TRAINING MATERIALS FOR AGRICULTURAL MANAGEMENT, MARKETING AND FINANCE

3

Farm planning and management for trainers of extension workers

ASIA

Module 6
FARM INVESTMENT AND RISK

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Module 6
FARM INVESTMENT AND RISK

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FARM INVESTMENT AND RISK

This volume has been designed
as a complete working package which includes all components
of the training programme needed for Module 6.

The "trainers information box",
at the beginning of each session, lists the handouts,
training slides and exercises needed for that segment of the course.
The trainer's guide, in the section "steps for instruction",
suggests a sequence for the use of these training materials.
Mini-versions of all slides are provided at the end of each session.
Where appropriate, answer keys for training exercises are also provided.

FARM INVESTMENT AND RISK

A thorough knowledge of techniques used in assessing alternative capital investments will enable extension workers and farmers to appraise the profitability of farm investments and decide between alternative investment opportunities. Investment appraisal is also useful for farmers who wish to prepare business plans in order to access term loans from financial institutions. There are different methods that can be used to appraise on-farm capital investments. These are usually divided into simple measures of investment appraisal and discounted measures. The simple measures covered include (i) payback period and (ii) simple rate of return. The discounted measures include (i) net present value (NPV) and (ii) internal rate of return (IRR).

In this module the element of risk is also discussed. Farmers make decisions in a risky and ever-changing environment. They can never be sure of the outcome of any decision. This is because of the constantly changing environment within which farms are managed. Even though it is impossible to prevent changes from happening, it is useful for farmers to know the source of their risks and the management strategies they can follow to ease them.

Investment appraisal

This unit examines the importance of investment decisions and looks at the types of investments farmers can make. Because investments often involve large sums of money, it is important that farmers become familiar with certain appraisal methods, such as "payback period" and "simple rate of return". They should also understand the strengths and weaknesses of discounted methods of appraisal. The unit goes on to examine the capacity of farmers to repay loans should they decide to borrow money to make farm investments.

Preparing for session 6.1.1
Investment decisions

Teaching methods
Group discussion, trainer/participant interaction, further group discussion, brainstorming, summarize methods and draw conclusions

Duration: 50 minutes

Learning support materials
Handout 6.1.1 (Investment decisions), Slide 97 (Capital investments), Slide 98 (Why do farmers invest?)

Notes

Investment decisions

This session discusses the different types of investment decisions often faced by farmers.

It is useful for farmers and extension workers alike to understand what is meant by a capital investment and the type of farm investments that most farmers make. This knowledge has a direct bearing on the way farmers should plan their farming activities. It is particularly important as capital for on-farm investment is scarce and expensive. Farm investment decisions need to be given serious consideration.

Objectives

At the end of the session the trainees are expected to:

- understand what capital investments are in farming;
- realize that these investments take different forms depending on the timing of expenses and the income received.

Key points

1. Investment decisions are a matter of choice between alternative investment opportunities.

2. Capital investment decisions tie up money. The use of these investments typically lasts for several production cycles or years.

3. Investing in capital assets often means that a large expense occurs in one time period with income generated from the investment distributed over a number of future periods.

4. Farmers invest because they believe that the long-term returns above the cost of the investment are greater than any immediate returns.

Steps for instruction

1. Distribute Handout 6.1.1 (Investment decisions) to the participants before the start of the session.

2. Initiate a discussion among participants on the definition, nature and importance of capital investments for farmers. Following the discussion explain what capital investments are and show Slide 97 (Capital investments).

3. Have the participants differentiate between two types of capital: (i) working capital, (ii) investments. Discuss the difference between the two and provide concrete examples. List examples on the classroom board.

4. Brainstorm among the participants on different uses of capital and the type of investments that farmers make. Discuss why farmers make these investments and show Slide 98 (Why do farmers invest?)

5. Encourage the participants to think about the methods farmers use to appraise investments in practice. Point out some of the drawbacks of these methods.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.1.1.

Notes

Investment decisions

Investment is a matter of choice. The choice of investment opportunities on farms are many — as are the returns that these investments offer. Farmers are often required to make choices between alternative investment opportunities: (i) whether to purchase farm machinery or continue to lease or rent, (ii) whether to install an irrigation system, (iii) whether or not to plant tree crops. The best policy to follow depends on the importance of the asset, the need for it and the capital available for investment.

Investments can occur by saving produce as working capital ...

Capital investments

Capital investment decisions are particularly important. They tie up much money and determine the farm's future profitability for many years ahead. Profits arise from correct investment decisions made in the past.

... generating assets from farm work ...

Investment can take place in different ways. The first way in which a farmer invests is by saving some produce. Crops that are stored are an addition to the stock of capital and are, therefore, investments. This is referred to as "working capital". The second method of investment involves assets generated by the effort made by farmers. When a farmer plants trees or constructs a store, an investment is made. The third form of investment is through purchasing capital assets such as tools, machinery and equipment.

... purchasing assets

Why do farmers invest?

Simply, farmers believe the long-term benefits over and above the cost of the investment are greater than any immediate benefits. This is known as the "return on capital".

However, most capital assets are eventually used up (e.g. a cow or oxen dies, a tractor is broken up for scrap or a building falls down). The farmer investing in a capital asset hopes to cover the value of the original investment by the end of its productive life. The productive life of a capital asset may be prolonged by regular maintenance and repairs. The farmer has to take all of these factors into account when making an investment decision.

Notes

Training slides
for Session 6.1.1
Investment decisions

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97 Capital investments

Investments can take place in a number of ways ...

Saving some of the produce
(stored crops are an addition to the stock of capital;
this is referred to as *"working capital"*)

Assets generated by efforts made by farmers
(e.g. income from the planting of tree crops)

Purchase of capital assets
(e.g. tools, machinery, equipment)

Good profits arise from correct investment decisions

98 Why do farmers invest?

Farmers believe that the long-term benefits over and above the cost of the investment are greater than any immediate benefits
(this is known as *"return capital"*)

However, most capital assets are eventually used up
(e.g. a cow or oxen dies, a tractor becomes too old to repair; such things must be taken into consideration)

The farmer investing in a capital asset hopes to cover the value of the original investment by the end of its productive life

Notes

Notes

Preparing for session 6.1.2
Simple methods of investment appraisal

Teaching methods
Group discussion, trainer/participant interaction, review previous session and differentiate

Duration: 100 minutes

Learning support materials
Handout 6.1.2 (Simple methods of investment appraisal), Slide 99 (Investment appraisal — payback period), Slide 100 (Using the payback period), Slide 101 (Investment appraisal — simple rate of return), Slide 102 (Calculating the simple rate of return)

Notes

Simple methods of investment appraisal

This session deals with simple methods of making investment decisions. These are (i) the payback period and (ii) the simple rate of return.

Investments often involve tying up sums of money. It is crucial for farmers that investments are thoroughly appraised before any final decision is made. Knowing how to apply simple investment appraisal methods and their advantages and disadvantages should assist both extension workers and farmers in deciding on the choice of the most appropriate method of investment appraisal to use.

Objectives

At the end of the session, the participants are expected to:

- understand the simple methods of appraising investments;
- know the differences between the two methods;
- understand the advantages and disadvantages of each method.

Key points

1. Simple measures of farm investment appraisal are easy to compute but are imprecise because they fail to take into consideration the time value of money.

2. The payback period method calculates the number of years it would take for an investment to cover its original cost through the annual cash benefits generated. An investment with a short payback period is more attractive than one with a longer payback period.

3. The simple rate of return expresses the average annual net income as a percentage of the investment. However, it fails to consider the size and timing of annual earnings.

Steps for instruction

1. Distribute Handout 6.1.2 (Simple methods of investment appraisal) before the session.

2. Initiate a discussion of the data needed for the simple methods of investment appraisal. Ask trainees to suggest what items are needed (initial cost of the investment, annual costs, annual benefits) and list them. Refer to cash flow in Module 5, but point out that here investments extend beyond a one-year period.

3. Explain the two main ways to measure the benefits and costs of farm investments. They can be classified as simple and discounted methods. The simple methods are popular and easy to compute. These are (i) the payback period and (ii) the simple rate of return; both are discussed in this session. Discounted methods, covered in Session 6.1.3, consider the time value of money. However, the trainer may wish to introduce the time value concept here.

4. Introduce the simple methods using: Slide 99 (Investment appraisal — payback period), Slide 100 (Using the payback period), Slide 101 (Investment appraisal — simple rate of return), Slide 102 (Calculating the simple rate of return).

5. Explain how the payback period is computed and mention advantages and disadvantages. Discuss what decision criteria should be used in order to select the most attractive investment. Show how the simple rate of return is computed for an example investment. It is important to explain how average annual net income is derived. Interpret, rank and differentiate the result from that obtained using the payback period method. Explain also the strengths and weaknesses of this method.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.1.2.

Notes

Simple methods of investment appraisal

The farmer can use different methods to appraise investments that have different timings of costs and benefits. Investing in capital items typically means that a large expense (the initial purchase) occurs in one time period while the benefits are distributed over a number of future time periods.

Investment appraisal requires a set of background information that includes estimates of (i) the annual net income from the investment, (ii) the initial cost of the investment, (iii) the salvage value, (iv) the interest or discount rate to be used. The following methods can be used for assessing the profitability of an investment:

- payback period
- simple rate of return

Investment appraisal is a way to determine investment profitability

Each of these methods has advantages and disadvantages and will be discussed in the course of this session. Since investment decisions can be quite complicated, it is assumed that extension workers will need to assist farmers in selecting the appropriate method and in making the correct decisions.

Payback period

The payback period method calculates the number of years it would take for an investment to return its original cost through the generation of income. This method assesses the time that is required until the cumulative income from the investment equals its initial cost. The method is useful to highlight those investments that are not viable (e.g. ones that never achieve payback). It can also be used to select the most appropriate source of finance. For instance, those investments having a short payback period would only require short-term finance.

To calculate the payback period the extension worker together with the farmer needs to assess the annual net cash flow that is expected after making the investment. This is the difference between the cash inflows and cash outflows for each year in the future. In comparing any two investments, the one having a shorter payback period would be more attractive than one with a long payback period.

Example

Annual net cash flow for two investments

Two investments are outlined below. Each needs an initial capital outlay of $10 000 but result in different patterns of cash flows. For simplicity, the salvage values are assumed to be zero*. It is convention to treat the initial cost of the investment as if it occurs in year 0.

