CB-NRM Technical Manual

Vol. 2 Sustainable Upland Farming Promotion (Including Community-Based Seed Extension and Sustainable Use of Backyard/Permanent Farms)

Prepared by

The Project for Community-Based Sustainable Natural Resource Management in the Democratic Republic of Timor-Leste

From the People of Japan

FOREWORD

Forest degradation and deforestation is one of the critical issues that the Government of Timor-Leste (GoTL) needs to tackle to achieve sustainable socio-economic development in the country. The study made in 2013 shows that approximately 184,000 ha of forest has disappeared between 2003 and 2012 and around 170,000 ha of dense forest has been degraded into sparse canopy forests for the same period.

Community-Based Natural Resource Management (CB-NRM) is an approach to nature conservation by recognizing the rights of local communities to benefit from sustainable management of natural resources (forests, lands, water, and biodiversity) within a designated area. This is an alternative to a top-down regulatory approach, which has not been necessarily effective in many countries, especially when the regulations do not fully cope with the changes in social, cultural, and economic contexts in the countries.

The Project for Community-Based Sustainable Natural Resource Management (the CB-NRM Project) jointly implemented by the Japan International Cooperation Agency (JICA) and the Ministry of Agriculture and Fisheries (MAF), particularly the National Directorate of Forest and Watershed Management (NDFWM), has developed an operative mechanism for CB-NRM in Timor-Leste. The same project has also issued the following manuals over the course of the project to help MAF expand the same mechanism in major river basins in the country.

- Operation Manual for Establishment of the CB-NRM Mechanism at the Village Level
- CB-NRM Technical Manuals
  Vol. 1: Seedling Production and Tree Planting Promotion
  Vol. 2: Sustainable Upland Farming Promotion
  Vol. 3: Income Generating/Livelihood Development
- Manual for Formation of a Watershed Management Council

The CB-NRM Technical Manuals introduce key techniques/skills relevant to sustainable land and forest management as well as livelihood development along with the detailed procedures for provision of hands-on training. They are based on learning from experiences in the field; therefore, we, as representatives of the MAF, strongly recommend that the manuals should be widely used by field practitioners of not only MAF but also other organizations working in the forestry and agriculture sectors as a guiding tool for provision of agriculture and forestry extension services to local communities.

October 2015

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About the CB-NRM Manuals

The CB-NRM Manuals have been developed and published by the JICA and MAF Joint Project named the Community-Based Sustainable Natural Resource Management to provide practical and useful tools for planners and practitioners in the forest sector in Timor-Leste to enable them to protect and manage natural resources in a collaborative and sustainable manner. There are three (3) types of manuals as shown below.

i) Operation Manual for Establishment of the CB-NRM Mechanism at the Village Level
ii) CB-NRM Technical Manuals
    Vol. 1: Seedling Production and Tree Planting
    Vol. 2: Sustainable Upland Farming Promotion
    Vol. 3: Income Generating/Livelihood Development
iii) Manual for Formation of the Watershed Management Council

The Operation Manual is the main document which spells out the standard operation procedures for introduction and establishment of the CB-NRM mechanism at the village level. It is designed for use by planners, field practitioners, and researchers working/studying in the forest sector in Timor-Leste, especially those who engage in forest protection, watershed conservation, and community forestry in the National Directorate of Forest and Watershed Management (NDFWM).

The CB-NRM Technical Manuals supplement the Operation Manual by introducing relevant techniques and skills which can help rural communities use and manage natural resources, especially lands and forests, in a productive and sustainable manner. They will be used mainly by field extension workers (such as MAF municipal staff: namely, municipal officers, extension officers, and forest guards) and NGO staff, as technical references for their field works.

The Manual for Formation of the Watershed Management Council introduces the process to develop a collaboration platform/framework for sustainable natural resource management at the sub-municipal or sub-watershed level, which can also lay groundwork for expansion of the CB-NRM mechanism on watershed scale. As one of the key approaches to improvement of environmental governance at the watershed level by enhancing coordination and networking among local stakeholders, this manual can be of help for those who engage in watershed management.

