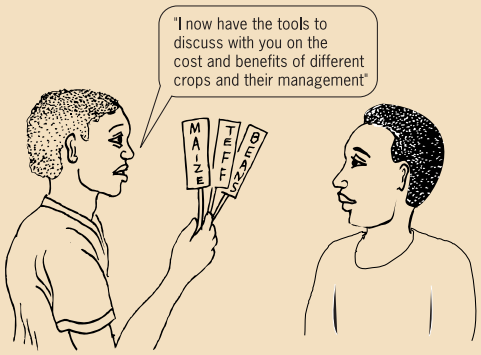
TECHNICAL REPORT No. 24

ESTIMATING COSTS AND BENEFITS ON CROP PRODUCTION

A Simplified Guide for Smallholder Farmers in Ethiopia



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RELMA

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Ato Takele Zegeye,
Ato Abdurahim Ali
Dr. Admasu Kebede

FOREWORD

Although Ethiopia is well known for its long history of agriculture, the method of production has largely remained predominantly subsistence in nature. Communication and lack of exposure have, among other factors, contributed towards this phenomenon to a very large extent.

In recent years, concerted effort has been made by the government to address the low level of food production in the country. Encouraging success has also been reported as a result of the introduction of improved agricultural packages such as seed, fertilizer and agrochemicals.

The department of Agricultural Extension of the Ministry of Agriculture of Ethiopia continues to be involved in the formulation of different technical extension packages to diversify the interventions. Although this process is initiated at the federal level, every regional state is also encouraged to emulate the ready made packages and modify them to suit the regional peculiarity. In addition to this, the regions also formulate their own packages around activities they want to promote in their states.

Although most of the packages relate to a set of activities in a particular sub-sector, there are some activities that are crosscutting. This cost and benefit analysis guide can be applied to the various agricultural sectors such as crop production, livestock, forestry and so on. It is with this understanding that the head of Extension Department requested RELMA to be involved in the preparation of a guide that will serve as reference material for field extension staff and the Woreda agricultural offices.

One major factor that was behind the introduction of cost / benefit analysis in the extension service is the shift in thinking from *Food Self Sufficiency to Food Security*. The Ethiopian traditional farming has been known to practice a good mix of crops and livestock to avert risks. Unfortunately, the production has been limited to satisfy the immediate needs of small communities.

There are three key issues that this manual will address:

- This manual is seen as a strategy for establishing market as a driving force for production.
- It can also provide an option or serve as a cause for farmers to move away from producing for their family needs, to adopting production systems that are best suited to the agro-ecological zones.
- Woreda offices can use this guide as an analytical tool to advise farmers on the optimum inputs and practices.

Benefit is the driving force for production among smallholder farmers. This is better expressed when it has a common denomination that is well understood by all. This cost benefit analysis guide therefore marks a shift in the extension approach and is very much

in line with the modern thinking. Teff, maize, salt, oil, etc cannot be bartered one in one but they all have a common denominator - money.

A forth contribution that this simplified guide could contribute is to assist as a tool to build team approach among different Subject Matter Specialists. When working in isolation, it is natural to think in terms of increased quantity and quality of production. Because of the nature of departmentalization, there has been little opportunity to share common means of measurement and to compare possible alternatives. Using such simple guide for analysis will serve as a management tool for decision makers to determine the area of emphasis for particular regions and to adjust their resources accordingly.

One of the mandates of RELMA is to build capacity of the partner institutions in member countries. It is a privilege for RELMA to be a part of an endeavor which will not only promote the productive capacity of the small scale farmer but also bring the issue of specialization by adopting suitable options of production led by market demand and supply. Let me take this opportunity to praise the Extension Department of the Ministry of Agriculture for identifying such a viable subject.

Åke Barklund
Director, RELMA

1 INTRODUCTION

With changes in the living standard of the rural population, no single household is able to produce everything it needs from its own farm. That is why marketing has become an important component of farm management. Farmers need to market their surplus produce and buy what they want and need for improving their lives. In doing so, they want to know which crop will bring the most profit or which will take less of their valuable resources but still provide good return.

A number of factors influence what decisions smallholder farmers make about their production. Household goals and objectives are in the forefront. A typical decision the farmer must make is whether to produce for home consumption or for the market, or both. Fluctuations and seasonal variability of input and output prices affect farm profitability. It is therefore difficult for the farmer to predict produce prices. The uncertainty of weather always makes farming a business of risk. Therefore, the farmer must use inputs judicially, time farm activities properly and manage the farm efficiently. Most farmers have only a limited amount of such resources as capital, land, labour and technology. Whether these production factors are well used or not will likely determine farm profitability.

1.1 Objectives of the simplified guide

This simplified guide for estimating costs and benefits is a tool for extension staff at various levels, to help farmers make rational decisions.

- It is a tool for identifying bottlenecks and constraints in a particular farming practice. Working through these bottlenecks can help link research and extension.
- It can identify the resources (labour, material, improved inputs) that are required to undertake the production of a particular crop.
- It can be used to plan future activities or analyse past performance. If it is used for planning future activities, the price of the produce and inputs will have to be estimated and the benefit based on current prices.
- The partial budget analysis can help identify opportunities by varying projected inputs or technology, including marketing. The analysis enables the farmer to choose which crop to produce as well as what, how and how much to produce.

The farmer will understand the liberalized market better, and know when marketing the produce is most profitable and how best to do it.

The analytical method provided in this simplified guideline should be used flexibly. It is a tool that should be modified and adapted according to the enterprise and the geographical reality. It is developed for small-scale farmers whose operations are not complex, who are not using high technology, and who are not involved in advanced financial transactions.

2 BUDGETING

2.1 Record keeping

Variation in the cost of production depends on the inputs and labour that are used to produce a particular crop. Keeping records of these activities and inputs helps determine the cost of production of current produce and estimate the cost of future enterprises. Keeping records can improve the standard of farm management. The farmer can compare the records with general standards. The records provide farmers with valuable information that helps them plan, budget and prepare a business plan, and it can be used as a tool in decision making. It is therefore important that the farmer continuously keeps records of all farm activities.

Record keeping is writing down all transactions involved in a particular activity that can be expressed in money. To run a farming business well, the farmer must know what money has been received, how much money is spent and, most important of all, how it is spent. For a smaller enterprise, it is usually enough to have books for recording money (cash book and account book) and another for recording production details. In the account book the farmer keeps a daily register of all the income and expenses of the enterprise (including labour), together with any sales or purchases using credit. It does not matter whether the money is coming in or going out, the transaction should be registered in the cash book. The records in this book indicate the amount of cash available to buy raw material, pay bills or take care of other farm expenses. The production records include all the operations carried out for each enterprise, such as crop records on area grown, amount of seeds, fertilizers, chemicals and their cost, crop yield, how much of the crop is stored or sold.

The farmer must always take into consideration the produce that the household consumes or that is given away, by putting a value on it and entering it as a receipt in the accounts. The farmer should also record how much crop or other produce is wasted or destroyed. Because the literacy rate in the rural areas of Ethiopia is low, development agents need to identify farmers that can keep records. Such a farmer can serve as a source of information for the small-scale farmers in the area.

2.2 Single-enterprise budget

An enterprise consists of a single crop-production system. For example, a budget for only teff or for only wheat is an enterprise budget. Estimating costs of an enterprise involves recording the cost of all inputs and all activities plus any interest that the farmer has to pay if a loan was taken out to purchase inputs. The benefits include crop residues and crop consumed at home as well as crop sold. A single-enterprise budget should give the answer to the question: what will be the profit (or loss) of a particular enterprise?

Table 1: *Example of farm records*

Date	Activity	Out	In
3/1	Paid land tax	30	
5/1	Received loan for teff production	780	
7/1	Bought improved teff seeds		50
8/2	Received loan for maize production		770
12/2	Paid rent for 1-ha maize field	400	
5/3	Paid labour for land-clearing		
	16 person-days @ 8birr	128	
7/4	Bought DAP fertilizer	500	
9/4	Rented oxen for ploughing	72	
	[...and so on]		
Total			

2.3 Whole-farm budget

Small-scale farmers usually grow more than one crop. Then an enterprise budget should be prepared for each crop. The summary of all the enterprises gives the budget for the whole farm.