Year	Investment A	Investment B
0	$(10 000)	$(10 000)
1	3 000	1 000
2	3 000	2 000
3	3 000	3 000
4	3 000	4 000
5	3 000	6 000
Total	**15 000**	**16 000**
Payback period (yrs)	3.3	4.0
Avg. annual net cash flow (5 yrs)	3 000	3 200
Less annual depreciation	-2 000	-2 000
Average annual net income	**$1 000**	**$1 200**

When the annual net cash flow is the same for each year of the investment, the payback period is calculated by dividing the amount of the investment by the expected annual net cash flow.

*Whenever salvage values exist, they should be added to the income flow because they represent an additional cash receipt.

Investment A

The payback period is 3.3 years. The cost of the investment ($10 000) is divided by the annual net cash flow ($3 000). When the cash flows are irregular and unequal they are accumulated and the payback period is assessed by taking the year where the net cash flow is equal to the cost of the investment.

Investment B

The payback period is 4 years. The cumulative net cash flow covers the cost of the investment ($10 000) in year 4.

Therefore, investment A is preferred over investment B because it has the shorter payback period.

The payback method is attractive because it is easy to calculate and is a simple way of comparing alternative investments. It is also easily understood by farmers. If the farm is short of cash, it is essential that income is generated as soon as possible.

However, the payback method also has deficiencies. It ignores the cash flows arising after the payback has occurred as well as the timing of the income flows. Money received earlier in the life of the investment is more valuable than money received later. For example, by selecting investment A, the method ignores the higher net cash flows from investment B in year 4 and year 5.

The payback period does not measure profitability, but is more a measure of how quickly the investment will contribute to the farm's liquidity.

Simple rate of return

The simple rate of return recognizes that it is not only income that is important to the farm but also the amount of capital used to produce it. Income is regarded not by itself but as a return on the capital used. More precisely, the rate of return expresses the average annual net income or profit as a percentage of the investment. The term of net income is used and is calculated by subtracting the average annual depreciation of the investment from the average annual net cash flow, as shown in the previous example (Annual cash flow for two investments). The return on capital is calculated as follows:

$$\textbf{Simple rate of return} = \frac{\textbf{Average annual net income}}{\textbf{Cost of investment}} \times 100$$

The return on capital is used to compare alternative investments.

Investment A

$$\frac{\$1\,000}{\$\ 10\,000} \times 100 = 10\%$$

Investment B

$$\frac{\$1\,200}{\$\ 10\,000} \times 100 = 12\%$$

This method ranks investment B higher than investment A.

The result, however, is different from using the payback method of appraisal. The rate of return is preferred to the payback period because it considers the earnings of the investment over its entire life. The advantage is that it is simple to calculate and to rank competing investment opportunities. Investments with higher rates of return are preferred.

However, it uses the average annual net income, and thereby fails to consider the size and timing of the annual income flow. This can result in errors and is particularly when there is increasing or decreasing net income flows. For example, investment A would have the same 10 percent rate of return if there were no net cash flow in the first 4 years but $15 000 in year 5. The average net cash flow would remain the same at $3 000 per year. Furthermore, the method ignores the time value of money, which will be discussed next (see "Discounted methods of investment appraisal").

Notes

Training slides
for Session 6.1.2
Simple methods of investment appraisal

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99 Invesment appraisal — payback period

The **payback period** method calculates
the number of years it would take for an investment to return
its original cost through the generation of income as follows ...

$$\textbf{Payback period} = \frac{\textbf{Cost of the investment}}{\textbf{Annual net cash flow}}$$

When net cash revenues are not equal,
they should be summed up year by year to find the year
where the total is equal to the amount of the investment

Advantages: (i) easily understood by farmers, (ii) easy to calculate, (iii) alternative investments are ranked according to attractiveness.
Disadvantages: (i) ignores cash flow arising from after the payback period and timing of receipts, (ii) it is more a measure of how quickly the investments will contribute to the liquidity of a business.

100 Using the payback period

This example shows net cash benefits from two investments of $10 000

Year	Investment A	Investment B
0	$(10 000)	$(10 000)
1	3 000	1 000
2	3 000	2 000
3	3 000	3 000
4	3 000	4 000
5	3 000	6 000
Total	**15 000**	**16 000**
Payback period (yrs)	3.3	4.0
Avg. annual net cash flow (5 yrs)	3 000	3 200
Less annual depreciation	-2 000	-2 000
Average annual net income	**$1 000**	**$1 200**

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101 Investment appraisal — simple rate of return

The **simple rate of return** recognizes that it is not only income that is important, but also the amount of capital used to produce it

Income is regarded not by itself but as a return on the capital used

More precisely, the rate of return expresses the average annual net income as a percentage of the investment

Advantage: using the simple rate of return is better than using the payback period because it considers earnings over the entire life of an investment.
Disadvantage: is based on average annual earnings, thus failing to consider the size and timing of annual earnings causing possible error in selecting investments.

102 Calculating the simple rate of return

The return on capital is calculated as follows ...

$$\textbf{Simple rate of return} = \frac{\textbf{Average annual net income}}{\textbf{Cost of investment}} \times 100$$

The return on capital is used
to compare alternative investments ...

Investment A

$$\frac{\$1\,000}{\$\ 10\,000} \times 100 = 10\%$$

Investment B

$$\frac{\$1\,200}{\$\ 10\,000} \times 100 = 12\%$$

This method ranks investment B higher than investment A

Notes

Preparing for session 6.1.3
Discounted methods of investment appraisal

Teaching methods
Lecture, trainer/participant interaction, class training exercise, practical examples, further group work, summarize findings and draw conclusions

Duration: 120 minutes

Learning support materials
Handout 6.1.3 (Discounted methods of investment appraisal), Slide 103 (Time value of money in investment appraisal), Slide 104 (Discounted investment appraisal — net present value [NPV]), Slide 105 (Calculating the net present value), Slide 106 (Discounted investment appraisal — internal rate of return [IRR]), Slide 107 (Calculating the internal rate of return), Slide 108 (Selection of discount rate), Slide 109 (Weighted average cost of capital [WACC]), Training exercise 16 (Net present value and internal rate of return)

Notes

Discounted methods of investment appraisal

This session deals with ways of appraising investments by using discounted methods such as the: net present value (NPV) and the internal rate of return (IRR).

Investments often involve tying up sums of money over periods of time. It is crucial to understand the advantages and disadvantages of discounted methods and how these can be of help to farmers in making investment decisions. It is also important to understand the comparative advantages and disadvantages of simple and discounted methods for investment appraisal.

Objectives

At the end of the session, the participants should understand:

- the concept of time value of money;
- discounted methods;
- how to discount an investment;
- how farmers take investment decisions;
- the advantages and disadvantages of undiscounted and discounted methods of investment appraisal.

Key points

1. Time value of money means that money today has a higher value than money in the future.

2. Compounding is computing by how much the principal grows based on the amount of the accumulated interest.

3. Discounting is calculating what a known future amount is worth today.

4. NPV of an investment is the sum of the present values for each year's net cash flow less the initial cost of investment.

5. Farmers should accept investments with a positive NPV, reject those with negative NPV and be indifferent to a zero value.

6. The IRR is the interest rate at which the NPV of an investment is equal to zero.

7. The acceptability of the IRR depends on the opportunity cost of capital used in the investment.

8. Opportunity cost can be computed as the weighted average of the interest rates charged by the sources if there are two or more different sources of capital.

9. The NPV is used to compare different investments. However IRR may be easier to understand.

Steps for instruction

1. Distribute Handout 6.1.3 (Discounted methods of investment appraisal) to the participants before the start of the session.

2. Explain that the cash flow streams presented previously can be set up in another way, closer to the concept of cash flow given in Module 5.

3. Clarify the conventions used in setting up a cash flow, the phasing of income and cost flows. Mention that investments are made at the end of year 1, but operating costs and income begin from year 2. The time scale of a cash flow should also be discussed, explaining that the appraisal should extend up to the end of the life of the investment.

4. Show Slide 103 (Time value of money in investment appraisal), and discuss the importance of this concept in discounted measures.

5. Define compounding and explain the formula for compounding. Point out that discounting is the reciprocal process of compounding. Demonstrate how a table of prepared discount rates (see Table 6.1) can be used and illustrate with an example computation.

6. Ensure that the participants have a clear understanding of the concept of the time value of money. The use of an example would greatly enhance understanding of the concept. Try to borrow some money from the trainees. It can be any amount and for any period, but suggest at least 3 months. Encourage the trainees to "play the game". Ask them all to write down what rate of interest they would charge you (the trainer). Convert the rates to a per annum basis and discuss the reasons behind the different rates suggested. Use this example to explain time preference.

7. Encourage discussion among the participants about the type of data needed to conduct a discounted investment appraisal. Ask trainees to suggest what is needed. Some items include: (i) initial cost of the investment, (ii) annual costs, (iii) annual benefits, (iv) salvage value. Write their suggestions on the classroom board.

8. Refer again to the session on cash flow in Module 5, pointing out the difference that here we are concerned with investment beyond a 1-year period. Explain that investment appraisal is concerned with incremental investments; the cost stream should only include cash items (depreciation is omitted); and that ther is a need to carefully assess the phasing of investment costs and benefits.

9. Using Slide 104 (Discountred investment appraisal — net present value [NPV]), discuss this method of appraisal and point out its advantages and disadvantages. With Slide 105 (Calculating the net present value), explain how to arrive at the values required.

10. Show slide 106 (Discounted investment appraisal — internal rate of return [IRR]), discuss this method of appraisal and point out its advantages and disadvantages.

11. Explain that the IRR is the interest rate (discount rate) at which the NPV of an investment is equal to zero and can be found using the NPV method by trial and error. The use of trial and error method implies that the initial choice of interest rate to use is arbitrary. However, the choice of the second rate can be done by increments of 5 percent, in the process changing the choice of the higher and lower discount rates until a negative NPV is reached. The higher discount rate is where NPV is negative and the lower discount rate is where NPV is positive.

12. Show Slide 107 (Calculating the internal rate of return). Point out that because there are two discount rates used in the computation of NPV, there is now a necessity for interpolation in order to arrive at a single discount rate that sets the NPV equal to zero. Explain the process of interpolation.

13. After calculating the IRR, explain how it is used; mention that a decision whether or not to invest depends on the opportunity cost of capital. Show Slide 108 (Selection of discount rate) and Slide 109 (Weighted average cost of capital [WACC]). Explain that the opportunity cost of capital is calculated as the weighted average interest rate of different sources of capital (if two or more sources are used). Provide an example from the handout for explanation.

14. Divide participants into pairs and distribute Training exercise 16. On completion of the exercise discuss the solutions presented.

15. Initiate a discussion among participants on the advantages and disadvantages of the different types of appraisal methods discussed. In particular, compare the use of the IRR and the NPV.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.1.3, (iii) refer to Training exercise 16.

