CARIBBEAN FOOD CROPS SOCIETY

22

Twenty Second Annual Meeting 1986

St. Lucia

Vol. XXII

ECONOMIC EVALUATION OF INTERCROPPING YAM WITH FOOD CROPS IN ST. LUCIA

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ABSTRACT

Intercropping trials involving yam with legumes and/or dasheen were conducted in St. Lucia in 1985 on farmers holdings and of the Union Agricultural Station. Economic analyses of the results revealed that intercropping did not significantly reduce income from yams. In addition, it was revealed that in most cases, returns from growing the intercrop were greater than the additional cost of establishing the intercrop into the system.

INTRODUCTION

Intercropping (or mixed cropping of two or more crops is a common practice among small farmers in the Eastern Caribbean. Some arguments which can be put forward in favour of intercropping are:

- Insures against total crop failure. If one crop fails, the other may compensate.
- Reduces the incidence of pests and diseases and this could help prevent low yield situations. It can lead to a change in the microclimate of the canopy and thus influence the succession and build-up of insect pests (Singh & Singh, 1974.
- Increasing total productivity per unit of land per unit time by growing more than one crop in the same field.

The two or more crops should be such, however, that their peak periods of growth do not coincide. That is, crops of varying maturity durations need to be chosen so that a quick-maturing crop completes its life cycle before the grand period of growth of the other crop starts (Sacens, 1972). For maximum yield advantage, there should be some element of complementarity between crops in order to reduce to a minimum the competition between the main crop and the intercropping component(s). For example, systems with properly selected legumes may benefit non-legumes.

In general, experience with intercropping has shown that income from one or all the crops in the intercrop system may be lower than the respective pure-stand incomes, but that the combined income is higher than those from any of the crops in pure stand. Another superiority of intercropping, in terms of gross returns, is that it can give a more even distribution of income over time.

Areas which require increased understanding with respect to multiple cropping systems include the economic effects of intercropping yams with various food crops with respect to the potential for:

- increased farm incomes;
- improved cash flow among households; and
- improved farm family nutritional status.

The main objective of this study was to determine the economics of intercropping yam **(Dioscorea alata)** with snapbeans **(Phaseolus vulgaris)**, cowpeas **(Vigna unguiculata)**, and dasheen **(Colocasia esculenta)**.

In the study herein reported it is hypothesized that intercropping does not affect the full yield and income potential of the primary crop, and that additional net income is derived from the secondary crop(s).

MATERIALS AND METHODS

The data used in the analysis were obtained from experiments conducted at Union Agriucltural Station of the Ministry of Agriculture and on farmers' holdings in the south-western part of the island.

The field experiment was laid out in a randomized complete block design with nine treatments and three replicates. The land was mechanically ploughed and harrowed and ridges were prepared 1 m apart. Yam was planted on the ridges at a spacing of 1.0 m on July 8, 1985. The yam plants were staked at about 45 days after planting and each plant was fertilized with 32 g of an NPK mixed fertilizer (16-8-24).

The intercrop was planted on July 30, 1985 on the ridges between the yam plants. Dasheen was given 16 g of an NPK fertilizer mixture (16-8-24) at about 45 days after planting. The treatments used in the experiment are presented in the following tabulation:

Code[1/]	Treatment
Y	Sole crop of yam
Y-C-Y-C	One plant of cowpea between every yam plant along the ridge.
Y--Y-2C	Two plants of cowpea between every other yam plant along the ridge.
Y-S-Y-S	One plant of snapbean between every yam plant along the ridge.
Y--Y-2S	Two plants of snapbeans between every other yam plant along the ridge.
Y-D-Y-D	One plant of dasheen between every yam plant along the ridge.
Y--Y-D	One plant of dasheen between every other yam plant along the ridge.
Y-d-Y-2-C	One plant of dasheen and two plants of cowpeas between every other yam plant along the rigde.
Y-D-Y-2S	One plant of dasheen and two plants of snapbeans between every other yam plant along the ridges.

