

7

Economic Aspects

NOTE: Most agricultural officers in Sierra Leone still record and plan in imperial units (acres, pounds, bushels, etc). To void the confusion of using two systems of units the SI units have been omitted;

1 ha = 2.47 ac 1 kg = 2.2 lb

7.1 INTRODUCTION

Even a small subsistence farmer is a businessman and he is only likely to invest in new techniques if he considers that they will profit him. Previous chapters have shown that ox-cultivation is practicable, but it is also important to consider whether ox-cultivation is economically attractive. Farmers in Bombali and Koinadugu Districts have continued to use oxen for many years, which suggests that there must be significant benefits for them.

Similarly the fact that during the years 1978 to 1981 farmers in the very north of the country were, for the first time, adopting ox-cultivation following the local diffusion of equipment and techniques from Guinea, suggests that they must have found significant benefits from ox-cultivation. The benefits might be defined in terms of reduced drudgery for the farmer, improved timeliness of operations or in actual money saved. If a farmer has to buy oxen and a new plough, he has to invest a great deal of money and he may well seek a loan. In such circumstances it is important to show that the investment is profitable in terms of money. The use of oxen must therefore be considered from an economic standpoint.

The problem with economic discussions is that they sometimes appear theoretical, for it is necessary to make specific assumptions on costs which are actually very variable. For example, the cost of cattle varies with the season of purchase, the weight of the animal, the ability of the purchaser to bargain and, most importantly, the location within the country, with the cost effectively doubling between the Guinea border in the north and the towns in the south. Village labour rates which generally include food as well as cash, also vary greatly and specific contract work is more common than work on a daily wage basis. A farmer who uses family labour for grazing cattle or for crop

cultivation may not consider the labour as a real cost at all, particularly as opportunities for alternative employment of the members of the family are likely to be very restricted. Even when costs can be accurately fixed for labour or specific items, the general economic inflation can make many figures out of date in a very short time. Changes in international exchange rates can also greatly affect the costs of imported materials. Assumptions on economic costs, therefore, have to be made with great care in order to reflect accurately realistic values.

7.2 THE COST OF OWNING OXEN

With all due caution, bearing in mind the problems of fixing average values, a budget has been prepared for what it might cost a farmer to own a pair of oxen, see Table 7.1 This budget assumes that animals are bought from traders at 180 kg (400 lb), but grow to 295 kg (650 lb) before being sold and that the profit is considered to be spread over 5 years' use. Interest of 12% pa is charged on the mean value of the oxen to enable a commercial loan to be considered. While the farmer cannot actually take out an insurance policy to cover his animals, the budget assumes that there may be a 1 in 12 risk of any animal dying in a year, (ie a 1 in 6 risk of one of a pair of oxen dying in any one year); so a theoretical insurance cost to cover this risk is included.

The budget also assumes that the farmer will have to make some arrangement for supervising the animals' grazing, perhaps by child supervision, perhaps by contract with another cattle owner, or possibly the cost of tethering the animals and moving them during the day. The farmer is also likely to incur a small amount of expenditure in providing a shelter, in the purchase of ropes and in obtaining some simple medication. In addition it is necessary to budget for ox-handlers, even though it may be that the farmer, assisted by a member of his family, controls his oxen himself; Le 4.00 per working day has been allowed for this. Also salt may be offered to the animals each working day at a

cost of Le 0.20. Thus it is assumed that to buy and keep a pair of oxen will cost a farmer approximately Le 340 pa. To use the oxen may cost an extra Le 4.20 a day. From this it is clear that if he only uses his animals a little, their labour will be expensive, while if he uses them a lot, the daily or hourly cost will decrease.

Table 7.1

Annual Budget for maintaining a pair of Oxen in Sierra Leone

Item	Annual Cost	Notes
FIXED COSTS		
Oxen	Le	Bought at 400 lb each and sold at 650 lb each @ Le 0.80/lb. Profit averaged over 5 years.
Purchase @ Le 640		
Sale @ Le 1040		
5-yr amortisation	-80	
Interest		
12% on mean value of oxen	101	12% of $\frac{640 + 1040}{2}$
Insurance (Risk of accidental death)	67	8% of mean value as a 1 in 12 risk of death.
Grazing costs	183	Le 0.50 per day throughout the year to cover grazing supervision.
Ropes & Reins	25	Locally made ropes.
Housing	15	Simple shelter only.
Animal health costs	30	Tick spray & wound oil etc. Other veterinary services generally not available.
TOTAL Annual Overheads	Le 341	
VARIABLE COSTS		
	Daily Le	
Ox handlers	4.00	2 men @ Le 2.00/day
Supplementary salt	.20	$\frac{1}{2}$ lb salt/Working day
TOTAL Daily costs	4.20	
TOTAL Hourly costs	1.05	Assuming 4 hrs work/day.