Notes

Discounted methods of investment appraisal

Some simple methods of investment appraisal were considered in Session 6.1.2. This session explores discounted methods for assessing the profitability of an investment. These include:

- net present value (NPV)
- internal rate of return (IRR)

Both methods have advantages and disadvantages, which will be discussed in the course of this session. Since investment decisions can be quite complicated, extension workers will likely need to assist farmers in selecting the appropriate method and making the correct decisions. But before looking at these methods it is important to understand the time value of money and take it into account when discounting.

The time value of money in investment appraisal

Time value of money means that a dollar today does not have the same value a year from now. Understanding the time value of money is important in appraising and making farm investment decisions.

Money not invested loses value over time

If you were offered $1 000 today or $1 000 a year from now, which would you choose? There are many reasons for choosing cash now instead of later. One might place the $1 000 in a savings account and earn 5 percent interest. This would generate $50 in extra income, an advantage that would be missed by receiving the $1 000 one year later.

Other uses could earn the farmer even more money. For example, why wait a year for new farm machinery when it can be purchased and used now? Alternatively, one may worry about the uncertainties of life. Either the giver or the receiver of the $1 000 might not be alive in a year to fulfil their part of the transaction. These different reasons demonstrate the importance of the time value of money.

Realizing that money is worth more to a person in the present rather than in the future may appear obvious but quantifying the effect is more complex. Interest rates are used to compare present and future claims on investments. Different interest rates imply different time values.

Lenders of capital receive interest, and borrowers pay interest because of the perceived benefits of time. For example, a lender who provides $100 today at 8 percent interest per year is paid back $108 in 1 year. The $8 compensates the lender for alternative investments not made, personal consumption foregone or for the risk that the money might not be repaid.

The borrower and lender agree that $100 today is worth $108 a year from now. The borrower agrees to receive $100 now and pay back $108 in 1 year; the lender gives $100 now to receive $108 in 1 year. However, the lender is not convinced that $8 (8 percent) is enough. It might be that 9 percent interest would be necessary to convince the lender. In this case, the time value of money over the 1-year period would be $9.

Compounding and discounting. The time dimension of money is taken into account through the use of discounting. It is simply a technique by which future benefits and costs can be reduced to a present value. This can be better understood by explaining the notion of compounding.

Example
Compounding

Consider a case where a farmer lends $1 000 to a neighbour at an interest rate of 5 percent annually. The following year the neighbour will owe $1 050, consisting of the $1 000 principal and $50 in interest ($1000 x 0.05). Suppose the neighbour wants to keep the money for two years. Then 5 percent must be paid for the use of the money for the first year and an additional 5 percent for the second year . The neighbour must also pay interest on the amount due to have been paid the lender at the end of the first year. In other words, the farmer must be paid compound interest.

Compounding is the process of finding the future value of a present amount

Example
Discounting

Now suppose we ask a different question. If a borrower promises to pay the farmer $1 200 at the end of five years at an interest rate of 8 percent, how much is that promise worth to the farmer today? Put another way, what is the present worth of $1 200 five years in the future if the interest is assumed to be 8 percent? To answer the question the farmer would have to divide the amount due by 1.08 for each project year as shown below:

Discounting is the process of finding the present value of a future amount

Year	Amount at end of year ($)	One plus interest rate	Amount at beginning of year ($)
1	1 200	1.08	1 111
2	1 111	1.08	1 029
3	1 029	1.08	953
4	953	1.08	882
5	882	1.08	817

The present value of $1 200, 5 years in the future, is $817.

This process of finding the present worth of a future value is called "discounting". Discounting looks backward from the future to the present. The interest rate assumed for discounting is the "discount rate" (see Table 6.1 at the end of this handout). Using this table the discount factor for 8 percent and 5 years is given as 0.681. To find the present value of $1 200 received 5 years in the future, the amount due in the future is multiplied by the discount factor for the fifth year. This gives $817 (1 200 x 0.681 = 817).

Example

Find the present value of $6 438 received 9 years in the future if the discount rate is 15 percent.

The relevant factor in the discounting tables shows that at a 15 percent rate and for a period of 9 years, the coefficient is 0.284. The future amount is multiplied by the discount factor to obtain a present value of $1 828 ($6 438 x 0.284 = $1 828).

Net present value (NPV)

The NPV of an investment is the sum of the present values for each year's net cash flow less the initial cost of the investment. It is also called the discounted cash flow method because it uses the discounting method of analysis. This method considers the time value of money and the stream of cash flows over the entire life of the investment.

A general rule regarding the number of years to include in the cash flow analysis is to choose a period of time that is comparable to the life of the major investment item. In the case of farm machinery and equipment, this is often taken as between 5 and 7 years and for buildings 30 to 40 years.

With this method, the farmer would accept an investment with a positive NPV, reject those with a negative NPV and be indifferent to a zero value. The rationale behind accepting investments with a positive NPV can be explained in two ways.

First, it means the rate of return on the investment is greater than the discount rate used in the calculations. A second explanation is that the farmer can afford to pay more for the investment and still achieve a rate of return equal to the discount rate used in calculating the NPV.

Example

Calculating net present value

This example assumes that the investment has no salvage value at the end of its life. If this assumption is relaxed, an entry would need to be made of the salvage value of the investment as part of the cash inflow and entered in the respective year incurred.

(8% discount rate and no salvage values)

Year	Investment A			Investment B		
	Net cash flow ($)	Discount rate	Present value ($)	Net cash flow ($)	Discount rate	Present value ($)
1	3 000	0.926	2 778	1 000	0.926	926
2	3 000	0.857	2 571	2 000	0.857	1 714
3	3 000	0.794	2 382	3 000	0.794	2 382
4	3 000	0.735	2 205	4 000	0.735	2 940
5	3 000	0.681	2 043	6 000	0.681	4 086
		Total	**11 979**			**12 048**
	Less investment cost		10 000			10 000
	Net present value		**1 979**			**2 048**

The farmer could pay up to $11 979 ($10 000 + $1 979) for investment A and $12 048 ($10 000 + $2 048) for investment B and still receive an 8 percent return or more on invested capital. Both investments show a positive NPV using an 8 percent discount rate.

The selection of the discount rate consequently affects the result of the appraisal. When a higher discount rate is used, the NPV decreases and vice versa. At some higher discount rates the NPV values would be zero, and at an even higher rate it could become negative.

Internal rate of return (IRR)

The IRR is the interest rate at which the NPV of an investment is equal to zero. This is the maximum rate of interest that the farmer can afford to pay for the resources used, in order to recover the original investment and its operating costs and still break even.

Example

Calculating the internal rate of return

Since there is no formula for finding the IRR, a procedure of trial and error is needed in an attempt to equate the net present value of the cash flow with the zero break-even point.

Estimation IRR for Investment A

Year	Net cash flow ($)	14%		16%	
		Present value factor	Present value ($)	Present value factor	Present value ($)
1	3 000	0.877	2 631	0.862	2 586
2	3 000	0.769	2 307	0.743	2 229
3	3 000	0.675	2 025	0.641	1 923
4	3 000	0.592	1 776	0.552	1 656
5	3 000	0.519	1 557	0.476	1 428
		Total	**10 296**	**Total**	**9 822**
		Less investment cost	–10 000	Less cost	–10 000
		NPV	**296**		**–178**

The relatively high NPV of the investment with an 8 percent discount rate suggests that the actual rate of return on the investment may be considerably higher than this rate. An interest rate of 14 percent was arbitrarily chosen as a first estimate of the IRR. The calculation shows a positive NPV of $296, indicating that the IRR is still high and in excess of zero, the break-even point. An even higher discount rate is used next (16 percent) assuming that this will result in a lower NPV. The result shows that there is a negative IRR of -$178. The actual IRR lies somewhere between 14 and 16 percent.

The most difficult aspect of this trial and error process is making an initial estimate. If the estimate is too far from the final result, then several trials will have to be made to find two rates that are sufficiently close enough to allow the break-even point to be calculated. This is done by interpolation (i.e. finding a desired value between two other values).

The rule for interpolating the value of the IRR between two discount rates (with a negative and positive NPV) is as follows:

$$\text{Low discount rate} + \frac{\text{High NPV}}{\text{High NPV - Low NPV}} \times (\text{High discount rate - Low discount rate})\%$$

This procedure is applied to the above example. The lower discount rate is 14 percent. The difference between the two rates is 2 percent. The present worth of the lower discount rate cash flow is $296 and the present worth of the higher rate is -$178. The sum of the present worth of the cash flows at the two discount rates, ignoring the signs, is $474.

Through interpolation the IRR is calculated as follows:

$$14\% + \frac{296}{296 - (-178)} \times (16 - 14)\% = 15.2\%$$

At a discount rate of 15.2 percent the investment just breaks even. From another angle the IRR can be understood as the earning capacity of the investment.

The formal selection decision for the IRR is to accept all investments with a return equal to or greater than the discount rate. If the IRR of the investment as a whole is lower than the discount rate, the investment is not profitable. If the IRR exceeds the interest rate, the farmer may try to borrow as much as possible to increase the return on the investement.

Finally, it should be pointed out that an IRR can only be calculated when at least one value in the net cash flow is negative. If all the values are positive, no discount rate can make the NPV of the cash flow equal to zero. In this event the IRR would be infinite.

Selection of discount rate

An appropriate discount rate has to be selected in order to use discounted measures of investment appraisal. The discount rate used is usually the cost of capital to the farmer for whom the appraisal is being done. But how should the cost of capital be measured? This is often assumed to be the rate of interest at which the farmer is able to borrow money. However, if the capital that the farmer uses to finance the investment is a mixture of equity and borrowed capital, the discount rate should also be weighted to take account of the return necessary to attract equity capital on the one hand and the borrowing rate on the other.

A weighted average cost of capital (WACC) calculation is needed, estimating the rate of return for both forms of capital tied up in the investment: debt and equity. This reflects the cost of all forms of financing that the farmer may use.

The WACC can be calculated as follows:

$$WACC = \frac{\text{Equity capital} \times \text{Return needed to attract equity capital}}{\text{Total capital}} + \frac{\text{Borrowed capital} \times \text{Borrowing rate}}{\text{Total capital}}$$

This requires information on the:

- cost of capital funds from each source employed by the farmer;
- weights to be given each source of capital in computing a weighted average cost.

The proper set of weights to use is the relative proportion of each type of capital in the farmer's desired financing of the investment. The assumption is that the farmer will, in fact, fund the capital investment in the proportions assumed in the weighting system. If bank loans represent 67 percent of a farmer's funds, it should be assigned a weight of 0.67. If equity capital represents 33 percent of the investment, it would be given a weight of 0.33.

