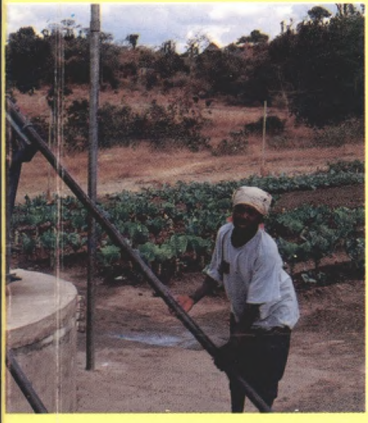
Smallholder Horticulture

in ZIMBABWE



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OPPORTUNITIES FOR INCREASING LAND AND CROP PRODUCTIVITY AMONG ZIMBABWE'S SMALL-SCALE IRRIGATION SCHEMES

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ABSTRACT

Land productivity, crop yields, and the associated production costs and cash returns of five different cropping systems were compared to the farmers' cropping practices (FCP) from 1983 to 1986 in the southeast of Zimbabwe. In most cases, the FCP involve growing of either maize (for green mealies or for grain), cotton or groundnuts as the main cash crop during summer followed in winter by vegetables (tomato, onion, cabbage, and other leafy brassicas), wheat and/or beans. Generally, during each cropping season, a single crop occupied the whole plot owned by an individual farmer resulting in the growing of two or three crops within a year.

Land was split to accommodate at least three crops during each growing season for a total of 9 to 12 crops per year under the five different cropping systems that were tested. The crops that were grown included maize (for green mealies), tomato, cabbage, cauliflower, rape *(Brassica napus)*, sweet potato, okra, onion, garlic, beans and watermelon. These multicrop systems produced significantly higher profits ($P < 0.01$) than the FCP but needed timely and more disciplined management. The FCP were slightly less expensive than multicrop systems because of the comparatively smaller quantities of seed and fertilizer used. Land productivity and crop yields under the FCP were low because of long intervals between successive crops, unreliable irrigation water and the inflexibility of the Agricultural, Technical and Extension Services (AGRITEX) advice on the choice of crops to be grown by a farmer during a cropping season. Labour accounted for 42 to 52% of the production costs among all the cropping systems tested. Fertilizer, seed and crop protection chemicals accounted for 19, 18 and 9 percent respectively. Profitability indices for crops that can be grown all year round are provided, however, the final choice of when and which crop combinations to be grown at any particular time should be the responsibility of the farmer.

INTRODUCTION

The individual sizes of small-scale irrigation schemes in the southeast lowveld of Zimbabwe ranges from 6.5 to 120 ha. Each plotholder has 0.1 to 2 ha depending on the size of the scheme; however, some individual plotholders possess more than one such plot. The crops that are grown on these schemes include maize for both green

mealies and grain, cotton, wheat, groundnuts, beans, sweet potato and vegetables such as cabbage, rape *(Brassica napus L.)*, a type of mustard - *"chemberedzagumana"*, tomato, onion, shallot and okra. A few of these schemes now grow bananas and are introducing other fruits such as mango and citrus. The least productive of these schemes grow maize or cotton as the predominant summer cash crops followed by vegetables (cabbage, tomato and other leafy vegetables) and dry beans during winter. However, Rukuni (1984a) in a survey of 55 smallholder irrigation schemes in five provinces of Zimbabwe reported a wide variation of cropping patterns. We have also observed some variations in the crops that are grown in individual irrigation schemes of the southeast lowveld. For instance, some farmers at Chilonga and Mutema grow cotton in summer and wheat in winter instead of vegetables or beans. Most farmers at Manjinji grow maize throughout the year, whereas some farmers at Rupangwana and Banga irrigation schemes grow groundnuts and sweet potato.

