

Talking About Money



No.3

EXPLAINING THE FINANCES OF MACHINERY OWNERSHIP

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Introduction

This booklet is part of a series that is designed to be used by farmer discussion groups, farmer field schools and extension or advisory officers involved in agricultural or rural development.

The ability to adopt or introduce changes to agricultural production methods and non-farm enterprises depends on the availability of money. It is, therefore, very important for farmers to be able to think carefully about their financial circumstances. Predicting costs, prices, profit margins and cash flow patterns is vital for planning and decision-making and the poorer the farmer, the more important it is.

These concepts need to be explained in a way which small scale, possibly illiterate, farmers can understand. The "Talking About Money" booklets aim to introduce financial topics to farmers using a variety of tools, some of which can be used even when people are not able to read or write. The concepts are intended to provoke discussion and be used in a participatory manner.

Field officers involved in giving agricultural advice in developing countries are most commonly technical experts of some kind, e.g. agronomists, livestock, irrigation or engineering specialists. They usually do not have much experience in giving advice about money and this topic is generally avoided, apart perhaps from some simplified profit calculations. It is hoped this series will help them "talk about money" more readily and enable them to give good advice to farmers about the use of financial services such as credit.

The figures used in this book are largely fictitious and should not be taken as representative of any particular currency at any given point in time. The \$ symbol is used simply as a generic money symbol. If the book is being translated for a specific local context, the figures can be replaced with appropriate amounts in the local currency.

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1 THE IMPORTANCE OF TOOLS AND MACHINERY IN FARMING

Aim:

- To examine how tools and machinery increase labour productivity and reduce drudgery
- To introduce the idea of improving tools and farming methods

Productivity

Rural livelihoods involve hard work. Just think what is involved in the successful production of crops and livestock. Land has to be cleared and prepared for planting. Crops have to be weeded and harvested. Livestock have to be fed, watered and herded.

Imagine doing this without tools of any kind! It would be impossible. We can think of tools as simple machines which greatly increase the effective use of human energy. Without tools we would not be able to farm, or do much else when you come to think about it.



But when we talk of machinery you may think of much more complicated pieces of equipment than a simple tool. Over the years human ingenuity has led to the development of many devices which help us complete tasks more effectively. These often involve the use of additional forms of power such as that provided by animals, water or engines. Using machines with additional sources of power greatly increases the amount of work we can complete in a given time.



Do you have any idea how many days it would take you to cultivate 0.5 hectare with

- i) a hoe
- ii) an ox-drawn plough
- iii) a tractor drawn plough?

It would take a man about one month to hoe 0.5 ha of land, 3-4 days to plough it with oxen and less than half a day to plough it with a tractor.

If you can complete work more quickly, it is likely to enable you to complete essential tasks in a more timely manner. If you can plough better and more quickly, you will be able to plant at the optimal time to get a good yield. If you can weed at the right time and more quickly, you are likely to get better yields.

So using machines and additional sources of power generally makes human labour more productive. You can do more work at a faster rate. You may be able to increase the area you cultivate and produce more crops to sell. You may be able to transport products to more distant markets and sell your crops for a better price.

Drudgery

Apart from making you more productive, improved tools and additional forms of power make farming easier and less tiring! For example, hoeing 1 hectare of land requires about ½ million strokes. That is exhausting work!



No-one relishes the thought of wielding a hoe for days on end, so reducing the burden of manual labour is a very important way of improving people's quality of life. Using animal power makes a huge difference but even so, the person controlling and guiding oxen pulling a single furrow plough will walk about 50 km when cultivating 1 hectare.



A great deal of time is spent fetching and carrying goods to and from fields, markets and homesteads. Animal or motor assisted transport can dramatically reduce this and enable people to use their time more effectively.

Nevertheless, for many farmers, human energy is the only form of power they have to do all the work of cultivating, planting, weeding and so on. Thus the amount of work they can do is limited by the amount of human labour available. Perhaps you are in this situation.



Which are your most onerous activities? Why not list them and then put them in order according to how demanding they are?

Compare your answer with these examples from Kenya which show how some rural communities there ranked the activities which were most time-consuming:

Ranking by men	Ranking by married women
1. Weeding	1. Weeding
2. Digging	2. Land preparation
3. Cattle herding	3. Water collection
4. Casual labouring	4. Harvesting
5. Trading	5. Searching for vegetables

Source: IFAD/FAO Labour saving technologies and practices for farming and household activities in Eastern and Southern Africa 2003

As you can see, in this part of Kenya both men and women consider weeding and land preparation to be the most onerous activities. This has serious consequences for their ability to improve crop yields if they are dependent on hand labour. It can take 15 days to weed 1 ha of sorghum or finger millet, 25 days to weed 1 ha of groundnuts or sunflower and 45 - 50 days to weed 1 ha of maize or cassava. If weeding is delayed by just 1 or 2 weeks, yields can be reduced by half or more.

Drudgery is often a major problem for women. Apart from work in the fields, women usually have the main responsibility for collecting water and firewood, preparing and cooking food and taking care of children. These tasks are hard and very time-consuming, and when combined with farm work mean that women have little time for rest.



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The downward spiral

If a household finds itself facing a shortage of farm power, the family are likely to respond by scaling back their activities. For example, they may reduce the area under cultivation and grow a more limited range of crops. They may struggle to keep pace with the seasonal calendar and end up taking shortcuts, resulting in poor land clearing and preparation, late planting, use of broadcasting to sow seed and an incomplete first weeding.



Households can enter into a spiral of decline. Shortcuts in one season have knock-on effects in the next. The productivity of the land and the workforce deteriorates and, over time, people become demoralised and lack hope for their future. To avoid this it is important to look at ways of improving working methods, ensuring tools work adequately and obtaining additional sources of power.

Using improved tools and farming methods

People can work better with well kept tools. Farmers should always make sure their hoes, axes, machetes or cutlasses are kept sharp and that handles are fitted firmly. In many cases labour efficiency can be improved simply by keeping tools and equipment in better condition.