While the interest rate charged on long-term bank loans is used as the cost of capital from lending, placing a meaningful cost on equity capital is much more difficult. This is so because equity has no clear cost. There is no interest paid. However, there is an opportunity cost. If farmers put their money into an investment they are denied the use of these funds for other purposes. If by investing in their own farms, the farmers forgo making investments that will earn 10 percent, they should view equity capital as costing the alternative 10 percent.

The opportunity cost of farmers' equity differs between farmers because individuals differ in their abilities to find alternative investment possibilities for their capital and in their management capacity and attitude to risk. With this in mind farmers must use their judgement in assessing their cost of equity. The important point is for the farmer to recognize that equity capital is not "costless" and, in fact, should be regarded as a more expensive source of capital than bank loans.

Example

Calculating weighted average cost of capital

In this example, the WACC is 8 percent. Investments

Source	Amount	Weighted average cost of capital	
Loan (7% IR)	5 000 (67%)	7% of 67% = 4.7%	
Equity capital (10% IR)	2 500 (33%)	10% of 33% = 3.3%	
Total	**$7 500 (100%)**	**Total**	**8.0%**

promising a return of less than 8 percent (i.e. investments with a negative NPV using 8 percent as the discount factor or investments with an IRR of less than 10 percent) would appear undesirable. On the other hand, investments promising a rate of return of something over 8 percent would be acceptable.

Comparison of measures

The two discounting measures give the same answer to the simple question of whether the investment pays. Many extension workers might prefer the NPV criterion for its simplicity, unambiguous quality and straightforward way of selecting among mutually exclusive investments. Some, however, may prefer the IRR criterion because it is understood easily by those unfamiliar with the discounted measures. The IRR can be explained easily as the maximum rate of interest that a farmer could pay if all resources used in the investment were borrowed.

But if the investment alternatives considered by the farmer are mutually exclusive, the IRR is not a useful measure and the NPV would be more appropriate. The NPV better serves this purpose because it measures the absolute surplus of the benefits over the costs, discounted. Furthermore, it escapes the problem of having to estimate the opportunity cost of capital to the farmer.

Notes

Table 6.1 — Discount rates
(present value of a single sum of 1$ received or paid at the end of the period)

Rate of Interest (%)

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162
11	0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135
12	0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112
13	0.879	0.773	0.681	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093
14	0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078
15	0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065
16	0.853	0.728	0.623	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054
17	0.844	0.714	0.605	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045
18	0.836	0.700	0.587	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038
19	0.828	0.686	0.570	0.475	0.396	0.331	0.277	0.232	0.194	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031
20	0.820	0.673	0.554	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026
21	0.811	0.660	0.538	0.439	0.359	0.294	0.242	0.199	0.164	0.135	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.026	0.022
22	0.803	0.647	0.522	0.422	0.342	0.278	0.226	0.184	0.150	0.123	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.022	0.018
23	0.795	0.634	0.507	0.406	0.326	0.262	0.211	0.170	0.138	0.112	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.018	0.015
24	0.788	0.622	0.492	0.390	0.310	0.247	0.197	0.158	0.126	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013
25	0.780	0.610	0.478	0.375	0.295	0.233	0.184	0.146	0.116	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010
26	0.772	0.598	0.464	0.361	0.281	0.220	0.172	0.135	0.106	0.084	0.066	0.053	0.042	0.033	0.026	0.021	0.017	0.014	0.011	0.009
27	0.764	0.586	0.450	0.347	0.268	0.207	0.161	0.125	0.098	0.076	0.060	0.047	0.037	0.029	0.023	0.018	0.014	0.011	0.009	0.007
28	0.757	0.574	0.437	0.333	0.255	0.196	0.150	0.116	0.090	0.069	0.054	0.042	0.033	0.026	0.020	0.016	0.012	0.010	0.008	0.006
29	0.749	0.563	0.424	0.321	0.243	0.185	0.141	0.107	0.082	0.063	0.048	0.037	0.029	0.022	0.017	0.014	0.011	0.008	0.006	0.005

1) To find present value (PV) of future amount:
PV = Factor x Amount

2) To find future amount representing the present value:
Amount = PV ÷ Factor

Unit 6.1 — Training exercise 16
Net present value and internal rate of return

Background information

A farmer decides to buy a tractor at a cost of $1 125 and estimates that the annual net benefits (cash inflows minus cash outflows) generated as a result of the investment are:

Year 1: $500 Year 3: $300
Year 2: $400 Year 4: $200

Task

Calculate the NPV assuming a discount rate of 8 percent
(record the results in the table below)

(space for calculations)

(8% discount rate)

Year	Investment (tractor)		
	Net cash flow ($)	**Discount rate**	**Present value ($)**
1			
2			
3			
4			
		Total	
		Less investment cost	
		Net present value	

(continued on the next page)

Training exercise 16 (continued)

Calculate the NPVs at different discount rates
(record the results in the table below)

(space for calculations)

Estimation of IRR for the investment

Year	Net cash flow ($)	10%		14%	
		Present value factor	Present value ($)	Present value factor	Present value ($)
1					
2					
3					
4					
		Total		**Total**	
		Less investment cost		Less cost	
		NPV			

Interpolate the IRR using the figures you have found

(Answer key on the following page)

Answer key for
Training exercise 16

The net present value can be calculated as in the following table.

(8% discount rate)

Year	Investment (tractor)		
	Net cash flow ($)	Discount rate	Present value ($)
1	500	0.926	463.0
2	400	0.857	342.8
3	300	0.794	238.2
4	200	0.735	147.0
		Total	**1 191.0**
		Less investment cost	-1 125.0
		Net present value	**66.0**

Since the IRR is calculated through a procedure of trial and error any two discount rates can be chosen as long as one results in a positive NPV and the other in a negative NPV. The discount rate that makes the NPV zero is then found by interpolation. Below are summarized the results with 10 and 14 percent as discount rates.

Estimation of IRR for the investment

Year	Net cash flow ($)	10%		14%	
		Present value factor	Present value ($)	Present value factor	Present value ($)
1	500	0.909	454.5	0.862	431.0
2	400	0.826	330.4	0.743	297.2
3	300	0.751	225.3	0.641	192.3
4	200	0.683	136.6	0.552	110.4
		Total	**1 146.8**	**Total**	**1 030.9**
		Less investment cost	-1 125.0	Less cost	-1 125.0
		NPV	**21.8**		**-94.1**

The interpolation is calculated as follows and then rounded:

$$10\% + \frac{21.8}{21.8-(-94.1)} \times (14-10)\% = 10.75\%$$

11%

Training slides
for Session 6.1.3
Discounted methods of investment appraisal

103 Time value of money in investment appraisal

The **time value of money** means that a dollar today
will not have the same value a year from now ...
Discounted measures take into consideration the **time value of money**

Compounding is the process of finding the *future value* in some future year
of a present amount growing at compound interset calculated as follows ...

$$\textbf{Future worth} = \textbf{Present worth } (1 + \textbf{Rate of interest})^{n}$$

Discounting is the process of finding the *present value*
of a future amount calculated as follows ...

$$\textbf{Present worth} = \frac{1}{(1 + \textbf{Rate of interest})^{n}}$$

n = time frame used (days/weeks/months/years)

104 Discounted investment apprasial — net present value (NPV)

The **net present value** of an investment
is the sum of the present values for each year's cash flow
less the initial cost of the investment
(also called the discounted cash flow method
since it uses discounting measures to appraise investments
that take into consideration the time value of money)

Advantages: it accounts for (i) the scale of the project, (ii) the timing of cash flow over the life of the investment.
Disadvantages: (i) the capital required for the investment is ignored, (ii) it is difficult to understand, (iii) discount rates must be chosen by trial and error.

---

105 Calculating the net present value

(8% discount rate and no salvage values)

Year	Investment A			Investment B		
	Net cash flow ($)	Discount rate	Present value ($)	Net cash flow ($)	Discount rate	Present value ($)
1	3 000	0.926	2 778	1 000	0.926	926
2	3 000	0.857	2 571	2 000	0.857	1 714
3	3 000	0.794	2 382	3 000	0.794	2 382
4	3 000	0.735	2 205	4 000	0.735	2 940
5	3 000	0.681	2 043	6 000	0.681	4 086
		Total	**11 979**			**12 048**
	Less investment cost		10 000			10 000
	Net present value		**1 979**			**2 048**

106 Discounted investment appraisal — internal rate of return (IRR)

The **internal rate of return** is the interest rate at which the **net present value** of an investment equals zero *(or the maximum rate of interest that the farmer can afford to pay for the resources used, in order to recover the original investment and its operating costs and still break even)*

Advantages: (i) the return on capital invested can be measured, (ii) does not require discount rate approximation, (iii) IRR is easier to understand than the NPV.
Disadvantages: (i) does not take into account project scale or timing of the cash flow, (ii) can only be estimated when at least one value in the net cash flow is negative.

---

107 Calculating the internal rate of return

(estimating the IRR for Investment A)

Year	Net cash flow ($)	14%		16%	
		Present value factor	Present value ($)	Present value factor	Present value ($)
1	3 000	0.877	2 631	0.862	2 586
2	3 000	0.769	2 307	0.743	2 229
3	3 000	0.675	2 025	0.641	1 923
4	3 000	0.592	1 776	0.552	1 656
5	3 000	0.519	1 557	0.476	1 428
		Total	**10 296**	**Total**	**9 822**
		Less investment cost	–10 000	Less cost	–10 000
		NPV	**296**		**–178**

Note: Since there is no formula for finding the IRR trial and error must be used to equate the NPV of the cash flow with the zero break-even point

108 Selection of discount rate

An appropriate **discount rate** has to be selected
in order to use discounted measures of investment appraisal
and the discount rate is usally the **cost of capital**

However, if the capital used to finance an investment
is a **mixture of equity and borrowed capital**
the discount rate should be weighted accordingly

Calculate the **weighted average cost of capital** (WACC) as follows ...

$$\text{WACC} = \frac{\text{Equity capital} \times \text{Return needed to attract equity capital}}{\text{Total capital}} + \frac{\text{Borrowed capital} \times \text{Borrowing rate}}{\text{Total capital}}$$

Note: This requires information on (i) the cost of capital funds from each source of employment, (ii) the weight to be given to each source of capital in competing a weighted average cost (see also Slide 109).

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109 Weighted average cost of capital (WACC)

The proper set of weights to use is the relative proportion
of each type of capital desired in financing the investment

If bank loans represent 67 percent of a farmer's funds
(7 percent interest) and equity capital represents 33 percent
of the investment (10 percent interest), then ...

