INTERIM FINANCIAL ANALYSIS OF ON-STATION INTERCROPPING STUDY

K.M. Siddiqui, Director General, and ***Fazli Subhan Khan,*** Senior Research Officer, Pakistan Forest Institute, Peshawar.

INTRODUCTION

Agriculture is the main stay of Pakistan economy contributing about 26% to GDP and employing about 54% of the labour force. Farmlands account for about 36.1% of the total land area. 76% of rural and 55% of urban population mainly depends on wood for their energy needs, fodder, food and wood based industries. This has necessitated growing of trees not only on marginal lands but farmlands as well.

Intercropping, a form of agroforestry land use, is a joint production system that is considered as one mean to solve food and fuel crises. It takes advantage of the mutual benefits obtained from combining trees and agriculture/fodder crops. Various combinations of intercropping for commercial as well as subsistence production have been developed to maximize land use and economic returns to communities. In China about 1.8 million ha. of farmland have been intercropped with Paulownia, a fast growing valuable timber tree. Other forms of agroforestry that includes integration of annual fodder as intercrop with multipurpose tree species may enhance land productivity and increase wood and animal production.

Intercropping is very complex. It combines all the factors of ecology, crop yield, economic and social effects. Theoretically it must ensure maximum returns from unit land and efficiently improve the ecological environment of farm land to promote productivity.

Considering importance of intercropping, Pakistan Forest Institute, Peshawar established on-station studies to compare effects of some multipurpose tree species on the yield of agriculture/fodder crops. Four tree species namely *Eucalyptus camaldulensis*, *Acacia nilotica* (Babul), *Leucaena leucocephala* (Ipil Ipil) and *Populus deltoides* (Poplar) were planted in 1988. Berseem (*Trifolium alexandorium*) was intercropped for the first three consective years and wheat (*Triticum indicum*) during the fourth year as winter fodder crop. Data on yield of trees and crops, revenue and expenditure collected during the last four years of establishment is analyzed for yield effect and financial profitability. The objective of this analysis is to evaluate and compare yield and financial returns from four intercropping practices using cash flow analysis technique under experimental farm condition.

MATERIAL AND METHODS

The experiment was established in March, 1988 at research garden in Peshawar on 0.67 ha. of land in randomized complete block design with four replications and four tree species treatments. Tubed plants of *E. camaldulensis, A. nilotica* (Babul), *Leucaena leucocephala* (Ipil Ipil) and one year old plants of *Populus deltoides* were planted at a spacing of 1.8 m x 4.6 m with 42 trees in a plot of 418 m^2 (27.5 m x 15.2 m).

Agriculture/fodder crop was grown in whole of experimental area. Thinnings were carried out during 1990-91 and 1991-92. Every alternate row from 7 rows of trees was removed in 1990-91 leaving 24 trees per plot at a spacing of

3.2 m x 4.6 m. Another 12 trees per plot (2 rows of the remaining 4 rows) were removed during 1991-92. Presently 12 trees per plot at a spacing of 6.4 m x 4.6 m are growing.

Data on yield of tree biomass, income from sale of tree biomass and agriculture crops and expenditure was recorded every year. Cash out flows included establishment costs of intercropping the land, planting, seed, fertilizer, water and cost of various operations every year. Cash in flows included open auction value of agriculture crops and tree biomass.

Treatmentwise data was projected on hectare basis. Returns from sale of crops and biomass of thinning material was apportioned proportionately to the overall share in the biomass yield of the four different species. This had to be done because separate sale data for each tree species were not maintained. An enormous variation in auction price of produce was observed, therefore, the study results might be conservative in nature.

RESULTS AND DISCUSSION

Table 1 shows fodder production of intercropping in metric tonnes projected per hectare and corresponding crop yield ratio relative to monocropping (control). The table, though self explanatory, needs some elaboration. Trees were planted during March, 1988 while berseem being winter crop was sown in October, 1988. Tree height and crown had developed to the extent that did effect berseem crop yield. The crop yield ratio indicate that poplar depressed fodder yield more than other crops (21.1%) during the first year of establishment and it was followed by Ipil Ipil. The decreasing trend continued at much higher rate upto third year beyond which growing of crop without appropriate thinning was not possible. Though the fodder yield during the first year was lower than the second year in absolute term it cannot be explained on the basis of available information. This may probably be attributed to uneven soil working, levelling, irrigation, seed quality and inefficient seed broadcasting.

In the third growing season decrease in crop yield relative to control ranged from 43% to 57%. Surprisingly the overall yield including control during this period is lower than the previous two years. Therefore, addition of a tree component may provide some monetary protection during such seasonal cycles of crop losses.