Hoes are probably the most important hand tool, used for a variety of operations from land clearance and digging, to ridging and weeding. There is a corresponding variety of shapes and weights - heavy blades for digging, wide blades for ridging, narrow or forked blades for weeding. Hoes may be made by local blacksmiths or larger scale manufacturers, or they may be imported from other countries. The quality of these may differ widely and it is important to learn how to choose hoes that do not break easily and are made from durable steel.

It is possible that there are tools which are unfamiliar to you that could make it easier to complete various farming operations. Using a wheelbarrow, for example, enables a man to transport three times as much as he can carry. Scythes enable crops to be cut much faster than they can be with a sickle or machete.

There are also different farming methods which can help to overcome shortages of farm power. For example, conservation agriculture techniques can improve crop yields while saving labour on land preparation and over time, on weeding. The following guidelines from the Conservation Farming Unit in Zambia illustrate how the key principles of conservation agriculture - minimum tillage, soil cover and crop rotation - can be applied in practice.



Crops grown using hand hoes and conservation farming methods in Zambia

Source: CFU Zambia

- Restrict tillage of the land to the precise area where the crop is to be sown, i.e. only 10-15% of the surface area of the land need be tilled to establish crops, and only to a depth sufficient to break through plough or hoe pans.
- Complete land preparation in the dry season.
- Establish a precise and permanent grid of planting basins or furrows, within which fertilisers are accurately applied and successive crops are planted each year.
- Conduct early and continuous weeding that inhibits seeding and in time reduces the soil weed bank.
- Rotate or inter-crop with nitrogen fixing legumes up to a maximum of 30% of the cultivated area.

There are special tools that facilitate conservation farming practices, such as a hand-jab planter, but the methods can be introduced without acquiring these.



What tools and methods do you currently use to complete your most important farming operations? Why not make a list and then write down how you think your system could be improved, e.g. by using better tools or draught animals, or changing how you do things.

You can set your list out like this:

Task	Current system	How we could improve
Land preparation	Cultivate land with a hoe. Work with family and neighbours in a group to make work easier	Use better quality hoes Hire or purchase oxen and plough Adopt conservation farming methods
Weeding	Hoeing by hand	Use hoes designed for weeding Use row planting and correct spacing Apply mulch or intercrop Use draught animal power
Threshing		

If you are using a hand hoe system to grow your crops, then it is easy to conclude that using draught animal power or even hiring a tractor would enable you to get better yields and increase the area you cultivate. It seems obvious but is it possible? Perhaps there are no tractor hire services. Perhaps fewer people have draught animals than in the past. Perhaps you do not have enough money to buy better tools or pay for hire services.

In order to decide if it is possible to solve the problem of money, we must first understand clearly how to calculate the costs of owning and operating new types of equipment on the farm.



Source: IIRR Extension Manual 1998

2 THE COSTS OF MACHINERY OWNERSHIP

Aim:

- To explain the concept of depreciation and how to calculate it
- To examine other costs associated with the ownership and use of draught animal power, tractors and other tools and machines

Initial investment

When you purchase a hoe or plough or draught animal or any other piece of equipment, there is a price to pay. Each item will cost a certain amount of money. Other inputs like seed and fertiliser also cost money, of course, but tools and machines are different. You are not going to use them up in one production cycle.

Let's think about how much different tools and machines cost.



Make a list of all the tools and implements you own and then write down how much you paid for each one. If you do not know how much you paid for something, find out how much it would cost now to buy a similar item.

An example list (prices in Kenyan shillings):

Large hoe	270
Small hoe	150
Forked hoe	300
Machete	120
Axe	500
Shovel	250
Knapsack sprayer	1,100
Cart	16,000
Trek chains	5,500
Treadle pump	9,800

Depreciation

As we have already mentioned, tools and implements are not used up in one production cycle. When you buy a piece of machinery, you expect to keep it for a while, maybe many years. So when calculating the annual cost of equipment, you cannot use the full purchase price. You have to work out a share of the price which you can include in your estimate of input costs for any given accounting period.

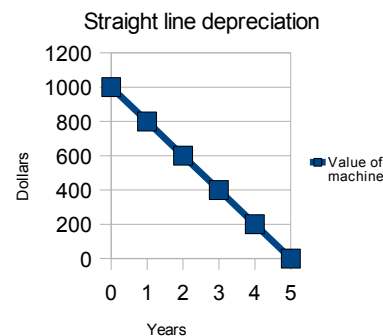


We call this share of the initial purchase price “depreciation”. This name makes sense when you think of it as the amount by which the equipment reduces in value every year as a result of being used.

Let's look at the simplest way to calculate the depreciation charge for a tool or machine used on a farm. We will imagine we have paid \$1000 for a particular item. We know that if we use this machine for five years it will then be worn out and will have to be replaced. So dividing \$1000 by five will give us the annual depreciation charge, like this:

$$\frac{1000}{5} = \$200$$

So this means that the cost of owning this machine is \$200 per year. It also means that the equipment is not worth anything at the end of that period.



We call this method of calculating depreciation the “straight line” method. You can see why by looking at the diagram.

The value of the equipment goes down by an equal amount each year, from 1000 to 800, then 600, 400, 200 and finally zero. Thus the value declines in a straight line.

Sometimes machines are not completely worn out when we decide to replace them; in which case we may be able to sell them to somebody else for a certain amount. We call this the resale or scrap value and it affects our calculation of straight line depreciation like this:

$$\text{Annual depreciation} = \frac{\text{Purchase price} - \text{scrap value}}{\text{Useful life (years)}}$$



What is the annual depreciation of a tool that cost \$460 and could be sold for \$100 after 3 years of use?

$$\frac{460 - 100}{3} = 120$$

There is another way of working out annual depreciation which is perhaps better suited to machinery that loses value faster in the early years and slowly tails off as it gets older. This is known as the “diminishing balance” method and is worked out by calculating a fixed percentage of the item's value at the start of each year.

