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ANALYTICAL TOOLS

Module 022

WinDASI Exercise

NGAMO 2 - An Irrigation Project: Impacts of Irrigation and Mechanization on Traditional Farms

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NGAMO 2 - An Irrigation Project: Impacts of Irrigation and Mechanization on Traditional Farms

by

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for the

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About EASYPol
EASYPol is a an on-line, interactive multilingual repository of downloadable resource materials for capacity development in policy making for food, agriculture and rural development. The EASYPol home page is available at: ***www.fao.org/tc/easypol***.
EASYPol has been developed and is maintained by the Agricultural Policy Support Service, FAO.

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1 SUMMARY

This module presents NGAMO2, a practical step-by-step exercise in Cost Benefit Analysis (CBA) of investment projects, to be run with the WinDASI software. (the word NGAMO comes from the name of the zone of the original project that was located in Myanmar).

The goal of this exercise is to analyze the technical feasibility of the irrigation project at farm level. The project analyst has to solve two major problems due to the expansion of production generated by the new irrigation scheme: excess demand of labour compared with the supply available form the farm household and a lack of draught animals in the peak periods. The reader will see how project constraints are solved and which are the main changes with versus the without project situations (WiP versus WoP). Moreover, a new constraint is introduced, which is the financing constraint, with the purpose to analyze the economic impact of the credit component by calculating project indicators such as incremental NPV, IRR and Benefit/Cost Ratio and comparing them before and after the financing.

2 INTRODUCTION

Objectives

The main objective of this module is to allow the user to practice using the software by analysing a real project (although simplified). In this exercise you are guided thorough a path, from the background of the exercise to its solution. Figure A below provides a synoptic view of the steps of the NGAMO2 exercise.

Target audience

This module targets current or future project analysts in the public administration or in Non-Governmental Organizations (NGOs), professional organizations, consulting firms willing to enhance their expertise in financial and economic analyses of agricultural investment projects.

Required background

In order to fully understand the content of this module the user must be familiar with:

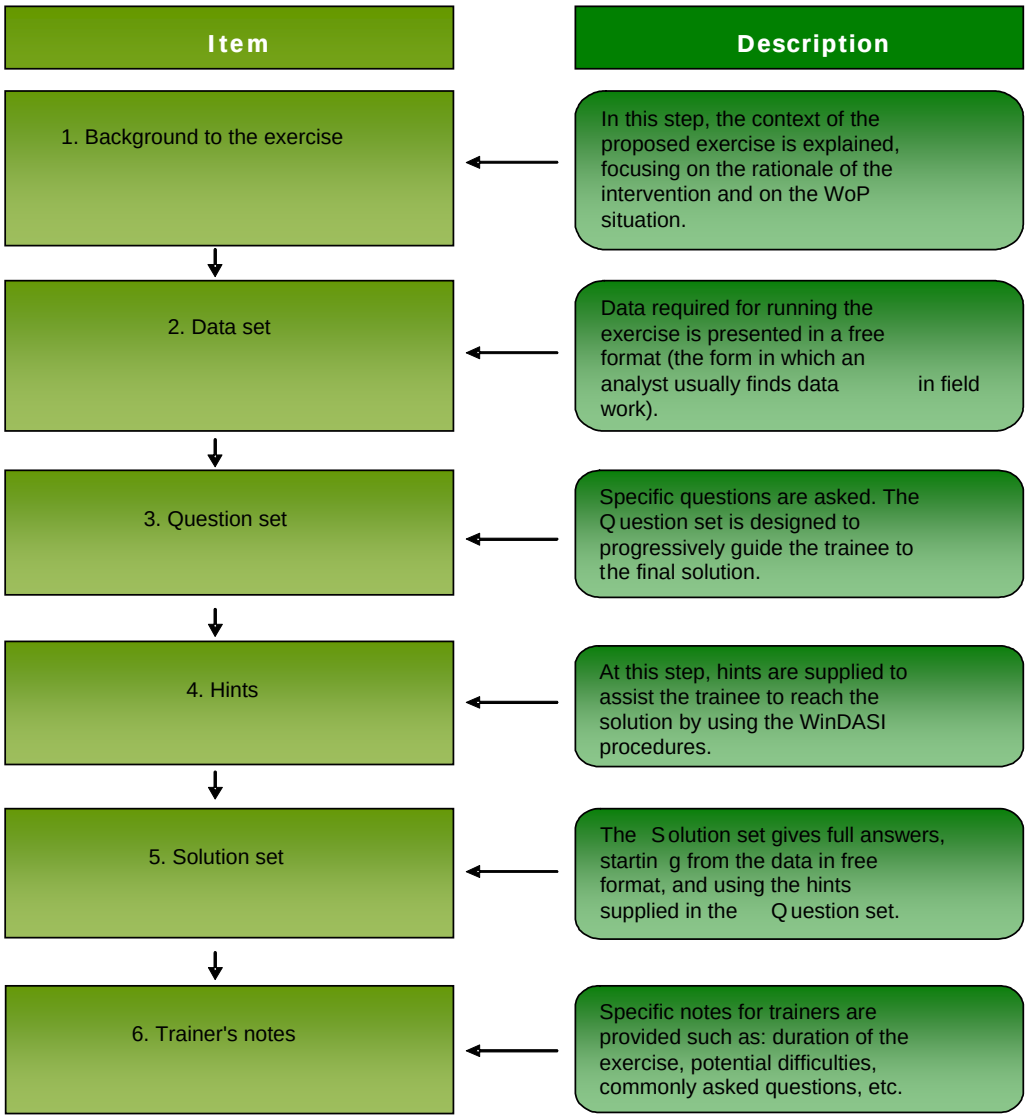
- concepts of project cycle management;
- concepts of project financial analysis;
- concepts of project economic analysis.

In addition , the user must have downloaded and installed the WinDASI software.

To find relevant material in the areas above, the reader can follow the links to other EASYPol modules included in the text or in the footnotes[1]. A set of linked EASYPol modules is reported in a section at the end od this document.

[1] EASYPol hyperlinks are shown in blue, as follows :

Figure 1: Structure of the NGAMO Exercises



a) training paths are shown in **underlined bold**;
b) other EASYPol modules or complementary EASYPol materials are in ***bold underlined italics***;
c) links to the glossary are in **bold**; and
d) external links are in *italics*

3 BACKGROUND TO THE EXERCISE

The irrigation scheme rehabilitation project analyzed in the previous NGAMO1 exercise has raised two major problems at the farm level:

- excess demand of labour compared with the supply available from the farm household; and

- a lack of draught animals in the peak periods.

According to the project experts, these issues may put at risk the achievement of the project's objectives, and must therefore be resolved. Hence, it is suggested that the following adjustments should be made to the project concept developed in NGAMO1:

i. the lack of household labour at farm level has to be solved by hiring some labour force from outside the farm;
ii. a number of farmers should purchase a power-tiller each, in order to overcome the problem of shortage of draught animals; and
iii. given that farmers cannot afford to pay for the whole investment, a credit component should also be added to the project.

This exercise aims to analyze the implications of these changes in terms of:

i. viability to the farmers of the irrigation project, once the hired labour force is introduced;
ii. viability to the farmers of the mechanization; and
iii. credit requirements and the impacts on project feasibility and profitability.

4 DATA SET

To address the issues listed above, the following actions need to be carried out by the formulation team:

- According to the requirements for hired labour identified in NGAMO1, the hired labour component will be added to the plan TRADIT to generate a new plan (e.g., AN-FARM). Table 2 shows the price of hired labour.