Contrary to the general notion that leguminous tree species will increase site productivity, yield from intercropping with Ipil Ipil was the lowest.

Table 1 Berseem (fodder) production intercropped with different tree species in metric tonnes per hectarer and corresponding crop yield ratio (CYR)

Tree crop	1988-89		1989-90		1990-91	
	Yield	CYR(%)	Yield	CYR(%)	Yield	CYR(%)
Babul	21.4	86.6	25.6	88.3	13.2	57.4
Ipil Ipil	20.3	82.2	22.2	76.6	9.9	43.0
Eucalyptus	24.1	97.6	25.0	86.2	11.7	50.9
Poplar	19.5	78.9	21.4	73.8	12.7	55.2
Control	24.7	100	29.0	100	23.0	100

Yield from thinning biomass

As discussed earlier canopy closure decreased crop yield tremendouslyfrom first year. Therefore, thinning was carried out by removing alternate row of trees in a plot of 27.5 m x 15.2 m in one replications. Projected number of trees thinned works out to be 430 per ha. The thinned material of all the four tree species was stacked in one lot and sold in open auction. The on-site price thus calculated works out to be Rs.0.282/kg. Specieswise biomass estimates revealed that poplar had the highest biomass yield (88.8 kg/tree) followed by Eucalyptus (61.7 kg/tree); Babul (42.7 kg/tree) and Ipil Ipil being the lowest (33.5 kg/tree). The value of this biomass in rupees is given in Table 2.

Another thinning with lower intensity removing about 287 trees per hectare was carried out during the third year (1991-92) of establishment. Sample from green weight biomass were also collected and analysed. Poplar and Eucalyptus again had the highest biomass (220 kg and 168 kg per tree) respectively and Ipil Ipil being the lowest.

Since auction of this material was not completed at the time of the analysis last year's rate per kg (Rs.0.282) was used for calculating value of thinned biomass (Table 2).

Table 2 Total per hectare biomass from thinning of tree species and their corresponding monetary returns

Tree crop	1990-91			1991-92			
	Wt. kg/ tree	No. of trees	Value in rupees	W. kg/ tree	standard deviation	No. of trees	Value in rupees
Babul	42.7	430	5185	68	17.85	287	5505
Ipil Ipil	33.5	430	4067	66	17.79	282	5343
Eucalyptus	61.7	430	7492	168	69.43	287	13600
Poplar	88.8	430	10873	220	74.08	287	17810

Table 3 Total per ha income from intercropping (trees and fodder)

Tree crop	1988-89	1989-90	1990-91			1991-92		
	Berseem (Rs)	Berseem (Rs)	Berseem (Rs)	Trees (Rs)	Total (Rs)	Wheat fodder	Trees (Rs)	Total (Rs)
Babul	8021	9600	4950	5185	10135	2537	5505	8042
Ipil Ipil	7596	8325	3712	4067	7779	2537	5343	7880
Eucalyptus	9033	9375	4387	7492	11879	2537	13600	16137
Poplar	7295	8025	4762	10873	15635	2537	17810	20347
Control	9248	10875	8625	-	8625	-	-	-

Financial analysis

Appendix-I gives cash in and out flows for total, deflated and compounded revenues and expenditures projected per hectare for the four growing seasons. It was prepared from Table 3 which gives yearwise statement of income from fodder and berseem for each alternative comparison. A price of Rs.15/- per 40 kg green weight of woody biomass was assumed for valuing each option.

Deflated numbers were calculated for intercropping and fodder alternatives from the General Price Index numbers. Each crop combination revenues were first deflated to the base year (1988-89) and the resultant deflated values were then compounded to present (i.e. 1992-93) at 12% interest rate. The decision criteria to quantify certain options financially superior to others were that of current Net Present Value estimated in Appendix-I and summarized in Table 4.

Results of the cash flow analysis suggest that for the first three years, all the five options are competitive not only in biological terms but also in financial terms as well (Table 1 and Table 4). Even the returns from the first thinning during the third year could not compensate for the decrease in crop yield as compared with fodder monocropping. Beginning the third year comptition for light, water and nutrient appear to be so great that the crops grown are suppressed and less productive.

Since yield estimates for fodder monocropping during the fourth year was not available, the sum of net present value of intercropping with each other could not be compared (Table 4-6). During this period a second thinning was carried out which added enormous biomass income to each crop combination. NPV for Poplar-fodder intercropping was highest (Rs.9565/- per annum) followed by Eucalyptus (Rs.8922/-). The comparative advantage of Poplar-fodder intercropping to other options is not unrealistic. Poplar is a fast growing species and can put on more biomass per tree in short period. Poplar though considered firewood in this analysis could also be used as industrial wood which will receive higher market price. Since farmers are rational human beings, they have been growing this species in areas around Peshawar for the same reason.