Table 7.2

HOURLY COSTS OF WORK OXEN by different annual workloads (in leones)

	Days worked per year					
	50	75	100	150	200	300
Overhead costs (Tab 7.1)	341	341	341	341	341	341
Daily costs @ Le 4.20	210	315	420	630	840	1260
TOTAL	551	656	761	971	1181	1601
Overall cost/working day	11.02	8.75	7.61	6.47	5.90	5.34
Overall cost/working hour *	2.76	2.18	1.90	1.61	1.48	1.53

* Assuming 4-hour working day

From the above Table it is apparent that the hourly cost of the ox-team and handlers is Le 2.76 working 50 days a year, but only Le 1.48 if they work 200 days a year. These figures can be used in calculating the potential economic benefits of using oxen but, in doing so, reference must again be made to the need for caution that has already been stressed.

The figures are considered realistic values for what an entrepreneurial farmer in the centre of the country might pay if he obtained credit from a commercial bank and employed local labour in the village for his farming operations. However, a cattle-owning farmer near the Guinea border using family labour might consider the overhead costs of his cattle as almost zero, and his own and his family labour would require no immediate outlay of cash; in his case the budget would seem a gross overestimate. For the purposes of the economic arguments that follow, however, the budget presented is considered acceptable, particularly as the comparisons with hand operations will be based on comparable and consistent assumptions.

7.3 COST OF OWNING OX-EQUIPMENT

7.3.1 Oxen & Plough

Table 7.1 shows that the cost of owning a pair of oxen (including interest charges) is Le 341 per year, and that the extra cost of using the animals works out at Le 4.20 a day, or Le 1.05 per hour of work.

From Table 7.3 below it can be seen that the annual cost of owning a plough is Le 58 and a harrow Le 20. Thus, total overhead costs for the farmer are Le 419 a year.

Table 7.3

ANNUAL COST OF OWNING OX-EQUIPMENT¹

	Annual Cost (Leones)					TOTAL ²
	Initial Cost (Le)	Time for depreciation (years)	Depreciation	Interest ²	Maintenance	
Basic plough	317	10	31	19	8	58
Harrow (Locally made)	50	4	13	3	4	20
3-tine Weeder	167	10	17	10	4	31
Groundnut Lifter	34	10	3	2	4	9
Ridger	123	10	12	7	4	23
Seeder	212	7	30	13	10	53
Cart (Locally made)	300	10	30	18	10	58
TOTAL						252

¹ Based on imported Anglebar prices landed and cleared in Freetown (Table 5.1). Costs of Pecotool and Sine Houe systems are generally lower than these prices.

² 12% interest on the mean value of the equipment is charged. The total figure is sufficient to repay interest and capital on a loan of 12% over the full period of depreciation. To repay the interest and capital in just four years would require 80% more than the figure in the Total column for the four years; thereafter maintenance would be the only cost.

Table 7.4

COMPARISON OF COSTS OF OX-PLOUGHING & HAND CULTIVATION, by different areas of cultivation (in Leones)

	(Area cultivated (acres))					
	1	2	4	6	8	10
Ox-Cultivation						
Fixed costs:						
Oxen, Tab 7.1	341	341	341	341	341	341
Plough, Tab 7.3	58	58	58	58	58	58
Harrow, Tab 7.3	20	20	20	20	20	20
Variable costs:						
Le 1.05/hr, Table 7.1	17	34	67	101	134	168
Total	436	453	486	520	553	587
Hand-Cultivation						
300 manhrs/ acre @ Le 0.25/hr	75	150	300	450	600	750
Difference: (Savings by using oxen)	-361	-303	-186	-70	47	163

Conclusion: Ox ploughing is cheaper than hand cultivation if over 7 acres are cultivated each year.

Trials at Njala University College indicated that to plough and harrow upland soils using oxen required about 16 ox-team hours/acre (40 hrs/ha), while to achieve the same with hand labour required 300 manhours/acre (750 hrs/ha). From these figures can be calculated the cost of primary cultivation by hand and by oxen, for increasing areas of cultivation, Table 7.4 above.

From this table it can be seen that ox-ploughing is economically justified if over 7 acres (2.8 ha) of upland crops are cultivated each year. Cultivating this area would only require 28 working days each year, and so the farmer would have ample time for swamp cultivation or other operations, which would further justify the cost of owning the oxen. He might therefore consider investing in an ox-weeder, a seeder or a groundnut lifter.

7.3.2 Ox-weeder

Using the same system, we have calculated the area of crops planted in rows that would make a weeder profitable. Since the overheads of the oxen and plough have already been covered, only the extra cost of the weeder will be considered.

Table 7.5

COMPARISON OF COSTS OF OX-WEEDING & MANUAL WEEDING by different areas of cultivation (in leones)

	Area cultivated (acres)					
	1	2	4	6	8	10
Ox-weeding (twice)						
Fixed cost:						
Weeder, Tab 7.3	31	31	31	31	31	31
Variable costs:						
Oxen 8 hr/ac @ Le 1.05/hr	8	17	34	50	67	84
Hand weeding 60 hr/ac @ Le 0.25/hr	15	30	60	90	120	150
Total	54	78	125	171	218	265
Hand-weeding (twice)						
320 manhrs/acre @ Le 0.25/hr	80	160	320	480	640	800
Difference: (savings using oxen)	26	82	195	309	422	535

Conclusion: Ox-weeding is cheaper than hand-weeding (with a hoe) even if only one acre of row crops is planted each year.