1/ Y = Yam; C = Cowpeas; S = Snapbeans; D = Dasheen.

The cowpeas were harvested in October 1985; the snapbeans, in November 1985; and the dasheen and yam, in February 1986.

The second experiment was conducted on farmers' holdings in the south-western part of St. Lucia. The experiment was conducted on six farms and laid out in a randomized complete block design with one replication per farm. The treatments are presented in the following tabulation:

Code[1/]	Treatment
Y	Sole crop of yam
Y+S	Yam intercropped with one crop of snapbeans.
Y+S-- >S	Yam intercropped with two crops of snapbeans.
Y+C	Yam intercropped with one crop of cowpeas.
Y+C-- >C	Yam intercropped with two crops of cowpeas.

Yams were planted on mounds at a spacing of 1 x 1 m in April 1985. They were staked at 7 weeks after plating, fertilized at 7 weeks and 15 weeks after planting, on each occasion with 15 g of an NPK mixture of fertilizer (16-8-24). The first and second plantings of intercrops were done at 3 and 11 weeks after planting the yam.

Rao and George (1985) give a more comprehensive description of the experiments. In this case, data were also collected from both experiments on cost of labour and materials used during the experiment through the use of proformas designed to determine input/output coefficients. Information was collected on a bi-weekly basis.

RESULTS AND DISCUSSION

Mean yields obtained from yam and the intercrops snapbean, cowpeas, and dasheen are presented in Tables 1 and 2.

Table 1. Mean yields of yam, snapbean, cowpeas and dasheen from the yam intercropping experiment at Union Agricultural Station (t ha^{-1})

Code[1/]	Yam	Snapbean	Cowpeas	Dasheen
Y	16.3			
Y-C-Y-C	13.7		2.29	
Y-Y-2C	15.2		1.45	
Y-S-Y-S	21.7	1.35		
Y-Y-2S	16.7	0.97		
Y-D-Y-D	16.3			4.42
Y-Y-2D	20.5			1.83
Y-D-Y-C	15.0		1.62	1.75
Y-D-Y-S	15.5	0.44		2.67

[1/] Y = Yam; C = Cowpeas; S = Snapbeans; D = Dasheen.

Table 2. Mean yields of yam, snapbeans and cowpeas from the on-farm yam experiment (t ha^{-1})

Code[1/]	Yam	Snapbean 1[2/]	Snapbean 2[3/]	Cowpeas 1	Cowpeas 2
Y	12.6				
Y+S	11.3	1.80			
Y+S-- >S	12.3	1.67	0.70		
Y+C	9.6			0.85	
Y+C-- >C	10.5			0.93	0.23

1/ Y = yam, S = snapbeans, C = cowpeas.
2/ 1st. planting.
3/ 2nd. planting.

These yield data were used to compute total receipts which are presented in Tables 3 and 4. According to Table 3, total receipts from the sole crop of yam at the Union Agricultural Station was EC$25,000 per hectare: material and service costs were $3,460, and labor costs $5,677. This resulted in a return to land, risk and management of $15,855 per hectare.

Total receipts from intercrop treatments were higher than those from pure stand yam. Receipts ranged from $26,865 per hectare for treatment Y-Y-2C to $39,564 per hectare for treatment Y-S-Y-S. Additional material costs for the treatments involving cowpeas and snapbeans increased by only $74.00 per hectare. This was for purchasing planting material. With respect to the dasheen intercrop, it was assumed that the planting material was obtained free.

Similarly, labor costs for the intercrop treatments were higher than those for pure stand yam (Table 3).

The increased labor costs were due to increased labor use for planting and harvesting the intercrop and so on.

Total receipts from intercropped yams in the trial conducted on farmers' holdings were higher than those from the pure stand yam, except for treatment Y+C (Table 4). Material costs with an intercrop were higher due to planting material and insecticide costs. Labor costs were also higher because of increased labor required for planting, applying insecticides and harvesting the intercrop.