- A new plan (e.g., MEC-FARM) has to be developed for the irrigated mechanized farm model. It is assumed that mechanization will not affect yields. Moreover, it is assumed that hired labour requirements for the mechanized farm model is the same as for the non-mechanized model, i.e., mechanization does not affect labour requirements, but only draught services. The mechanized farm model includes the investment component, and the four mechanized activities (high yield paddy, traditional paddy, sunflower and sesame), which in turn include the cost of utilization of the power tiller. To build the mechanized farm model, the following components have to be taken into account:

a. **Cost of power-tiller utilization.** Table 2 shows the list of commodities to be considered in the NGAMO2 exercise, which includes the cost of power tiller utilization (TRACTOR).

b. **Investment.** One power-tiller per farm. Farmers are supposed to purchase one power-tiller in the first year of the project. Its cost is estimated at Francs 20 000. The characteristics of the investment are displayed in Table 3.

c. **Mechanized activities.** Four new activities will be created, based on irrigated and mechanized technology. Tables 4a-d show the coefficients of inputs and outputs for each individual activity in the WoP and WiP situations.

d. **Other costs.** Land tax, irrigation tax, and other expenses are the same as in NGAMO1. They are reported in Table 5.

e. **Land utilization.** Land use is unaffected by mechanization, and the same areas are used for the same crops as in the plan TRADIT. Land utilization by activity is reported in Table 6.

f. **Credit.** As mentioned earlier, a credit component is added to the project, as farmers require some external financial resources to purchase the tiller. It is assumed that 95% of the total cost of the tiller will be financed by the credit institution. The credit and reimbursement conditions likely to be suitable for the envisaged investment are presented in Table 7.

Before displaying the data set for NGAMO2 exercise, the list of codes is presented (Table 1). New entries (those not already used in NGAMO1) are in **boldface type**.

Tables 1a-d - Updated list of codes

Table 1a : Commodities

Name	Code
High Yield Paddy	Pad-HY
Paddy Traditional	Pad-TRA
Seed – Paddy	S-PADDY
Sunflower	SUNF
Seed – Sunflower	S-SUNF
Sesame	SESAME
Seed – Sesame	S-SESAME
Urea	UREA
TSP [triplesuperphosphate]	TSP
MOP [muriate of potash]	MOP
Manure	MANURE
Draught Animals	BULLOCKS
Hired Labour	**HIR-LAB**
Pesticides	PESTIC
Workforce	LABOUR
Land-tax	LAND-TAX
Irrigation Tax	IRR-TAX
Other Expenses	OTHER
Power-tiller cost of utilization	**TRACTOR**

Table 1b : Investments

Name	Code
Power-Tiller Investment	TRACT-I

Table 1c : Activities

Name	Code
Irrigated Non-Mechanized HY Paddy Production	CUL-HYV
Irrigated Non-Mechanized TRA Paddy Production	CUL-TRA
Irrigated Non-Mechanized Sunflower Production	CUL-SUN
Irrigated Non-Mechanized Sesame Production	CUL-SES
Irrigated Mechanized HY Paddy Production	**MEC-HYV**
Irrigated Mechanized TRA Paddy Production	**MEC-TRA**
Irrigated Mechanized Sunflower Production	**MEC-SUN**
Irrigated Mechanized Sesame Production	**MEC-SES**

Table 1d : Plans

Name	Code
Irrigated Animal Traction Farm Model	AN-FARM
Irrigated Mechanized Farm Model	**MEC-FARM**

Table 2 : Commodity financial prices (inputs and outputs)

Item	Code	Price
Seeds – HY paddy (kg)	S-PADDY	0.60
Seeds – Traditional paddy (kg)	S-PADDY	0.60
Seeds – Sunflower(kg)	S-SUNF	6.00
Seeds – Sesame (kg)	S-SESAME	10.40
Fertilizer – Urea (kg)	UREA	0.34
Fertilizer – TSP [triple superphosphate] (kg)	TSP	1.14
Fertilizer – MOP [muriate of potash] (kg)	MOP	0.54
Fertilizer – manure (per cart)	MANURE	15.00
Pesticide (Francs)	PESTIC	1.00
Hired labour (per day)	**HIR-LAB**	**7.00**
Workforce – Family (per day)	LABOUR	–
Draught animals (per day)	BULLOCKS	30.00
Power-tiller (per hour)	**TRACTOR**	**2.00**
Yield – HY paddy (ton)	PAD-HY	441
Yield – Traditional paddy (ton)	PAD-TRA	662
Yield – Sunflower (ton)	SUNF	4 550
Yield – Sesame (ton)	SESAME	7 674

Table 3 : Investment dataset (Code: TRACT-I)

Name	Parameters
Life time (years)	**8**
Price (from Year 1 to Year 15) (Francs)	**20 000**
Maintenance (% of cost)	**10%**
Lag period for maintenance (years)	**1**
Residual value (% of cost)	**10%**
Contingency costs (% of cost)	**5%**

Note: The entries in **boldface** are new entries, i.e., those not used previously in NGAMO1.

Table 4a-d : Activities, for 1. WiP and 2. WoP situations

Table 4a
i. Mechanized HY paddy (MEC-HY) WiP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-PADDY	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Urea (kg)	UREA	112.0	112.0	112.0	112.0	112.0	112.0	112.0
TSP (kg)	TSP	56.0	56.0	56.0	56.0	56.0	56.0	56.0
MOP (kg)	MOP	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Manure (carts)	MANURE	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pesticide (Francs)	PESTIC	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Workforce (workdays)	LABOUR	102.0	102.0	100.0	100.0	100.0	100.0	100.0
Power-tiller (hours)	**TRACTOR**	**64.0**	**64.0**	**64.0**	**64.0**	**64.0**	**64.0**	**64.0**
Draught animals (days)	**BULLOCKS**	–	–	–	–	–	–	–
Yield – HY paddy (tons)	PAD-HY	3.6	3.6	3.8	3.8	4.2	4.2	4.2

Table 4a
ii. Mechanized HY paddy (MEC-HY) WoP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-PADDY	70.0	→	→	→	→	→	→
Urea (kg)	UREA	112.0	→	→	→	→	→	→
TSP (kg)	TSP	56.0	→	→	→	→	→	→
MOP (kg)	MOP	28.0	→	→	→	→	→	→
Manure (carts)	MANURE	1.0	→	→	→	→	→	→
Pesticide (Francs)	PESTIC	5.0	→	→	→	→	→	→
Workforce (workdays)	LABOUR	102.0	→	→	→	→	→	→
Power-tiller (hours)	**TRACTOR**	–						
Draught animals (days)	**BULLOCKS**	32.0	→	→	→	→	→	→
Yield – HY paddy (tons)	PAD-HY	3.6	→	→	→	→	→	→

Table 4b
iii. Mechanized traditional paddy (MEC-TRA) WiP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-PADDY	46.0	46.0	46.0	46.0	46.0	46.0	46.0
Urea (kg)	UREA	28.0	28.0	28.0	28.0	28.0	28.0	28.0
TSP (kg)	TSP	–	–	–	–	–	–	–
MOP (kg)	MOP	–	–	–	–	–	–	–
Manure (carts)	MANURE	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pesticide (Francs)	PESTIC	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Workforce (workdays)	LABOUR	68.0	68.0	86.0	86.0	86.0	86.0	86.0
Power-tiller (hours)	**TRACTOR**	**44.0**	**44.0**	**52.0**	**52.0**	**52.0**	**52.0**	**52.0**
Draught animals (days)	**BULLOCKS**	–	–	–	–	–	–	–
Yield – trad paddy (tons)	PAD-TRA	2.0	2.0	2.2	2.2	2.2	2.2	2.2