Source	Amount	WACC	
Loan (at 7% IR)	5 000 (67%)	7% of 67% = 4.7%	
Equity capital (at 10% IR)	2 500 (33%)	10% of 33% = 3.3%	
Total	**$7 500 (100%)**	**Total**	**8.0%**

Note: Investments promising a return of less than 8 percent (i.e. investments with a negative net present value using 8 percent as the discount factor or investments with an IRR of less than 10 percent) would appear undesirable. Investments promising a rate of return of something over 8 percent would be acceptable.

Notes

Preparing for session 6.1.4
Loan appraisal

Teaching methods
Group discussion, trainer/participant interaction, role play exercise, draw conclusions

Duration: 45 minutes

Learning support materials
Handout 6.1.4 (Loan appraisal),
Slide 110 (Loan appraisal), Slide 111 (Computing loan repayment)

Notes

Loan appraisal

This session considers a way of assessing the capacity of a farmer to repay loans taken out to finance a farm investment. The appraisal builds on the net cash flow projection before financing.

Investments often involve tying up money for a period of time. This money may have been borrowed and, therefore, it is important for farmers to understand whether or not they can repay loans. Also the farmer must consider repayment in terms of its affect on cash flow. It is particularly useful to assess the cash flow of an investment after negotiating a financial package.

Objectives

At the end of the session, the participants are expected to:

- understand the concept of debt repayment capacity;
- apply methods of assessing the capacity of the investment to cover debt services and repay loans.

Key points

1. The capacity of a farmer to repay a loan is assessed by examining the cash flow after taking into account the loan and accounting for the repayment of interest and principal.

2. The loan appraisal treats the loan as an inflow and repayment of debt as an outflow.

3. Debt repayment is conducted on the outstanding balance of the loan.

4. Net financing is calculated as the difference between the value of the loan taken and the repayment of interest and principal.

5. The net cash flow after financing is calculated by deducting the net financing costs from the cash flow before financing. The cumulative cash flow is used to assess whether the income and loan cover costs.

6. A negative cumulative cash flow indicates that the farmer requires either additional financing to cover a debt shortfall or better terms of financing. The loan appraisal provides a farmer with information to allow the renegotiation of a loan package.

Steps for instruction

1. Distribute Handout 6.1.4 (Loan appraisal) to the participants before the start of the session.

2. Encourage the participants to discuss the type of data needed to conduct a loan appraisal. Ask participants to suggest what items are needed: (i) interest on loan, (ii) time span of loan, (iii) cash flow, (iv) amount to be repaid. Write suggestions on the classroom board. The participants should be made aware that the presentation of the cash flow is a little different from the monthly cash flow schedule, discussed in Module 5. Also point out that in accounting terms loans are assumed to be received at the end of the year and the loan repayment is made in the consecutive year.

3. Show Slide 110 (Loan appraisal). Discuss the concept and its usefulness in practice. Explain how loan appraisal is computed with emphasis on the declining balance through the aid of Slide 111 (Computing loan repayment).

4. Involve the participants in a role play exercise, selecting one of the participants to play the role of the farmer. Use the data given in Table 6.2 in the handout. The example refers to a farmer who has taken a loan of $1 000 at 10 percent interest and with a repayment period of 5 years.

5. Encourage the trainees to "play the game" by either renegotiating the repayment of the loan, providing additional working capital to cover the financial shortfall, or receiving financial assistance from friends or family. Each participant should be encouraged to provide solutions alongside those given by the trainee playing the role of the farmer.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.1.4.

Notes

Loan appraisal

Farmers are often interested in assessing their capacity to repay the loans that they take out. The capacity to repay loans is assessed by looking at its affect on the farmers' cash flow. The appraisal builds on the net cash flow projection before financing. The presentation of the cash flow is, however, seen a little differently.

In the table below, the annual net cash flow is presented horizontally. The vertical column explains in detail the net financing costs, the net cash flow after financing and the cumulative net cash flow. The methodology of appraising the capacity of the farmer to pay back the loan is also different following the accounting convention that loans are assumed to be received at the end of the year, and the debt service repayment is made in the consecutive year.

Table 6.2 — Computing loan repayment

Items	1	2	3	4	5	6	7
Cash flow before financing ($)	-2 600	2 500	2 500	2 500	2 500	3 000	2 000
Loans							
Long-term loans	1 000						
Outstanding balance							
Long-term loans	1 000	800	600	400	200	0	0
Repayment of principal							
Long-term loans		200	200	200	200	200	0
Interest payments							
Long-term loans		100	80	60	40	20	0
Total cost of financing		**300**	**280**	**260**	**240**	**220**	**0**
Net financing	**1 000**	**-300**	**-280**	**-260**	**-240**	**-220**	**0**
Net cash flow after financing	**-1 600**	**2 200**	**2 220**	**2 240**	**2 260**	**2 780**	**2 000**
Cumulative cash flow	**-1 600**	**600**	**2 820**	**5 060**	**7 320**	**10 100**	**12 100**

Note: The net cash flow before financing is as given above.

Example
Computing loan repayment

The farmer takes out a loan for $1 000 at 10 percent interest and a repayment period of 5 years. The calculations involved in appraising the capacity of the farmer to repay the loan are described as follows: The farmer receives a $1 000 loan at an interest rate of 10 percent. Thus the interest paid in year 2 is $100. The principal on the loan has to be repaid at equal instalments over a 5-year period of $200 annually.

The interest payment for year 3 is calculated on the outstanding balance of the loan after the principal has been repaid. We assume that the loan repayment is made at the end of the year, so interest is due on the full amount of the principal outstanding at the end of the previous year. In year 3, the outstanding balance is the $1 000 loan minus $200 repaid as the *first instalment* of the principal (i.e. $800).

The interest on $800 is $80 ($800 x 10 percent). This is entered as repayment on interest in year 3. It is assumed that the principal repayment is made at the end of the year, and interest must be paid for a full year on the amount outstanding at the end of the previous year.

Beginning year 6 the outstanding balance at the end of the previous year has been reduced by the principal repayment of $200 made at the end of year 5, so the interest is calculated on the outstanding balance of $200 and amounts to $20.

In this particular example, the cumulative cash flow is positive for every year of the investment starting from year 2. This suggests that the farmer has a liquidity problem in year 1 but in year 2 is able to finance the costs of the loan. If the cumulative net cash flow shows a financial shortfall (i.e. a negative figure), in any year, the implication is that the farmer would need to find additional financing to cover that shortfall.

The difference could be made up by renegotiating the repayment of the long-term loan, utilizing equity capital, providing additional working capital to cover the financing deficits or receiving grants from friends or family.

Notes

Training slides
for Session 6.1.4
Loan appraisal

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110 Loan appraisal

Farmers are often interested in assessing their capacity to repay the loans that they take out

The capacity to repay loans is assessed by looking at its affect on the farmers' cash flow

The appraisal builds on the net cash flow projection before financing

However, the presentation of the cash flow is seen a little differently as shown in Slide 111 (Computing loan repayment)

111 Computing loan repayment

Items	1	2	3	4	5	6	7
Cash flow before financing ($)	-2 600	2 500	2 500	2 500	2 500	3 000	2 000
Loans							
Long-term loans	1 000						
Outstanding balance							
Long-term loans	1 000	800	600	400	200	0	0
Repayment of principal							
Long-term loans		200	200	200	200	200	0
Interest payments							
Long-term loans		100	80	60	40	20	0
Total cost of financing		**300**	**280**	**260**	**240**	**220**	**0**
Net financing	**1 000**	**-300**	**-280**	**-260**	**-240**	**-220**	**0**
Net cash flow after financing	**-1 600**	**2 200**	**2 220**	**2 240**	**2 260**	**2 780**	**2 000**
Cumulative cash flow	**-1 600**	**600**	**2 820**	**5 060**	**7 320**	**10 100**	**12 100**

Notes

Notes

Managing risk

This unit examines the risky environment in which farmers work and considers methods of assessing and managing the risk. It begins by defining exactly what risk is and separates risk into different categories. Strategies to understand risks and steps to take to help manage them are discussed. The unit also presents the use of sensitivity analysis as a tool to help predict possible changes in the assumptions used to assess risk.

Preparing for session 6.2.1
Risk and risk management

Teaching methods
Group discussion, trainer/participant interaction, summarize replies, draw conclusions

Duration: 45 minutes

Learning support materials
Handout 6.2.1 (Risk and risk management), Slide 112 (Risk), Slide 113 (What is risk?), Slide 114 (Risk management)

Notes

Risk and risk management

There is a need to define and understand risk so that extension workers gain a better understanding of the risky environment within which farmers work. This session defines risk and discusses it in the context of the management decisions made by farmers.

Objectives

At the end of this session, the participants are expected to:

- define risk;
- understand the principles of managing risk;
- know how farmers make risky decisions.

Key points

1. Variability in yields and prices are major sources of risk in agriculture. Other factors are changing technologies, markets, policies and social factors.

2. Risk is the probable occurrence of an event that can be calculated with some accuracy.

3. Effective risk management involves:

    - anticipating that an unfavourable event may occur and acting to reduce the chance of its occurrence;
    - taking actions to reduce the adverse consequences should unfavourable events occur.

Steps for instruction

1. Distribute Handout 6.2.1 (Risk and risk management) before the start of the session.

2. Using Slide 112 (Risk) and Slide 113 (What is risk?) discuss the element of risk in farming with the class.

3. Have the participants name some factors likely to increase the risks of a farmer making management decisions. Refer to the list (Risk factors in farming) in the handout.

4. Show Slide 114 (Risk management) and discuss this with the class. Explain the notion that risk management is concerned with actions that reduce the possibility of unfavourable outcomes occurring or at least softening their effects.

5. Emphasize that risk management involves anticipating possible difficulties and planning to reduce their consequences. Mention that risk management is a proactive strategy aimed at reacting to unfavourable events before they occur.

6. Highlight the two main elements of risk management. These are: (i) anticipating that an unfavourable event may occur, (ii) taking actions to reduce the probability of its occurrence. Ask the participants for examples of each.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.2.1.

Notes

Risk and risk management

Farmers make decisions in a risky and ever-changing environment. The consequences of their decisions generally are not known when the decisions are made, and outcomes may be better or worse than expected. Variability of prices and yields are major sources of risk in agriculture. Changes in technologies, markets, policies and social factors all contribute to the risky environment of farming. Risks must be taken in order to grow a crop or raise livestock. Farmers cannot be sure about (i) the weather, (ii) disease, (iii) the price they may get if they choose to sell, (iv) what consumers want to buy.

Farmers can never be sure of the outcome of their decisions

What is risk?