The estimation of cost and return for the entire farm as a single unit is called a whole-farm budget. For example, if the farming is mixed and includes crop production, dairy, poultry or fishery, the statement showing estimated returns and expenses of all these enterprises combined is the complete or whole-farm budget of that farm.

2.4 Labour costs

Person-days

A 'person-day' is the work one person would normally do in one working day to carry out a specific activity. In factories, a person-day is usually 8 working hours. In farming activities, particularly those of smallholder farmers, the number of working hours in a day varies, depending on the area and the activity. The labour cost of various activities may also vary, not only from place to place, but also from season to season, depending on the demand for labour and its availability. In some places, such as Bako in western Ethiopia, 5 hours of work is considered one working day; in others, such as North Shoa,a working day may be up to 9 hours.

The working hours in a day for activities like harvesting and weeding are longer than for ploughing, clearing land and applying herbicide. However, it is advisable for the development

agent to survey and establish the actual unit cost for person-days for different activities in a particular area. Consider the wage rate in the community as the basis for estimating labour cost. Thus, multiply the number of person-days by the unit price of each activity to estimate labour cost.

Family labour

It is easy to calculate hired labour according to the actual wage paid, but farmers often fail to consider the cost of the labour that they themselves and their families do. Because of the time spent, family labour, which is a limited resource, has a value that must be taken into account. The farmer who wants to estimate real costs and profits needs to include its estimated cost.

Different enterprises need different amounts of labour, and the farmer can work only at certain times each day. As farm family labour spent on the enterprise could otherwise have been spent on other activities, it must be calculated as a cost for the farmer (so-called alternative or opportunity cost). Children's labour can be recorded as equivalent to half or a quarter of a person-day, depending on the age of the child and the activity.

Oxen-days

One oxen-day is the work of a pair of oxen or of any other animal a farmer is using performed during one working day of the farmer. Just like person-days for human power, the number of working hours in one oxen-day may vary; it depends on the type of soil, the strength of the oxen and if the season is wet or dry. Here also the rate paid per oxen-day varies from one ecological area to another, from one type of activity to another, and from season to season. Since there is high demand for oxen during the ploughing season, the price per oxen-day at that time is relatively higher. The total cost of oxen-days is estimated in the simplified format by multiplying the price per oxen-day by the number of days required for each activity.

3 CASE STUDY OF ATO TULU

To better understand how to prepare cost and benefit calculations, a case study serves as an example. Although Ato Tulu has more than two enterprises, only teff and maize production are considered in this example.

Ato Tulu Chaka is a 40-year-old farmer who lives in West Shoa zone, which is in the *weyna dega* agroecological zone. He is literate. He is married to Weyzero Chaltu and they have four children. The wife participates in all the farming practices except ploughing, which is the husband's duty.

Ato Tulu owns 2 ha of land on which he pays a land tax of 20 birr per year. He produces teff on 1 ha. The other hectare is for horticulture and permanent crops. He also rents 1 ha of land from his neighbour for maize production. The rent is 400 birr a year. Ato Tulu applies fertilizers to his crops and uses improved seeds. He also uses chemicals on his teff and maize fields. The main objective of production, according to Ato Tulu, is for household consumption, but he also markets some of his teff and maize output in the nearest market. At the beginning of the season, Ato Tulu got a loan of 580 birr for financing his teff enterprise and 720 birr for the maize enterprise. The agreed interest rate was 10.5% and the loan was to be repaid in 9 months.

The season was relatively favourable, with adequate rainfall. To clear the crop stubble from the 1 ha for teff, he needed 4 persons working for 2 days. He ploughed that hectare 4 times. He used 4 pairs of oxen each time, or 16 oxen-days. He ploughed the land for maize only 3 times of 4 oxen-days each, or a total of 12 oxen-days. The rate at the time of ploughing for 1 person-day was 8 birr and 10 birr an oxen-day.

Ato Tulu transported 200 kg of fertilizer, 25 kg seeds of improved maize and 25 kg of teff from the nearby store. He used 2 donkeys for 1 day at a rent of 5 birr for each.

Planting teff was different from planting maize. Ato Tulu, who ploughed the land, also broadcast the teff seeds and the fertilizer. It took him 4 days with oxen to do the planting. The maize was planted in rows, which is quite a different operation from broadcasting. It required 2 additional persons for 1 day; 1 person dropped the seeds and the other applied the fertilizer. Ato Tulu ploughed with a pair of oxen to open the planting furrow. The wage rate for the planting was the same as for the ploughing.

He applied half a litre of herbicides on the teff field and the same amount for the maize field, at a cost of 50 birr per field.

The 1-ha teff field was weeded only once, taking 2 persons 8 days. At that time, the rate for a person-day was only 7 birr. The maize field had to be weeded twice; each weeding required 2 persons for 5 days. Ato Tulu thinned his maize field in 4 days, using a pair of oxen at the rate of 10 birr per day. The person wage rate for thinning the maize field was still 7 birr per day.

Stalk borer attacked Ato Tulu's maize, so he applied insecticides worth 75 birr (0.5 litres at a unit cost of 150 birr per litre). Applying the chemicals took 1 whole day, for which he employed a labourer. Because the toxic nature of the chemical made the work hazardous, he paid the labourer 10 birr. He also rented a sprayer for 2 birr.

To guard the maize field from flocks of birds, he hired 2 youngsters whom he paid 3 birr each per day for 30 days.

Ato Tulu and his wife harvested the teff, cutting and transporting it in 10 days, using 2 donkeys. Since most farmers in the area harvested at the same time of the year, demand for labour was much higher than at other times of the year, and therefore the unit price was as high as 10 birr. They harvested 1 tonne of teff from the 1-ha field.

Ato Tulu needed to smooth the ground where he would thresh his teff. His son, whose work was valued at 5 birr per day, did this in 2 days. For the threshing, he used 5 oxen. He and 2 neighbours spent 4 days threshing the teff with the pack of oxen. Labour was 10 birr per person-day and the oxen were hired at 4 birr per day each.

The couple worked together to harvest and stack the maize ears, which took them 15 days (30 person-days). For this activity, they rented a donkey for 4 days at a daily rate of 5 birr. Ato Tulu rented a sheller, for which he paid 5 birr per 100 kg harvested. They harvested a total of 7000 kg of maize.

After harvesting and threshing, Ato Tulu and his wife needed to store the produce. It took them 2 days to bag the teff and transport it to their granaries. To transport it, Ato Tulu rented 2 donkeys. The maize was stored in 100-kg bags and to complete this task he hired 4 persons to help him; they did the work in 1 day.

Two years ago, Ato Tulu built a big room for storing maize and 2 granaries for teff, so he could provide his own storage. The cost of constructing these structures was valued at 500 birr for the storeroom and 60 birr for the 2 granaries. Although Ato Tulu is a conscientious farmer, he has experienced a considerable loss of produce every year when storing. He therefore spent 80 birr for insecticides to protect the maize from weevils.

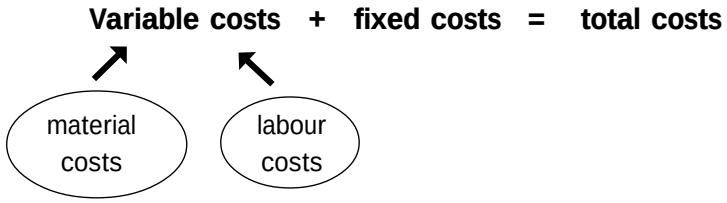
Out of his harvest of 7000 kg of maize, his family used 700 kg for their own consumption, he sold 5300 kg at the local market at a price of birr 1.20 per kilogram, and he gave 200 kg away to relatives and friends. The other 800 kg were destroyed during storage. From the 2000 kg of teff harvested, 700 kg were used for home consumption, 1100 kg were marketed at a price of 1.60 birr per kilogram and 150 were given away.

Ato Tulu's wife, Weyzero Chaltu, took the produce to market using a donkey, which they rented for 5 birr. She spent only a few hours in transporting the produce, and her labour was estimated at 0.02 birr a kilogram for both the maize and the teff, so 5300 kg maize + 1100 teff = 6400 x 0.02 = 128 birr for her labour.