Table 4b
ii. Mechanized traditional paddy (MEC-TRA) WoP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-PADDY	46.0	→	→	→	→	→	→
Urea (kg)	UREA	28.0	→	→	→	→	→	→
TSP (kg)	TSP	–	→	→	→	→	→	→
MOP (kg)	MOP	–	→	→	→	→	→	→
Manure (carts)	MANURE	1.0	→	→	→	→	→	→
Pesticide (Francs)	PESTIC	5.0	→	→	→	→	→	→
Workforce (workdays)	LABOUR	68.0	→	→	→	→	→	→
Power-tiller (hours)	**TRACTOR**	–	→	→	→	→	→	→
Draught animals (days)	**BULLOCKS**	22.0	→	→	→	→	→	→
Yield – trad paddy (tons)	PAD-TRA	2.0	→	→	→	→	→	→

Table 4c
i. Mechanized sunflower (MEC-SUN) WiP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-SUNF	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Urea (kg)	UREA	84.0	84.0	84.0	84.0	84.0	84.0	84.0
TSP (kg)	TSP	56.0	56.0	56.0	56.0	56.0	56.0	56.0
MOP (kg)	MOP	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Manure (carts)	MANURE	–	–	–	–	–	–	–
Pesticide (Francs)	PESTIC	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Workforce (workdays)	LABOUR	32.0	32.0	50.0	50.0	50.0	50.0	50.0
Power-tiller (hours)	**TRACTOR**	**24.0**	**24.0**	**36.0**	**36.0**	**36.0**	**36.0**	**36.0**
Draught animals (days)	**BULLOCKS**	–	–	–	–	–	–	–
Yield – sunflower (tons)	SUNF	0.8	0.8	0.8	1.2	1.2	1.2	1.2

Table 4c
ii. Mechanized sunflower (MEC-SUN) WoP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-SUNF	11.0	→	→	→	→	→	→
Urea (kg)	UREA	84.0	→	→	→	→	→	→
TSP (kg)	TSP	56.0	→	→	→	→	→	→
MOP (kg)	MOP	28.0	→	→	→	→	→	→
Manure (carts)	MANURE	–	→	→	→	→	→	→
Pesticide (Francs)	PESTIC	5.0	→	→	→	→	→	→
Workforce (workdays)	LABOUR	32.0	→	→	→	→	→	→
Power-tiller (hours)	**TRACTOR**	–	→	→	→	→	→	→
Draught animals (days)	**BULLOCKS**	12.0	→	→	→	→	→	→
Yield – sunflower (tons)	SUNF	0.8	→	→	→	→	→	→

Table 4d
i. Mechanized sesame (MEC-SES) WiP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S-SESAME	15.0	15.0	17.0	17.0	17.0	17.0	17.0
Urea (kg)	UREA	84.0	84.0	84.0	84.0	84.0	84.0	84.0
TSP (kg)	TSP	56.0	56.0	56.0	56.0	56.0	56.0	56.0
MOP (kg)	MOP	–	–	–	–	–	–	–
Manure (carts)	MANURE	–	–	–	–	–	–	–
Pesticide (Francs)	PESTIC	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Workforce (workdays)	LABOUR	42.0	42.0	66.0	66.0	66.0	66.0	66.0
Power-tiller (hours)	**TRACTOR**	**36.0**	**36.0**	**40.0**	**40.0**	**40.0**	**40.0**	**40.0**
Draught animals (days)	**BULLOCKS**	–	–	–	–	–	–	–
Yield – sesame (tons)	SESAME	0.2	0.2	0.4	0.6	0.6	0.6	0.6

Table 4d
ii. Mechanized sesame (MEC-SES) WoP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Seed (kg)	S- SESAME	15.0	→					
Urea (kg)	UREA	84.0	→					
TSP (kg)	TSP	56.0	→					
MOP (kg)	MOP	–	→					
Manure (carts)	MANURE	–	→					
Pesticide (Francs)	PESTIC	20.0	→					
Workforce (workdays)	LABOUR	42.0	→					
Power-tiller (hours)	**TRACTOR**	–	→					
Draught animals (days)	**BULLOCKS**	18.0	→					
Yield – sesame (tons)	SESAME	0.2	→					

Table 5a : Plan MEC-FARM (WiP)

1. Other cost items - WiP

Item	Code	Year 1	2	3	4	5	6	7 - 15
Land tax (Francs/farm)	LAND-TAX	28.0	→					
Irrigation tax (Francs/farm)	IRR-TAX	–	–	110	110	→		
Hired labour (days)	HIR-LAB	–	–	65.1	81.5	100.4	116.0	116.0
Other expenses (Francs)	OTHER	90.0	90.0	120.0	136.0	152.0	169.0	185.0

Table 5b: Plan MEC-FARM (WoP)

2. Other cost items – WoP

Item	Code	Year 1	2	3	4	5	6	7 – 15
Land tax (Francs/farm)	LAND-TAX	28.0						
Irrigation tax (Francs/farm)	IRR-TAX	–						
Hired labour (days)	HIR-LAB	–						
Other expenses (Francs)	OTHER	90.0						

Table 6a : Plan mechanized farm (MEC-FARM) land utilization (ha.) (WiP)

1. WiP situation

Item	Activity code	Year 1	2	3	4	5	6	7 - 15
(a) Humid season								
HY paddy	MEC-HYV	3.85	3.85	3.90	3.95	4.00	4.05	4.05
Traditional paddy	MEC-TRA	1.65	1.65	1.60	1.55	1.45	1.45	1.45
Total		5.50	5.50	5.50	5.50	5.50	5.50	5.50
(b) Dry season								
Sunflower	MEC-SUN	0.10	0.10	0.20	0.25	0.35	0.45	0.45
Sesame	MEC-SES	1.10	1.10	1.25	1.45	1.65	1.80	1.80
Total		1.20	1.20	1.45	1.70	2.00	2.25	2.25

Table 6b : Plan mechanized farm (MEC-FARM) land utilization (ha.) (WoP)

2. WoP situation

Item	Activity code	Year 1	2	3	4	5	6	7 - 15
(a) Humid season								
HY paddy	CUL-HYV	3.85						
Traditional paddy	CUL-TRA	1.65						
Total		5.50						
(b) Dry season								
Sunflower	CUL-SUN	0.10						
Sesame	CUL-SES	1.10						
Total		1.20						

Table 7 : Credit component dataset

Item	Code	Credit	Parameters
Amount of loan (principal) (L)	PRINCIPAL	% of investment	95
Duration (D)		years	5
Interest rate (I)	INTEREST	%	10
Grace period (GP)		years	1
Payment of interest during grace period		yes/no	yes
Constant Capital Reimbursement (CCR)	INSTALM	yes/no	yes

5 QUESTION SET

The analyst is required to provide the decision-makers and farmers with information on expected project outcomes.

5.1 Main questions

i. Once the hired labour force is introduced at farm level, is it financially viable for the farmer (AN-FARM) to enter the irrigation project? Assuming a 12% actualization rate and a project length of 15 years, work out its cash flow.

ii. After inserting the MEC-FARM model, and after checking that the data has been entered correctly, compare inputs and outputs in physical terms of the plan MEC-FARM with those of the plan AN-FARM. What are the differences?

iii. Assuming 12% discount rate and a timespan of 15 years, is the proposed mechanized farm model (MEC-FARM) financially viable and profitable to farmers, compared with the WoP situation? Work out its cash flow.

5.2 Additional Questions

iv. How do the Net Benefits evolve during the lifetime of the project?

v. How does the credit component affect the cash situation of the farmers? Compare the project indicators before and after financing.

vi. In the plan AN-FARM, what is the maximum irrigation tax the farmer is willing to pay to enter the irrigation project? (Always assuming the same discount rate and the timespan of the projects).

vii. Is the second farm model (MEC-FARM) more viable and profitable to farmers than the first farm model (AN-FARM)?