Limiting factor analysis was conducted to determine the efficiency of the treatments from both intercropping experiments in terms of utilization of land, labor and capital (Tables 3 and 4). The treatments were then ranked, and the results of the ranking are presented in Tables 5 and 6.

In the intercropping trial at the Union Agricultural Station, intercropping yam with snapbeans ranked highest for most efficient utilization of land, labor and capital (Treatment Y-S-Y-S). This was followed by intercropping with dasheen (Y--Y-2D) for efficient utilization of land and capital but fifth for efficient labor utilization.

In the trial on farmers' holdings, intercropping yam with snapbean (Y+S--S) ranked highest for efficient utilization of land and capital

Table 3. Costs and returns per hectare for the treatments in the Union Agricultural Station yam intercropping experiment (EC$)

Category	Y	Values for indicated treatments (EC$)[1/]							
		Y-C-Y-	Y-Y-2C	Y-S-Y-S	Y--Y-2S	Y-D-Y-D	Y--Y-D	Y-D-Y-2C	Y-D-Y-2S
Total receipts	25591	30692	29679	39483	30109	32972	35241	32669	30558
Material & service costs	3468	3542	3542	3542	3542	3468	3468	3542	3542
Return to land, labor, risk and management	22123	27150	26137	35941	26567	29504	31773	29157	27016
Labor costs	5677	6841	7375	6841	6669	7233	7233		
Returns to land risk and management:									
Per unit land	16446	20309	18762	29100	19898	22271	24540	21924	19783
Per unit labor	9.6	9.9	9.1	14.0	9.8	10.2	11.2	10.0	9.0
Per unit capital	4.7	5.7	5.3	8.2	5.6	6.4	7.1	6.2	5.6

1/ Y = Yam, C = Cowpeas, S = Snapbeans, D = Dasheen.
Total receipts from yam and intercrop. Farm gate price of $1570 for yam, $4010 for snapbeans/cowpeas and $16.70 t^{-1} for dasheen.
Service cost is cost of machinery for land ploughing and ridging.
Labor costs computed at @ $3.30 hr^{-1}.

Table 4. Costs and returns per hectare for the treatments in the on-farm yam intercropping experiment (EC$)

Category	Values for indicated treatments (EC$)[1/]				
	Y	Y + S	Y+S-->S	Y+S-C	Y+C-->C
Total receipts	19782	24959	28815	18481	21136
Materials and service costs	1810	1883	1956	1883	1956
Return to land, labor, risk and management	17972	23076	26859	16598	19180
Labor costs	10371	12367	13702	12257	13640
Returns to land risk and management:					
Per unit land	7601	10709	13157	4341	5540
Per unit labor	2.4	2.9	3.2	1.2	1.3
Per unit capital	4.2	5.7	6.7	2.3	2.8

1/ Y = yam, C = cowpeas, S = snapbeans.
Total receipts from yam and intercropping. Farm gate price of $1570 for yam and $4010 t^{-1} for snapbean/cowpeas.
Service cost is cost of machinery for land ploughing and ridging. Labor costs computed at $3.30 hr^{-1}.

Table 5. Ranking of treatments in the intercropping experiment at Union Agricultural Station according to efficiency of utilization of land, labor and capital

Criteria	Treatments[1/]								
	Y	Y-C-Y-C	Y--Y-2C	Y-S-Y-S	Y--Y-2S	Y-D-Y-D	Y--Y-D	Y-D-Y-2C	Y-D-Y-2S
Land	9	5	8	1	7	3	2	4	6
Labor	7	5	8	1	6	3	2	4	9
Capital	9	5	8	1	6	3	2	4	6

1/ Y = yam, C = cowpea, S = snapbeans, D = dasheen.
1 = highest, 9 = lowest.

Table 6. Ranking of treatments in the on-farm yam intercropping experiment according to efficiency of utilization of land, labor and capital

Criteria	Treatments[1/]				
	Y	Y+S	Y+S-->S	Y+C	Y+C-->C
Land	3	2	1	5	4
Labor	3	1	2	5	4
Capital	3	2	1	5	4

1/ Y = yam, C = cowpeas, S = snapbeans.
1 = highest, 5 = lowest.

but second for utilization of labor. Intercropping yam with snapbean at one planting, (Y+S), ranked highest for utilization of labor. Sole yam was ranked third for efficient utilization of land, labor and capital.