4 EXPLANATION OF FIELD ACTIVITIES AND COSTS IN THE SIMPLIFIED FORMAT

The major field activities, costs and returns vary with the type of crop, the season and the agroecology of the area. A simplified format, the model of which is presented on pages 38 to 40, can help compute these costs and benefits. Following are detailed examples of how the various elements in the format are computed. Costs are of two types:.

- *Variable costs.* The variable costs in the format are for human and animal labour and material inputs such as fertilizers, seeds, pesticides and interest on input credit. Variable costs vary with changes in the production.
- *Fixed costs.* Fixed costs include land and income taxes, land rent, interest on fixed assets and depreciation. They remain the same regardless of change in production.



Other items in the format are gross income and net income or loss, explained later.

4.1 Variable costs

Land clearing

Land clearing is the process of removing shrubs, crop stubble and like material from the field. If the land is new, clearing activities take more person-days and therefore incur higher costs.

Ato Tulu incurred a cost in clearing land for the 1-ha teff field. He did not need to do any clearing on the field where he planted maize. It took 4 persons 2 days to clear the teff field (no. persons x no. days = 4 x 2 = 8). If a daily wage is 8 birr, that is the unit cost.

Table 2: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-day or machine rent			Total cost
	Person-costs (*a*)	Unit days (*b*)	Total cost (*a***b*)=*c*	cost (*d*)	Unit /days (*e*)	cost (*d***e*)=*f*	cost (*c*+*f*)=*g*
Land clearing	8	8	64	—	—	—	64

Column *d* should reflect the kind of draught power used.

Ploughing

Ploughing is a major farm activity. In almost all areas where annual crops are produced, the land is ploughed with a pair of oxen and human labour. In a few places, it is ploughed only with human labour. The frequency of ploughing varies from place to place and from crop to crop. The type of the soil and amount of rainfall also determine the frequency of ploughing.

Ato Tulu ploughed his 1-ha teff field 4 times with a pair of oxen. Each ploughing took 4 days, so the total number of person-days for Ato Tulu was 16 (4 x 4) and there were 16 oxen-days. The unit price of 1 person-day in that area at that time was 8 birr; the oxen-day price for a pair of oxen was 10 birr. The total labour cost is therefore 128 birr (8 x 16), and the total oxen-day cost 160 birr (10 x 16).

Table 3: *Labour and oxen costs, teff*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days / days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/ days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
1st ploughing	4	8	32	4	10	40	72
2nd ploughing	4	8	32	4	10	40	72
3rd ploughing	4	8	32	4	10	40	72
4th ploughing	4	8	32	4	10	40	72
5th ploughing	—	—	—	—	—	—	—

Ato Tulu also ploughed his 1-ha maize field. He ploughed 3 times with 4 pair of oxen each operation. It is given that a person-day costs 8 birr and an oxen-day 10 birr

.

Table 4: *Labour and oxen costs, maize*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days / days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/ days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
1st ploughing	4	8	32	4	10	40	72
2nd ploughing	4	8	32	4	10	40	72
3rd ploughing	4	8	32	4	10	40	72
4th ploughing	—	—	—	—	—	—	—
5th ploughing	—	—	—	—	—	—	—

Transporting inputs

Farm products or inputs must be transported from farm to homestead or market and vice versa. Any costs incurred in transporting inputs to the homestead, including family labour, need to be considered and recorded for the particular enterprise, or crop, to which it applies.

Ato Tulu used 2 donkeys at a daily rent of 5 birr each to transport fertilizers and seeds for the teff enterprise. He used the same means to transport the maize.

Table 5: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person--days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Input transport for teff	—	—	—	2	5	10	10
Input transport for maize	—	—	—	2	5	10	10

Labour cost is not included in the charge, as it does not take a whole day.

Planting seeds

Planting traditionally is done by broadcasting seed. Fertilizer, if applied, is broadcast at the same time. The seeds and fertilizer are covered immediately after broadcasting by ploughing them in, usually done by the same person or persons who ploughed the land.

When farmers practise row planting, one person ploughs, a person following drops the seed and a second person applies fertilizer and then covers seed and fertilizer.

Ato Tulu used a pair of oxen for 4 days to broadcast the teff field. For the maize field, he needed 1 day to row plant; he was assisted by 2 hired labourers and 1 pair of oxen, which he handled himself.

Table 6: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Planting teff	4	8	32	4	10	40	72
Planting maize	3	8	24	1	10	10	34

Applying herbicides

Applying herbicides on farmland reduces weeds, but it costs the farmer both to buy and to apply the chemicals. However, the herbicides reduce the weeding costs.

Ato Tulu applied 0.50 litres of herbicide on the teff, which cost him 50 birr. He did not hire anyone but used his own labour, taking 1 day. He hired a sprayer for the operation for 2 birr.

Table 7: *Labour and oxen costs*

Activities, teff	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Herbicide application	1	8	8	—	—	—	8
Rent of sprayer	—	—	—	1	2	2	2

Weeding, cultivation, topdressing and thinning

Weeding is removing any unwanted crop or herb that is growing in a crop field. If a farmer does not use herbicides, manual weeding becomes a major labour cost. Most teff and maize fields are weeded more than 3 times.

Thinning *(shilshalo)* involves turning the soil, both to aerate plant roots and to reduce the plant population to the required density. Maize and sorghum crops are usually thinned with oxen when the plant reaches knee height. Fertilizers are sometimes applied for the 2nd time at the same time (topdressing). Thinning is generally a 1-time practice. In row planting, the 2nd application of fertilizers is the main activity, rather than thinning.

Ato Tulu weeded the teff field only once. It took 2 persons 8 days to weed the 1-ha field (16 person-days). The unit cost for 1 person-day was 7 birr, so the total for weeding was 112 birr (2 x 8 x 7). Since he used herbicides, he did not have to do a 2nd or 3rd weeding.

He weeded the maize field twice. The 1st weeding, which was done 5 weeks after planting, took 10 person-days. The 2nd weeding was combined with topdressing and thinning. It took 6 person-days for the weeding, 2 for applying the urea fertilizer and 2 for thinning.

Table 8: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
1st teff weeding—cultivation	16	7	112	—	—	—	112
2nd weeding	—	—	—	—	—	—	—
3rd weeding	—	—	—	—	—	—	—
1st maize weeding	10	7	70	—	—	—	70
2nd weeding	6	7	42	—	—	—	42
Topdress	2	7	14	—	—	—	14
Shilshalo	2	7	14	2	10	20	34

Applying insecticides

If a crop becomes infested with insect pests, the farmer must apply insecticides to ensure good crop yield.

It took 1 person 1 day to apply the insecticide on Ato Tulu's maize field, at the daily rate of 10 birr. It took 0.5 litre of insecticide to spray the field; at 150 birr per litre, the insecticide for the operation cost 75 birr. Sprayer rental was 2 birr for the day.

Table 9: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Application of insecticide, maize	1	10	10	—	—	—	10
Rent of sprayer	—	—	—	1	2	2	2

The cost for the chemicals will show in 'material input cost'; see section 4.1.16.

Guarding and bird-watching

Ato Tulu hired 2 youngsters to watch the maize field for 30 days. Since guarding is usually a task given to children and not well paid, it is here calculated as 0.25 of an adult cost, that is, in this example, 3 birr per day. Total cost for this activity adds up to 180 birr (30 x 2 x 3 = 180).

Table 10: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Guarding maize field	60	3	180	—	—	—	180

Harvesting and stacking

Harvesting and stacking are separate activities, although in most areas, the whole of harvesting, transporting the harvested product to the threshing area, and stacking the bags are considered as one activity. Harvesting is a major farm activity, and during this time, as labour is often in short supply, its cost is usually high. In some areas, harvesting costs are calculated or agreed on by the hectare, instead of by the number of days worked. Harvesting customs vary from area to area and also depend on the type of crop. The cost for each operation therefore needs to be recorded.

For Ato Tulu, harvesting 1 ha of teff required 20 person-days and 8 donkey-days. The unit price per person was 10 birr. The labour cost was higher than for other activities because the demand for labour was high at the peak of the harvesting season. To harvest the maize ears and stack them in the granary took 30 person-days. Ato Tulu also hired 4 donkeys for 1 day at birr 5 each.