6 HINTS

Most of the data necessary to develop the exercise with WinDASI have already been inserted during the NGAMO1 exercise. For the NGAMO2 analysis, the user should therefore duplicate the NGAMO1 file (to duplicate files, see section 5.1 in part 1 of the WinDASI manual) and provide the entry of additional data as required in the following steps:

i. Create a new plan equal to TRADIT (call it, e.g., AN-FARM). Codify the new commodity “HIR-LAB” and insert the hired labour requirements as calculated in NGAMO1 at plan level, compute the financial indicators of the new plan and the suitable critical changes and switching values. Recall that in WoP the hired

labour requirements are zero, as the household labour is just sufficient to run the current agricultural activities.

ii. The answer to question (i) can be obtained by calculating the project indicators of the plan AN-FARM.

iii. Insert the cost of use of the power-tiller (commodity TRACTOR).

iv. Insert the mechanized activities using the appropriate "duplicate" function of WinDASI to duplicate the non-mechanized activities (to duplicate activities see section 3.3 in part 1 of WinDASI the manual), assign the new name (boldfaced in Table 1c) and add the cost of use for the power-tiller.

v. Insert the investment with its code (Table 1b) as well as all its characteristics (Table 3).

vi. After inserting in the database the cost of use of the power-tiller, the mechanized activities and the investment, create a new plan MEC-FARM using the land utilization data in Table 6. Recall that the WoP situation of MEC-FARM assumes non-mechanized activities, as used in the plan AN-FARM. Also include investment in the plan.

vii. The answer to question (ii) can be obtained by calculating the MEC-FARM inputs and outputs in physical units, using the relevant WinDASI function.

viii. The answer to question (iii) is easily obtained by computing the Net Present Value and the project indicators of the plan MEC-FARM.

ix. Concerning question (iv), the trend of the Net Benefits can be analysed by looking at the results obtained from the plan MEC-FARM

x. The flows of the credit component can be calculated on a spreadsheet, using a table similar to the following:

Table 8 : Credit component items

Item	Code	WoP	Year						
			1	2	3	4	5	6	7
Principal	PRINCIPAL	–	19 000	0	0	0	0	0	0
Payment of principal	INSTALM	–							
Payment of interest	INTEREST	–							
Total debt service									
Outstanding balance at end of period									

New "commodities" called, for example, PRINCIPAL, INSTALM and INTEREST, have to be added, with the value set to 1 (in monetary units). A new plan, called, for example, MEC-FARM-LR, identical to MEC-FARM, could be created. The credit component will be added to the plan by means of a dummy activity that includes the credit-related items. The project indicators of the plan MEC-FARM-LR can then be compared with those of the plan MEC-FARM.

xi. The answer to question (vi) is easily obtained by using the Switching Value (SV) of the irrigation tax, (see 4.2.2, Project Indicators in Part 1 of the WinDASI manual).

xii. The answer to question (vii) can be obtained by looking at the project indicators of the plan MEC-FARM and comparing them with those of the plan AN-FARM (recall that, for both of them, the WoP situation is the non-irrigated non mechanized situation).

7 SOLUTION SET

7.1 Answer to question (i)

After inserting the hired labour requirements costs in the plan TRADIT to obtain the plan AN-FARM, an analysis of the overall flow of Net Benefits is required. The costs and benefits are shown in Table 9. Note that hired labour now appears among the cost items.

Table 9 : Costs and benefits of the plan AN-FARM

Item	WoP	Years						
		1	2	3	4	5	6	7 - 15
OUTPUT								
Pad-HY	6,112.3	6,112.3	6,112.3	6,535.6	6,619.4	7,408.8	7,501.4	7,501.4
Pad-TRA	2,184.6	2,184.6	2,184.6	2,330.2	2,257.4	2,184.6	2,111.8	2,111.8
SESAME	1,688.3	1,688.3	1,688.3	3,837.0	6,676.4	7,597.3	8,287.9	8,287.9
SUNF	364.0	364.0	364.0	728.0	1,365.0	1,911.0	2,457.0	2,457.0
TOTAL	10,349.1	10,349.1	10,349.1	13,430.9	16,918.2	19,101.7	20,358.1	20,358.1
INPUTS and FACTORS								
BULLOCKS	5415	5415	5415	5850	6006	6189	6342	6342
HIR-LAB	-	-	-	455.7	570.5	702.8	812	812
IRR-TAX	-	-	-	110	110	110	110	110
LABOUR	-	-	-	-	-	-	-	-
LAND-TAX	28	28	28	28	28	28	28	28
MANURE	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5
MOP	59.72	59.72	59.72	61.99	63.5	65.77	68.04	68.04
OTHER	90	90	90	120	136	152	169	185
PESTIC	50	50	50	53.5	57.75	62.25	65.75	65.75
S-PADDY	207.24	207.24	207.24	207.96	208.68	209.4	210.12	210.12
S-SESAME	171.6	171.6	171.6	221	256.36	291.72	318.24	318.24
S-SUNF	6.6	6.6	6.6	13.2	16.5	23.1	29.7	29.7
TSP	322.39	322.39	322.39	341.54	360.7	383.04	402.19	402.19
UREA	196.59	196.59	196.59	205.16	213.72	223.72	232.29	232.29
TOTAL Inputs and factors	6,629.6	6,629.6	6,629.6	7,750.6	8,110.2	8,523.3	8,869.8	8,885.8
Net Benefits	3,719.5	3,719.5	3,719.5	5,680.3	8,808.0	10,578.4	11,488.3	11,472.3
Net Incremental Benefits	-	-	-	1,960.8	5,088.5	6,858.9	7,768.8	7,752.8

To judge the farmers' economic interest in joining the project, the Net Present Value (NPV) of the incremental Net Benefits must be calculated. Assuming an opportunity cost of capital of 12%, the incremental net discounted cumulated benefits over 15 years, i.e., the incremental NPV, is 33 385.6. It is positive, indicating that the project is

economically viable for the farmer. Table 10 shows the incremental NPV, together with the incremental Net Benefits and the incremental net discounted benefits year by year.

Note that if the summary project indicators are calculated with the SV function, then both the incremental NPV and the Internal Rate of Return (IRR) are reported. In this case, the IRR is reported to be greater than 100%. This is due to the fact that since there is no investment there is no change in the sign of the net incremental flows (all of them are positive). This implies that no finite discount rate exists to lead to an incremental NPV = 0 (remember that the definition of the IRR of a project is the discount rate generating an NPV=0 for a project. The IRR here is infinite.

Table 10 : Net Incremental discounted benefits of the plan AN-FARM and incremental NPV (Net Incremental Discounted Cumulated benefits at year 15)

Itam	Years						
	1	2	3	4	5	6	7
Net incremental benefits	-	-	1,960.8	5,088.5	6,858.9	7,768.8	7,752.8
Discount factor (@12%)	0.893	0.797	0.712	0.636	0.567	0.507	0.452
Net incremental discounted benefits (@12%)	-	-	1,395.7	3,233.8	3,891.9	3,935.9	3,507.0
Net incremental discounted benefits	-	-	1,395.7	4,629.5	8,521.4	12,457.3	15,964.3

Item	Years							
	8	9	10	11	12	13	14	15
Net incremental benefits	7,752.8	7,752.8	7,752.8	7,752.8	7,752.8	7,752.8	7,752.8	7,752.8
Discount factor (@12%)	0.404	0.361	0.322	0.287	0.257	0.229	0.205	0.183
Net incremental discounted benefits (@12%)	3,131.2	2,795.7	2,496.2	2,228.7	1,989.9	1,776.7	1,586.4	1,416.4
Net incremental discounted benefits	19,095.5	21,891.2	24,387.4	26,616.1	28,606.1	30,382.8	31,969.2	33,385.6

7.2 Answer to question (ii)

Once all the data have been entered in WinDASI, calculations can be run to provide the decision-makers and farmers with the inputs and outputs in physical units.