7.3.3 Groundnut Lifter

Again using the same system, it is possible to examine the marginal costs and benefits of using a groundnut lifter, costing Le 9 per year Tab 7.3. Lifting groundnuts by hand requires 60 manhrs/ac (12 hrs/ha) plus 11 manhrs/ac (28 hrs/ha).

Table 7.5

**COMPARISON OF COSTS
OF GROUNDNUT LIFTING using ox-power
and manual power for different areas
of cultivation (in leones)**

	Area cultivated (acres)					
	1	2	4	6	8	10
Lifting with Oxen						
Fixed costs:						
Annual, Tab 7.3	9	9	9	9	9	9
Variable costs:						
5 ox-team hrs/ac @ Le 1.05/hr	5	11	21	32	42	53
11 manhrs/ac @ Le 0.25/hr	3	6	11	17	22	27
Total	17	26	41	58	73	89
Lifting by Hand						
150 manhrs/ac @ Le 0.25/hr	38	75	150	225	300	375
Difference: (savings using oxen)	21	49	109	167	227	286
Conclusion: Ox-lifting is cheaper than hand-lifting if one acre or more of groundnuts is planted each year.						

7.3.4 Seeder

Following the system used already, the economic benefits of a seeder can be judged using the facts that hand seeding (in rows) requires 40 manhrs/acre (100 manhrs/ha), while ox-seeding requires 4 ox-teamhrs/ac (10 hrs/ha)

Table 7.7

**COMPARISON OF COSTS OF OX-SEEDING &
HAND-SEEDING by different areas of
cultivation (in leones)**

	Area planted (acres)					
	1	2	4	6	8	10
Seeding with Oxen						
Fixed costs:						
Annual, Tab 7.3	53	53	53	53	53	53
Variable costs:						
4 ox-team hrs/ac @ Le 1.05/hr	4	8	16	25	34	42
Total	57	61	69	78	87	95
Seeding by hand						
40 manhrs/ac @ Le 0.25/hr	10	20	40	60	80	100
Difference: (Savings using oxen)	47	40	29	18	7	5
Conclusion: 10 acres or more of land has to be planted in rows each year to justify the cost of ox-seeder.						

7.3.5 Ridger

Table 7.8

**COMPARISON OF COSTS OF RIDGING WITH OXEN
AND WITH HOES by different areas of
cultivation (in leones)**

	Area ridged (acres)					
	1	2	4	6	8	10
Ridging with Oxen						
Fixed costs:						
Annual, Tab 7.3	23	23	23	23	23	23
Variable costs:						
18 ox-team hrs/ac @ Le 1.05/hr	19	38	76	113	151	189
Total	42	61	99	136	174	212
Ridging by hand						
192 manhrs/ac @ Le 0.25/hr	48	96	192	288	384	480
Difference: (Savings using oxen)	6	35	93	152	210	268
Conclusion: Investment in a ridger is justified if one acre or more of land is ridged each year.						

7.3.6 Ox-cart

While it is reasonably easy to compare the use of hand labour with the use of ox-cultivation by taking information from field data, it is not possible to assess the use of an ox-cart in the same way. An ox-cart can easily carry 500 kg/½ ton of produce a distance of 4 km/2½ miles in a 4-hour day, but it is not easy to make a realistic estimate of the cost of moving the same produce in head loads. Perhaps it would require 20 manhours @ Le 0.25 per hour, but this would only be a very approximate comparison. However, the running and overhead costs can be assessed for different annual usages to find the cost of each day's work.

Table 7.9

**COST OF OX-TRANSPORT
at different rates of annual use (in leones)**

	Number of days used each yr				
	10	50	100	200	250
Fixed costs:					
Annual cost of cart, Tab 7.3	58	58	58	58	58
Variable costs:					
Le 4.20 per working day	42	210	420	840	1050
Total	100	268	478	898	1108
Per day's use	10.00	5.40	4.80	4.50	4.40

7.3.7 Conclusions

From the foregoing examples, the following conclusion on the economic justification of owning ox-equipment can be made:

- The cost of owning oxen is about Le 340 pa.
- The cost of owning a plough is about Le 58 per annum.
- These costs are justified if good use is made of the animals and a minimum of 28 days' use a year, equivalent to about 3 ha/7 ac of upland ploughing appears necessary.
- If a farmer has a toolbar type ox-plough that can take other attachments, the use of a weeder, ridger and groundnut lifter is indicated if an acre (0.4 ha) or more crops could be cultivated using them.
- The use of a seeder is only economically justified on larger farms where 4 ha/10ac or more of crops are seeded, or on smaller farms where communal or contract use can bring the seeded area to these figures.
- The use of an ox-cart may be justified if it would be used at least 50 times a year, and if the value of a day's transport was considered to be in excess of Le 5.