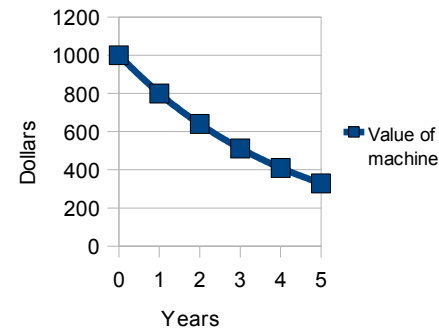


Can you complete the calculations in the following table?

	Value at start of year	Depreciation at 20% of the value at the start of each year	Value at end of year
1 st year	1000	200 (1000/100 x 20)	800 (1000 - 200)
2 nd year	800	160 (800/100 x 20)	640 (800 - 160)
3 rd year	640	128 (640/100 x 20)	512 (640 - 128)
4 th year	512		
5 th year			

4th year depreciation 102; value at end of year 410
 5th year depreciation 82; value at end of year 328

Diminishing balance depreciation



As you can see in this diagram the pattern of reduction in the value of the machine is a curved rather than a straight line.



Depreciation is not a “real” financial outlay each year as you will have paid for the machine using your own money or a loan when you bought it. It is a means of making the estimate of the cost of owning machinery more realistic in terms of our profit and loss account.



However, tools and machines do wear out and then we have to replace them with new ones. So some people try to set aside an amount equivalent to the annual depreciation each year, which will help to pay for a new machine when the time comes. This is only possible if you make a profit and are able to set aside some of it as savings.

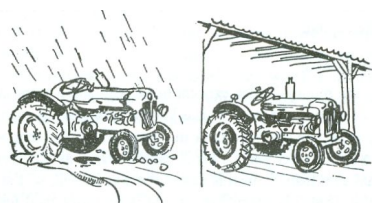
Draught animals do not depreciate in the same way as a manufactured machine. In fact as they grow they become stronger and more experienced in their role, and thus more valuable. When they are considered too old to continue working as a draught animal, they can be slaughtered for their meat and skin. However, they do have to be replaced with new working animals, so it is still prudent to save up some money each year to meet this cost when it is necessary.



Source: CFU, Zambia

Other costs

There are other costs involved in owning and operating tools and machinery. You have to look after them - cleaning, sharpening, oiling and repairing them if something breaks. You need to provide adequate shelter to protect them from the weather.



Source: Farming as a Business (OUP)

Engine driven equipment requires fuel, tractors may require a road licence and some items need to be insured against theft and fire. You may find you need to employ extra labour to look after oxen or repair machinery and if you borrow money, there will be interest to pay.



Some costs depend on how much you use the machinery. If you use something a lot, repair costs will be higher. If an engine needs fuel, it will use a certain amount for every hour that it runs. Let's say it uses 5.0 litres an hour. So if you run the engine for 300 hours in the year, it will use 1500 litres. If you run the engine for 500 hours, it will use 2500 litres.

Draught animals require yokes and harnesses, feed and veterinary care. This is a typical daily ration for oxen weighing 300-400 kg when working hard:

10kg hay or 40kg grazed grass + 2kg maize bran or cotton cake or sunflower cake + 1kg molasses + 1 handful salt + mineral lick

When they are not busy, the ration might be:

10kg hay or 40kg grazed grass + 2kg maize bran + 1 handful salt

They will also need water three times a day. Veterinary requirements will include insecticides, worm medicine and inoculations.



Source: IFAD

Some examples

Here is an example of how a farmer might calculate the annual cost of owning and using a pair of draught oxen and conservation farming techniques. The farmer has a plough with a ripper, a cultivator and a cart for transporting goods. Depreciation of the equipment has been worked out using the straight line method (purchase price - scrap value / the useful life).

Costs	\$
Depreciation:	
Oxen (they maintain their value)	0
Plough (150 - 20) / 10 yrs	13
Cultivator (200 - 30) / 10 yrs	17
Cart (400 - 50) / 5 yrs	70
Yoke, chains 45 / 3 yrs	15
Spares: tines, nuts and bolts, tyres	35
Maintenance work: welding, etc.	40
Purchased feed: 1.0t maize bran, 0.5t cotton seed cake and minerals	180
Medicine and veterinary costs	30
Extra labour	120
TOTAL	520

The amount of \$520 is part of the farm's overhead costs and must be subtracted from the Farm Gross Margin to find out if the farmer is making any profit, as explained in Book 2.

The best way of working out power and machinery costs is to keep a record of what you spend during the year, for example, on veterinary services, purchased feed or spare parts. If you can carry out repair work yourself this will help to keep costs down.



Source: CFU, Zambia



Source: IFAD

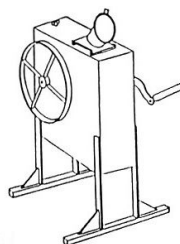
You can work out the costs of owning a tractor and plough in a similar manner, as long as you have kept a note of expenditure on repairs, fuel and so on during the year. Here are some example figures, using the same currency as in the previous example:

Costs	\$
Depreciation: Tractor (20,000 - 5,000) / 5 yrs Plough (1600 - 270) / 7 yrs	3000 190
Tractor shed depreciation (1000/10 yrs)	100
5500 litres of fuel and 20 litres oil	2835
Spare parts and repair work	950
Part time driver	500
Insurance and road tax	220
TOTAL	7795

As you can see the annual cost of owning and operating a tractor is far higher than that of draught animal power. If you imagine including tractor costs in a profit and loss account you will realise that the farm will have to be producing a much larger gross margin to cover the cost of a tractor and still leave a profit. We will look at this issue more closely in Chapter 4.

Working out the cost of owning hand tools and implements is much simpler. Here is an example of the annual cost of owning a maize sheller.

Costs	\$
Depreciation (\$500 - 50) / 15 yrs	30
Repairs, spares and lubricants	25
TOTAL	55



With hand operated tools, the costs are just depreciation and any repair work that must be done. Repair costs are likely to be lower when the tool is new and higher as it gets older.

Tools like a maize sheller can save people a great deal of time and thus reduce the costs of employing people to do this task or free up family members for other tasks.

Throughout this section we have not made any reference to the interest which you may be paying if you have borrowed money to purchase equipment. We will come to this in the next chapter.