Table 11a : Plan MEC-FARM. Inputs, outputs and investments in physical units
1. Inputs

Item	Unit	WoP	Years						
			1	2	3	4	5	6	7-15
BULLOCKS	DAYS	180.50							
HIR-LAB	DAYS				65.10	81.50	100.40	116.00	116.00
IRR-TAX	FRANC				110.00	110.00	110.00	110.00	110.00
LABOUR	DAYS	554.30	554.30	554.30	620.10	636.50	655.40	671.00	671.00
LAND-TAX	FRANC	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
MANURE	CART	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
MOP	KG	110.60	110.60	110.60	114.80	117.60	121.80	126.00	126.00
OTHER	FRANC	90.00	90.00	90.00	120.00	136.00	152.00	169.00	185.00
PESTIC	FRANC	50.00	50.00	50.00	53.50	57.75	62.25	65.75	65.75
S-PADDY	KG	345.40	345.40	345.40	346.60	347.80	349.00	350.20	350.20
S-SESAME	KG	16.50	16.50	16.50	21.25	24.65	28.05	30.60	30.60
S-SUNF	KG	1.10	1.10	1.10	2.20	2.75	3.85	4.95	4.95
TRACTOR	HR		361.00	361.00	390.00	400.40	412.60	422.80	422.80
TSP	KG	282.80	282.80	282.80	299.60	316.40	336.00	352.80	352.80
UREA	KG	578.20	578.20	578.20	603.40	628.60	658.00	683.20	683.20

Table 11b : Plan MEC-FARM. Inputs, outputs and investments in physical units
2. Outputs

Item	Unit	WoP	Years						
			1	2	3	4	5	6	7-15
Pad-HY	Ton	13.86	13.86	13.86	14.82	15.01	16.80	17.01	17.01
Pad-TRA	Ton	3.30	3.30	3.30	3.52	3.41	3.30	3.19	3.19
Sesame	Ton	0.22	0.22	0.22	0.50	0.87	0.99	1.08	1.08
Sunflow	Ton	0.08	0.08	0.08	0.16	0.30	0.42	0.54	0.54

Table 11c: Plan MEC-FARM Inputs, outputs and investments in physical units
3. Investments

Unit	WoP	Years			
		1	2 - 8	9	10 -15
TRAC-I	0	1	0	1	0

Notice that, as expected, inputs and outputs of the plan MEC-FARM except for the Animal Draught Services (item BULLOCKS) and the cost of use for the tiller (item TRACTOR), are equal to those of AN-FARM. In addition, the plan MEC-FARM includes the investment component, i.e., the power tiller, at the beginning of the project and in year 9 (substitution of the worn-out power-tiller). Remember that the substitution of the equipment is automatically provided for by WinDASI on the basis of the foreseen duration of the investment.

7.3 Answer to question (iii)

To judge the economic viability to the farmers of the mechanized plan, the cost and benefit flows need to be analysed.

Table 12 shows the calculations of the streams of costs and benefits from current inputs, outputs and investment. The flows of the investment component are calculated on the basis of the parameters chosen by the analyst. The residual value at the end of the project is determined as shown in part 2 of the WinDASI manual.

Table 12a-b: Plan MEC-FARM Costs and benefits in monetary units (Francs)

Table 12a : Inputs and factors

Item	WoP	Years						
		1	2	3	4	5	6	7-15
Pad-HY	6,112.3	6,112.3	6,112.3	6,535.6	6,619.4	7,408.8	7,501.4	7,501.4
Pad-TRA	2,184.6	2,184.6	2,184.6	2,330.2	2,257.4	2,184.6	2,111.8	2,111.8
Sesame	1,688.3	1,688.3	1,688.3	3,837.0	6,676.4	7,597.3	8,287.9	8,287.9
Sunflow	364.0	364.0	364.0	728.0	1,365.0	1,911.0	2,457.0	2,457.0
Total output	10,349.1	10,349.1	10,349.1	13,430.9	16,918.2	19,101.7	20,358.1	20,358.1
BULLOCKS	5,415.0	-	-	-	-	-	-	-
HIR-LAB	-	-	-	455.7	570.5	702.8	812.0	812.0
IRR-TAX	-	-	-	110.0	110.0	110.0	110.0	110.0
LABOUR	-	-	-	-	-	-	-	-
LAND-TAX	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
MANURE	82.5	82.5	82.5	82.5	82.5	82.5	82.5	82.5
MOP	59.7	59.7	59.7	62.0	63.5	65.8	68.0	68.0
OTHER	90.0	90.0	90.0	120.0	136.0	152.0	169.0	185.0
PESTIC	50.0	50.0	50.0	53.5	57.8	62.3	65.8	65.8
S-PADDY	207.2	207.2	207.2	208.0	208.7	209.4	210.1	210.1
S-SESAME	171.6	171.6	171.6	221.0	256.4	291.7	318.2	318.2
S-SUNF	6.6	6.6	6.6	13.2	16.5	23.1	29.7	29.7
TRACTOR	-	722.0	722.0	780.0	800.8	825.2	845.6	845.6
TSP	322.4	322.4	322.4	341.5	360.7	383.0	402.2	402.2
UREA	196.6	196.6	196.6	205.2	213.7	223.7	232.3	232.3
Total Inputs and factors	6,629.6	1,936.6	1,936.6	2,680.6	2,905.0	3,159.5	3,373.4	3,389.4

Table 12b : Investment outflows

Item	WoP	Years						
		1	2	3	4	5	6	7
Tiller (Investment)		20,000	-	-	-	-	-	-
Contingencies		1,000	-	-	-	-	-	-
Maintenance		-	2,000	2,000	2,000	2,000	2,000	2,000
Residual value		-	-	-	-	-	-	-
Total Investment outflows		21,000	2,000	2,000	2,000	2,000	2,000	2,000

Item	Years							
	8	9	10	11	12	13	14	15
Tiller (Investment)	-	20,000	-	-	-	-	-	-
Contingencies	-	1,000	-	-	-	-	-	-
Maintenance	2,000	-	2,000	2,000	2,000	2,000	2,000	2,000
Residual value	-	2,000	-	-	-	-	-	6,500
Total Investment outflows	2,000	19,000	2,000	2,000	2,000	2,000	2,000	- 4,500

Table 13 shows the calculations of the Cumulated discounted incremental Net Benefits, including the investment component, for a project life of 15 years and a discount rate of

12%. Notice that at the end of the fifteenth year the cumulated discounted incremental Net Benefits are positive, i.e., the incremental NPV of the project, with respect to the WoP scenario, is positive.

Other things being equal, it is therefore worthwhile for the farmer to enter the irrigation project, even if mechanization is required.