Table 11: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	Unit /days (*d*)	Total cost (*e*)	cost (*d***e*)=*f*	(*c*+*f*)=*g*
Harvesting and stacking, teff	20	10	200	8	5	40	240
Harvesting and stacking, maize	30	10	300	4	5	20	320

Preparing the threshing ground

Preparing the threshing ground is especially necessary for teff because the seeds are tiny, although it is prepared for other crops as well, such as barley. The ground is smoothed by using cow dung and water *(awdima)*.

Preparing the threshing area for Ato Tulu's teff harvest took 2 person-days at the unit price of 5 birr per person-day.

Table 12: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Preparation, threshing ground	2	5	10	—	—	—	10

Threshing

Ato Tulu used a pack of 5 cattle for 4 days to thresh the teff (5 x 4 = 20). He and 2 hired men spent the same number of days (3 x 4 = 12). The labour cost was 10 birr per person-day and oxen-days were 4 birr each. He used a sheller for the maize.

Table 13: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Threshing of teff	12	10	120	20	4	80	200

Combine harvesting, shelling and threshing

If a farmer hires machinery for harvesting, shelling and threshing, the rent of operation forms the basis of the cost. Payment may be made by weight of the produce shelled and threshed or by the hectarage of the land harvested.

Ato Tulu hired a sheller to thresh the maize field at a cost of 0.05 birr per kilogram harvested. The total yield from the field was 7000 kg; therefore, the total machine cost for the shelling was 0.05 x 7000 = 350 birr.

Table 14: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Combine harvesting, shelling, threshing	—	—	—	7000	0.05	350	350

[a] in this instance, the unit is kilograms for machine rental, not oxen-days

Transporting to storage

Farmers must transport the threshed grain to its storage place, with human or animal labour. The cost can be significant, particularly for teff, wheat and barley.

Ato Tulu and his wife used 2 donkeys for 2 days, bagging and transporting the teff to the granary. Storing the maize grain in 100-kg bags took Ato Tulu and 4 hired labourers 1 day.

Table 15: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Transport to storage, teff	4	10	40	4	5	20	60
Transport to storage, maize	5	10	50	—	—	—	50

Storage cost (variable)

If storage is rented, the actual rental price should appear in the calculation. But many farmers have their own storing facilities and should therefore estimate its depreciation and include that as a fixed cost (see section 4.2.3).

Other costs related to storage are chemicals used to protect against grain loss during storage. Chemical costs show as 'material inputs', section 4.1.16, and storage loss is explained in section 4.1.18.

Ato Tulu has his own storage facilities, and consequently the estimated amount of depreciation appears as a fixed cost.

Marketing costs

Taking produce to market for sale also incurs costs. Costs include packaging (cost of sacks and other containers), transportation and the time the farmer spends to sell the produce.

Ato Tulu sold 1100 kg of teff and 5300 kg of maize. His transport expenses were 5 birr for donkey rent and a 2-birr equivalent for human labour for each enterprise.

Table 16: *Labour and oxen costs*

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Marketing costs, teff	—	—	2	—	—	5	7
Marketing costs, maize	—	—	2	—	—	5	7

Material costs

Material input costs include such items as seed, fertilizers, pesticides and packaging, which are valued according to their actual purchase price or their market price. Seed from the farmer's own source is valued at the market price prevailing during the period, as the seed used could otherwise have been sold and thus have been income. The quantity of each material input must be multiplied by its unit cost to arrive at its total cost. Interest needs to be computed on any inputs that the farmer purchased on credit.

Ato Tulu spent 50 birr for teff seed and 40 birr for maize seed. For teff, he used 100 kg of DAP fertlizer at 250 birr and 100 kg of urea at 230 birr. He used the same amounts for maize. He bought the fertilizer through a loan with an interest rate of 10.5% per year.

Ato Tulu used a herbicide on the teff, so he had to weed it only once. Using chemical insecticides, he protected the maize against stalk borer with 0.5 litre insecticide and against storage weevils with another 0.5 litre. The insecticide cost 150 birr per litre.

Table 17: *Material inputs cost, teff*

Item		Quantity	Unit cost (birr)	Total cost (birr)
Seed	Local (kg)	—	—	—
	Improved (kg)	100.0	0.50	50.00
Fertilizer	DAP (kg)	100.0	2.50	250.00
	Urea (kg)	100.0	2.30	230.00
Pesticide	Herbicide (litre)	0.5	100.00	50.00
	Insecticide	—	—	—
Empty grain sacks (no.)		13.0	3.00	39.00

Table 18: *Material inputs cost, maize*

Item		Quantity	Unit cost (birr)	Total cost (birr)
Seed	Local	—	—	—
	Improved (kg)	100.0	—	0.40
Fertilizer	DAP	—	—	250.00
	Urea	—	—	230.00
Pesticide	Herbicide (litre)	—	—	—
	Insecticide (litre)	0.5 + 0.5	150.00	150.00
Empty grain sacks (no.)		53.0	3.00	159.00

Credit cost

A loan is money borrowed at an agreed interest rate for an agreed period of time. Credit is a form of loan. Credit is money, goods or services that may be borrowed and used without immediately paying for them. Receiving credit means borrowing money or goods that are to be repaid later and are neither free nor a grant. When farmers have increased costs (such as labour or time spent) or expenses in processing a loan or gaining credit, these should be included in the calculation.

Interest is the cost on credit or borrowed money. It must be paid back in addition to the total sum of money that is borrowed. Farmers must ask themselves why they want to borrow money and how much they should borrow. How and when will they be able to pay back the loan and what will it add to the business? Farmers thinking of taking a loan must be sure to make the best use of it. If it is spent on things other than the farm enterprise, such as for personal items, it could cause a farmer to lose the business, as additional interest will have to be paid on the loan.

Ato Tulu borrowed 580 birr for the teff enterprise and 720 birr for the maize. The interest was paid back in 9 months at 10.5% per year. This is calculated as—

Loan for teff		birr 580.00
Interest at 10.5% for 9 months	9/12 x 0.105 x 580 =	45.67
Loan for maize		720.00
Interest at 10.5% for 9 months	9/12 x 0.105 x 720 =	56.70
Payment in interest at the end of the 9th month	=	102.37

Table 19: *Material inputs cost*

Item	Quantity (loan amt)	Unit cost (birr)	Total cost (birr)
Interest on inputs, 10.5% for 9 months for teff	580	0.105 x 9/12	45.67
Interest on inputs, 10.5% for 9 months for maize	720	0.105 x 9/12	56.70

Storage loss

Storage loss can be quite significant, especially with maize, sorghum and wheat. Although it is difficult to measure directly, farmers should always take note of the amount of grain damaged by insects or moisture and include this in the record keeping.

A way of estimating storage loss in quantity is to measure the total harvest stored and calculate the loss that is the difference between what was stored and what has been sold, consumed or given away. The difference is the loss to the farmer. A change in quality of the stored grain will also affect its price.

Ato Tulu, although a conscientious farmer, has experienced storage loss every year. Out of his harvest of 7000 kg of maize, 700 kg were used at home, 5300 kg were sold at an average price of 113 birr, and 200 kg were given away to relatives and friends. The rest was destroyed during storage—that is, 7000 – (700 + 5300 + 200) = 800 kg lost, or 800/7000 = 11.5% of the harvest.

From the 2000 kg of teff harvested, 700 kg were used at home, 1100 kg were marketed at a price of 2.00 birr per kilogram and 150 kg were given away. Storage loss therefore was 2000 – (700 + 1100 + 150) = 50 kg, which is 2.5% of the harvested teff.

These loss amounts are now multiplied by the average market price of the crop to get the total storage loss cost. For maize, it comes to 904 birr and for teff 100 birr.

Table 20: *Storage loss*

Item	Amount lost (kg)	Price (kg)	Total cost (birr)
Storage loss, teff	50	2.00	100
Storage loss, maize	800	1.13	904

4.2 Fixed costs

Land tax

In Ethiopia, land tax is fixed per family, not on size of the holding, irrespective of the farm enterprise. The land tax for each enterprise can therefore be calculated by figuring its percentage of the total tax for the holding.