Now go back to the list you made of all the equipment you own and the price you paid (or would pay now) for each item. Take each one in turn and work out the annual costs of owning and operating that equipment in your own local currency.

You may only have hand tools in your list. Perhaps you can research how much it would cost to buy some draught animals and implements in your local area. What are the local prices of animal feed and medicines?

At the end of Chapter 1, you reflected on how you could improve your current methods of doing important tasks on the farm. If you identified new tools or machines as part of that process, find out how much those items would cost and how long they would last under normal conditions.

Then you can estimate the depreciation costs. Can you guess what the annual repair costs might be? Would there be any other costs?



Source: IRR Extension Manual 1998

3 SHOULD YOU INVEST IN NEW MACHINERY?

Aim:

- To learn how to assess the pros and cons of investing in new machinery through partial budgets and cash flows
- To introduce the idea of opportunity cost and break-even point

Can you cover the costs?

We have established the usefulness of machinery and extra farm power and now we know something about how much machines cost to own and operate. Clearly it is essential to know whether or not our business activities generate enough output to cover these costs, if we want to own and use machinery as part of our production systems.

The first thing to do is work out whether or not you are making any profit from your current farming activities. We looked at how to do this in Book 2. If you are not making any profit or very little, then some serious analysis is required before any plans to invest in new tools and machinery are considered.



Source: CFU, Zambia

Tools and machines do not improve production simply by possessing them - they have to be used correctly and can only complement the other resources you have. If your soil is poor or you are busy with other work or a long way from markets, machinery may not improve your profit at all.

If you do buy a new tool or invest in some draught animals and implements, your costs will go up. There will be extra depreciation costs and extra repair costs, and perhaps some new costs such as animal feed, labour or fuel. So if your output and other costs remain the same, your profit will go down.

If you are only spending a small amount of money and the benefit of reducing the drudgery associated with a task is significant, you may feel the reduction in profit is worth it. It would be a way of spending some of your profit to improve your lives.

If you plan to invest a larger amount of money, however, it is usually important that you either increase your output in some way or reduce other costs such as labour, to offset the extra costs of machinery ownership and use. These extra costs may well include interest charges, if you decide to borrow the money needed to purchase the equipment.

The best way of working out whether you can cover the annual costs and benefit from an investment in machinery is to make a partial budget. A partial budget is set out in a special way to help us decide if a planned change in our farming system is worthwhile:



Costs of change	Benefits of change
Any extra costs that will be incurred	Any income that will be gained
Any income that will be lost	Any costs that will be saved
TOTAL (A)	TOTAL (B)

If Total B is greater than total A, we should increase our profit as a result of the change. If A is greater than B, we will have less profit.



Source: CFU, Zambia

Let's suppose a farmer is thinking of buying a ripper and cultivator to use with his oxen. He intends to switch to a conservation tillage system, which involves using the ripper in the dry season to make planting furrows ready for early planting. He will need a wide yoke to use when weeding with the cultivator.

Part of his land will be switched from maize to groundnuts, to improve the nitrogen content of the soil.

The farmer knows that the system will take one or two years to show its full benefits but he hopes to obtain improved yields of maize and cotton as a result of the new system but will this increase his annual profit? He decides to prepare a partial budget.

He first lists all the things that he thinks will change under each of the four headings:

Extra costs	Extra income
<ul style="list-style-type: none"> • Depreciation of ripper, cultivator and yoke • Maintenance and repairs • Groundnut production costs - seeds, fertiliser, labour for harvesting 	<ul style="list-style-type: none"> • Increased yield from maize and cotton • Groundnut sales
Income lost	Costs saved
<ul style="list-style-type: none"> • Maize crop replaced by groundnuts 	<ul style="list-style-type: none"> • Maize seed and fertiliser from area replaced by groundnuts

Then he gathers information about prices and decides what assumptions he will make in terms of the life of the new implements, yield increases and so on. All budgeting is guess work - you just need to guess as accurately as possible. You need to draw on your experience and talk to others who have experience with the system and implements you plan to use.

So our farmer discovers that he can buy a ripper for \$3900. He thinks the implement will last 7 years and may have a scrap value of \$400. So he calculates the annual depreciation cost:

$$\frac{3900 - 400}{7} = \$500$$



He finds the cultivator will cost \$2500 and thinks it will last 10 years. The yoke will cost \$300 and should last 3 years. The cultivator will have a scrap value of \$200 but the yoke will be worth nothing. Can you work the depreciation out?

He estimates the other costs and returns that will change and constructs a partial budget like this:

Extra costs		Extra income	
Depreciation:		1 tonne maize	1120
Ripper	500	300 kg cotton	2000
Cultivator	230	1.5 t groundnuts	3500
Yoke	100		
Spares and repairs	250	Total	6620
100kg groundnut seed	90		
Fertiliser	1000		
Labour	200		
Total	2370		
Income lost		Costs saved	
2.5 tonnes maize	2800	Maize seed and fertiliser	1700
TOTAL (A)	5170	TOTAL (B)	8320

Looking at these figures, you can see that Total B is greater than Total A. So it seems that he will make more profit by changing his system and buying the new equipment - about \$3150 more.



Source: CFU, Zambia

There are a number of questions that he should ask himself, however. If he does not cope with the extra weeding, there may not be any increase in the yields of cotton and maize. Would it still be worthwhile? Will he be able to sell the groundnuts for that price? Will his oxen require more supplementary feed in the dry season? Are spare parts available for the new implements?

Of course, if he could also expand the area under cultivation using this system, he would be more certain of increasing his profit.

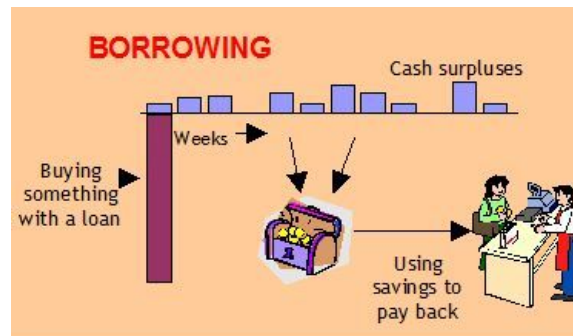
Can you afford the purchase price?