Table 7.10

BUDGET FOR FARMER USING OXEN for primary cultivation only

Example 1 Assumed cropping programme	Operation	Time/ acre (hrs/ac)	Total Time (hrs)
Swamp rice: 1½ ac	Ploughing & puddling	28	42
Dry season swamp: 1 ac	Ploughing & harrowing	15	15
Upland cropped twice (eg maize followed by cowpeas) 4 ac	Ploughing & harrowing	15	120
Total effective working hrs			177
Total days work, 4 hrs/day			44

Budget for average year

	Le
Fixed costs: Oxen	341
Plough	58
Harrow	20
	419
Variable costs: 177 ox-team hrs @ Le 1.05/hr	186
Total Annual costs	605

Cost per working hour: Le 3.41

Note: If twice the area were cultivated, the cost per working hour of the oxen would be reduced by 35% to Le 2.23.

Table 7.11

BUDGET FOR FARMER USING OXEN for primary cultivation, seeding & weeding

Examples 2 & 3 Assumed cropping programme	Operation	Time/ acre (hrs/ac)	Total Time (hrs)
Swamp rice: 1½ ac	Ploughing & puddling	28	42
Dry season swamp: 1 ac	Ploughing & harrowing	15	15
Groundnuts 4 ac	Ploughing & harrowing	15	60
	Seeding	5	20
	Weeding (twice)	7	28
	Lifting	5	20
Maize (2nd crop) 4 ac	Ploughing & harrowing	15	60
	Seeding	5	20
	Weeding (twice)	7	28
Total effective working hours			293
Total days work, 4 hrs/day			73

Budget for average year:

	Le
Fixed costs: Oxen	341
Plough	58
Harrow	20
Weeder	31
Seeder	53
Lifter	9
Total	512

Variable costs: 293 ox-team hrs @ Le 1.05	308
Total annual costs	820

Cost per working hour: Le 2.80

Note: If twice the area were cultivated, the cost per working hour would be reduced by 31% to Le 1.93.

7.4 FARM BUDGETS

While the economic justification for each piece of ox-equipment can be useful, it is also valuable to consider budgets for specific farming situations. Two examples have been prepared illustrating what might be reasonably expected of a small farmer using work oxen. Table 7.10 shows a possible budget for a farmer who has invested in oxen, a plough and a harrow and cultivates 1½ acres of swamp and 4 acres of upland each year. On the upland he grows two crops (say maize followed by cowpeas, or groundnuts followed by maize); in the swamp he grows one crop of rice in the rainy season and some vegetables in the dry season. His annual costs for using the oxen are Le 605, or Le 3.16 per working hour. As he only uses his animals 44 days a year, he might consider doubling

his acreage, or contracting his services to a neighbouring farm of similar size, which would reduce his hourly cost by 35% to Le 2.23 per hour.

In the second example on Table 7.11, the farmer has a farm of the same size, but he has invested in certain attachments for his ploughs - a weeder, a groundnut lifter and a seeder. His farm is really too small to justify the seeder, but he finds it a convenient way of spacing rows accurately. His annual costs are higher, at Le 820, for he has more equipment and uses his oxen more, but his hourly costs are reduced to Le 2.80 per ox-team hour, which makes his cultivation more economical. He only uses his oxen for 73 days a year and could also consider doubling his acreage or contracting his services to a neighbouring farm. This could reduce his hourly cost by 31% to Le 1.93/ox-team hour.

From these two examples it is clear that investment in the package of equipment is extremely attractive and, while the seeder may be rather a luxury on a small farm, the particular benefits of the weeding tines justify the overall investment.

Table 7.12

ESTIMATED COST OF TRACTOR USAGE

Assumed work programme:

65 HP tractor, disc plough, disc harrow: Le 30 000

Average life: 5000 hrs over 5 yrs.

1000 running hours/yr.

500 effective cultivation hrs/yr

320 acres of unconsolidated land ploughed and harrowed each year.

Capital costs: Le Le

5-yr depreciation, Le 30 000 6 000

12% interest on average value 1 800

Total 7 800

Running costs: 1000 hrs/yr

Fuel: 1.5 gal/hr @ Le 2.92 on site 4 380

Lubricants: @ 10% fuel value 438

Tyres: 1 front, 1 rear pa 740

Repairs & maintenance:

75% of capital cost over working life 4 500

Driver: salary & allowances 870

Insurance: 2% of mean value 300

Total 11 228

TOTAL, Capital & Running costs 19 028

Effective cost per hr for 500 hrs = $\frac{19\ 028}{500}$ =

= Le 38 ph

Cost per acre @ 1½ hrs work per acre = Le 57.

7.5 COMPARISON OF OX-PLOUGHING, TRACTOR PLOUGHING & HAND CULTIVATION

It is interesting to compare the costs of ox-cultivation with the costs of tractor or hand cultivation. To do this a budget has been prepared for the costs of operating a tractor in Sierra Leone, Table 7.12, and it may be noted that the estimated cost for an acre of cultivation of Le 57 is very close to the figure of Le 60/ac estimated for the tractor cultivation of the Crash Rice Programme for 1980/81, (Johnson, 1981). Hand labour is costed at Le 0.25 per hour, or Le 2.00 for an 8-hour working day. From these figures and the examples for ox-cultivation costs already quoted, a table of comparative costs may be drawn and this is done in Table 7.13.