Though Eucalyptus remain second preferred species it is not much lower than poplar in monetary term as far as its utility as firewood is concerned. If market for Eucalyptus wood is established, this species would then compete with poplar in years to come.

As mentioned elsewhere Ipil Ipil-fodder option resulted in lowest income (Rs.5173/- per annum) suggesting that this combination is financially not feasible.

Benefit-cost ratio, through relative, is also reported for all combinations which is highest (3.22) for fodder monocropping (3.22 Table 4-a) and 3.24 for poplar-fodder option (Table 4-b).

Since the experiment is located on state land the analysis does not include market land rent, the opportunity cost of land, although the land location enjoys a definite land rent advantage over other areas and could be used for variety of other purposes.

The study is being continued and about 287 trees per hectare are still available which will be thinned again to provide space for crop growing and a final harvest probably after 6-7 years of establishment will be conducted.

Table 4(a) Sum of total and net present value (SPV & NPV upto 1991-92) after 3 growing season of intercropping compared with fodder monocropping

Tree crop	SPV Revenues	SPV Expenditure	SNPV	Net Rev. per annum	B/C
Babul	32008	12248	19760	6587	2.61
Ipil Ipil	27719	12248	15471	5157	2.26
Eucalyptus	34786	12248	22538	7513	2.84
Poplar	33874	12248	21625	7208	2.76
Fodder crop (Berseem)	33831	10490	23341	7780	3.22

Table 4(b) Sum of total and net present value (1992-93) after 4 growing seasons of intercropping

Tree crop	SPV Revnues	SPV Expenditure	SNPV	Net Rev. per annum	B/C
Babul	44513	17048	27465	6866	2.61
Ipil Ipil	37742	17048	20694	5173	2.21
Eucalyptus	52736	17048	35688	8922	3.09
Poplar	55308	17048	38260	9565	3.24

CONCLUSION

The foregoing discussion suggest that land profit can be maximized through certain intercropping combinations. A likely strong competition continues for the first three years between the componants while tree supplimantarity starts from the fourth year and onward. Since only fodder was grown as annual crop with different tree species for a short period of 4 year in one location, the results are interim, crop and area specific and limited to the present assumptions only. Final harvest of tree species will throw more light on bioeconomic aspect.

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APPENDIX-I

1988-89

Tree crop	Total Revenue		Total Expenditure	
	Berseem	Future value (FV) at 12%	Expenditure	Future value (FV) at 12%
0	1	2	3	4
Babul	8021	12621	3784	5954
Ipil Ipil	7596	11925	3784	5954
Eucalyptus	9033	14213	3784	5954
Poplar	7295	11479	3784	5954
Fodder crop	9284	14552	2784	4381

1989-90

Tree crop	Total Revenue			Total Expenditure		
0	5	6	7	8	9	10
Babul	9600	9022	12675	3785	3557	4997
Ipil Ipil	8325	7824	10992	3785	3557	4997
Eucalyptus	9375	8811	12379	3785	3557	4997
Poplar	8025	7245	10179	3785	3557	4997
Fodder crop	10875	10220	14358	3485	3275	4601

1990-91						
Tree crop	Revenue	Deflated at 1.2046	FV at 12%	Expenditure	Deflated at 1.2036	FV at 12%
0	11	12	13	14	15	16
Babul	10135	8213	10553	2657	2206	2767
Ipil Ipil	7779	6458	8101	2657	2206	2767
Eucalyptus	11879	9861	12369	2657	2206	2767
Poplar	15635	12979	16281	2657	2206	2767
Fodder	8625	7160	8981	2657	2206	2767

1991-92						
	Revenue	Deflated at 1.312	FV at 12%	Expenditure	Deflated at 1.312	FV at 12%
0	17	18	19	20	21	22
Babul	8024	6129	8664	3900	2973	3330
Ipil Ipil	7880	6006	6727	3900	2973	3330
Eucalypts	16137	12299	13775	3900	2973	3330
Poplar	20374	15508	17369	3900	2973	3330
Fodder crop	-	-	-	-	-	-

	Total present value Rev. Col. 2+7+13+19	Exp. Col 4+10+16+22	Net present value 92-93 Col. 23-24	B/C Col. 23-24
0	23	24	25	
Babul	44513	17048	27465	2.61
Ipil Ipil	37742	17048	20694	2.21
Eucalypts	52736	17048	35688	3.09
Poplar	55308	17048	38260	3.24
Fodder crop	-	-	-	-