As we noted earlier, when you buy a tool, a machine or some draught animals, you have to pay the price that is being asked by the seller. So although we know this amount can be spread over a number of years in our accounts, we have to have the full amount to make the purchase. This can be very difficult. Do you remember learning about cash flows in Book 1?

A cash flow describes the pattern of money coming in and out of our household each week or month. We learned that we have to save to manage our cash flow. Savings allow us to make purchases when we have no money coming in and enable us to save up to buy more expensive items. We also saw that we can borrow money to make a purchase but then we have to save in order to pay the money back. Borrowing is a way of using our future income now.



Perhaps you remember these diagrams.



So when you decide you would like to purchase a piece of equipment, you need to make a cash flow plan to see if you are able to save up enough money to buy it. A cash flow plan will also show you whether you will be able to pay for repairs and save up enough each year to replace the equipment when it is worn out. Some people have cattle or goats they can sell when they want to buy something that needs more money than they have to hand.

Let's suppose a farmer is going to buy a pair of oxen and a plough. He first prepares a cash flow plan without including the cost of the equipment. Here is a quarterly summary of the plan:

MONEY COMING IN	Quarter: 1	Quarter: 2	Quarter: 3	Quarter: 4
Sales of:				
Maize			400	300
Cotton	100			500
Groundnuts			200	400
Vegetables	100	150	80	
Goats				
Other sources:				
Wages	150	250		
Remittances	75	75	75	75
TOTAL (A)	425	475	755	1275
MONEY GOING OUT				
Farm / business inputs:				
Seed	190			
Fertiliser	400	200		
Pesticides		180		
Veterinary costs	20	20	20	20
Maize bran and minerals	35	25	15	15
Tool repairs and maintenance	10		10	
Hired labour		30		50
Capital equipment:				
Household expenses				
	160	100	160	175
TOTAL (B)	815	555	205	260
QUARTERLY BALANCE (A-B)	-390	-80	550	1015
<i>Add or subtract the quarterly balance to or from the previous quarter's savings to get the new savings figure</i>				
SAVINGS				
Savings at start: 600	210	130	680	1695

He finds out that the total cost of the oxen, plough and yoke will be \$1690. He decides that he will sell some livestock to raise part of the money and recalculates the cash flow to see how much he will need to borrow:

MONEY COMING IN	Quarter: 1	Quarter: 2	Quarter: 3	Quarter: 4
Sales of:				
Maize			400	300
Cotton	100			500
Groundnuts			200	400
Vegetables	100	150	80	
Livestock	250			
Other sources:				
Wages	150	250		
Remittances	75	75	75	75
TOTAL (A)	675	475	755	1275
MONEY GOING OUT				
Farm / business inputs:				
Seed	190			
Fertiliser	400	200		
Pesticides		180		
Veterinary costs	20	20	20	20
Maize bran and minerals	35	25	15	15
Tool repairs and maintenance	10		10	
Hired labour		30		50
Capital equipment:				
Pair of trained oxen	1200			
Plough	450			
Yokes and straps	40			
Household expenses	160	100	160	175
TOTAL (B)	2505	555	205	260
QUARTERLY BALANCE (A-B)	-1830	-80	550	1015
<i>Add or subtract the quarterly balance to or from the previous quarter's savings to get the new savings figure</i>				
SAVINGS				
Savings at start: 600	-1230	-1310	-760	255

He can see from this that he will need to borrow at least \$1230 to pay for the oxen, plough and yoke. He finds that he can get a loan at an interest rate of 12% and thinks that he can repay it in two years.

Let's see what the first year of the cash flow might look like.

In the first quarter the farmer has borrowed \$1300 and plans to repay half of this by the end of the first year.

MONEY COMING IN	Quarter: 1	Quarter: 2	Quarter: 3	Quarter: 4
Sales of:				
Maize			400	300
Cotton	100			500
Groundnuts			200	400
Vegetables	100	150	80	
Livestock	250			
Other sources:				
Wages	150	250		
Remittances	75	75	75	75
Loan	1300			
TOTAL (A)	1975	475	755	1275
MONEY GOING OUT				
Farm / business inputs:				
Seed	190			
Fertiliser	400	200		
Pesticides		180		
Veterinary costs	20	20	20	20
Maize bran and minerals	35	25	15	15
Tool repairs and maintenance	10		10	
Hired labour		30		50
Capital equipment:				
Pair of trained oxen	1200			
Plough	450			
Yokes and straps	40			
Household expenses	160	100	160	175
Loan interest				156
Loan repayment				650
TOTAL (B)	2505	555	205	1066
QUARTERLY BALANCE (A-B)	-530	-80	550	209
<i>Add or subtract the quarterly balance to or from the previous quarter's savings to get the new savings figure</i>				
SAVINGS				
Savings at start: 600	70	-10	540	749

As you can see, the plan shows that the farmer should be able to cope with this investment and repay the money he has borrowed, together with the interest, although there is nothing to spare in the first six months. By the end of the year though, he has enough savings to meet the expenditure requirements of the next season.

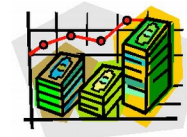


Can you prepare the cash flow plan for the next year?

Here is a possible version of the cash flow plan for the second year. We have replaced the wages the farmer used to earn by income from contract ploughing, which he can do now he owns oxen and a plough, and have increased the annual repair costs accordingly. He would not need to sell livestock this year but otherwise the pattern of income and expenditure is the same as year one.