Notwithstanding these local variations, the cropping programs on most schemes are typical extensions of the subsistence cropping systems that are practised under rainfed agriculture. These cropping systems result in low productivity of land and in sequences of oversupply and acute shortages of produce at different times of the year (see also paper by Mazhangara *et al.* in this book). Rukuni (1984b) concluded that the three main limiting resources among small-scale farmers on such schemes were low financial returns that result in shortages of cash for buying inputs, shortage of labour for the peak demand period for most cash crops and lack of draught power for cultivation. Furthermore, farmers, AGRITEX and Blackie *et al.* (1984) believe that a family cannot make a decent living from 0.1 ha on these schemes. However, the climate in the lowveld is conducive to growing of several different crops throughout the year. Also, the greatest potential returns from irrigated cropping are from growing horticultural crops. Intercropping and relay cropping with horticultural crops have been investigated for both rice and sugarcane as principal crops in Asia (Villareal and Lai, 1977). Brown *et al.* (1985) and Nzima (1988) independently reported that multicrop systems offered more efficient use of land and gave greater yields and profit than monocrop systems. This paper presents results of a study that measured the productivity of land and the monetary returns from different cropping patterns and sequences.

MATERIALS AND METHODS

Crop yields and cash returns of five different cropping systems were compared to the farmers' cropping practices (FCP) using a randomised complete block design with four replicates in 1983/84 and 1984/85 and five replicates in 1985/86. The net plot was 4.5 m long and 7.5 m wide and consisted of 10 ridges that were spaced 0.75 m apart. Plants were spaced 0.3 m apart within the row for all crops. Each net plot was completely surrounded by a single row of plants that were similar to the crop on the adjacent row of the net plot. This single row of plants constitute a perimeter guard row. There were no guard rows separating individual crops within a net plot of the alternative cropping patterns and sequences.

A total of three crops were grown each year in the FCP (Table 1). During each cropping season, only one crop was planted on each of the ten ridges of three replicates

mealies and grain, cotton, wheat, groundnuts, beans, sweet potato and vegetables such as cabbage, rape *(Brassica napus L.)*, a type of mustard - *"chemberedzagumana"*, tomato, onion, shallot and okra. A few of these schemes now grow bananas and are introducing other fruits such as mango and citrus. The least productive of these schemes grow maize or cotton as the predominant summer cash crops followed by vegetables (cabbage, tomato and other leafy vegetables) and dry beans during winter. However, Rukuni (1984a) in a survey of 55 smallholder irrigation schemes in five provinces of Zimbabwe reported a wide variation of cropping patterns. We have also observed some variations in the crops that are grown in individual irrigation schemes of the southeast lowveld. For instance, some farmers at Chilonga and Mutema grow cotton in summer and wheat in winter instead of vegetables or beans. Most farmers at Manjinji grow maize throughout the year, whereas some farmers at Rupangwana and Banga irrigation schemes grow groundnuts and sweet potato.

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A total of three crops were grown each year in the FCP (Table 1). During each cropping season, only one crop was planted on each of the ten ridges of three replicates and only nine ridges of the fourth and fifth replicates. This

ble 1: List of crops that were grown and their sequences for the five alternative cropping systems (ACS) and the farmers' cropping practice CP) from 1983 to 1986