Risk is defined as "the probable occurrence of an event, which can be calculated with some accuracy". Risk can be determined by identifying all of the possible outcomes of a given situation. It is impossible to predict what will really happen. This unknown factor is risk.

Risk is the chance that something will go wrong with the plans that farmers make

Risk factors in farming

1. Agriculture depends on biological processes and is subject to fluctuations in production as a result of weather change or disease.

2. Enterprises, such as vegetables, are subject to sudden changes in price.

3. Long-term enterprises, such as tree crops, require investment for a long period and may be subject to price changes that may make them uneconomic.

4. Certain crops may thrive under conditions prevalent in some parts of the country but prove uneconomic in others.

Effective risk management involves:

- anticipating that an unfavourable event may occur and acting to reduce the chance of it happening;
- taking actions to reduce the adverse consequences of risk should an unfavourable event take place.

For example, a risk management strategy for mechanization might involve a complete overhaul of an old tractor before the peak season workload. This is to reduce the chances of a major breakdown in operations over the period. During planting and harvesting, farmers may decide to keep some spare parts readily available. While they may not be able to prevent a breakdown from occurring, they can help to reduce the unfavourable consequences should it happen.

Farmers need to make choices. They will need to know about input and selling prices, yields, markets and technical information. However, very often farmers find that their best decisions turn out to be wrong because something changes between the time the decision is made and the time the crop is harvested or the animal is sold.

Farmers must make decisions early in the cropping season about things such as what crops to plant, what seeding rates and fertilizer levels to use. The final yield and prices may not be known for several months, or even several years in the case of tree crops. Risks in farming activities can come from unexpected places and result in low prices, drought or disease. Risk management is concerned with reducing the chances of less favourable outcomes occurring, or at least softening their effects.

Notes

Training slides
for Session 6.2.1
Risk and risk management

---

112 Risk

Farmers make decisions in a risky environment

The consequences of their decisions generally
are not known when the decisions are made and ...

... outcomes may be better or worse than expected

Variability of prices and yields
are major sources of risk in agriculture

Changes in technologies, markets, policies, social factors
all contribute to the risky environment of farming

113 What is risk?

Risk is defined as ...

**"the probable occurrence of an event,
which can be calculated with some accuracy"**

Risk can be determined by ...

**identifying all of the possible outcomes
of a given situation**

*It is impossible to predict what will really happen
and this unknown factor is risk*

---

114 Risk management

Effective risk management involves ...

**Anticipating that an unfavourable event may occur
and acting to reduce the chance of it happening**
(e.g. a complete overhaul of an old tractor
before the peak season and workload)

**Taking actions to reduce
the adverse consequences of risk
should an unfavourable event take place**
(e.g. decide to keep spare parts for equipment
readily available during planting and harvesting)

*Risk management is concerned with reducing
the chances of less favourable outcomes occurring*

Notes

Preparing for session 6.2.2
Sources of risk

Teaching methods
Brief presentation, trainer/participant interaction and discussion

Duration: 45 minutes

Learning support materials
Handout 6.2.2 (Sources of risk),
Slide 115 (Sources of risk)

Notes

Sources of risk

This session discusses the different sources of risk. Knowing what type of risk would enable the farmer to determine which ones can be controlled and/or minimized and thereby lessening their negative effects. Each category of risk will be discussed in turn.

Objectives

At the end of the session, the participants should be able to:

- understand the sources of risk;
- identify which risks are within the farmer's control and which are not.

Key points

1. The most common sources of risks are described as:

    - production and technical risk;
    - marketing or price risk;
    - financial risk;
    - institutional risk;
    - human or personal risk.

2. Many of these risks are interrelated.

Steps for instruction

1. Distribute Handout 6.2.2 (Sources of risk) before the start of the session.

2. Show Slide 115 (Sources of risk) and discuss these most common sources with the participants.

3. Ask the participants to give examples of the risks involved in farming.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.2.2.

Notes

Sources of risk

Although risk is present in all farms, risk management is a personal matter and can vary between farmers. Risks can be classified in several ways. Some of them are:

- production and technical risk;
- marketing or price risk;
- financial risk;
- institutional risk;
- human or personal risk.

Risk exists in many different forms ...

Production and technical risk. Crop and livestock performance depend on biological processes, which are affected by weather, soil, pests and disease. These processes cannot be predicted accurately. Farmers experience a wide range of weather conditions and refer to them simply as a "good" year, "normal" year or "bad" year. In periods of drought, poor plant growth means that livestock-fodder supplies and livestock production are likely to be reduced.

... and with potentially devastating effect

Then again outbreaks of pests or diseases can cause major yield losses. Inputs, such as seed and fertilizer, are applied before the farmer knows what the weather will be, and regardless of the levels used the weather often affects results. Another source of production risk is the introduction of a new technology. The question is often posed whether the new technology will perform as expected. Will it actually reduce costs and/or increase yields?

Marketing or price risk. Prices of farm products not only vary from year to year but also in some situations on a daily basis because of reasons beyond the control of the farmer. Supply of a product is affected by a combination of production decisions made and the resulting weather. Demand for a product is affected by the level of income that consumers have, the exchange rate and other policies, the strength of the general economy and the supply of competing products.

Price movements can often follow seasonal or cyclical trends, which can be predicted. Costs of production represent another source of price risk. Although input prices tend to be less variable than output prices, the cost of production depends on both costs and yield and is subsequently highly variable.

Financial risk. This occurs when money is borrowed to finance the operation of the farm. This risk is caused by uncertainty about future interest rates, a lender's willingness to continue lending and the ability of the farm to generate the cash flows necessary for debt payments.

Institutional risk. This refers to irregularities in the provision of services, such as the supply of credit, purchased inputs and needed information deriving from both traditional and modern institutions. Part of institutional risk is the uncertainties of government policy with respect to price support and subsidies.

All too often these risks are a result of weak management and poor institutional performance. Subsidies, regulation in food quality and chemical use, rules for animal waste disposal and the level of price or income support payments are examples of decisions taken by government that can have a major effect on the farm activities.

Human or personal risk. Human risk refers to problems of human health and personal relationships that can affect the farm business. Accidents, illness and death, for example, often threaten and disrupt farm performance. In many countries, labour migration away from the farm is a common phenomenon that occurs as a result of poverty and food insecurity, and this often brings with it additional risks of contraction of human disease and illness.

Production, marketing, financial, institutional and personal risks exist on most farms and are often interrelated. The ability to repay debts depends on production levels and prices received for produce sold. Financing of production depends on the ability to borrow and supply capital in time.

The different types of risk often need to be considered together.

Notes

Training slides
for Session 6.2.2
Sources of risk

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115 Sources of risk

Production/technical risk. Crop and livestock production are affected by weather, soil, pests and disease or by the introduction of a new technology.
Marketing or price risk. Prices of farm products vary from year to year and in some situations on a daily basis.
Financial risk. Occurs when money is borrowed to finance the operation of the farm.
Institutional risk. Irregularities in the provision of services, (i.e. supply of credit, purchased inputs, needed information).
Human or personal risk. Human risk refers to problems of human health and personal relationships that can affect the farm business.

Preparing for session 6.2.3
Risk management strategies

Teaching methods
Brief presentation, trainer/participant interaction, group discussion, brainstorming, list results, draw conclusions

Duration: 60 minutes

Learning support materials
Handout 6.2.3 (Risk management strategies), Slide 116 (Steps in managing risk), Slide 117 (Strategies for risk management)

Notes

Risk management strategies

This session presents five steps in decision-making and risk management and describes management strategies in greater depth.

Extension workers should have an understanding of typical risk management strategies. They can then help farmers recognize different ways to reduce risk through better management practices.

Objectives

At the end of this session the participants are expected to:

- have learned the steps in making risky decisions;
- understand the different types of responses when dealing with risk.

Key points

1. There are five steps that are usually followed when making risky decisions. These are:

    - identification of possible sources of risk;
    - identification of possible outcomes or events that could occur;
    - deciding on the alternative strategies available;
    - quantifying the consequences or results of each possible outcome for each strategy;
    - evaluating trade-offs between risk and returns.

2. The common risk management strategies are summarized here.

Production-led responses:

- choosing low risk activities;
- diversifying enterprises;
- dispersing production geographically;
- selecting and diversifying production practices;
- maintaining flexibility.

Marketing-led responses:

- obtaining market information;
- participating in government programs;
- spreading sales;
- forward contracting;
- minimum price contracts.

Financial responses:

- insurance;
- maintaining liquidity reserves;
- working off-farm;
- pacing investments;
- limiting credits.

Steps for instruction

1. Distribute Handout 6.2.3 (Risk management strategies) among the participants before the start of the session.

2. Explain the steps involved in decision-making under risk with the aid of Slide 116 (Steps in managing risk). Initiate group discussions and discuss ways to minimize and cope with risks. List the main types of risk on a posterboard (production, market and financial). Brainstorm possible risk management strategies for each category.

3. On completion of the brainstorming session compare the information provided by the class against that given in Slide 117 (Strategies for risk management).

4. Review the following conclusions to the session and discuss each thoroughly with the participants.

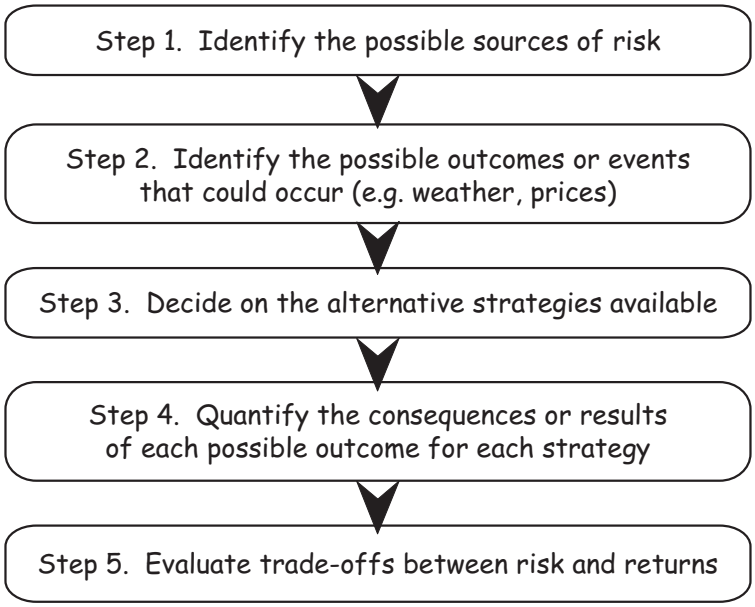
   - Farmers should be encouraged to "grow what they know".
   - Farmers should make use of extension services and adopt the most appropriate agricultural techniques.
   - Farmers should diversify crops and enterprises to minimize the risks of market prices and crop yield variability.
   - Farmers should save some of the profits earned as savings.
   - Farmers should keep farm and enterprise records.
   - Farmers should diversify their farming system into non-agricultural activities.
   - Farmers should collaborate among themselves.