Furthermore, the JICA and MAF Joint Project has also developed and issued simplified versions of those manuals to help users in the field easily follow the procedures or apply the techniques described in the manuals.

It is hoped that these manuals with their simplified versions will serve as practical references for a wide range of stakeholders in the forest sector in Timor-Leste.

CB-NRM Technical Manual

Vol. 2: Sustainable Upland Farming Promotion (Including Community-Based Seed Extension and Sustainable Use of Backyard/Permanent Farms)

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Vol.2 Sustainable Upland Farming Promotion (including Community-Based Seed Extension and Sustainable Use of Backyard/Permanent Farm)

1. Introduction

1.1 Rationale for the Techniques

The Sustainable Upland Farming Promotion Micro Program (SUFP-MP) implemented under the Project for Community-Based Sustainable Natural Resource Management (hereinafter referred to as "the JICA CB-NRM Project") has introduced a number of techniques on sloping land agriculture and improved upland farming with an aim to demonstrate a sustainable upland farming system which enables local communities to secure stable production of staple crops while maintaining land productivity of sloping farmlands and not harming existing forests in the localities. It is, in fact, a crucial program for achievement of sustainable natural resource management, especially sustainable land management, and simultaneously security of daily food in hilly and mountainous areas in Timor-Leste.

Introduction and dissemination of the techniques of the SUFP-MP are expected to contribute to the achievement of the objectives of the MAF strategic plan 2014-2020, especially those of Program 1: Sustainable Increase in Production and Productivity and Program 5: Natural Resource Conservation and Management. Moreover, the techniques introduced by the micro program are highly consistent with the needs of local communities as the lack of knowledge on proper land management is the major cause of low crop productivity and depletion of soil fertility in hilly and mountainous areas. Thus, communities in all the target villages that the JICA CB-NRM Project has worked in selected the micro program as a priority program that they wanted to engage in.

1.2 Objectives of the Techniques

The main objective of the SUFP-MP is to enable communities to use sloping farmlands for production of staple crops and other cash crops continuously without deterioration of soil fertility. Technically, the techniques aim to enable them to:

- apply the sloping agriculture techniques, which are easy to apply but effective in conservation of soils;
- convert their farming practices from shifting cultivation to permanent farming using organic farming techniques;
- use improved varieties of upland staple crops in a proper manner; and
- increase the productivity of staple crops.

1.3 Objectives of the Manual

This manual aims to guide field workers and planners who intend to introduce sustainable upland farming techniques in hilly and mountainous areas in Timor-Leste. Specifically, the manual should be used and referred when communities select/determine the sustainable upland farming as the priority techniques for sustainable natural resource management at suco level. As a nature of the techniques, District Forestry Officers, Coordinators of Extension officers, Extension officers, Forest guards, and field staff of NGOs are considered as main target users of the manual.

2. Approaches to Effective Extension

2.1 Farmers' Field School (FFS)

Farmers' Field School (FFS) is one of the extension methods prevailingly used in developing countries for agricultural extension. Originally, it was developed in Southeast Asia for introduction of integrated pest management (IPM) in the 1990s. Since then, the method has evolved owing to its effectiveness, and been promoted/applied to a wide range of subjects. FFS employs a non-formal educational method based on the concepts of "experimental," "participatory," and "learner-centered."

FFS aims to create an environment where participants/farmers could learn a specific subject by doing/practicing in the fields, debating results/observations, and periodically working together with other participants/farmers in the same fields. Through a series of FFS sessions, participants/farmers can:

- experience the whole cycle of the subject, such as cropping, animal husbandry, soil improvement, and commodity production;
- assess and analyze current situations in the field and consider necessary actions to be taken for improvement; and
- capacitate themselves to replicate techniques/skills introduced in the course of FFSs in their own farms.

The following key elements should be considered in the design of FFS.