The figures actually refer to upland cultivation based on data from Njala, but boliland figures would be similar and the land preparation could be for upland rice, maize, cowpeas, groundnuts or similar upland crops.

Table 7.13

COMPARISON OF COSTS OF PRIMARY CULTIVATION using different power sources

Power source	Time/ Hrs/ac	Cost/ Le/hr	Cost/ Le/ac
Hand labour	300	0.25	75
Tractor	1½	38	57
Oxen			
Example 1, Table 7.10	15	3.41	51
Example 2, Table 7.11	15	2.8	42
Example 3, Table 7.11	15	1.93	29

From the Table above it can be seen that hand cultivation, costed at Le 2 per day, is most expensive at Le 75/ac; tractor cultivation costs Le 57/ac, while ox-ploughing is cheaper, ranging from Le 29/ac to Le 51/ac, depending on the amount of use that is made of the oxen.

However, while oxen feed on renewable sources of energy, contributing their dung to the soil, tractors use imported oil.

It can be seen from Table 7.14 below that the foreign exchange cost of tractor cultivation is about 7 times that of ox-cultivation and, as oil prices rise, and machinery costs increase, this difference is likely to become even more pronounced.

Table 7.14

COMPARISON OF FOREIGN EXCHANGE COSTS OF PRIMARY CULTIVATION

System	Cost/ acre	Foreign Exchange	
		Estimated component	Exchange per acre
	Le	%	Le/ac
Hand	75	0	0
Oxen (restricted use)	51	12	6
(medium use)	42	18	8
Tractor	57	90	51

7.6 UPLAND CROP CULTIVATION:
Comparison of different systems

Once land has been ploughed and harrowed, whether by hand, oxen or tractor, different crops may be grown each requiring different operations. For some of these operations there may be a choice between hand cultivation or ox-cultivation; at present in Sierra Leone, tractors are not normally used for any cultivation operations after harrowing.

Table 7.15

MAIZE CULTIVATION: Ox- and hand operations after ground preparation

Operations	Hand operations only		Oxen/Hand operations	
	Time (hr/ac)	Cost ¹ (Le/ac)	Time (hr/ac)	Cost ¹ (Le/ac)
Planting	51	13	5 (o)	14
Weeding (twice)	312	78	7 (o)	20
Fertiliser application	36	9	36 (m)	9
Harvesting	48	12	48 (m)	12
Total	447	112	12 (o) +124 (m)	65

(o) = ox-team hrs (m) = manhours

Note: Bird-scaring may be required at up to 200 manhours/acre. Hand-shelling requires about 56 manhours/acre.

¹ Hand labour is costed at Le 0.25/hr and ox-team labour is costed at Le 2.80/hr.

Table 7.16

GROUNDNUT CULTIVATION: Ox- and hand operations after ground preparation

Operations	Hand operations only		Oxen/Hand operations	
	Time (hr/ac)	Cost ¹ (Le/ac)	Time (hr/ac)	Cost ¹ (Le/ac)
Planting	40	10	5 (o)	14
Weeding (twice)	322	81	7 (o) +40 (m)	20 10
Lifting			5 (o) +11 (m)	14 3
Harvesting	100	25	100 (m)	25
Total	522	131	17 (o) +151 (m)	86

(o) = ox-team hrs (m) = manhours

Note: Hand-shelling requires about 320 manhrs/acre

¹ Hand labour is costed at Le 0.25/hr and ox-team labour at Le 2.80 per hour.

Using field data from the trials at Njala, costings can be made for the growing of maize, groundnuts and cowpeas. (Tables 7.15, 7.16 and 7.17). In all these cases it can be seen that the use of oxen reduces the cultivation costs relative to hand cultivation. These figures can be combined with the costs of different systems of primary cultivation, (Table 7.13), to examine the costs of different combinations of cultivation techniques using power from human labour, oxen and tractors.

This is illustrated in Table 7.18 and it can be seen that the cheapest systems for growing maize, groundnuts and cowpeas use ox-power, while the most expensive systems use hand labour only. Tractor cultivation is slightly cheaper than hand cultivation, but costs can be reduced if oxen are used to plant and weed crops afterwards.

Table 7.17

COWPEA CULTIVATION: Ox- and hand operations after ground preparation

Operations	Hand operations only		Oxen/Hand operations	
	Time (hr/ac)	Cost ¹ (Le/ac)	Time (hr/ac)	Cost ¹ (Le/ac)
Planting	60	15	5 (o)	14
Weeding	170	43	3 (o) 72 (m)	8 18
Harvesting	242	60	242 (m)	60
Total	372	118	8 (o) 314 (m)	100

(o) = ox-team hrs (m) = manhours

Note: Threshing requires about 39 manhrs/acre

¹ Hand labour is costed at Le 0.25/hr and ox-team labour is costed at Le 2.80 per hour.

