporate effects of risk is to do a sensitivity analysis. The common risk in shelterbelts agroforestry is that wood prices may go down because of increased supply into the market or that prices of agricultural products may go up. The sensitivity analysis takes care of such questions to some extent. Such an analysis may help the decision makers (in our case a rural farmer) decide whether to invest in windbreaks or not. This analysis was carried out with price changes in input costs and market prices, as well as changes in yield functions.

Analytical Procedure

The analysis began with the cost of establishing agricultural and wood crops and ran through 6 - 10 - and 20 - year life span for poplars, eucalypts, and shisham (*Dalbergia sissoo*) shelterbelt, depending upon rotation. The crop data for wheat, cotton and suger cane were used in analysis. A representative budget under "with" and "without" windbreak conditions was constructed. The budget assumed a representative farm size of one hectare for each parcel of land in each locality.

Most international literature suggests complementarity of shelterbelts (3,5,7). However, the studies in Pakistan indicate competition in biological terms, probably because of the location of the studies. The shelterbelt in Pakistan extends over private lands in the irrigated tract of the country when production could be high without shelterbelts. There is insufficient evidence available in Pakistan regarding desert conditions in rainfed areas where production could be high due to the sheltering effect of trees.

Discount Rate

Because of the long investment horizons for shelterbelts and the exponential effect of discounting, the choice of discount rate is critical. In this analysis the discount rate used is 12 percent (4). This is a real rate which is calculated from the nominal interest rate less the inflation rate and which approximates the long-term average real rate of interest.

Defining Investment Horizons

Since rotations for all species were different for different regions, the sum of net present value of all alternatives was brought to a common point within a region in order to be comparable. In Peshawar valley, five rotations of poplar harvested on a six year period and three rotations of shisham on 10 years cycle were compared in analysis. In Punjab two rotations of poplar on a 10-year cycle and 1 rotation of shisham for 20 years with wheat were compared. Only a 10- years rotation for Eucalyptus was considered in Sindh with cotton and wheat.

Net Present Values and Benefit/Cost ratios were calculated based on annual cash flows and done "with" and "without" land rent at each of three discount rates: 10, 12 and 14 percent. The built - in command system of Lotus 1-2-3 was used to calculate the net present values of total costs, total benefits, and net benefits "with" and "without" land rent.

Results and Discussions

Influence of shelterbelts on crop yield

Crop yield showing the influence of shelterbelts at the three study sites are summarized in Table 1. These data suggest that wheat yields are less responsive to tree effect than yields of cotton and sugarcane. On the other hand, poplar reduced the yield of sugarcane by more than 10 percent in the Peshawar valley and wheat yield by about 10 percent in Punjab. Eucalyptus affects the yield of cotton by about 10 percent in Sindh while its effects on wheat yield is negligible. The effects are cumulative on a per hectare basis and are very conservative for Punjab and Sindh. Therefore,a sensitivity analysis associated with change in yield was also carried out for these two regions.

In wheat growing areas of the Peshawar valley, wheat and poplar generate the highest net present value (NPV): Rs. 85687.00 for owner cultivator and Rs. 57824.00 for tenant cultivator over a period of 30 years (Table 2a). Wheat and shisham generated the next highest NPV and the highest B/C ratio for all cultivators. There is probably no significant difference between these two options. The B/C for wheat alone is 6 percent higher than wheat with shisham. However, when relative and absolute financial criteria disagree, the absolute is the primary criterion.

In the sugarcane growing areas, poplar shelterbelts give the highest NPV of Rs. 109480.00 for owners and Rs. 53737.00 for tenants for the same 30 years period. The NPV of sugarcane alone is next. The NPV of sugarcane with shisham shelterbelt is less because the decrease in sugarcane yield due to shisham is higher than the associated cashflow increase from shisham trees.

Table 1.
Yield per hectare of agricultural crops "with" and "without" shelterbelt and the associated percent decrease in yield.

a. Peshawar Valley, N.W.F.P.

Crop or Crop combination	Crop yield in Kg	% decrease in yield due to shelterbelt
Wheat	4134	-
Wheat and Poplar	4087	1.14
Wheat and Shisham	4123	0.27
Sugarcane	67703	-
Sugarcane and Poplar	59883	11.55
Sugarcane and Shisham	63305	6.50
b. Mianwali, Punjab,		
Wheat	2800	-
Wheat and Poplar	2520	10.0
Wheat and Shisham	2800	-
c. Tharparkar, Sindh.		
Wheat	2800	-
Wheat and Eucalyptus	2800	0.0
Cotton	2527	-
Cotton and Eucalyptus	2274	10.0

Peshawar Valley, NWFP

There could be other reasons for relative financial efficiency of different system. Since poplar grows faster than shisham, it could give returns in 5 to 10 years while shisham takes 50 to 60 years to be fully marketable. The analysis of a 10- to 20 years horizon means harvested shisham could be used only as firewood, limiting the applicability of the shisham finding. Poplar is used for making match splinters and for packing, splinters and for packing, crating and shuttering as well as for firewood on a short rotation. The B/C ratio of this analysis favour using poplar for wheat and sugarcane and for owner and tenant cultivators.

Mianwali, Punjab

The wheat situation in the Mianwali region of Punjab is a bit different from the one in the Peshawar valley. The shelterbelt results are based on yield decreases of 10 percent using poplar and no decrease associated with shisham. Wheat and shisham combinations generate a higher NPV than the other alternatives over a 20-year period, a NVP of Rs. 31478 for owners and Rs. 17099 for tenants (Table 2b). This fact is also supported by the B/C ratio.

Growing poplars will probably decrease crop yield because the region is comparatively dry and poplar requires more water than shisham; hence it will grow slower here. also a good market system does not exist within reasonable economic distance.