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.2.3

Notes

Risk management strategies

Farmers need to cope with risk and protect themselves from the decisions they make today, not knowing what may happen tomorrow. There are many risk management strategies that may reduce the chance of a "bad" event occurring and/or reduce the effect of the bad event if it occurs. The decision-making process can be broken down into the following steps:



Steps in risk management strategies

Making decisions in which there is a high risk requires careful consideration of the various strategies available and the possible outcome of each. Risk responses are commonly grouped into production, marketing and finance (money). Most farmers use a combination of strategies for each of these groups. Examples are listed on the following page.

Risk responses by function

Function	Strategy
Production	Choosing low-risk activities Diversifying enterprises Dispersing production geographically Selecting and diversifying production practices Maintaining flexibility Varying production capacity
Marketing	Obtaining market information Spreading sales Contract farming Participating in government programmes Minimum price contracts
Financial	Working off-farm Maintaining liquidity reserves Phasing investments Acquiring assets Limiting credit Insuring against losses

Production responses

Production responses have traditionally been very important in risk management. There are a number of response strategies that can be followed to reduce the risks that farmers face, such as the following:

- choosing low-risk enterprises;
- growing many things (diversification);
- growing crops on different land parcels or plots;
- selecting and changing production practices;
- maintaining flexibility.

Choosing low-risk enterprises. Most farmers have experience with farm enterprises that are more stable than others. Farmers may select farm enterprises or crop varieties that produce a reliable and stable yield. Although the yield of a new improved variety may be more stable than those of local

varieties, farmers may not have had the experience of growing that variety, and the risk to the farmer in its cultivation may be high. Some of the crops grown and livestock enterprises raised by the farmer may be simple while others are more complex.

Growing many things (diversification). Farmers often diversify their enterprises as a way of reducing risk. They do so by managing a number of enterprises together on the farm, producing the same enterprise in different physical locations or managing the same enterprise at different periods of time.

Farmers can spread risks by growing more than one enterprise

An example of diversification is the growing of several different crops or the keeping of livestock . If one enterprise fails, the income from the other enterprises is expected to be sufficient to keep going. While the income from any two enterprises may be equally risky, the combined risk will be less than the risk from either crop alone, because the two crops react in different ways to risk. This strategy ensures that farmers avoid having their income totally dependent on the production and price of a single enterprise.

Farmers rotate crops to protect their soils and stop diseases building up. This reduces costs and increases yields. For most farmers, combining crops (crop rotation or diversification) is not a risk management activity, it is simply good management.

Some factors can make crop diversification difficult. For example, some crops use similar machinery and equipment, while other crops may require specialized equipment. The benefit of diversification is often offset by increased costs. Other enterprises may make very little money. Consequently, the incomes farmers make from the crop may not be as high as if they were to specialize in growing just one crop, but the differences in year-to-year yields are reduced.

Farmers must be flexible in choosing farm-crop locations ...

Growing crops on different land parcels or plots. Growing crops in different locations on the farm reduces the impact of localized disease and microclimatic factors. In order to increase the scale of their crop production, farmers must cultivate over a wide area. This costs more money as operating costs increase. Spreading out production is one way of reducing risk. Another is to increase efficiency in machinery and labour use.

Selecting and changing production practices. Farmers often spread risk by doing things in different ways. Some farmers may purchase inputs and materials that control crop diseases, pests and water use, and by doing so diminish deterioration in animal health. The application of these inputs might reduce the chances of low yields occurring, in particular, in situations of rain-fed farming. Drought-resistant seed varieties, for instance, could reduce the likelihood of crop failure when low rainfall occurs.

... and appropriate production practices

Pesticides and fungicides are more expensive inputs that might affect yield and farm income in different ways. These more costly inputs may reduce the risk of low yields but could increase the risk of income shortfall. More stable yields as a result of their application may not lead to a more stable income. Profits are affected also by the prices of products and inputs. The additional cost of doing this has to be compared against what could happen if they were not.

Maintaining flexibility. Flexibility of the farming system allows the farmer to shift from one cropping pattern to another, smoothly and easily, without having a negative effect on farm profitability. Farmers may change the area of land under cultivation and/or the number of livestock kept if, for example, market prices change markedly. Some farmers might decide to keep land fallow at times of low rainfall in order not to risk unnecessary expenditure on inputs. Farmers who raise intensive small stock, such as pigs, sheep and poultry, might vary the use of housing facilities if external conditions, such

as price changes, call for it. If farmers believe that product prices are likely to be good, they could increase production by intensifying the use of the facilities. Or alternatively, if prices are not satisfactory, they may try to increase efficiency and cut costs. Often, however, the costs associated with flexibility in production are higher than most farmers are willing to risk.

Market-related responses

The rapid change of food prices in the marketplace has increased farmers' awareness of price risks and has made good marketing skills important. Farmers can improve their knowledge of marketing and develop new marketing skills. Some of the ways this can be done are:

- obtaining market information;
- spreading sales;
- contract farming;
- minimum price contracts.

Farmers need good management skills to deal with market changes

Obtaining market information. No one can predict the future exactly. But the more knowledge farmers have about price changes and the past profitability of enterprises, the better position they are in when predicting the future. Better information on seasonal variations in prices and changes in prices over the years can be used to plan when produce should be marketed. A farmer can reduce risk by collecting information about market prices and costs, and the returns of the alternatives open to them.

Spreading sales. Making several sales of a product during a year, or spreading sales, is a method commonly used by farmers to reduce risk. Dairy and other livestock producers are often forced to spread the sales over the entire year because of the nature of their production. With frequent sales throughout the year, the average price received by a farmer is nearly equal to the average price for the season or year.

Farmers with marketing flexibility can also spread sales and obtain a price similar to the seasonal average price. This method enables a farmer to avoid selling all production at the lowest price in the market.

Contract farming. Price uncertainty can be eliminated entirely if the farmer could make advance contracts, both with the buyer of the produce and with the seller of agricultural inputs. Some farmers make contracts with suppliers so that inputs are provided at specified prices. This avoids the risk of price increases and the unavailability of key inputs at critical times.

Farmers, similarly, contract production sales at given prices agreed upon by both parties.

Farmers should consider ways of stabilizing prices and ensuring market outlets

Contract farming may result in the farmers getting a lower price than they would have if they had sold on the "day". However, a guaranteed price for the farmers allows them to plan. If farmers are satisfied with the gross margin received and feel that they can safely supply the quantities contracted, then forward contracting is a good strategy to avoid risk.

Minimum price contracts. Minimum price contracts provide farmers with a "price insurance", but this is not always a guarantee of profit. It does provide the farmer, however, with greater flexibility.

Financial responses

The following are responses that help farmers reduce financial risks:

- crop and livestock insurance;
- maintaining liquidity reserves;
- working off-farm;
- pacing investments;
- limiting credits.

Crop and livestock insurance. Typhoons, fire or crop failure

can have a serious impact on the survival of the farm business. Without insurance the financial setback could be so large as to cause the farm business to fail and even cease operations. Formal insurance can reduce these risks.

Maintaining liquidity reserves. Holding reserves also reduces financial risks. It can be viewed as a "self-insuring" form of protection. Reserves may take the form of extra cash to meet unusual increases in the prices of inputs, such as livestock feeds that are needed on a daily basis. Other assets that can be easily converted to cash can also be used.

Farmers need to know how to increase their financial security

Working off-farm. Farmers may not work all day and every day of the week on their farm. They may choose to work in other jobs in order to augment their income. Farmers can work off-farm as salaried labour, either as a hired hand on other farms, or alternatively may find employment in non-farm work.

Scheduling investments. Proper scheduling or timing of investments on the farm can also help reduce financial risk. There are some cases in which investments can be staggered beginning with the most urgent or important ones, especially for fixed investments. However, provisions for expansion always need to be made available.

Limiting credits. Credit supplies should be carefully programmed so that payment coincides with the inflow of receipts from the sale of the produce. If farmers borrow beyond their capacity to pay or the period of loan payment is ill-timed, there is a likelihood that the farm business will be in financial difficulty. Although they have the option to borrow funds from several sources, caution needs to be exercised. There comes a time when loans taken out will have to be repaid with interest.

Common farmer responses

The general lessons that can be learned from these experiences are summarized below:

1. Farmers should be encouraged to grow what they know, although trying new potentially attractive farm enterprises should not be avoided. They should be tried out on a small scale.

2. Farmers should make use of extension services and adopt the most appropriate agricultural techniques.

3. Farmers would do well to diversify within the farming system by planting several types of crops and/or introducing livestock.

4. Farmers should set aside profits and save some of their funds as a reserve.

5. Farmers should be well-informed of the implications of risk on the profitability of their farm enterprise by keeping records, collecting market information and better utilizing extension information.

6. Farmers may need to undertake off-farm income generating activities as a supplementary source of income.

7. Farmers should be encouraged to work with other farmers to reduce costs and increase profits.

Notes

Training slides
for Session 6.2.3
Risk management strategies

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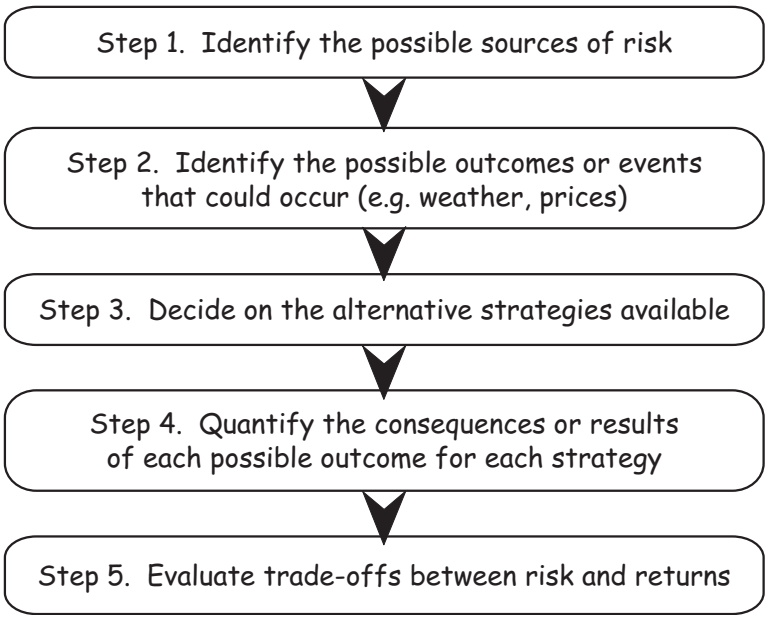
116 Steps in managing risk



117 Strategies for risk management

Responses by function

Function	Strategy
Production	Choosing low-risk activities Diversifying enterprises Dispersing production geographically Selecting and diversifying production Maintaining flexibility Varying production capacity
Marketing	Obtaining market information Spreading sales Contract farming Participating in government programmes Minimum price contracts
Financial	Working off-farm Maintaining liquidity reserves Phasing investments Acquiring assets Limiting credit Insuring against losses

Notes

Notes

Preparing for session 6.2.4
Dealing with risk

Teaching methods
Lecture, class training exercise, group work, question and answer period

Duration: 90 minutes

Learning support materials
Handout 6.2.4 (Dealing with risk), Slide 118 (Procedure for conducting sensitivity analyses), Slide 119 (Making a sensitivity analysis), Slide 120 (Example of a sensitivity analysis) Training exercise 17 (Risk in farming)

Notes

Dealing with risk

This session looks at ways farmers can better plan farm decisions through the use of one simple tool: sensitivity analysis.