Table 13 : Plan MEC-FARM
Discounted incremental Net Benefits and NPV

Item	WoP	Years						
		1	2	3	4	5	6	7
Total benefits	10,349.1	10,349.1	10,349.1	13,430.9	16,918.2	19,101.7	20,358.1	20,358.1
Total inputs and factors costs	6,629.6	1,936.6	1,936.6	2,680.6	2,905.0	3,159.5	3,373.4	3,389.4
Total Investment costs		21,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0
Net benefits	3,719.5	-12,587.5	6,412.5	8,750.3	12,013.2	13,942.2	14,984.7	14,968.7
Net incremental benefits	-	-16,307.0	2,693.0	5,030.8	8,293.7	10,222.7	11,265.2	11,249.2
Discount factor (@12%)		0.893	0.797	0.712	0.636	0.567	0.507	0.452
Net increm.discounted benefits (@12%)	-	-14,559.8	2,146.8	3,580.8	5,270.8	5,800.6	5,707.3	5,088.6
Net increm.disc.cumulated benefits	-	-14,559.8	-12,413.0	- 8,832.1	- 3,561.4	2,239.3	7,946.6	13,035.1

Item	Years							
	8	9	10	11	12	13	14	15
Total benefits	20,358.1	20,358.1	20,358.1	20,358.1	20,358.1	20,358.1	20,358.1	20,358.1
Total inputs and factors costs	3,389.4	3,389.4	3,389.4	3,389.4	3,389.4	3,389.4	3,389.4	3,389.4
Total investment costs	2,000.0	19,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	- 4,500.0
Net benefits	14,968.7	- 2,031.3	14,968.7	14,968.7	14,968.7	14,968.7	14,968.7	21,468.7
Net incremental benefits	11,249.2	- 5,750.8	11,249.2	11,249.2	11,249.2	11,249.2	11,249.2	17,749.2
Discount factor (@12%)	0.404	0.361	0.322	0.287	0.257	0.229	0.205	0.183
Net increm.discounted benefits (@12%)	4,543.4	- 2,073.8	3,621.9	3,233.9	2,887.4	2,578.0	2,301.8	3,242.7
Net increm. disc.cumulated benefits	17,578.5	15,504.7	19,126.6	22,360.5	25,247.9	27,825.9	30,127.7	33,370.4

Some other summary project indicators, based on the flows of costs and benefits illustrated above, can be obtained using the WinDASI SV function, as described in section 4.2.2, Part 1 of the WinDASI manual. They are shown in Table 14. Notice that the incremental NPV is the difference between the cumulated discounted incremental benefits (43 424.3) and the cumulated discounted incremental costs, which include the investment (10 053.9).

Table 14 : Plan MEC-FARM
Summary project indicators

Indicator	Coeff.	Discounted values	Switching value (SV)%	Critical change (CC)
Incremental discounted benefits	+1	43 424.3	-76.85	10 053
Incremental costs, incl. investments	-1	10 053.9	331.91	43 424
Incremental NPV		33 370.41		
IRR		39.69		
Benefit/cost ratio (BCR)		4.32		

Two main aggregates are analysed: the incremental benefits and the incremental costs. The coefficient, (+1) or (-1), means that the item is a positive or negative component,

respectively, of the incremental NPV. The reported values are incremental discounted flows. Table 12 also shows Switching Values (SV) and Critical Changes (CC). SV represents the percentage change that, other things being equal, would lead to a zero value of the NPV of the project. The change can be generated by either the indicated percentage change in each price of the components of the aggregate, or by the same percentage change in the quantities. For the interpretation of SVs and CCs, see the answer to question (ii) of the present exercise, and, for more detail, part 2 of the WinDASI manual. In the case of output, for example, a reduction in the incremental value of the output of 76.85% would lead, allowing for rounding, to an incremental benefit of 10 053 (the CC), i.e., 43 424*(1-0.7685) = 10 053.

If the project's incremental benefits were 10 053, other things remaining equal (i.e., with the NPV of the incremental costs at 10 053), the NPV of the project would have been zero (allowing for rounding).

The same reasoning applies to the SV and CC of the costs.

Notice that the project appears to be rather robust. It is unlikely, indeed, to incur a negative NPV because it is unlikely to have a reduction of incremental benefits of about 77% or an increase of costs of about 3.32%.

Table 14 also gives the Benefit/Cost Ratio (BCR) and the IRR.

The BCR is the ratio of the incremental discounted benefits to the incremental discounted costs. Being greater than 1, it indicates that the incremental NPV of the project is greater than 1, as already observed. The value 4.32 means that the incremental benefits are 4.32 times the incremental costs.

The IRR of 39.69% is far higher than the opportunity cost of capital (12%), signalling that the project is better than the best alternative investment available and that it is worthwhile participating.

Other aggregates can be analysed. In Table 15, the summary project indicators are reported for some aggregates.

Table 15 : Plan MEC-FARM
Summary project indicators for other aggregates

Description	Coeff.	Discounted incr. values	Switching values %	Critical changes
ITEMS				
PADDY	1	5729.55	-582.43	-27641.07
PRO.IRR	1	37694.78	-88.53	4,323.6
COSTS				
BULLOCKS	-1	-36880.83	-90.48	-3511.06
HIR-LAB	-1	3689.05	904.58	37,059.5
OTH.COST	-1	945.53	3529.28	34,315.9
LABOUR	-1	0	Not Avail.	Not Avail.
FERTIL	-1	574.05	5813.16	33,944.5
SEEDS	-1	733.63	4548.68	34,104.1
TRACTOR	-1	5463.64	610.77	38,833.9
TRAC-I	-1	35528.86	93.92	68,897.6
Increm. Net Present Value (NPV)		33370.41		
Internal Rate of Return (IRR)		39.69		
Benefit / Cost Ratio (BCR)		4.32		

Pay attention to the interpretation of the SV of the incremental benefits of paddy production.

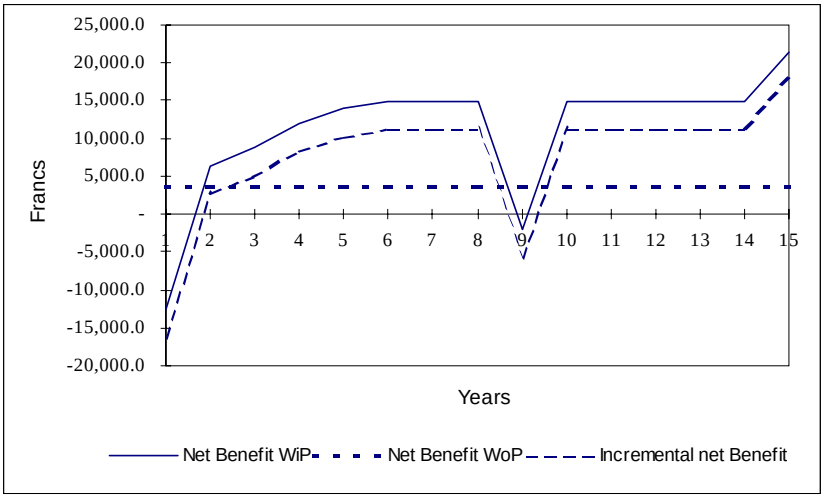
In this case, the incremental benefits from paddy production (Francs 5 729.55) should go below zero (Francs –27 641.1) which means that Paddy production should decrease below the WoP production level.

The list of incremental costs includes the item BULLOCKS, shown as a "negative incremental cost" (note the "-" sign of the coefficient and of the monetary value). Such an item represents a reduction in costs due to the avoided expenses for draught animals in the WiP situation with respect to the WoP situation.

7.4 Answer to question (iv)

From Table 10, it is apparent that the Net Benefits and the incremental Net Benefits to the farmer of the plan MEC-FARM show sharp changes. The evolution of the Net Benefits and the incremental Net Benefits is also illustrated in Figure 2.

Figure 2 : Plan MEC-FARM Net Benefits and incremental Net Benefits



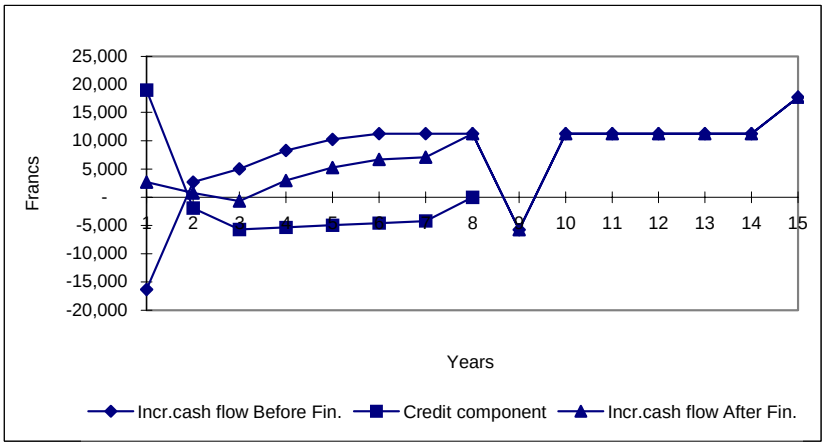
7.5 Answer to question (v)

The credit component is designed on the basis of the data supplied in the data set, and set out in Table 17. Figure 3 indicates the incremental cash flows before financing, after financing and the credit component.