	Crops and their Sequences								
	1983/84			1984/85			1985/86		
eatment	First crop	Second crop	Third crop	First crop	Second crop	Third crop	First crop	Second crop	Third crop
S1	Tomato	Beans	—	Tomato	Cabbage	Onion	Tomato	Cabbage	Maize
	Cabbage	Tomato	Maize	Cabbage	Tomato	Maize	Cabbage	Tomato	Beans
	Maize	Onion	—	Maize	Sweet potato	Beans	Maize	Sweet potato	Onion
S2	Tomato	Beans	—	Tomato	Garlic		Tomato	Onion	
	Cabbage	Okra	—	Cabbage	Okra	Maize	Cabbage	Cabbage	Garlic
	Maize	Rape	—	Maize	Cabbage	Cauliflower	Maize	Okra	Maize
S3	Tomato	Beans	—	Tomato	Beans	Maize	Tomato	Cabbage	Tomato
	Cabbage	Maize	—	Cabbage	Maize	Okra	Cabbage	Maize	Beans
	Maize	Cabbage	—	Maize	Cabbage	Garlic	Maize	Watermelon	Onion
S4	Tomato	Beans	—	Tomato	Sweet potato	Beans	Tomato	Sweet potato	Maize
	Cabbage	Tomato	Maize	Cabbage	Tomato	Maize	Cabbage	Okra	Beans
	Maize	Rape	—	Maize	Tomato	Maize	Maize	Tomato	Cabbage
S5	Tomato	Beans	—	Tomato	Cabbage	Beans	Tomato	Cabbage	Beans
	Cabbage	Tomato	Maize	Cabbage	Tomato	Maize	Cabbage	Tomato	Maize
	Maize	Rape	—	Maize	Tomato	Maize	Maize	Tomato	Garlic
P	Maize	Cabbage	Beans	Maize	Cabbage	Beans	Maize	Cabbage	Beans

RESULTS AND DISCUSSION

The productivity of land varied from year to year because of the type of crops that were grown each year (Table 1) as well as the prevailing weather conditions. It was not possible to grow the projected nine crops in all the alternative cropping patterns during 1983/84 (Table 1) because of the difficulty of correctly judging the time to sow seeds for the next crop so that seedlings were ready at the end of harvest of the previous crop. Still, the performance of some of the multicrop systems after two cropping sequences showed much promise (Table 2). The total marketable yields show that both in 1984/85 and 1985/86, land was more productive under multicrop systems than under the farmers' cropping practices (Table 2). This was achieved after improvements in crop timing as well as in better formulation of cropping sequences. Market information on the supply and demand of vegetables at Chiredzi town was used to decide on the alternative crops. These results highlight the importance of understanding and carefully studying all the factors that influence both crop production at the farm and consumption at the market levels (also see paper by Mazhangara *et al.* in this book).

Table 2: Marketable yields (kg/0.1 ha) of five different alternative cropping systems (ACS) compared to the farmers' cropping system (FCP) during 1983 to 1986

	Total Marketable Yields		
Treatment	1983/84	1984/85	1985/86
ACS1	5 132.4 NS	5 062.3**	8 598.3**
ACS2	1 864.2**	3 443.9**	6 248.5**
ACS3	2 921.5**	3 493.9**	7 549.5**
ACS4	3 268.7**	2 932.3**	7 348.3**
ACS5	3 233.4**	3 088.5**	5 061.0**
FCP	4 995.8	1 674.1	2 511.4
Mean	3 566.4	3 282.5	6 219.5
LSD (0.05)	642.50	993.18	1 075.94
LSD (0.01)	888.52	1 373.48	1 467.42

NS = Not significantly different from FCP
*** = Significant at 0.01 level of probability compared to FCP*

The general trend of cash incomes followed that of total marketable yields (Table 3). The FCP was very productive when the farmer could market all his crop. However, in practice a portion of the standing crop remains and is allowed to dry in the field because of lack of market or the farmer is not allowed by AGRITEX to plant a second crop until *"the appropriate season"*. This increases the interval between crops and reduced the number of crops that could be grown on the same land during a single year. Splitting the land into three small subplots and growing more than one crop at the same time gave greater monetary returns than FCP (Table 3). Multicrop sequences reduced the risk of failure during times of low market demand for any single crop grown in monoculture (Tables 1 and 3). The alternative cropping patterns offered as

the cropping of an equivalent of 0.1 ha of land for each treatment. Maize was always the starting crop of the first cropping season of the year, followed in the subsequent two seasons by cabbage and beans, respectively.