Ato Tulu pays tax at an amount of 20 birr per holding per year. The fixed cost for the teff enterprise is therefore birr 10 per year since it occupies 1 ha out of a total of 2 ha. The maize land was rented and it is the owner of the land who pays the tax.

Table 21: *Land and income tax for teff*

Item	Quantity	Unit cost (birr)	Total cost (birr)
Tax per hectare	$^1/_2$ holding	20/holding	10

Land rent

Land rent varies from region to region and according to the fertility and the potential of the land. The market determines the going price. The land rent for any enterprise is calculated by multiplying the size of the piece of land by the unit rent price.

Ato Tulu rented the maize field from his neighbour at 400 birr per year.

Table 22: *Land rent for maize field*

Item	Quantity	Unit cost (birr)	Total cost (birr)
Land rent	1 ha	400 per ha	400

Depreciation on fixed assets

Depreciation cost is calculated on fixed assets such as farm equipment, tools, granaries. The purpose of calculating and determining the rate of depreciation is to help the farmer

set aside money needed to replace a particular asset at the time when it has worn out. The simplest way to calculate it is by dividing the value of the asset at the time of purchase or construction by the number of years that the asset is expected to last. That amount is the depreciation cost per year.

If, for example, the harvest is stored in the farmer's own structure or granary, an easy way of calculating the cost is as follows. Estimate the cost of building the granary and also estimate its life span. Dividing the construction cost by the number of estimated years provides an estimated cost of storage per year.

Depreciation costs are not taken into consideration if assets are rented. If storage is rented, the cost is calculated directly by multiplying the rent by the length of storage time. The rent is considered a variable cost. To make it easier to calculate depreciation for small equipment items and tools for every single operation, an alternate way to calculate is to use the rental cost of the equipment.

Ato Tulu used his own storeroom for storing the maize and his 2 granaries for the teff. The cost of construction was estimated at 500 birr for the room and 60 birr for the granaries. He estimated that the room would last for 10 years and the granaries for 3 years. The cost of depreciation per year is calculated by dividing the value by the years of the life span, or 50 birr (500/10) for the storeroom and birr 20 (60/3) for each granary.

Table 23: *Storage cost*

Item	Construction cost (birr)	Divided by years	Total cost (birr)
Storage cost, teff	60	3	20
Storage cost, maize	500	10	50

Interest on fixed assets

If the farmer has borrowed money to buy or to rent land, the interest on the borrowed money is calculated in a way similar to the interest on variable costs. If the loan covers several years, this must be taken into account. In the example following, the farmer gets a loan of 500 birr with a repayment period of 5 years and an annual interest rate of 10%. One-fifth of the loan will thus be repayed every year. The total loan was 500 birr and the annual repayment is therefore 100 birr each year. Since the total sum of the loan will decrease for each year, the interest cost will also be adjusted downward, as in the example. The total interest cost in birr adds up to 150 (50 + 40 + 30 + 20 + 10).

Table 24: *Loan to farmer*

Period	Original loan = 500 birr	Payment	Remaining loan
End of 1st year	Interest rate 10% of 500 birr	50	
	Repayment of loan	100	400
End of 2nd year	Interest rate 10% of 400 birr	40	
	Repayment of loan	100	300
End of 3rd year	Interest rate 10% of 300 birr	30	
	Repayment of loan	100	200
End of 4th year	Interest rate 10% of 200 birr	20	
	Repayment of loan	100	100
End of 5th year	Interest rate 10% of 100 birr	10	
	Final repayment of loan	100	0

Ato Tulu did not borrow money to finance any fixed costs, such as to buy machinery or build farm structures like stores.

5 INCOME

Income is the total harvested amount multiplied by the market value for the produce. To determine the final outcome of the harvest, all produce should be included in the calculations, even what is used for home consumption, given away to friend or relatives, and destroyed or spoiled in storage.

The income from Ato Tulu's enterprises derived from the grain he sold: 1100 kg of teff and 5300 kg of maize, plus the estimated average price for the products that were given away, consumed or destroyed.

The 1100 kg of teff were sold 5 months after harvest at a price of 2 birr per kilogram (1100 x 2 = 2200). The rest (700 + 150 + 50 = 900) was valued at 1800 birr.

The maize was sold on 3 different occasions: 1500 kg were sold directly after harvest at a price of 0.80 birr each, 2000 kg after 3 months at 1.10 birr and 1800 kg after 6 months at 1.50 birr [(1500 x 0.80) + (2000 x 1.10) + (1800 x 1.50) = 6100 birr]. The remaining maize was valued 4294 birr [(28 + 2 + 8) x 113)]. Ato Tulu also considered the value of the straw as a by-product.

Table 25: *Gross income/gross revenue*

Item	Quantity	Unit cost (birr)	Total cost (birr)
Teff item (gross income /gross revenue/)			
Grain value	20	200	4000
Straw value	—	—	300
Total gross income /gross revenue/ (3.1 + 3.2)		4300	
Maize item (gross income /gross revenue/)			
Grain value	15	80	1200
	20	110	220
	18	150	27000
Straw value	—	—	80
Total gross income /gross revenue/ (3.1 + 3.2)			6180

6 SUMMARY OF COSTS AND BENEFITS

All the activities are now summarized (see the summary tables for teff and for maize on pages 22 to 27).

The first category is termed variable costs, that is, operational costs; it is divided into 2 parts. Part A of the table refers to labour plus draught power, rent of machinery, and so on, and B to material input costs. The costs in this category will change whenever production changes.

The second category is termed fixed costs, which include cost-related assets. These costs remain the same regardless of the amount of production.

The total of the amounts in categories 1 and 2 is the gross cost.

On the income side, the value of the components of the produce is calculated to give the total gross income (category 3).

The net income is the difference between the total gross income and the total gross cost. With the net income for the different enterprises, it is possible to compare their profitability and use the information as a basis for decision-making on the farm. It can also be used as a tool to see if what management improvements should be made to make enterprises more profitable.

The net income of the enterprises shows the results of the management of Ato Tulu and his family. The financial analysis shows that maize is the most profitable crop. However, analysis of the case study indicates that Ato Tulu grows different crops to avoid the risks associated with crop failure if production is concentrated on too few crops.

SIMPLIFIED FORMAT FOR COMPUTING COSTS AND BENEFITS

Type of crop: *Teff*

Table 26: *Variable costs*

A. Labour and machine costs

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a* * *b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d* * *e*)=*f*	(*c*+*f*)=*g*
Land clearing	8	8	64	—	—	—	64
1st ploughing	4	8	32	4	10	40	72
2nd ploughing	4	8	32	4	10	40	72
3rd ploughing	4	8	32	4	10	40	72
4th ploughing	4	8	32	4	10	40	72
5th ploughing	—	—	—	—	—	—	—
Ploughing and planting at the same time	—	—	—	—	—	—	—
Input transport	—	—	—	2	5	10	10
Planting and fertilizer application	4	8	32	4	10	40	72
Herbicide application	1	8	8	—	—	—	8
Rental of herbicide sprayer	—	—	—	1	2	2	2
1st weeding (cultivation)	16	7	112	—	—	—	112
2nd weeding	—	—	—	—	—	—	—
Thinning and shilshalo	—	—	—	—	—	—	—
3rd weeding	—	—	—	—	—	—	—
Insecticide application	—	—	—	—	—	—	—
Guarding, bird-watching	—	—	—	—	—	—	—
Harvesting and stacking	20	10	200	8	5	40	240
Preparation of threshing ground	2	5	10	—	—	—	10
Threshing	12	10	120	20	4	80	200
Transport to threshing area	—	—	—	—	—	—	—
Combine harvesting, shelling, threshing	—	—	—	—	—	—	—
Transport to storage	4	10	40	4	5	20	60
Storage cost (variable)	—	—	—	—	—	—	—
Marketing costs	—	—	2	—	—	5	7
Total labour and oxen cost	—	—	—	—	—	—	**1073**