Table 17 : Credit component for the plan Farm-AN1. At 10% interest rate

Item	Code	WoP	Years						
			1	2	3	4	5	6	7
Principal	PRINCIPAL	-	19000	0	0	0	0	0	0
Reimbursement of principal	INSTALM	-	0	0	-3800	-3800	-3800	-3800	-3800
Payment of interest	INTEREST	-	0	-1900	-1900	-1520	-1140	-760	-380
Total debt service		-	0	-1900	-5700	-5320	-4940	-4560	-4180
End of period outstanding balance		-	19000	19000	15200	11400	7600	3800	0

Figure 3 : Plan MEC-FARM Incremental cash flows before financing, after financing and the credit component



The items of the credit components PRINCIPAL, INTEREST and INSTALM are entered in WinDASI and the new plan MEC-FARM-CR is created. The credit items are then aggregated (aggregate CREDITCOMP) in order to calculate their incremental NPV. Summary project indicators of MEC-FARM-CR are shown in Table 18.

Note that the aggregate CREDITCOMP appears both among the benefits (the item PRINCIPAL is an inflow to the project) and among the costs (the items INTEREST and INSTALM constitute outflows). Notice that the net contribution of the credit component to the incremental NPV of the plan is positive: Francs 16 964.29 - 15 956.92 = 1 007.37.

The incremental NPV of the plan with the credit component (Francs 34 378) is therefore greater than the incremental NPV of the plan without the credit component (Francs 33 370). This is because the interest rate applied to the loan (10%) is lower than the opportunity cost of capital to the farmer (12%).

As long as the interest rate of the financing plans is lower than the discount rate of the project, the overall credit component will result as a net benefit to the project. If the interest rate of the financing plan is greater than the discount rate of the project, the credit component will result in a net cost. If the rates are equal, the credit component is neutral. This can be verified as an exercise.

As far as the financing plan is concerned, the replacement of the power-tiller generates a fall in the cash flow that is not covered by the first loan. The project however generates some extra cash (in excess of household necessities) in the previous periods that could be capitalized and used at the moment of the second investment.

Table 18 : Plan MEC-FARM, with credit component
Summary project Indicators

Description	Coeff.	Discounted incr.values	Switching values %	Critical changes
BENEFITS				
PADDY	1	5729.55	-28,648	-600.01
CREDITCOMP	**1**	**16964.29**	**-17,414**	**-202.65**
PRO.IRR	1	37694.78	-91.2	3,317
COSTS				
BULLOCKS	-1	-36880.83	-2,504	-93.21
HIR-LAB	-1	3689.05	931.89	38,067
CREDITCOMP	**-1**	**15956.92**	**215.44**	**50,335**
OTH.COST	-1	945.53	3635.82	35,323
LABOUR	-1	0	Not Avail.	Not Avail.
FERTIL	-1	574.05	5988.64	34,952
SEEDS	-1	733.63	4686	35,112
TRACTOR	-1	5463.64	629.21	39,841
TRAC-I	-1	35528.86	96.76	69,907
Increm. Net Present Value (NPV)		34377.77		
Internal Rate of Return (IRR)		> 100		
Benefit / Cost Ratio (BCR)		2.32		

7.6 Answer to question (vi)

Assuming that all the Net Benefits obtained by a farmer participating in the project are due to the irrigation, the maximum annual irrigation tax the farmer is willing to pay can be estimated as the amount of money that offsets the Net Benefits the farmer obtains by joining the project. This amount of money is called the Critical Change (CC) for the irrigation tax, i.e., the value of the tax that equates to zero NPV of the project. If a charge lower than the CC is applied, the farmer will enjoy Net Benefits. If a charge greater than the CC were applied, the farmer would have losses from entering the project and it is unlikely that he would voluntarily participate.

The CC is obtained with the WinDASI SV function, as explained in section 4.2.2 of Part 1, and Part 2 of the WinDASI manual.

The SV of the item IRR-TAX is 5926.9. This means that if the item IRR-TAX increases by 5926.9%, the NPV of the project goes to zero. This is easily verified, as the discounted value of the item IRR-TAX is reported as Francs 563.29. Francs 563.29* (1 + 5926.9 / 100) = 563.29 * 60.269 = Francs 33948.93. In other words, the irrigation tax can be increased by a factor of about 60 before the incremental NPV becomes zero.

Similarly, the CC of the annual irrigation tax is:

CC = Francs (110 * 60.269) = Francs 6 629.59

When the irrigation tax exceeds Francs 6 629.59 per year (scheduled as in AN-FARM, i.e., starting from the third year) the incremental NPV of the project for the farmer is negative and there would be no incentive for him to participate in the project. This can be easily verified by modifying the plan AN-FARM accordingly and running a new calculation of the incremental NPV. The result will equal zero.

7.7 Answer to question (vii)

To compare the plan MEC-FARM with the plan AN-FARM, the incremental NPV with respect to the same WoP scenario of the two plans has to be compared. The incremental NPV of MEC-FARM is Francs 33 370.9, and the one of the AN-FARM is 33 385.6. Other things being equal, the plan AN-FARM is indeed very slightly more profitable to the farmer compared to the mechanized one, leaving about 15 Francs more in the hands of the farmer in 15 years. Unfortunately, due to lack of draught animals, not all the farmers can apply the AN-FARM plan. If some farmers, notably those without draught animals, try to avoid the mechanization element, it is likely that the price of draught services in the zone will increase due to lack of supply. On these grounds, it must be noted that the comparison between MEC-FARM and AN-FARM is made on the basis of the observed current prices, and any changes in the demand and supply relationships for draught animals may offset or even reverse the very slight advantages shown by the plan AN-FARM.

Alternatively, to answer question (v) on calculating the incremental flows of a plan with respect to a dynamic alternative represented by another plan, a zone could be created where the first plan appears with the coefficient (+1) in year 1 and onwards and the second plan

with the coefficient (-1) for the same periods. In this case, the WoP column has to be put at zero for both plans.

8 READERS' NOTES

The NGAMO2 exercise should be used after NGAMO1. If run completely, it requires on average about one full day of training. Many conceptual issues, such as opportunity costs, maximum willingness to pay for an input, design of financing plans, etc., can be discussed during the presentation of this exercise.

The main questions should be addressed before going to NGAMO3 exercise. The additional questions help in addressing some specific issues, such as the financing impact of the credit component, the use of switching values as price policy making devices, and comparing different alternative plans. The questions could be skipped without hampering comprehension of the logical sequence of the NGAMO exercises. In addition, the main questions are very useful in a second round of training sessions and in showing how to use WinDASI as an operational tool.

8.1 Frequently asked questions

i. Regarding the sign "+" of the item BULLOCKS (i.e., "-" times "-"): stress the fact that the item BULLOCKS has the sign "+" as it represents a reduction in costs with respect to the WoP situation, i.e., a positive component of the incremental value of the project.

ii. Concerning the entry of investment data: the value of capital goods required must be entered only in the year or years where the investment is made. The user should:

   (a) not fill the cells of all the periods the investment is in place. This would lead to a cumulative investment, period after period, e.g., one tiller the first period, an additional tiller in the second period, an additional third, tiller in the subsequent period, and so on; and
   (b) not insert the investment when the capital equipment is worn out. This would lead again to a cumulative effect because renewal of capital equipment is done automatically on the basis of the duration parameter.

iii. For calculation of the residual values and of the final values of the capital equipment, refer to the part 2 of the WinDASI manual for details.

iv. Regarding definition of the WoP situation: it must be stressed that, as far as question (iv) is concerned, the incremental NPV refers to the mechanized irrigated situation in comparison with the non-irrigated non-mechanized situation. It does not refer to the mechanized irrigated situation versus the non-mechanized irrigated situation.