MONEY COMING IN	Quarter: 1	Quarter: 2	Quarter: 3	Quarter: 4
Sales of:				
Maize			400	300
Cotton	100			500
Groundnuts			200	400
Vegetables	100	150	80	
Livestock				
Other sources:				
Contract ploughing	150	150		
Remittances	75	75	75	75
Loan				
TOTAL (A)	425	375	755	1275
MONEY GOING OUT				
Farm / business inputs:				
Seed	190			
Fertiliser	400	200		
Pesticides		180		
Veterinary costs	20	20	20	20
Maize bran and minerals	35	25	15	15
Tool repairs and maintenance	10	10	10	10
Hired labour		30		50
Capital equipment:				
Pair of trained oxen				
Plough				
Yokes and straps				
Household expenses	160	100	160	175
Loan interest				78
Loan repayment				650
TOTAL (B)	815	565	205	998
QUARTERLY BALANCE (A-B)	-390	-190	550	277
<i>Add or subtract the quarterly balance to or from the previous quarter's savings to get the new savings figure</i>				
SAVINGS				
Savings at start: 749	359	169	719	996

Cash flow planning helps you work out whether you can meet the actual demands of buying new equipment and all the other expenditures that you need to make. In our example it looks as though the farmer can easily manage the cost of investing in draught animal power, including the extra cost of paying interest on a loan.



Everything depends on your assumptions, however, and as we explained in Book 2, borrowing is always a risk. You always have to check whether an investment in farm power and machinery will increase profit enough to offset the extra costs and interest charges on any loans you take.

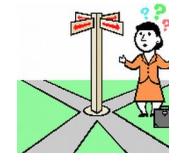
Buying a tractor is particularly challenging. Tractors cost a great deal of money and most farmers require a loan to purchase one. A relatively small tractor will cost 25 - 30,000 US dollars and large machines can cost as much as 100,000 dollars or more.

Budgeting to ensure that sufficient income will be generated to meet the annual costs and loan repayment is crucial.

What is the opportunity cost?

When you do decide to invest in machinery and buy a piece of equipment, it means you are tying up your money in that item.

When we are in business, we always face choices about what to do and what to invest in, and have to consider if the profit we will make is enough. Do you remember working out the return on capital in Book 2? If we commit significant amounts of money into the purchase of machinery, we should expect to generate a return that is at least as good as investing the money in an alternative activity.



So money always has an opportunity cost - that which it could have earned if invested in something else. The simplest comparison we can make is to imagine we had invested the money in a bank savings account. How much interest would we have earned?

First we have to work out the average amount of capital that is tied up over the life of the machine and then multiply this by the interest rate that we would have got if we had put our money on deposit in the bank. So the formula for calculating opportunity cost looks like this:

$$\frac{\text{Purchase price} + \text{scrap value}}{2} \times \text{interest rate}$$

Let's say you invest in an animal drawn sprayer that costs 7500 and has a scrap value of 1500 after five years, the opportunity cost of investing in this equipment when the interest rate on deposits is 6% would be:

$$\frac{7500 + 1500}{2} \times \frac{6}{100} = 270$$



An opportunity cost calculated in this way is often included in machinery ownership costs.

You may feel that a better comparison of what to do with your money is investing in more cattle or in a different enterprise and that is absolutely reasonable. The important thing is to be sure that purchasing a long term asset such as machinery will enhance your business and improve your livelihood.

Is it better to hire?

One alternative to buying your own machinery is to hire or rent equipment from other people. If you only have a small area of land or only need to use a piece of machinery for a few hours a year, hiring is usually cheaper than buying your own equipment.

Machinery hire services may be offered by farmers who own a tractor or draught animals and are able to do extra work beyond that required on their own farms or by people who have purchased equipment specifically to provide contract services to others.



What hire services are available in your area? Make a list and find out how much they cost to use.

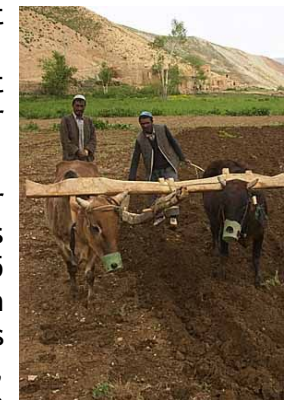
When you pay for hire services the charges will be set per hour or hectare, load or tonne - whatever is appropriate for the task being undertaken. So to decide whether it is better to hire someone or buy your own machine, you need to work out the cost of owning and operating the machinery on a similar basis.

Let's suppose you work out the annual cost of buying and using a pair of oxen to plough your land as follows:

Costs	\$
Depreciation:	
Oxen (1000 - 750) / 5 yrs	50
Plough (500 - 50) / 10 yrs	45
Yoke, chains 50 / 2 yrs	25
Spares and repairs	20
Interest charges	70
Supplementary feed and minerals	120
Medicine and veterinary costs	30
Labour for animal care	150
TOTAL	510

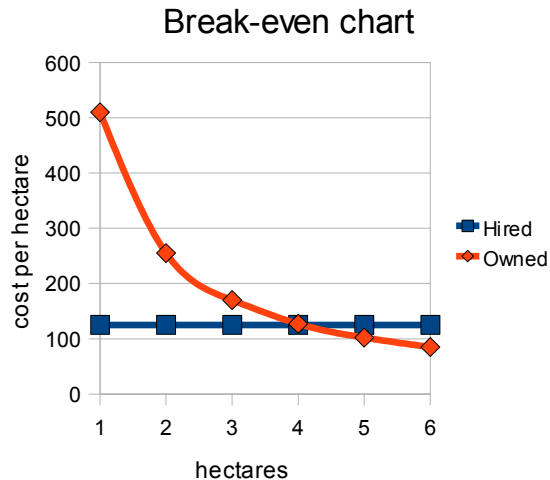
If you only have 3 hectares to plough, the cost per hectare will be 510 / 3 which equals 170. If you were able to hire someone to plough at a cost of 125 per hectare, it would be cheaper to use the hire service.

If you had 4 hectares, the cost of using your own oxen would be 127.5 per hectare which is almost the same as the hire cost. If you had 5 hectares the cost of using your own equipment would be 102 per hectare which is cheaper than hiring someone. However, feed, veterinary and repair costs may increase when you work bigger areas.



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As you can see the cost per hectare of owning your own animals and equipment comes down as the area cultivated increases. When you use the animals to plough 4 hectares it is the same price as hiring someone to plough. We call this the break-even point and it is illustrated in the following diagram.