Table 7.18

COMPARISONS OF COMPLETE CULTIVATION COSTS¹ using different systems of cultivation

SYSTEM		CROP		
Primary Cultivation	Weeding	Maize	Ground-nuts	Cowpeas
Hand	Hand	187	206	193
Tractor	Hand	169	188	175
Oxen	Hand	163	182	169
Tractor	Oxen	122	143	157
Oxen	Oxen	107	128	142

¹ Costs based on primary cultivation costs (Table 7.13) and planting, weeding and harvesting costs (Tables 7.15, 7.16 and 7.17).

7.7 UPLAND CULTIVATION:

Profitability of different systems

It has been shown that fully costed ox-cultivation is cheaper than fully costed manual cultivation, but for the farmer it is the overall profitability of the enterprise that is crucial. Using the figures already presented for the cultivation costs of maize, groundnuts and cowpeas, together with assumptions on yields and prices, it is possible to prepare budgets, which include the critical 'bottom line' calculation of overall income less overall expenditure. These are presented in Tables 7.19, 7.20 and 7.21.

These budgets should be studied with appropriate caution, for it must once again be stressed that the actual figures for work input and overall yield will vary considerably from place to place and from year to year. In all cases, farm labour has been costed at Le 0.25 per hour of work. This is in line with the assumptions made concerning ox-cultivation, that the costs should be reasonable for an entrepreneurial farmer investing in farming operations.

However, Le 0.25 per hour may be particularly high for certain operations such as crop processing (maize shelling and groundnut shelling) for which timeliness is not critical and which may be carried out in villages at lower cost by women and children.

Table 7.19

MAIZE PRODUCTION: Overall costs & margins for different systems, by Leones per acre

Costs	Cultivation system			
	Hand only	Oxen/hand	Tractor/hand	Tractor/hand
Cultivation				
Land preparation	75	42	57	57
Planting	13	14	13	14
Weeding	78	30	78	30
Fertiliser				
application	9	9	9	9
Bird-scaring	25	25	25	25
Harvesting	12	12	12	12
Shelling	14	14	14	14
Total	226	146	208	181
Inputs				
Seed				
(25 lb @ Le 0.20)	5	5	5	5
Fertiliser:				
80 kg urea,				
80 kg s/phosphate	16	16	16	16
Total	247	167	229	182
Receipts				
Value maize				
0.8 ton @ Le 240	192	192	192	192
Margin	-55	25	-37	10

It may be noted that in groundnut production, one of the highest costs is the labour intensive shelling process. Without that large cost in the budgets illustrated, the growing of groundnuts by hand using hired labour would appear to be profitable. However, the budgets clearly illustrate that, for the cultivation of these crops to be economically attractive, family labour or cheap labour is probably necessary. They also illustrate the fact that commercial farming with oxen can be profitable, and clearly more profitable than the other systems illustrated.

In practice, in the villages, family labour or cheap labour is likely to be available, and so the actual outgoings on all systems of cultivation are likely to be lower than those budgeted for in Tables 7.19-7.21. Thus, it is likely that cash profits can be made on all the systems of cultivation illustrated; the ox-cultivation systems remain most profitable even when all labour rates are assumed to be reduced by 50%.

Table 7.20

GROUNDNUT PRODUCTION: Overall costs & margins for different systems, by Leones per acre

Costs	Cultivation system			
	Hand only	Oxen/hand	Tractor/hand	Tractor/hand
Cultivation				
Land preparation	75	42	57	57
Planting	10	14	10	14
Weeding	81	30	81	30
Lifting	15	17	15	17
Harvesting	25	25	25	25
Shelling	80	80	80	80
Total	286	208	268	223
Inputs				
Seed				
(60 lb @ Le 0.50)	30	30	30	30
Total	316	238	298	253
Receipts				
Groundnuts				
710 lb/ac @ Le p.35	249	249	249	249
Margin	-67	11	-49	-4

Table 7.21

COWPEA PRODUCTION: Overall costs & margins for different systems, by Leones per acre

Costs	Cultivation system			
	Hand only	Oxen/hand	Tractor/hand	Tractor hand
Cultivation				
Land preparation	75	42	57	57
Fertiliser application	4	4	4	4
Planting	15	14	15	14
Weeding	43	26	43	26
Harvesting	60	60	60	60
Threshing	10	10	10	10
Total	207	156	189	171
Inputs				
Seed				
(20 lb @ Le 1.00	20	20	20	20
Fertiliser:				
4 bags basic slag @ Le 9				
1 bag urea @ Le 12.00	42	42	42	42
Total	269	218	251	233
Receipts				
Value cowpeas				
550 lb @ Le 0.50	275	275	275	275
Margin	6	57	24	42

7.8 UPLAND RICE WITH OX-CULTIVATION

Although the trials at Njala in which oxen were used for upland rice cultivation could not be completed, it is possible to consider the economics of growing upland rice by using the information already presented on land preparation, together with some estimates on labour requirements, from a previous trial. This is illustrated in Table 7.22 below which shows that the margins are negative whether land preparation is done by hand, oxen or tractors.