Key Element of FFS

Elements	Descriptions
a. Participants of FFS	In general, FFS is designed for 20~25 participants in a group. In the case of the JICA CB-NRM Project, one (1) group is composed of 15~40 members. Ideally, the number of the members should not be more than 30.
b. Field school	FFS sessions should be held in the field. Under the JICA CB-NRM Project, the demonstration plot was used as a venue of FFS where the members have learned and practiced a series of techniques.
c. Curriculum of FFS	The curriculum of FFS should basically cover all the topics/techniques in the cycle of the subject, so that the participants could actually experience in the entire process in the field. In the case of the JICA CB-NRM Project, the members have experienced the procedures for introduction of the sustainable upland farming system, such as compost making, application of soil conservation measures, compost application, use of liquid fertilizer, and harvesting including collection of seeds.
d. Facilitator	The facilitator who has enough technical background in the subject as well as competent skills in facilitation should be assigned for FFS to lead the members through the hands-on training sessions. Ideally, the extension officers (or extensionists) are supposed to be the facilitators. It is, however, unrealistic that the extension officers could perform as facilitators at present, as their technical and facilitation capacities are still quite limited. Hence, the NGOs who have experienced FFSs would be the main sources of the facilitators.
e. Core members	The members who can offer his/her lands/farms for FFS and lead the members in the sessions should be selected as core members.
e. Budget allocation	FFS is not necessarily a low-budget training scheme in Timor-Leste as compared to the conventional extension method. There is a need to secure sufficient budget for the conducts of a series of FFS sessions.

Source: JICA Project Team (2015)

2.2 On-farm Demonstration

Simultaneously with FFS, the on-farm demonstration approach is to be taken to facilitate the technical dissemination among communities at suco level, since FFS cannot cover all communities in suco at once. Consequently, a demonstration plot is to be developed as a venue for FFS sessions, so that the same plot can also function as a model that non-members who are not involved in FFS can observe the results of the techniques introduced in the course of FFS sessions. The following criteria should be considered in the selection of a plot for a demonstration plot.

- The plot should be accessible to many communities in aldeia;
- The plot should have characteristics similar to other farms/plots in terms of slopes, soils, and history of use; and
- An owner of the plot should agree to use the plot for training purposes and share the products from the plot among the participants in FFS.

2.3 Farmer-to-Farmer Extension

Farmer-to-farmer extension is still not common in Timor-Leste, as there are less innovative farmers existing in the field. It is, however, considered that its approach would be effective in Timor, since many communities, especially those living in hilly and mountainous areas, generally tend not to instantly accept new techniques introduced by outsiders and often feel an affinity with the techniques adopted by neighboring farmers as "those applicable to their own farms."

It is therefore expected that the techniques introduced and demonstrated through FFS sessions in the demonstration plots could be regarded as those worth applying once communities realize that the neighboring farm (i.e., demonstration plot) perform better than their own as well as other farms in suco.

2.4 Two-Step Extension

One of the difficulties that farmers have faced in the application of the sustainable upland farming techniques to their own plot is a lack of laborers as some of the key techniques, such as compost production and application of soil conservation measures, are rather laborious. Thus, it is not necessarily easy for farmers participating in the FFS sessions to apply techniques that they have learned in the sessions to their own farms/plots even though they appreciate the effects of the techniques.

In order to ensure that farmers participating in the FFS sessions could apply the techniques that they have learned, especially those essential to sustainable upland farming, the JICA CB-NRM Project adopted the following two-step approach where farmers were encouraged to help each other apply the key techniques in accordance with the existing traditional collective working system named "Halosan" in the target sucos. As a result, about 80~100 % of the members applied the same techniques that they have learned in the demonstration plots to their own plots over the course of the JICA CB-NRM Project.