B. Material input costs and storage loss

Item		Quantity	Unit cost (birr)	Total cost (birr)
Seed	local (kg)	—	—	—
	improved (kg)	100	0.50	50
Fertilizer	DAP	—	—	250
	urea	—	—	230
Pesticide	herbicide	—	—	50
	insecticide	—	—	—
Empty grain sacks		13	3	39
Interest on inputs: __% for __months		580	0.105 x 9/12	46
Total material inputs cost		—	—	665
Storage loss —		—	100	
Total material inputs and storage loss		—	—	**765**

Total variable cost

TVC	=	(A+B)
A	=	1073
B	=	765
Total cost	**=**	**1838**

Table 27: *Fixed costs*

Item	Quantity	Unit cost	Total cost
Land and income tax per hectare	—	—	10
Land rent	—	—	—
Interest	—	—	—
Total fixed cost	—	—	**10**

Table 28: *Depreciation*

Item	Construction cost	Divided by years	Total cost (birr)
Depreciation	60	3	**20**

Table 29: *Total costs*

Total cost (1 + 2 + 3)	**1868**

Table 30: *Gross income (gross revenue)*

Item	Quantity (kg)	Unit cost (birr)	Total cost (birr)
5.1 Grain value	2000	2.00	4000
5.2 Straw value			300
Total gross income /gross revenue/ (5.1 + 5.2)			**4300**

Table 31: *Net income*

6.1 Total gross income	**4300**
6.2 Total cost	**1868**
Net income (loss) per hectare (6.1 + 6.2)	**2432**

Type of crop:*Maize*

Table 32: *Variable costs*

A. **Labour and machine costs**

Activities	Value of person-days			Value of pair of oxen-days or machine rent			Total cost
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a***b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d***e*)=*f*	(*c*+*f*)=*g*
Land clearing	—	—	—	—	—	—	—
1st ploughing	4	8	32	4	10	40	72
2nd ploughing	4	8	32	4	10	40	72
3rd ploughing	4	8	32	4	10	40	72
4th ploughing	—	—	—	—	—	—	—
5th ploughing	—	—	—	—	—	—	—
Ploughing and planting at the same time	—	—	—	—	—	—	—
Input transportation	—	—	—	2	5	10	10
Planting and fertilizer application	3	8	24	1	10	10	34
Application of herbicide	—	—	—	—	—	—	—
Rental of herbicide sprayer	—	—	—	—	—	—	—
1st weeding (cultivation)	10	7	70	—	—	—	70
2nd weeding	6	7	42	—	—	—	42
Top dressing	2	7	14	—	—	—	14
Shilshalo	2	7	14	2	10	20	34
Application of insecticide	1	10	10	—	—	—	10
Rental of insecticide sprayer	—	—	—	1	2	2	2
Guarding	60	3	180	—	—	—	180
Harvesting and stacking	30	10	300	4	5	20	320
Preparation of threshing ground	—	—	—	—	—	—	—
Threshing	—	—	—	—	—	—	—
Transport to threshing area	—	—	—	—	—	—	—
Combine harvesting, shelling, threshing	—	—	—	70	5	350	350
Transport to storage	5	10	50	—	—	—	50
Storage cost (variable)	—	—	—	—	—	—	—
Marketing costs	—	—	2	—	—	5	7
Total labour and oxen cost	—	—	—	—	—	—	**1339**

B Material input costs and storage loss

Item		Quantity	Unit cost (birr)	Total cost (birr)
Seed	local (kg)	—	—	—
	improved (kg)	100	0.40	40
Fertilizer	DAP	—	—	250
	urea	—	—	230
Pesticide	herbicide	—	—	—
	insecticide	0.5 + 0.5 l	150/litre	150
Empty grain sacks		53	3	159
Interest on inputs: __% for __months		720	0.105 x 9/12	57
Total material inputs cost		—	—	886
Storage loss 800		1.13	904	
Total material inputs and storage loss		—	—	**1790**

Total variable cost

TVC	=	(A+B)
A	=	1397
B	=	1690.64
Total cost	**=**	**3129**

Table 33: *Fixed costs*

Item	Quantity	Unit cost	Total cost
Land and income tax per hectare	—	—	—
Land rent	—	—	400
Interest	—	—	—
Total fixed cost	—	—	**400**

Table 34: *Depreciation*

Item	Construction cost	Divided by years	Total cost
Depreciation	500	10	**50**

Table 35: *Total cost*

Total cost (1 + 2 + 3)	**3579**

Table 36: *Gross income (gross revenue)*

Item	Quantity (kg)	Unit cost (birr)	Total cost (birr)
5.1 Grain value	1500	0.80	1200
	2000	1.10	2200
	1800	1.10	2200
5.2 Straw value	—	—	80
Total gross income /gross revenue/ (5.1 + 5.2)			**6180**

Table 37: *Net income*

6.1 Total gross income	**6180**
6.2 Total cost	**3579**
Net income (loss) per hectare (6.1+ 6.2)	**2601**

7 PARTIAL BUDGET

With a partial budget for an enterprise, the farmer can analyse the profitability of the use of inputs (such as improved seed, fertilizers, insecticides, herbicides) or implements (such as oxen versus tractor, planter, harvester). The budget makes it easier to determine the advantage or disadvantage of using a particular input or implement.

Let us assume that an extension worker is trying to convince a farmer to use improved maize seed and fertilizer. The farmer is aware that fertilizer and improved seed provide higher yield but is uncertain about how much increased yield to expect or if the increased yield will be worth the extra cost. Let us follow the analysis that the extension worker makes.

The size of the farmer's plot, as the farmer and the extension worker measured it, was 0.5 ha. They discussed the farming operation. The farmer uses 5 kg of seed which, at the local price, costs 8 birr (5 kg x 1.60 birr per kg). The farmer ploughs 3 times using 2 pair of oxen each time (a total of 6 oxen-days and 6 person-days) and covers the seed on the third ploughing. A pair of oxen costs 10 birr per oxen-day and a person-day costs 8 birr, totalling 60 birr for oxen and 48 birr for labour. The farmer does not use herbicide or chemicals for the maize but does weed it twice, using 4 person-days each time (total of 8) costing 8 x 8 = 64 birr.

To compare the budget for using improved seed and fertilizer, let us assume the farmer needs 5 kg of hybrid seed, which costs 40 birr (5 kg x 8 birr per kg). The number of times ploughed is the same but the farmer needs 2 extra person-days to apply the fertilizer and row-plant the seeds. The crop also needs 100 kg of DAP and 50 kg of urea fertilizer. The DAP costs 250 birr and the urea 115 (50 x 2.30). If the farmer opts to use herbicide, it will cost 25 birr plus 2 birr to hire the sprayer and 2 person-days for labour (including applying the chemical and weeding manually). This farmer opts to use insecticide to protect the maize from stalk borer, which costs him 75 birr for the chemical and 1 person-day for applying it. He acquires the fertilizer on credit from the government at an interest rate of 10.5% per year.

When the crop is maturing, he usually employs 2 children for 20 days to chase off birds, paying each 3 birr per day, totalling 120 birr (2 x 20 x 3). That cost will remain the same whether or not he uses the improved, recommended practices.

The cost of harvesting and transporting the produce to the shelling area will vary. Let us assume that the cost is paid on the basis of yield and that the cost of manually harvesting the ears and transporting them to the threshing area is 0.02 birr per kilogram. With traditional practice, the farmer's yield has on average been 1000 kg. With improved practices, his yield is estimated to be 3500 kg from the same area. The cost of harvest would thus be 20 birr and 70 birr respectively. The cost of shelling, bagging and storage will also vary. If we assume that a kilogram costs a total of 0.05 birr for threshing, bagging and storing, the cost will be 50 birr (1000 x 0.05) for the traditional practice and 175 birr (3500 x 0.05) for the improved practice.

Assuming that the farmer will sell all the produce at a market price of 1.50 birr per kilogram, he can expect to get 1500 birr (1000 x 1.50) from the traditional practice and 5250 birr (3500 x 1.50) from the improved practice. The increased amount of the crop residue from the improved practice is an added benefit that is not clearly shown here.