Upland rice is not generally considered a commercial crop and the low yields and receipts suggest that family labour or cheap contract labour is essential to ensure that the yields cover the costs of cultivation. Ox-ploughing does reduce the cost of upland rice production and, even if all labour rates were reduced by 50% to take into account family labour, upland rice farming with oxen would still be cheaper than hand cultivation; in this case the margins for both systems would be positive.

For ox-cultivation of rice to be even more attractive, ox-weeding could be used as weed competition is a major problem with upland rice. It is hoped that a system of ox-weeding of closely spaced rows of rice can be tested first at Njala and then on farmers' crops to evaluate the potential of this system for widespread use in uplands and bolis.

Table 7.22

UPLAND RICE PRODUCTION: Overall costs & margins for upland rice production

Costs	Cultivation system			
	(hrs/ac) ¹	Hand only	Oxen/hand	Tractor/hand
Cultivation				
Land preparation		75	42	57
Scattering seed	(8)	2	2	2
Weeding	(100)	25	25	25
Rodent control	(40)	10	10	10
Bird-scaring	(220)	55	55	55
Harvesting	(300)	75	75	75
Threshing	(20)	5	5	5
Total		247	214	229
Inputs				
1 bushel seed rice @ Le 9.00				
		9	9	9
Total		256	223	238
Receipts				
20 bushels @ Le 7.00				
		140	140	140
Margin		-116	-83	-98

¹ Estimates based on work on Njala University College farm in 1978.

7.9 SWAMP RICE WITH OX-CULTIVATION

Swamp rice has great advantages over upland rice in that standing water reduces the weed problem and higher yields are generally obtained. In many parts of the world animals are used to prepare paddy fields for transplantation and trials on the use of oxen for swamp rice cultivation were held at Njala in 1980.

From the data collected during the trials it has been possible to produce estimates on both the costs of ox-cultivation and hand cultivation, Table 7.23. From this it may be noted that ox-cultivation appears to be slightly more expensive than hand cultivation. These figures are based on an hourly manual labour rate of Le 0.25 and an hourly ox-team rate of Le 2.80, (Example 2, Table 7.11).

An element of Le 180 pa was allowed for grazing oxen (Le 0.50/day). It is known, however, that in Koinadugu District oxen may be handed to Fulah herders at a cost that is nearer Le 0.15 per day, while in Bombali District children graze or tether the animals at almost no cost to the farmer.

The ox-driver and his assistant working with the oxen may cost Le 4.00 per working day; this is quite high, particularly as the oxen may only work for three hours a day in swamps, or four hours a day in the upland.

One could go on to suggest that ALL the figures used are debatable and highly variable; certainly assumptions on labour

rates, interest rates, seed rates and yields are all open to question. However, this does not imply that the figures and examples are fictitious. They have been presented for the purpose of illustration; since there has been a reasonable degree of consistency in the assumptions, it would seem that the overall patterns that emerge have validity as illustrations. Thus, with the fair warning that the figures presented are illustrative rather than absolute, it is possible to accept the implications contained in this chapter.

The fact that hand cultivation can be cheaper than ox-cultivation in swamps suggests that investment in oxen and ploughs may not be justified if they are to be used mainly for swamp work. However, for a farmer using his oxen a great deal (Example 3, Table 7.11), the hourly rate for oxen including overheads is Le 1.93, at which rate ox-cultivation in swamps is marginally cheaper than hand cultivation. Also, if a farmer has a set of oxen and a plough, then for each additional hour of use, the cost is only Le 1.05 (Table 7.1); on this basis swamp ploughing with oxen is certainly cheaper than hand cultivation.

A further point is that the oxen work more quickly and, even if they only work three hours a day in the swamp, two men and an ox-team will cultivate an acre of swamp in nine days; the same two men working eight hours a day would require 14 days to cultivate the same area by hand. Thus, there may be additional benefits in timeliness using oxen for swamp preparation.

Table 7.23

SWAMP RICE PRODUCTION: Comparison of ox- and hand operations

Operations	Hand operations only		Oxen/hand operations	
	Time (hr/ac)	Cost (Le/ac)	Time (hr/ac)	Cost (Le/ac)
Brushing & clearing	158	39	158 (m)	39
Ploughing	167	42	13 (o)	36
Puddling, harrowing & levelling	60	15	14 (o)	39
Nursery preparation	8	2	8 (m)	2
Transplanting	80	20	80 (m)	20
Weeding	16	4	16 (m)	4
Bird-scaring	240	60	240 (m)	60
Harvesting (stems)	140	35	140 (m)	35
Threshing	26	7	26 (m)	7
Total	895	224	668 (m)	242
			+27 (o)	

(o) = ox-teamhrs (m) = manhours

¹ Hand labour is costed at Le 0.25/hr and ox-team labour is costed at Le 2.80/hr.

Looking at the overall margins for swamp rice cultivation, Table 7.24, it would seem that a farmer with access to sufficient labour may not be advised to invest in oxen simply for swamp cultivation. However, if he already has oxen, his cultivation costs could be reduced using them to prepare his swamp, although this would not be advisable if they were already being used on upland work which might be more profitable.