Two Step Extension Approach taken by the JICA CB-NRM Project

Step	Descriptions
Step 1 (Year 1)	A FFS group composed of 20 to 40 members was formed with the establishment of a demonstration plot at each aldeia. The members of the group practiced together all the topics of sustainable upland farming in a cycle of upland crop production in the demonstration plot in the 1st year. The 1st year FFS in the demonstration plot was aimed at helping the members practice the sustainable upland farming techniques and understand their effectiveness in crop production. It was also agreed among the members that the demonstration plot should be used for production of improved seeds of the major staple crops (maize, sweet potato, and cassava) for members' cropping in the 2nd year.
Step 2 (Year 2)	Each group divided the members into small groups according to the proximity of their houses/farms, as they used to group themselves when they needed to help each other for farming and traditional/religious activities. In addition to the FFS sessions in the demonstration plot, the Project held several FFS sessions on the selected key topics in one of the farms in each small group, and encouraged the members of the small groups to help each other do the same things in other members' farms in accordance with the Halosan system. The following topics, which were essential to sustainable upland farming but not necessarily easy to introduce by a single family, were handled in the FFS sessions at the small group level. ◆ Compost production ◆ Delineation of contour lines ◆ Application of soil conservation measures ◆ Application of compost ◆ Prepartion of liquid fertilizer The demonstration plot used in the 1st year was again used as a venue for the 2nd year FFS at the aldeia level and the place for seed multiplication for the members.

Source: JICA Project Team (2014)

2.5 Proposed Extension Method

It is recommended that the following integrated approach shall be taken as a principle extension method to promote and disseminate the sustainable upland farming techniques at suco level.

Proposed Framework of Extension of the Techniques

Items	Outlines
Duration	2 years
Extension method	1st year: Field Farmer Schools (FFSs) at the demonstration plot 2nd year: Two-step FFSs at both demonstration and small group plots
Target group	20~30 persons in a group at aldeia level
Outline of FFSs 1st year	a. Select a demonstration plot which can be easily accessible to as many members of the group as possible. b. Develop a FFS curriculum composed of a series of hands-on training courses on the sustainable upland farming techniques. c. Conduct a series of hands-on training courses at the demonstration plot to enable the members to practice all the techniques necessary for sustainable upland farming and optimum production of upland crops. d. Help the members practice and apply the techniques to the demonstration plot in the respective hands-on training courses. e. In the first year, the main aims of FFSs are to: i) introduce and demonstrate the techniques; ii) give the members opportunities to practices the techniques in the field; iii) give them chances to observe the results of the techniques introduced in the demonstration plot, and iv) help them assess/analyze the techniques based on the results in the demonstration plot.
2nd year	a. Divide the members of the group into small sub-groups according to the proximity of their houses/farms. b. Help the members select one farm each from the small groups where additional

Items	Outlines
	hands-on training courses on the selected key topics would be held. c. Hold the same hands-on training sessions as the 1st year curriculum arranged except those for sloping agriculture (i.e., delineation of contour lines and application of contour composting) in the demonstration plot to ensure that the members could acquire the techniques. d. Hold the additional hands-on training sessions on the selected key topics essential to sustainable upland farming (i.e., compost production, delineation of contour lines, application of contour composting, application of compost, and preparation of liquid fertilizer) in the selected farms of the respective small groups. e. Encourage the members of the small groups to help each other apply the techniques that they have practiced at the sub-group plots to the individual members' plots. f. The main focus of the second year's activity shall be put on encouraging the members to help each other apply the key techniques to their own farms.

Source: JICA Project Team (2014)

3. Techniques/Skills on Sustainable Upland Farming

3.1 Overall View of the Techniques

The members should go through or practice not only the process of growing crops but also introduction of sloping agriculture techniques. In order to enable the members to learn all the techniques, the FFSs should cover the whole cycle of the sustainable upland farming as listed below.

i) Production of compost
ii) Delineation of contour lines
iii) Application of contour composting (contour canalling)
iv) Plowing with compost application
v) Selection of seeds/planting materials
vi) Sowing/Planting (Line sowing/planting)
vii) Preparation of liquid fertilizer
viii) Weeding, mulching, and application of liquid fertilizer
ix) Post-harvesting and storage of seeds of maize

In general, a majority of communities in hilly and mountainous areas are not familiar with the techniques listed above; therefore, the FFS should be held as the form of hands-on training to ensure that the members of the group could acquire all the techniques properly, especially in the first year.