So based on these figures, if you have less than 4 hectares it is cheaper to hire someone to plough. There are other advantages to hiring - you don't have responsibility for operating or caring for the machinery, you don't have to pay for repairs and you do not have to tie your money up in an asset that you only use occasionally.

There are also disadvantages to relying on hired services, however. There may not be a competent operator and machine available for hire near you. You do not have control over the quality of work or when the operator can come to your farm. So you may not get your fields ploughed or harvested at the optimum time, leading to loss of yield or quality.



Time for a discussion.

Do you think it is better to hire or buy the equipment you need to improve your farming operations?

4 SPREADING THE COSTS

Aim:

- To discover how contract work can increase the viability of machinery ownership
- To find out how to structure an agreement for joint ownership of machinery

Doing contract work

At the end of the last chapter we saw that the cost per hectare of owning machinery and draught animals reduces as the area cultivated increases. This fact is extremely important to people who own machinery. The more work your machine does, the more income it can generate and the more chance you have of being able to maintain it and repay any loans.

This is why farmers who own machinery often do work for other farmers, if they cannot use a machine to full capacity on their own farm. Take, for example, a farmer who owns a tractor and plough. It is not a big tractor but he will be able to plough 2-3 hectares of land in a day. If he had, say, 10 hectares of land, he would have finished ploughing in 3-4 days. The ploughing season might last 25-30 days, so the tractor could be used to plough another 70 or 80 hectares during this time.



Doing work for other people is known as contract work or custom hire. Some people set themselves up as contractors to do work for others as their main form of business but many farmers do contract work on a part-time basis to supplement their income. They fit this work in between the tasks they have to do on their own farms.

In order to know how much you can charge someone for ploughing their field or transporting their crops or undertaking any other task such as drilling, spraying or harvesting, you have to understand how much it costs to own and operate your equipment on an hourly basis. Let's look again at how to do that.

The first thing to do is work out the annual costs of simply owning the machinery, i.e. the fixed costs. These include depreciation, housing, insurance, road tax and the interest you are paying on any loan. Here is an example for a tractor, plough and trailer:

Fixed Costs	\$
Depreciation:	
Tractor (35,000 - 8,000) / 8 yrs	3375
Plough (5,000 - 250) / 10 yrs	475
Trailer (6,000 - 400) / 8 yrs	700
Tractor shed depreciation (1000/10 yrs)	100
Interest estimated as 8% of average investment in machinery (46,000 + 8,650 / 2) x 8%	2186
Insurance and road tax	320
TOTAL	7156

If this tractor was used for 200 hours, the fixed costs per hour would be:

$$\frac{7156}{200} = 35.78$$

Next we have to work out the variable costs. Here are some estimates based on the assumption that the farmer drives the tractor himself and the tractor is used for 200 hours a year:

Variable Costs	\$
1200 litres fuel (estimated at 6l/hr and \$0.75/l)	900
Oil and filters (estimated at 15% of fuel cost)	135
Repairs and spares (estimated as 5% of purchase price)	2300
TOTAL	3335

So the variable costs per hour are \$16.68. Based on these figures the total costs per hour add up to \$52.46. This means that if it takes four hours to plough one hectare, the farmer needs an income of at least \$209.84 per hectare just to cover his machinery costs.

If this farmer could do another 200 hours work with his machinery during the year, this would reduce the costs significantly.

Fixed costs would now be spread over 400 hours which would reduce them to \$17.89 per hour. The total variable costs would double as a result of the extra hours worked but the rate per hour would remain the same at \$16.68, provided the farmer continued to do all the work himself. So the overall cost of the machinery would reduce to \$34.57 per hour.

Now an income of \$138.28 will cover the basic cost of ploughing, if it takes four hours to complete. Of course the farmer will not wish to merely cover his costs but to make a profit as well. So he might charge someone \$160 per hectare for ploughing their land which is a mark-up of just over 15%.



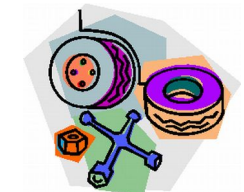
Source: IFAD

Contract charges for transport work are normally charged on an hourly basis, so the farmer in our example might charge \$40 an hour if he is using his tractor for 400 hours a year.



Have a look again at the list you made of hire services available in your area and the prices charged. What do these prices tell you about the machinery costs of these contractors?

If possible talk to one of the operators and find out how he works out his costs and charges. Make sure you ask how many hours of work he does with the equipment. A machine that is used for 2½ days every week of the year, working 8 hours a day, can do 1040 hours of work. The cost per hour for a tractor working over 1000 hours a year will be much lower but it will wear out faster and need more repairs.



When you make a budget to see if you can afford the purchase of a machine and decide to include some contract work to increase your income, you must be sure that work is really available. It is like a new enterprise - you must research your market. Here are some questions you may need to ask:

- What services do the farmers need in your area?
- What are they willing to pay for?
- Will you have to convince them to use the service you will be offering?
- Will they want the service every year?
- Are there any other people offering the same service?
- How far are you willing to travel to undertake contract jobs?

You will also need to decide how you are going to handle complaints about your work. Suppose a crop does not germinate or goods are damaged when being hauled somewhere, what will you do?



Source: IFAD

It is important to think through some of these possibilities and prepare a written contract which sets out the terms of agreement between you, the service provider, and your customer.

The contract should also set out exactly how payment is to be made and when. Are you going to allow your customers to defer their payments or expect them to pay cash on completion? If you permit deferred payments, you will need to keep good records of who owes you money or you will soon get into difficulties. Of course, if you are only going to do a few jobs for your immediate neighbours, you may take a more relaxed approach to these matters but it is still better to have proper contracts to keep things on a business-like footing.



Why not try and design a written agreement which you could use when doing contract work?

Here is a possible example:

HIRE SERVICE AGREEMENT

Evaristo Maanya, Contractor, has agreed to provide the following services to:

(Name) _____

(Address) _____

Type of work	Area or quantity required	Estimated hours	Rate
Ploughing			
Drilling			
Haulage			

The rates include expenses for tractor with implement, fuel and operator. If any other labour is supplied by the contractor, an additional charge will be made.