Table 7.24

SWAMP RICE PRODUCTION: Overall costs & margins by Leones per acre

Costs	Cultivation system	
	Hand only	Oxen/hand
Cultivation		
Brushing	39	39
Ploughing	42	36
Puddling & levelling	15	39
Nursing	2	2
Transplanting	20	20
Weeding	4	4
Bird-scaring	60	60
Harvesting	35	35
Threshing	7	7
Total	224	242
Inputs		
Seeds, ¼ bushel @ Le 9.00	7	7
Total	231	249
Receipts		
Value of rice, 40 bushels @ Le 7.00	280	280
Margin	49	31

7.10 ECONOMIC THEORY & FARM REALITY

Before drawing conclusions from the information presented, it would seem sensible to reconsider the assumptions which have been made. The labour rate quoted has been Le 0.25 per hour; this would seem reasonable for institutional farms and a businessman/farmer would be well advised to budget on this figure. However, a subsistence farmer would not have to part with cash for his own labour; he might well be able to hire labour for Le 1.00 per day together with some food and maybe some palm wine.

Men on contract work in the villages can sometimes achieve rates well over Le 0.25 per hour for themselves by completing a job ahead of schedule, but the overall contract cost to the farmer would probably still be below the figures quoted in this chapter. Many operations, including much of the weeding and crop processing, are performed by the women and children of a family farm; the cost to the farmer of this is impossible to fix in cash

terms. It would seem that all figures quoted for hand labour operations are likely to be higher than those that would really be paid by farmers. Similarly the costs of owning and using oxen have been overestimated.

7.11 CREDIT REQUIREMENTS

On the previous assumptions, a farmer wishing to purchase oxen around the centre of the country would require Le 640 cash. To invest in a complete package of equipment of the Anglebar range would require Le 903, plus a further Le 300 if he were to buy an ox-cart. Thus, allowing some money for ropes and a shelter, the farmer might need Le 1900 altogether.

To buy the simpler package of oxen, plough, harrow and weeder would require about Le 1200. If a bank charged 12% interest, a loan of Le 1200 would require repayments of Le 395/yr to repay the loan in four years, with a Le 1900 loan requiring repayments of Le 625.

Using the margins illustrated, the farmer in Example 2 would only seem to be making a cash profit of about Le 250 a year, but these figures have already taken into account the repayment of interest and capital. The farmer in Example 2 has been able to make small positive margins, having paid off interest and capital of Le 171 per year on equipment and interest of Le 101 per year on his animals. He has also insured himself against their accidental death and should reasonably expect to pay off the cost of his animals when he makes his capital gain after five years.

Thus, the entrepreneurial farmer would certainly be able to consider a bank loan for the purchase of his animals and equipment if he considered the potential margins provided sufficient income for him to live on.

For a farmer using his own and cheap family labour, it is still possible for him to repay a loan at commercial rates, provided he sells his produce for cash. The cash income from one acre of groundnuts followed by maize should be more than enough to meet a Le 400 repayment. Assuming the produce of the rest of his upland and swamp provided him with sufficient food and income, a Le 1200 loan should be quite acceptable.

Naturally, institutions giving credit would require information on the potential profitability of the farming operations of each applicant for credit; this chapter, however, should have helped to illustrate that ox-cultivation can be sufficiently economically attractive to attract commercial loans to assist the farmers to purchase the necessary animals and equipment.

7.12 CONCLUSIONS

An attempt has been made to estimate the economic costs and benefits of using work oxen. In doing so, it has been noted that certain benefits such as improved timeliness and reduced drudgery cannot be easily quantified. Also, certain costs involving village and family labour rates are difficult to estimate for the purpose of making simple budgets.

In order that the figures could not be considered biased in favour of ox-cultivation, several assumptions have been made which err on the expensive side; for example, the cost of cattle has been based on Southern rather than Northern Province prices. The most expensive set of ox-equipment was used and a fairly steep 12% interest charge was put on loans for equipment and animals. Further, in the costed examples, the assumed rate of Le 2.80 per hour of ox-team work was not only based on the 'expensive' assumptions, but on a relatively modest workload of 293 hours pa or 73 days' use a year. This is only half the figure of 585 hours pa worked by oxen at Njala in the 1940s (Kamara, 1974).

Despite this use of highly cautious assumptions, ox-cultivation has been shown to be economically attractive. Furthermore, the preceding chapter has endeavoured to show that the considerable agricultural potential of using work oxen in Sierra Leone can be realised through economically acceptable investments in the animals and appropriate equipment.

In conclusion, it would seem that a farmer could obtain significant benefits from training a set of oxen for work, even if only a relatively small area of land were cultivated:

- a farmer not already owning cattle could consider a commercial loan for the purchase of animals and equipment for cultivating at least seven acres of his own or his neighbour's land each year;
- the farmer's returns would be increased with the acreage cropped or double cropped;
- returns would be greatest if crops were planted in rows and oxen were used for weeding operations;
- a farmer owning oxen could use them for the cultivation of swamps for rice - particularly in areas of labour scarcity;
- a farmer could use a trained set of oxen for transport;
- a strong ox-cart would cost, on average, only about Le 1 a journey, not including the wages of ox-handlers.