In each of the five alternative cropping patterns, three different crops were grown simultaneously during any single cropping season. This enabled the growing of nine crops in 1984/85 and 1985/86 and only six crops in 1983/84 (Table 1). One crop occupied the first four ridges of a net plot and the other two crops each occupied three of the remaining six ridges. The assignment of the crops to ridges was changed around in the second and third replicates such that each of the three crops occupied a total of ten ridges in three replications. Finally, each of the crops occupied only three ridges within a plot in the fourth and fifth replicates. Maize, cabbage and tomato were the three crops that were grown at the beginning of each cropping year in the five alternative cropping patterns. However, different crop combinations were grown during the subsequent two cropping seasons of the year in each of the three years as shown in Table 1. The choice of crops to follow the initial three was strongly influenced by the supply and demand of vegetables at Chiredzi town.

All the ridges were in a north-south direction. Maize was always sown on the ridges to the west of each plot to provide shade to the vegetables during the afternoon. Tomato rows were always the farthest to the east of the maize, whereas cabbage and/or other vegetables occupied the area between maize and tomato. Preliminary trials had indicated that planting tomato nearest to maize significantly reduced tomato yields whilst cabbage yields were least affected by planting nearest to the maize. In all cases, land preparation was done soon after the harvesting of an individual crop had been completed and a follow-up crop was then planted immediately on that part of the plot.

Prices of vegetables were monitored every first and third week of each month from January 1983 through December 1986 at both the open markets *(musika)* and supermarkets in Chiredzi town and Triangle Estates. Vegetable prices at Triangle were not influenced by vegetable production at the small-scale irrigation schemes of the southeast lowveld, as a result, the prices from Triangle monitoring exercise were not used to compute the fortnightly farm gate prices that were calculated as:

$$\text{"Producer price"} = {}^{1}/_{2}\{\text{open market} + \text{supermarket prices}\}/2$$

The yield of a crop that was harvested during a two-week period was multiplied by the "producer price" for the corresponding fortnight to obtain the gross returns for the crop. The gross returns from each crop plot and all the replications were added to give gross incomes from 0.1 ha.

Employees of Chiredzi Research Station were assigned to manage individual treatments on a permanent basis and all sales of produce from these plots were extra income for these employees. The time spent performing any tasks such as land preparation, weeding, irrigating, applying fertilizer, spraying and harvesting of individual crops were recorded and used to determine the total labour costs associated with the particular cropping pattern. Similarly, records of all inputs such as fertilizer, pesticides and fuel used for land preparation were used to calculate production costs.

The different cropping systems were compared by carrying out analysis of variance on the marketable yields expressed in kg/0.1 ha and mean gross incomes expressed in Z$/0.1 ha and using the least significant diff[illegible]

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farm workers. The data presented in Table 2 and 3 strongly support the assertions of Brown *et al.* (1985) that double crop systems offer more efficient use of land, give higher yields and profits than instances of monocropping, but that these systems demand timely and more disciplined management.

Table 3: Gross income (Z$0.1 ha) of five different alternative cropping systems (ACS) compared to the farmers' cropping system (FCP) during 1983 to 1986.

Mean Gross Yields (Z$/0.1 ha) Treatment	1983/84	1984/85	1985/86	Average
ACS1	1 918.18**	1 500.37**	2 917.70**	2 112.08
ACS2	582.72**	853.10**	2 960.49**	1 465.44
ACS3	691.13**	1 277.95**	2 607.92**	1 525.67
ACS4	851.36*	539.46*	2 003.72**	1 131.51
ACS5	801.76**	550.31*	2 334.89**	1 228.99
FCP	1 074.46	317.36	723.24	705.02
Annual minimum farm wage	780.00	900.00	1 020.00	900.00
LSD (0.05)	173.57	174.64	345.10	
LSD (0.01)	240.04	241.51	470.67	

NS = Not significantly different from FCP
* = Significant at 0.05 level of probability compared to FCP
** = *Significant at 0.01 level of probability compared to FCP*

Water charges in these small-scale irrigation schemes are fixed at Z$145.00 per ha irrespective of the amount used, the cost of pumping and delivering the water and any maintenance costs. The FCP is marginally cheaper than the multicrop systems because of its lower requirements for seed and fertilizer.