8.2 Use of the WDS files for the exercise NGAMO2

NGAMO2 exercise is supported by specific WinDASI files (files with a .WDS extension), available together with the WinDASI software2. The set of files available for NGAMO2 is reported in Table 19.

The first file of the set contains only a small fraction of the data and each subsequent file contains additional data until the data set is complete.

Te paced release of these files allows the trainer to control the data entry process as the exercise is carried out. Each consecutive file will be loaded as indicated by the trainer during the execution of the exercise, thus enabling the trainer to:

- keep all the trainees at the same level during the data entry process;
- recover partial data sets in case of computer/power failure;
- manage a step-by-step entry of the data;
- speed up the data entry process, if necessary, by skipping some steps;
- allow slow trainees in the data entry process to catch up with the rest of the class;
- run the calculations starting with a common database.

The set of files complementing NGAMO2 may be used step-by-step by the trainer as follows:

Step 1

The exercise NGAMO2 starts by using the full data-set file NGAMO1.WDS. In this file the hired labour component has to be inserted and the plan AN-FARM created.

Step 2

At this stage the file NGAMO2a.WDS may be loaded to check the correct creation of the plan AN-FARM and to run all the calculations involving the traditional farm. Then, the operational costs of the tractor TRACTOR are inserted as a commodity. Afterwards, the mechanised activities are created by duplicating the traditional activities and modifying them as required. (Should the entering of mechanised activities be considered unnecessary by the trainer, he/she may skip it by directly loading the file NGAMO2b.WDS)

Step 3

At this stage, the file NGAMO2b.WDS has to be loaded. Here the investment TRAC-I has to be inserted.

Step 4

To check the correct entry of the investment data, the file NGAMO2c.WDS has to be loaded. In this file the plan MEC-FARM has to be created using both the mechanised activities, the hired labour component and the investment component.

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[2] WinDASI software and exercise files are available in the EASYPol Module 018: ***WinDASI: a Software for Cost-Benefit Analysis of Investment Projects. Installation Note.***

Step 5

After controlling the progress of the students in creating plans, the file NGAMO2d.WDS, which contains the plan MEC-FARM already inserted, may be loaded and used to run all the calculations concerning the mechanised farm. The next step is to calculate the credit component, manually or with the support of an Excel file. In this file the credit items must be inserted as commodities and the activity CREDIT must be created.

Step 6

The work executed in the previous step may be controlled by loading the file NGAMO2e.WDS. This file contains the activity CREDIT that is already complete and may be used to create the plan MEC-FARM-CR. This plan can be created either by modifying the plan MEC-FARM thus adding to the credit component, or by duplicating it (manually).

Step 7

The full data-set file NGAMO2.WDS may be loaded at this stage to control the work carried out so far and to run all the calculations involving the plan MEC-FARM-CR.

Table 19 : Files for the exercise NGAMO2

Step	File to be used	File content	Task to accomplish in the file
1	NGAMO1.WDS	The full data-set of NGAMO1	Start NGAMO2 by inserting the hired labour HIR-LAB and the plan AN-FARM
2	NGAMO2a.WDS	The "Hired labour" commodity and the plan AN-FARM	Insert the tractor's operational costs TRACTOR and the mechanised activities
3	NGAMO2b.WDS	All NGAMO2a plus the mechanised activities and the operational costs for the tractor TRACTOR	Insert the investment TRAC-I
4	NGAMO2c.WDS	All NGAMO2b plus the investment TRAC-I	Create the plan MEC-FARM
5	NGAMO2d.WDS	All NGAMO2c plus the mechanised plan MEC-FARM	Run all the calculations of the plan MEC-FARM. Calculate and insert the items of the credit component, and create the CREDIT activity
6	NGAMO2e.WDS	All NGAMO2d plus the credit items and the CREDIT activity	Create the plan MEC-FARM-CR
7	NGAMO2.WDS	Full data-set of the exercise NGAMO2.	Execute the required calculations.

8.3 EASYPol Links

This module belongs to a set of EASYPol modules which illustrate how to use the WinDASI application for financial and economic Cost Benefit Analysis of investment projects.

The user can learn how to install and handle WinDASI for Cost-Benefit Analysis of investment projects by going through the following EASYPol modules:

- EASYPol Module 018: ***WinDASI: A Software for Cost-Benefit Analysis of Investment Projects: Installation Note***
- EASYPol Module 019: ***WinDASI-A Software for Cost-Benefit Analysis of Investment Projects: Inserting and Managing Data***
- EASYPol Module 020: ***WinDASI-A Software for Cost-Benefit Analysis of Investment Projects: Calculations Performed by the Software***

The module:

- EASYPol Module 021: ***WinDASI Exercise: NGAMO1: An Irrigation Project: Impacts of Irrigation on Traditional Farms***

is logically preceding the present module and it is recommended to go through it before using the present module.

The user can also follow up with NGAMO exercises using the following EASYPol modules:

- EASYPol Module 023: ***WinDASI Exercise: NGAMO3: Economic Impacts of an Irrigation and Mechanization Project***
- EASYPol Module 024: ***WinDASI Exercise: NGAMO4: Starting a Coffee Plantation in a Phased Mode***

The main features of each NGAMO exercise, such as its objectives, the analysis of the WoP and WiP situations, the constraints of the context of the project, the improvements brought about by the proposed activities and other project items, are synoptically summarized in Table 1.

In addition, a case study presenting the use of WinDASI to analyse a real project is reported in the EASYPol module:

- EASYPol Module 039: ***WinDASI-A Software for Cost-Benefit Analysis of Investment Projects: Case Study – Crop Intensification and Coffee Plantation***

Module metadata

1. EASYPol module	022
2. Title in original language	
English	WinDASI Exercise
French	
Spanish	
Other language	
3. Subtitle in original language	
English	NGAMO 2 - An Irrigation Project: Impacts of Irrigation and Mechanisation on Traditional Farms
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Spanish	
Other language	

4. Summary

This module presents NGAMO 2, a practical step-by-step exercise in Cost Benefit Analysis (CBA) of investment projects, to be run with the WinDASI software. (the word NGAMO comes from the name of the zone of the original project that was located in Myanmar).

The goal of this exercise is to analyze the technical feasibility of the irrigation project at farm level. The project analyst has to solve two major problems due to the expansion of production generated by the new irrigation scheme: excess demand of labour compared with the supply available form the farm household and a lack of draught animals in the peak periods. The reader will see how project constraints are solved and which are the main changes with versus the without project situations (WiP versus WoP). Moreover, a new constraint is introduced, which is the financing constraint, with the purpose to analyze the economic impact of the credit component by calculating project indicators such as incremental NPV, IRR and Benefit/Cost Ratio and comparing them before and after the financing.

5. Date

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7. Module type	☐ Thematic overview ☐ Conceptual and technical materials ☒ Analytical tools ☐ Applied materials ☐ Complementary resources
8. Topic covered by the module	☐ Agriculture in the macroeconomic context ☐ Agricultural and sub-sectoral policies ☐ Agro-industry and food chain policies ☐ Environment and sustainability ☐ Institutional and organizational development ☒ Investment planning and policies ☐ Poverty and food security ☐ Regional integration and international trade ☐ Rural Development
9. Subtopics covered by the module	
10. Training path	Investment planning for rural development
11. Keywords	