Tharparkar, Sind

The financial results for the Tharparkar region of Sind are based on yield data which suggest no decrease in wheat yield and a decrease of 10 percent in cotton yield using Eucalyptus shelterbelts. Over a period of 10 years, the NPV of wheat and Eucalyptus is Rs. 22122.00 for owners and Rs. 14787 for tenants, while that for wheat alone is Rs. 18062.00 and Rs. 10995.00 in similar situations (Table 2 c). On the other hand, the NPV for cotton alone is better than that for the Eucalyptus - cotton combination. However, since the difference between these two alternatives is nominal Rs. 901.00 for

Table 2. Net present value and B/C ratio for crops 'with' and 'without' shelterbelts

	Peshawar valley, NWFP:	30 Years Investment horizen			
a.	Crop combinations	Owner cultivator		Tenant cultivator	
		NPV Rs.	B/C	NPV Rs.	B/C
	Wheat	51636	2.10	23764	1.32
	Wheat and Poplar	85695	2.87	57824	1.80
	Wheat and Shisham	56590	2.04	28719	1.39
	Sugarcane	101130	2.06	45388	1.30
	Sugarcane and poplar	109480	2.22	53737	1.38
	Sugarcane and Shisham	95658	2.04	39915	1.27
	Mianwali, Punjab:	20 years Investment horizen			
b.	Wheat	23871	1.88	9677	1.23
	Wheat and Shisham	31478	2.23	17099	1.46
	Wheat and poplar	30126	2.20	15792	1.42
	Tharparkar, Sind:	10 years Investment horizen			
c.	Wheat	18062	1.88	10995	1.40
	Wheat and eucalyptus	22122	2.10	14787	1.55
	Cotton	29240	1.79	17933	1.37
	Cotton and eucalyptus	28338	1.82	16763	1.37

Note A 12% interest rate was used for all sites but the amortization period ranges from 10 to 30 years.

owners and Rs. 1205.00 for tanants), operators may be indifferent about choosing between them. Certainly, it would be difficult for extension foresters to sell windbreaks with this such small and uncertain differences. Eucalyptus, though fast growing, does not have a viable current commercial market except as firewood. Also, cotton yield is adversely affected by trees.

In all cases the returns owner cultivators (without land rent) was greater than the returns to tenant cultivators (with land rent). B/C for owners ranged from 1.79 to 2.87 while B/C for tenants ranged from 1.27 to 1.80.

Sensitivity Analysis

A sensitivity analysis associated with increases or decreases of input/output prices was also tested for a simple case in Peshawar, NWFP. The test revealed that, though there is enormous change in NPV, the agroforestry option with poplar is better than wheat monocropping.

To illustrate how a decrease in wood prices might affect a decision, a simple case in Peshawar valley is presented where wheat and wood are supplementary. The costs of inputs were assumed to increase and to prices of wheat to decrease a 3 percent annually, while the prices of poplar wood were assumed to decrease at 3,5,10 and 15 percent annually (Table 3.a.).

The NPV for an owner cultivator under decreasing wood prices at 15 percent, per year decreases to Rs. 30070.00, which is still higher than the NPV for wheat alone (Rs. 21023). The same tendency also holds true for tenant cultivators. Supplementarity assures that this condition will hold over large ranges.

Assuming constant input costs and wheat prices, large decreasing prices of wood were tested until an operator would become indifferent between pure crop and a crop with a poplar shelterbelt (Table 3.b). At an enormous 45 percent decrease in wood prices, the NPV for an owner is Rs. 51523.00 with shelterbelt and Rs. 51625.00 for a pure wheat crop. A 45 percent annual decrease in wood price is so large that it will not affect the decision to plant shelterbelts under supplementarity between joint products.

Table 3: Sensitivity of NPV of wheat alone and wheat with poplar S.B. at Peshawar valley associated with decrease in wood price discounted at 12%

a. 3% increase in input cost, 3% decrease in wheat prices and 3,5,10 and 15 decrease in poplar wood price.

	Crop Combination	Owner cultivator	Tenant cultivator	Rate of decrease in wood prices
Return from wheat decrease	Wheat	21023	-14288	-
at 3%/annum	Wheat with	46487	11156	3%
	poplar	42168	6837	5%
	-do-	34697	-614	10%
	-do-	30070	-5240	15%

b. No increase or decrease in costs of input or prices of wheat and 0 to 45 percent decrease in prices of poplar wood.

Constant input prices

	Crop combination	Owner cultivator	Tenant cultivator	Rate of decrease in wood prices
Constant	Wheat	51625	23745	-
wheat prices	Wheat with poplar	85687	57807	0%
-do-	-do-	76844	48985	3%
-do-	-do-	52525	44645	5%
-do-	-do-	65053	37173	10%
-do-	-do-	55105	25935	30%
-do-	-do-	51523	23643	45%

Conclusions

The preceding financial analysis suggests that shelterbelts in several regions of Pakistan compete with crops in biological terms but supplement them in financial terms. Though the results are preliminary and conservative in nature, they provide a good understanding of the crop-tree interaction (both biologically and economically) for future discussion and guidance with respect to integrating shelterbelts into the agroforestry system of Pakistan.

Since a price support program for agricultural crops exists to keep farms running, which actually basis the decision against windbreaks, some sort of arrangement could be made to provide tree planting incentives in the form of land revenue exemption and credit facilities for those adopting organized shelterbelts systems.

Property right stability and land tenure relationships can have a sizeable impact on the willingness and ability to undertake a long term investment in tree planting. At present, only owner cultivators can get the highest net income from the agroforestry system, and tenure uncertainty would cause lower expected values than discussed here.

The results of the study are conclusive enough that shelterbelt agroforestry is financially feasible for certain crop combinations.

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