Risk is inherent in any farm decision and it is important to consider the extent to which it affects the different types of farm management decisions taken.

Understanding the effects of change when making our assumptions is a valuable tool in understanding the potential risks.

Objectives

At the end of the session participants are expected to:

- understand the concept and application of sensitivity analysis;
- know how to interpret the decisions made.

Key points

1. In order to reduce the risks involved in making a decision, farmers need both technical and financial information.

2. Sensitivity analysis examines what might happen if changes are made to selected factors.

3. Sensitivity analysis deals with changes to both single and multiple factors.

4. Sensitivity analysis can be applied to many of the farm management techniques mentioned in this training.

5. The procedure for conducting sensitivity analysis is to:

   - summarize the enterprise budget or investment cash flow;
   - identify the key factors that are most likely to change as a result of risk;
   - compute the change in gross margin or net cash flow as a result of the change in the factors selected (either single factors or a number of factors together);
   - compare the results with the original information.

Steps for instruction

1. Distribute Handout 6.2.4 (Dealing with risk) to the participants before the start of the session.

2. Explain that all farm decisions entail risk. Reference could be made to the farm management tools and techniques covered so far in the training.

3. Show Slide 118 (Procedure for conducting sensitivity analyses) and explain its use in enterprise budgets, farm plans and investment analysis.

4. Provide examples by showing Slide 119 (Making a sensitivity analysis) and Slide 120 (Example of a sensitivity analysis). Explain what happens to the computed values as a result of selected changes.

5. Distribute Training exercise 17 (Risk in farming). Divide participants into groups, each one representing a different farm type. Have each group select a farm enterprise, identify the risks involved and the strategies to deal with them. Ask each group to justify its decisions.

6. Proceed to the second part of the exercise. Mention that a farmer is considering purchasing a tractor and has sufficient equity sources to finance the investment. Ask the questions that each group needs to consider when deciding whether to make the investment. How would each group appraise the risks involved in making the investment? What information would be needed?

Evaluation: (i) review objectives in relation to key points, (ii) refer to Handout 6.2.4, (ii) refer to Training exercise 17.

Notes

Dealing with risk

Making risky decisions requires careful consideration of the various strategies available and their possible outcomes. Decision-making is the principal activity of the farmer. The farmer needs to have all the necessary information about input prices, output prices, yields and other technical data. Farmers, however, find that their best decisions often turn out to be less than perfect because of changes that take place between the time the decision is made and the time the outcome of that decision is realized.

As we have seen throughout this training programme, farm enterprise budgeting is a basic farm management tool used for analysing the performance of farm enterprises and planning the farm operations. This tool and others are used under the assumption that every year is a normal year where the outcomes can be predicted accurately. In practice, this is far from reality. The risks associated with farming need to be included in the management decisions taken. There is a simple method that takes into account the risks involved in farm planning and management. This is called sensitivity analysis.

Sensitivity analysis

Once an enterprise budget and cash flow have been prepared, sensitivity analysis is often conducted as a way of testing profitability and cash availability in the light of risk. The degree to which the farm enterprise gross margin, farm profit or cash flow changes, reflects the element of risk facing the farmer. Sensitivity analysis is a necessary part of the farmer's decision-making process. Sensitivity analysis assesses how sensitive the activity is to external factors. It involves identifying the critical variables and studying the effect of changes in these variables on profitability. These include yield, product price, quantity of inputs and materials used, and cost of inputs. It looks at "what if" the assumed values are changed. What happens? The technique then quantifies the outcome the changes.

Sensitivity analysis examines the effect of change on the farm enterprise

The procedure for conducting sensitivity analysis is summarized below:

- Summarize the enterprise budget or investment cash flow.
- Determine the assumptions for every scenario.
- Identify the key parameters that are most likely to change as a result of risk factors.
- Compute the change in gross margin or cash flow as a result of the change in parameters selected (either single parameters or a number of parameters together).
- Compare the original results with the results following the sensitivity analysis.

The extension worker could determine the effect on profitability of a percentage increase or decrease in benefits and costs or both. If the value of production changes by a certain percentage, how much of an effect would this have on expected profit? If the effect of a small change is very great, this would suggest that the proposed activity is sensitive to change and may not be financially stable.

Making a sensitivity analysis

When taking a farm decision, there is a need to predict what happens to farm profit in the future. What will happen if weather conditions change drastically or prices of inputs and produce sold increase? If these events occur, the actual benefits attained would be different from that expected. Farmers have to consider the extent to which these changes could affect their profit and make a final decision as to whether or not to proceed with the activity as planned or alternatively make necessary adjustments. On the following page there is an example.

Example
A sensitivity analysis
(projected gross margin for the next year
based on the figures below is $2 251)

The price of 1 kg of rice	$10
Yield per ha	2 250 kg
Post-harvest losses	10%
Gross income	$20 250
Variable costs	$17 999
Gross margin	**$2 251**

Farmers are concerned because they heard that crop disease broke out last year on a neighbouring farm. The disease resulted in a 25 percent decrease in yields. The question that now needs to be answered is "how will gross margin change if their crop contracts the same disease?" The following is an answer.

The price of 1 kg of rice	$10
Reduction in yield by 25%	562 kg
Yield per ha	1 688 kg
Post-harvest losses	10%
Gross income	$15 192
*Savings in variable costs**	*$3 000*
Variable costs	$14 999
Gross margin	**$193**

**Savings here are a side effect of crop losses*

In this case the likely gross margin would be greatly reduced from $2 251 to $193. The conclusion is that the gross margin is very sensitive to the risk of a disease outbreak that could reduce the yield by 25 percent. However, this still brings the farmer a positive gross margin. If yields drop below the 25 percent mark, the profitability of the crop will be questioned.

This example shows how crop disease affects not only the yield of the crop but also the costs of materials and labour applied in its cultivation.

By conducting a sensitivity analysis, the extension worker and farmer will be able to make better decisions concerning high-risk and low-risk activities and to weigh up the relative advantages and disadvantages of different farm management decisions.

Notes

Unit 6.2 — Training exercise 17
Risk in farming

This is a management exercise intended to help participants understand some of the risks involved in farming. Trainees in small groups should each choose a different farm type such as: (i) annual crops, (ii) cattle, (iii) small stock, (iv) tree crops.

Task 1

Identify the risks involved in farming for the enterprise chosen

Identify strategies to overcome these risks

Justify the decisions made

(continued on the next page)

Training exercise 17 (continued)

Task 2

A farmer is considering purchasing a tractor at a cost of $10 000 and has sufficient financing to do this from equity resources alone.

Is it feasible to make the investment?

What additional information is needed to appraise the viability of the investment?

(each group should estimate its own data)

What are the risks involved in making that decision?

How can the investment and its riskiness be appraised?

Training slides
for Session 6.2.4
Dealing with risk

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118 Procedure for conducting sensitivity analyses

Summarize the enterprise budget or investment cash flow

Determine the assumptions for every scenario

Identify the key parameters
that are most likely to change as a result of risk factors

Compute the change in gross margin or cash flow
as a result of the change in parameters selected

Compare the original results
with the results following the sensitivity analysis

119 Making a sensitivity analysis

When making a farm decision, there is a need to predict what happens to farm profit in the future. What will happen if weather conditions change drastically or prices of inputs and produce sold increase?

If these events occur, the actual benefits attained would be different from that expected

Farmers must consider the extent to which changes could affect profit and make a final decision as to whether or not to proceed with the activity as planned or alternatively make necessary adjustments.

The price of 1 kg of rice	$10
Yield per ha	2 250 kg
Post-harvest losses	10%
Gross income	$20 250
Variable costs	$17 999
Gross margin	**$2 251**

A crop disease broke out last year on a nearby farm resulting in a 25% decrease in yields.

Question: "How will gross margin change if the crop contracts the same disease?"

120 Example of a sensitivity analysis

The price of 1 kg of rice	$10
Reduction in yield by 25%	562 kg
Yield per ha	1 688 kg
Post-harvest losses	10%
Gross income	$15 192
*Savings in variable costs**	*$3 000*
Variable costs	$14 999
Gross margin	**$193**

**Savings here are a side effect of crop losses*

Notes

The following is a list of the AGSF series TRAINING MATERIALS FOR AGRICULTURAL MANAGEMENT, MARKETING AND FINANCE

1. Farm planning and management for trainers of extension workers in the Caribbean, 2004 (CD-ROM, English).
2. Horticultural marketing extension techniques, 2004 (CD-ROM, English)
3. Farm planning and management for trainers of extension workers. Asia, 2006 (Hard copy and CD-ROM, English).
4. Integrating environmental and economic accounting at the farm level, 2005 (CD-ROM, English)
5. Curso de gestión de agronegocios en empresas asociativas rurales en América Latina y el Caribe, 2005 (CD-ROM, Español)

In preparation

6. Market-oriented farm management for trainers of extension workers. Africa (Hard copy and CD-ROM, English).

- Farm planning and management for trainers of extension workers. Latin America (Hard copy and CD-ROM, in Spanish)
- Training manuals on farmer business schools. Asia and Africa.

Other work

- FAO Pacific Farm Management and Marketing Series 3, Helping small farmers think about better growing and marketing (Hard copy)*.

* Copies soon to be available from AGSF

Module 6 presents farm investment and risk management. The first part of the module introduces some of the management tools used in making farm investment decisions and explains how to appraise loans. The second part of the module discusses the risks that farmers face in managing their businesses and describes some of the strategies and techniques that farmers can employ to manage these risks more effectively.

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