The contractor agrees to complete the work as follows:

Operation	Estimated start date	Estimated completion date

If any delay in the work is caused by lack of suitable preparation by the farmer (e.g. access to fields), the contractor will not be held responsible for lost time.

Payment shall be made in cash on completion of the work by the contractor.

This Agreement can be cancelled by either party up to one week prior to the commencement of the operation.

.....
(Signature of contractor) (Signature of customer) (Date)

Work completed:

.....
(Signature of contractor) (Signature of customer) (Date)

Payment received: (Amount) (Date)

Joint ownership

Another way of spreading the cost of owning machinery is for a small group of farmers to form a partnership or association and share the ownership of the machines.

For example, if three people shared the ownership of the tractor and implements whose annual fixed cost we worked out earlier at \$6810, the share to be borne by each person would be \$2270, if divided equally. So if one of those farmers used the equipment for 200 hours, his fixed cost per hour would be \$11.35 and his total cost per hour would be $11.35 + 16.68$ which is \$28.03. The income required to cover this machinery cost on land that takes four hours to



plough is \$112.12.

The benefit of sharing machinery costs seems obvious and it should also be easier to raise the initial purchase price. Instead of one person having to find, say \$35,000, to buy a tractor, five people would only have to raise \$7,000 each. If half the money could be borrowed, they would only have to contribute \$3,500 each.

In instances where the strategy of joint ownership is successful the number of farmers in the partnership is usually very small - not more than five people. The farmers are usually close neighbours or even relatives. It is really important that the partners know and trust each other or disagreements can quickly arise.



Can you think of some of the difficulties that could arise when farmers share the ownership of a machine?

Here are some examples:

- All the partners may want seasonal work, such as ploughing or planting, done at the same time.
- If the machine breaks down, they may disagree about who has to pay for the repair.
- Some partners may be less experienced at using the machine or take less care of it than others.

The best way of avoiding such problems is to prepare an agreement which each participating farmer signs. Here is an example adapted from the FAO publication "Multifarm Use of Agricultural Machinery" (1967), which covers all the issues that joint owners should discuss.



Source: IFAD

MACHINERY PARTNERSHIP AGREEMENT

We, the undersigned, who own or rent the following farms:

Name	Farm	Area cultivated

have decided to jointly buy and use the following machine(s) or implement(s):

Machine or implement	Purchase price

and in addition have made the following agreement:

1. The purchase money for the machine or implements will be paid in cash, partly by the sum of _____ contributed by each partner according to his crop area as follows:

Name of partner	Crop area	Amount of money

and partly by a loan from _____ amounting to _____ with interest and capital repayment according to the plan drawn up in the loan agreement.

If, as a result of default, the loan and interest should become immediately payable, then we are all liable for the debt.

2. Everybody concerned owns a part of the machine(s) in relation to the area of crop cultivated stated in paragraph 1.
3. When the machines or implements are purchased, one member of the partnership will be elected to be the manager, responsible for looking after the equipment when it is not being used. His term of office will last one year, at the end of which he or another member will be elected.

For the appointment of the manager and for other decisions on matters mentioned in this agreement, each partner has one vote. (Alternatively voting rights may be related to the investment made by each partner.)

The settlement of matters not mentioned in this agreement will be by majority vote of the partners; if there is an equal number of votes for and against a proposal, then the Chairman appointed for the meeting will have the casting vote.

4. Each partner has the right to use the machine(s) or implement(s) against payment of expenses outlined in paragraph 5 and a commitment to take reasonable care of the machine. Expenses not included in the charges set out paragraph 5 are to be paid by the user of the equipment.

The machine(s) will be used in accordance with a rota drawn up and approved unanimously by us each year. If no such agreement can be reached, the manager will decide priorities and timing in the use of the machine(s).

Each partner is responsible during the time the machine is in his possession for any damage caused to it, either intentionally or by carelessness on the part of himself, his household or an employee.

5. Charges to be paid by the partners for the use of the machine(s) will be calculated by the manager and agreed unanimously by the partners. Charges will be calculated to cover:
 - Loan interest and capital repayment
 - Insurance premiums
 - Routine maintenance and spare parts
 - Housing costs
 - Any fuel, oil and wages not paid directly by the partners
 and based on (e.g. hours worked, hectares covered, amount of grain threshed, etc.) _____

6. Each partner using the machine will write his name in the daily journal kept for the purpose. The charges will be paid not later than ___ days after the work is finished.

If the charges for a year exceed the expenses for the same period, the excess will be transferred to next year's account. If, on the other hand, there is a deficit, we agree to pay it immediately upon the manager's request, according to the liability of each of us stated in paragraph 1.

7. It may be decided that a machine can be used by non-partners during the time it is not in use by us, and if so, charges will be decided upon when the occasion arises.
8. The manager will present us with the accounts for noting and approval each year by _____ at the latest.
9. The partnership will not be terminated unless three-quarters of the partners agree. If it is so agreed, the machine(s) will be sold to buyers at prices agreed to unanimously and if no such agreement can be reached, the machine(s) will be sold by auction.

Should some money remain from the sale of the machine(s) after the debts have been paid, this will be shared among the partners according to the area of cultivated land stated in paragraph 1, or the investment of each partner.

10. Each of us has a copy of this agreement. If a partner transfers his share to another, the latter must sign the agreements of the other partners and have his own copy signed by them.

Signed: _____ Date: _____

Signed: _____ Date: _____

Signed: _____ Date: _____

The points covered in this agreement do highlight the complex nature of joint ownership but if farmers can be very clear about their agreement and are all committed to making the arrangements work, it can offer a way for small scale farmers to gain the benefit of machinery in their operations.





If you think joint ownership is something you would like to consider, you should review and discuss each point in the draft partnership agreement to see if you would be able to come to such an agreement with some of your neighbours or friends.



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Acknowledgements

Thanks are due to Brian Sims, Engineering Consultant, for his first draft of this booklet and subsequent comments.

The draft contract and partnership agreement are based on examples found in “Multifarm Use of Agricultural Machinery” by H. Lönnemark, FAO Agricultural Development Paper No. 85 published in 1967 and now out of print.