It was hypothesized that intercropping did not reduce significantly returns from yam. Gross revenues obtained form yam in the two intercropping trials are presented in the following tabulation:

Treatment	Mean yam revenue, EC$ ha^{-1}
(Station Trial)[1/]	
Y	25591
Y-C-Y-C	21509
Y--Y-2C	23864
Y-S-Y-S	34069
Y--Y-2S	26219
Y-D-Y-D	25591
Y--Y-D	32185
Y-D-Y-2C	23550
Y-D-Y-2S	24335
(On-farm Trial)[2/]	
Y	19782
Y+S	17741
Y+S-->S	19311
Y+C	15072
Y+C-->C	16485

1/ CV 27.88
Y = yam, C = cowpea, S = snapbeans, D = dasheen.

2/ CV 32.4
Y = yam, C = cowpea, S = Snapbeans.

There were no significant differences between revenues obtained from sole yam and those from intercropped yam.

Revenues and costs per hectare for the intercrops in the two yam intercropping experiments were computed and are presented in Tables 7 and 8.

In the experiment at Union Agricultural Station, for all treatments and all crops, the costs of establishing the intercrop in the system were less than the revenues obtained from the intercrop (Table 7).

Table 7. Revenues and cost per hectare by intercrop in the intercropping experiment at the Union Agricultural Station.

Treatment	Crops					
	Cowpea		Snapbean		Dasheen	
	Revenue	Cost	Revenue	Cost	Revenue	Cost
Y-C-Y-C	9183	1772				
Y--Y-2C	5815	1238				
Y-S-Y-S			5414	1772		
Y--Y-2S			3890	1238		
Y-D-Y-D					7381	992
Y---Y-D					3056	992
Y-D-Y-2C	6496	1201			2923	992
Y-D-Y-2S			1764	1201	4459	992

1/ Y = yam, C = cowpea, S = snapbeans, D = dasheen.

2/ Cost of intercrop includes only costs borne directly by the intercrop such as planting material, planting, harvesting, etc. It is assumed that yam bears the full cost of land preparation, weeding, etc.

Similar results were obtained for the experiment on farmers' holdings, except for the second planting of cowpeas in treatment Y+C+C. For that planting costs were $1742 per hectare while returns were only $922 per hectare (Table 8).

Table 8. Revenues and cost per hectare by intercrop in the on farm experiment, EC$.

Treatment	Crops			
	Snapbean/Cowpea 1 1/		Snapbean/Cowpeas 2	
	Revenue	Cost 2/	Revenue	Cost
Y+S	7218	2132		
Y+S--> S	6697	2053	2807	1418
Y+C	3409	2037		
Y+C--> C	3729	2006	922	1472

1/ 1 = 1st, 2 = 2nd planting of intercrop.

2/ Cost of intercrop includes only costs borne directly by the intercrop such as planting material, planting, harvesting, etc. It is assumed that yam bears the full cost of land preparation, weeding, etc.

CONCLUSIONS

Based on the results presented above, the following conclusions are drawn:

- Intercropping of yam with food crops such as snapbeans, cowpeas or dasheen increases farm income. Snapbeans give a greater increase in farm income.

- Intercropping of yam with food crops can result in a more efficient utilization of land, labor and capital.

- The time of planting of the intercrop is important. It may not be economical to plant a second crop.

- Intercropping does not significantly reduce the returns from yam.

- The additional revenue obtained from intercropping yam with food crops is greater than the additional cost of establishing the intercrop within the system.

- In addition to increasing total returns, intercropping can improve the cash flow position and the nutritional status of farm households.

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ACKNOWLEDGEMENTS

Special thanks to Dr. M. M. Rao for providing the yield data used in the present analysis and to C. Flavius for assistance in collecting data on labor and material use.