Table 38: *Partial budget by varying inputs in the same enterprise*

	Maize without improved practice			Maize with improved practice			Difference
VARIABLE INPUTS	**PD**	**OD**	**Total**	**PD**	**OD**	**Total**	
A. LABOUR AND OXEN							
Land clearing removing crop							
stubble							
1st ploughing							
2nd ploughing							
3rd ploughing (making rows)							
4th ploughing							
5th ploughing							
Ploughing and planting at the							
same time							
Input transportation							
Planting							
Fertilizer application							
Planting and fertilizer application							
at the same time							
Covering seeds							
Herbicide application							
1st weeding (cultivation)							
2nd weeding							
Thinning/shilshalo							
2nd application of fertilizer							
3rd weeding							
Insecticide application							
Harvesting, transporting, shelling[a]							
Combine harvesting and threshing							
Preparation of threshing ground							
Transport to threshing area							
Shelling, threshing, transport to							
storage							
Guarding, bird-watching							
Total labour and oxen input							

	Maize without improved practice	Maize with improved practice	Difference
B. MATERIAL INPUTS			
Seed			
Fertilizer *a)* DAP			
b) urea			
Herbicide			
Pesticide			
Interest on inputs (10.5% x mo.)			
Total material cost			
Total variable cost (*A* + *B*)			
C. FIXED COST			
Land and income tax			
Land rent			
Interest on fixed cost			
Total fixed cost			
TOTAL COST			
GROSS INCOME			
Grain yield and value			
Crop residue			
Total gross income			
NET INCOME (gross income less total cost)			

PD – person-days; OD – oxen-days
[a] harvesting, transporting, dehiscing, shelling costs are based on kilograms

8 CONCLUSIONS

One characteristic assumption regarding small-scale farmers in developing countries is that they are forever confined to subsistence farming. Assessing the cost of production and the expected benefit is moving one step away from the attitude of producing only for subsistence. For the livelihood of the smallholder farmer to improve in the current era of agricultural development, the farmer must gain the optimum from the farming enterprise by marketing farm produce.

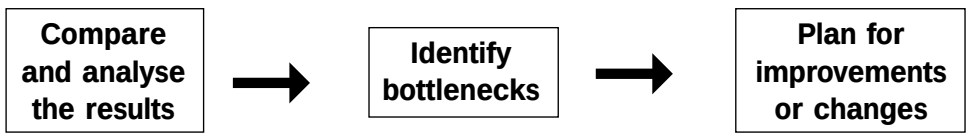
Extension officers and some subject matter specialists merely echo nationally set research recommendations, not adjusting them according to individual circumstances. This may be because they do not have the information to do so. This simplified guideline can help by drawing a picture that summarizes operations, inputs and expected outputs.

As illustrated by the case study of Ato Tulu and the following three case studies, the most time-consuming and resource-demanding operation in crop production is ploughing. Because farmers in Ethiopia plough and weed in several rounds, they must have their own oxen or access to draught power. Although oxen are used seasonally for only a short time, they must eat all year long and consume a substantial amount of feed, which cuts down on the productivity of the land. A cost and benefit picture such as drawn here brings to light such situations. With this picture, the farmer might decide that minimum tillage would be more profitable.

In the partial budget, the level of input used determines the level of expected output. By varying the type and amount of inputs in the partial budget, the extension agent and the farmer can analyse the possible results and thus determine the best combinations to obtain the maximum benefit, given the resource limitations.

The cost of production and the yield also depend on the cultural practices of cultivation, weeding, planting techniques, and general management of the soil and water resources. Here also, an informed subject matter specialist or extension agent can better assist farmers by using this simple method of analysis.

Thus providing such a vivid picture makes it easy for subject matter specialists and researchers to identify bottlenecks and provides them with a challenge to find ways to break through them. Depending on the level of analysis, the problems and opportunities might be either technical or managerial.



The case studies illustrate that the availability of agricultural inputs limits the adoption of improved practices. To provide these inputs, farmers could form their own service cooperatives and stock the inputs themselves.

Marketing is another issue that came out in the case studies. The variation in price for produce is too large to be neglected. As stated in some of the case studies, some people are taking advantage of the situation. Local lenders provide loans during planting time of the year when the price is high, and collect repayment in kind at the time of harvest, thereby taking in over 50% in interest over a short period. To overcome such an adverse situation, the same service cooperative could market grain to enable farmers to secure an average price. Another advantage of such an arrangement is that it would cut down on storage loss, as the service cooperative would be better able to provide safe storage.

An intangible effect of this simplified cost and benefit analysis is the increasing awareness among the extension staff and subject matter specialists and eventually farmers of the opportunities it points out. It is inevitable that when staff and farmers are conscious of the cost and benefit effects, they will be in a better position to improvise solutions to challenges. The three case studies following can be used to practise the exercise of cost–benefit analysis.

CASE STUDIES

Case 1

Farmer:	**Ato Mohammed Dabi, 22**
Region:	**Oromiya**
Zone:	**Eastern Shoa**
Woreda:	**Siraro**
Village (kebele):	**Awara Gama**
Family size :	**6**
Agroecology:	**Kola**

Ato Mohammed Dabi, an Oromo Muslim, completed the 10th grade in school. He is married, and he supports his brother-in-law and three other workers. In addition to his agriculture, he owns a small tearoom and is involved in the maize trade. His wife manages the tearoom. He uses an agricultural labourer for farming and related activities, to whom he gives food and shelter, seed, fertilizer and 0.5 ha of land to farm for himself. The other two workers are paid in birr, one earning 60 and the other 50 a month.

In 1996–97, Ato Mohammed planted maize on 2 ha, 0.5 ha of which he cultivated under a new extension package. From this 0.5 ha, he produced 3800 kg. On the remaining 1.5 ha, Ato Mohammed applied 100 kg of DAP and 50 kg of urea. He used local seed and harvested 4000 kg of maize. His explanation for the significant difference in yield per hectare is because of the seed variety and the low level of fertilizer applied.

Mohammed owns only 1 ha; the other hectare he rents for 320 birr a year. Land rental in the community varies between 240 and 320 birr per hectare, depending on the fertility of the land. In addition to crop production, he has livestock, owning 2 draught oxen, 3 cows and 2 calves.

Ato Mohammed produces maize mainly for the market. Out of the 7800 kg of maize produced, he sold 6000 kg (77%). The other 1800 kg (23%) were consumed at home. He sold his crops in December, immediately after harvest, because he thought it risky to store and handle the product until the off season, when prices would have been higher. It is sometimes difficult to get the pesticide actelic that is used to control the insect infestation

With the exception of credit from the Regional Bureau of Agriculture for the input, Ato Mohammed had no experience of getting credit. In his village, farmers get loans from relatives or friends, usually without interest. He said that his religion does not allow him to get or pay interest (usury is forbidden), but a few people practise it indirectly, that is, they provide poor farmers money during the off season and in return they get grain at harvest time at a fixed price that is usually very low—sometimes only 50% of the market price.

From his involvement in the grain trade, Ato Mohammed earned a net income of 1200 birr the previous year, and from the tearoom 1000. He sold 6000 kg of maize for 3600 birr (0.60 per kg). He purchased

600 kg of teff (1350 birr) and 100 kg of pulses (220 birr) for his family consumption. However, he did not purchase all the teff at one time but a little at a time.

The distance from his homestead to the nearest market is 3 km. But he did not pay any transportation cost because traders came to the farm to buy the grain. Since Ato Mohammed was engaged in the grain trade and was well informed about the market, marketing was not a problem for him.

He provided the unit prices in the community for labour and for a pair of oxen. However, he reported that since in the village it is not common to hire labour or oxen by the day, it is difficult to estimate a daily rate. Instead, they are rented by the year or the season. For one agricultural season, a pair of oxen rents for between 200 and 250 birr, depending on their condition. Members of the community also commonly borrow oxen from relatives and friends and plough their land free of charge. When Ato Mohammed estimated his cost and benefit, he considered only the material inputs that he purchased in the market.