In all cases, labour was the most expensive single factor of production, accounting for between 42 and 52% of the total production costs (Table 4). On average, fertilizer and seed accounted for 18.7 and 18.1% of the total production costs and were not different from what farmers spent under their practices (Table 4). The cost of controlling pests and diseases were almost equal in all the treatments and averaged 8.9 per cent of the total production costs despite that multicrop systems had more crops grown within any single year than in the FCP. This could be attributed to possible presence of predators and parasites in multicrop systems and to some crops being naturally repellent to certain insects (Altierie, 1987).

The net incomes summarized in Table 5 clearly demonstrate the possibility of realizing high monetary returns from a unit of land under multiple cropping and that if the most profitable systems were followed, the income from 0.1 ha can be better than farm employment. These results refute the assertion by Blackie *et al.* (1984) that plot sizes must be at least one hectare for "productive schemes" to achieve net incomes in the range of statutory urban minimum wages. It can be concluded from the data in Table 5 that small-scale irrigators in Zimbabwe can make good profits provided they adopt cropping systems that are different from those currently practised by most of these farmers. A lot of information has been

Table 4: Production costs (Z$/0.1 ha) for the five alternative cropping systems (ACS) and the farmers cropping practice (FCP) during 1983 to 1986.

Item	Production Costs (Z$/0.1 ha) ACS1	ACS2	ACS3	ACS4	ACS5	FCP
1983/84						
Labour*	—	—	—	—	—	—
Fertilizer	97.89	70.91	77.34	101.53	101.53	78.4
Seed	14.14	10.97	10.40	10.40	10.40	10.01
Chemicals	8.89	11.66	15.72	10.34	10.34	4.73
Water	14.50	14.50	14.50	14.50	14.50	14.50
Total	135.42	108.04	117.96	136.77	136.77	136.77
1984/85						
Labour	169.31	156.59	178.93	168.94	171.40	121.83
Fertilizer	67.60	56.19	63.72	67.68	65.82	50.53
Seed	71.66	72.60	94.16	61.39	37.38	34.89
Water	14.50	14.50	14.50	14.50	14.50	14.50
Total	336.49	312.13	361.43	325.18	297.43	230.70
1985/86						
Labour	171.21	181.34	206.38	172.98	176.58	148.35
Fertilizer	57.26	74.24	59.58	84.29	51.33	54.83
Water	14.50	14.50	14.50	14.50	14.50	14.50
Total	355.74	361.03	380.17	380.92	383.49	344.21

**In 1983/84 labour was assumed to have been provided by family members and was thus not costed.*

Table 5: Net incomes (Z$/0.1 ha) from the five alternative cropping systems (ACS) and the farmers cropping practice (FCP) and the annual minimum farm wages during 1983 to 1986

Treatment	Net Income (Z$/0.1 ha) 1983/94	1984/85	1985/86	Total
ACS1	1 782.76	1 163.88	2 561.96	5 508.60
ACS2	474.68	540.97	2 599.45	3 615.10
ACS3	573.17	916.52	2 227.75	3 717.44
ACS4	714.59	214.28	1 622.80	2 551.67
ACS5	664.99	252.88	1 951.40	2 869.27
FP	670.18	87.29	379.04	1 136.51
Annual minimum farm wage	780.00	900.00	1 020.00	2 700.00

the Lowveld Research Stations on the performance of a wide range of crops when planted at different times of the year. Farmers can use the principles from these experiences and then develop their own multicrop systems and sequences. Furthermore,

and the ability of the farmer to survive periods of depressed market prices as well as the contribution of the crop to the family nutrition.

This study quantified and demonstrated a wide range of crops that can be grown at different times of the year in small-scale irrigation schemes. Growers must determine the number of crops they will grow at any given time of the year and the amount of land to allocate to each crop based on the market size, the household needs, the extent to which the crop is grown in and around the scheme as well as the grower's ability to manage the crop. This may be incompatible with external control through an extension service, whose role should be to provide technical information on crop production and market intelligence.

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