Following are his estimates:

Activities	**Cost per day (birr)**
Ploughing	6
Cultivation	6
First weeding	6 or 52 per ha
Second weeding	6 or 15 per ha
Thinning	6 or 35 per ha
Harvesting, transport to threshing area, threshing	0.05 per kg
Hiring of pair of oxen	16
Interest rate	10.5%
Contract land price	320 per ha
Tax paid per hectare	30 per day
Hiring of donkey	6 per day
Transport from homestead to nearest market by vehicle	0.02 per kg
Maize stalk price	120 per ha
Price of maize	0.60 per kg

Case 2

Farmer: **Ato Lule Bayable, 43**
Region: **Amhara**
Zone: **East Gojam**
Woreda: **Eju Enise**
Village (kebele): **Tiru Sellam**
Family size: **6**
Agroecology: **Kola**

Both Ato Lule Bayable and his wife are illiterate. None of his children attend school. He owns 1.5 ha of land and rents another 0.75 ha on a crop-sharing basis. In 1996–97, he grew 0.38 ha of sorghum, 0.25 ha of maize and 1 ha of teff (the difference of 0.63 ha can be assumed was fallow for grazing.. He owns 1 ox and 1 donkey. In 1996–97, rainfall was inadequate, and the yield per hectare was very low. Thus, he produced only 100 kg of sorghum, 200 kg of maize, 400 kg of teff, 300 kg of haricot bean and 100 kg of red pepper from 600 square metres of land.

Although the fertility of his land is poor, Ato Lule did not use any agricultural inputs. He did not want to draw on credit for inputs because of the risk of crop failure. Teff and haricot bean were produced mainly for the market while the maize and sorghum were produced for household consumption.

The agreement that Ato Lule made for sharing the crop on the 0.75 ha was only for 1 year. He grew haricot bean on it. He is not involved in non-farm activities. He did not purchase grain for household consumption. He sold 200 kg of teff, 150 kg of haricot bean and 100 kg of red pepper. The distance from his homestead to Mota town is 21 km.

The estimated value and cost of Ato Lule's activities and inputs are as follows:

Activities	Cost per day (birr)
Ploughing	3
Pair of oxen	6
Fertilizer application	3
Weeding	2
Harvesting	5
Threshing	4
Teff residue price	135 from hectare
Interest (from nearby Gabriel saving club)	120%
Plastic sacks	4
Land-use tax	20 per person
Contract land	320 per ha
Transport	0.06 per kg

Case 3

Farmer: **Ato Ahmed Yimer, 47**
Region: **Amhara**
Zone: **Oromiya**
Woreda: **Dawa Chaffa**
Village (kebele): **Bedenosert**
Agroecology: **Kola**

Ato Ahmed Yimer is a Muslim; he is literate and some of his children are attending school. He owns 1 ha of land. In the 1996–97 cropping year, he grew sorghum on 0.75 ha and teff on 0.25 ha. The fertility of his land is average. He also rented 0.75 ha of land on a crop-sharing basis. He planted maize on 0.5 ha and teff on 0.25 ha of the rented land. He harvested 1000 kg of maize and 100 kg of teff. That cropping season there was a shortage of rain during plant flowering and an excess of rainfall at the grain-filling stage. During a normal year, he could produce up to 4000 kg of sorghum and 1500 kg of teff from his holding. He did not use fertilizer or improved seeds because he was afraid to risk crop failure. Ato Ahmed owns 4 oxen, 2 milking cows, 1 bull, 2 calves and 6 chickens. His source of cash income is from the sale of grain. In June, he sold 500 kg of sorghum at 2.00 birr per kg, 150 kg of teff at 2.60, and 200 kg of maize at 1.20.

The farm crops produced are for both household consumption and the market. The type and quantity of crops to be consumed or sold depends on the quantity produced and market prices. The distance from his homestead to the nearest market at Harbu is 7 km, and the transportation cost is 2 birr per 100 kg and per person. Although usury is forbidden by his religion, there are people who offer money in exchange for grain that they receive at harvest time. This is a long-lived tradition of the community. Based on community information, the indirect interest rate of this type of loan is estimated as 120% per year. According to Ato Ahmed, the major problems he encountered in using modern inputs were the absence of farmer institutions to supply and deliver modern inputs on credit.

Ato Ahmed provided price estimates of the following items:

Activities	Cost per day (birr)
Ploughing	3
Cultivation	3
Fertilizer application	3
Weeding	4
Harvesting	4
Threshing	4
Thinning (shilshalo)	4
Rent of oxen	8
Rent of oxen including labour	11

Activities	Cost per day (birr)
Price of using camel	0.03 per kg
Land tax	20 per ha
Land rent	
a) fertile	800 per ha
b) average	600 per ha
c) poor	400 per ha
Interest rate:	
a) community	120%
b) government	10.5%
Bird-watching	45 per month
Straw value:	
a) teff (good season)	240 per ha
b) sorghum	80 per ha

SIMPLIFIED FORMAT FOR COMPUTING COSTS AND BENEFITS

Type of crop: *Teff*

1. VARIABLE COSTS

A. Labour and machine costs

Activities	**Value of person-days**			**Value of pair of oxen-days or machine rent**			**Total cost**
	Person-days (*a*)	Unit cost (*b*)	Total cost (*a*b*)=*c*	/days (*d*)	Unit cost (*e*)	Total cost (*d*e*)=*f*	(*c*+*f*)=*g*
Land clearing							
1st ploughing							
2nd ploughing							
3rd ploughing							
4th ploughing							
5th ploughing							
Ploughing and planting at the same time							
Input transport							
Planting and fertilizer application							
Herbicide application							
Rent of herbicide sprayer							
1st weeding (cultivation)							
2nd weeding							
Thinning and shilshalo							
3rd weeding							
Insecticide application							
Guarding, bird-watching							
Harvesting and stacking							
Preparation of threshing ground							
Threshing							
Transport to threshing area							
Combine harvesting, shelling, threshing							
Transport to storage							
Storage cost (variable)							
Marketing costs							
Total labour and oxen cost							

B. Material input costs and storage loss

Item		Quantity	Unit cost	Total cost
Seed	local (kg)			
	improved (kg)			
Fertilizer	DAP			
	urea			
Pesticide	herbicide			
	insecticide			
Empty grain sacks				
Interest on inputs: __% for __months				
Total material inputs cost				
Storage loss				
Total material inputs and storage loss				

Total variable cost

TVC = (A+B)
A =
B =
Total cost =

2 FIXED COSTS

Item	Quantity	Unit cost	Total cost
Land and income tax per hectare			
Land rent			
Interest			
Total fixed cost			

3 DEPRECIATION

Item	Construction cost	Divided by years	Total cost
Depreciation			

4 TOTAL COST

Total cost (1 + 2 + 3)	

5 GROSS INCOME (GROSS REVENUE)

Item	Quantity (kg)	Unit cost (birr)	Total cost (birr)
5.1 Grain value			
5.2 Straw value			
Total gross income /gross revenue/ (5.1 + 5.2)			

6 NET INCOME

6.1 Total gross income	
6.2 Total cost	
Net income (loss) per hectare (6.1 + 6.2)	

The Swedish Development Cooperation Agency (Sida) has supported rural development programmes in Eastern Africa since the 1960s. It recognises that conservation of soil, water and vegetation must form the basis for sustainable utilisation of land and increased production of food, fuel and wood.

In January 1998, Sida inaugurated the Regional Land Management Unit (RELMA) based in Nairobi. RELMA is the successor of the Regional Soil Conservation Unit (RSCU), which had been facilitating soil conservation and agroforestry programmes in the region since 1982. RELMA's mandate is to contribute towards improved livelihoods and enhanced food security among small-scale land users in the region, and the geographical area covered remains the same as previously, namely, Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia. RELMA's objective is to increase technical know-how and institutional competence in the land-management field both in Sida-supported programmes and in those carried out under the auspices of other organisations.

RELMA organises training courses, workshops and study tours, gives technical advice, facilitates exchange of expertise, and initiates pilot activities for the development of new knowledge, techniques and approaches to practical land management.

To publicise the experiences gained from its activities in the region, RELMA publishes and distributes various reports, training materials and a series of technical handbooks.

About this book:
This guide is meant to serve as a reference and analytical tool for agricultural extension staff in the field and Woreda offices. What makes this guide special is the simplification of the cost benefit concept using step-by-step procedures and case examples.

It is hoped that this will mark a shift in the extension approach in line with commercial thinking on looking at agriculture as an enterprise, this will serve as input towards orienting the extension services and farmers perceptions.

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RELMA

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