3.2 Key Techniques essential to Sustainable Upland Farming

In the second year, the key techniques which are essential to sustainable upland farming should be handled in the selected farms of the small groups. The following techniques are considered essential to the sustainable upland farming based on the results of the JICA CB-NRM Project.

i) Compost production
ii) Delineation of contour lines (preparation and use of A-frames)
iii) Application of contour composting technique
iv) Application of compost
v) Preparation of liquid fertilizer

3.3 Application of the Techniques

The following sections describe the objectives of the techniques, procedures for application, timeframe, and important tips to be considered in the application of the techniques.

3.3.1 Production of Compost

(1) Objective

The main objective of the technique is to produce quality organic fertilizer using materials locally available so that communities can maintain soil fertility and improve upland crop production in terms of its quality and quantity.

(2) Procedures for Application

The following five (5) steps shall be taken to produce quality compost.

i) Selection of the location for a compost pit and pitting of a hole
ii) Collection and preparation of materials
iii) Piling of materials
iv) Maintenance of compost

a. Selection of the location for a compost pit and pitting of a hole

i) Identify and select the location of production of compost at the beginning. The location should be close to a source of water and a farm which compost is applied to.

ii) Dig a pit enough to produce the target volume of compost at the selected location. If the targeted volume is 3 ton, a pit should be 2 m long, 1.5 m wide, and 1 m deep.

iii) It is also advisable to make another pit which is the same size as the compost pit in the same place, to lighten the burden of turning/mixing compost during the maintenance of compost.

The pit should be located upper part of the farm, so that compost is easy to apply.

The target volume of compost should be determined according to the area of farm where you apply compost. You should produce at least 2~4 ton of compost for 1 hectare if you apply about 100~200 g each to planting plots.

In case that soils in the site are so compacted or too hard to dig a pit, you can also make a compost frame made of bamboo. But it is not much advisable as it would be difficult to maintain the moisture contents of compost during the fermentation process.

b. Collection and prepartion of materials

i) Collect the following materials.

- Vegetative materials, such as:
  - Grasses/weeds
  - Stalks of maize or banana

- Leaves of leguminous trees (e.g., caliandra, sesbania, and gamal)
- Coffee husk

▶ Animal manure, such as
- Cow dung
- Goat dung
- Chicken dropping

▶ Top/black soils and ashes

▶ EM (if possible) or other materials that can facilitate the fermentation process, such as
- Tua mutin
- Papaya flesh

The mixture ratio of vegetative materials to animal manure should be 2:1. If you plan to produce a total of 3 ton of compost, you need collect about 2 ton of vegetative materials and 1 ton of animal manure.

You can faster the fermentation process if you use EM or tua mutin/papaya flesh, which can facilitate the process of fermentation.

ii) Chop the vegetative materials into small pieces (several centimeters on average) at the site where a compost pit is dug.

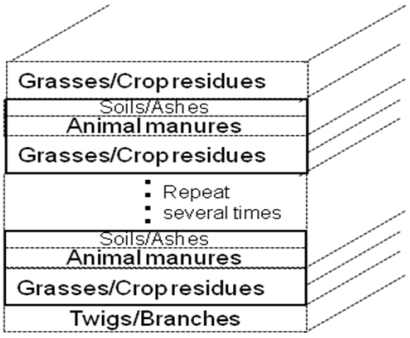
c. Piling of materials

i) Stratify the materials at a height of 5~10 cm each.

ii) First put a layer of maize and banana stalks or other stuff rather difficult to decompose, and then put a layer of grasses/weeds and that of wet animal manure.

iii) Cover the layer of animal manure with soils and ashes, and pour sufficient water after putting the layer of soils and ashes.

iv) Repeat ii) and iii) alternately until you use all the materials prepared or fill up the pit.



v) In the middle of piling-up, put a hollow-out bamboo pole with holes in the center of the piled stuff for ventilation.

vi) Pour again sufficient water on the top of the piled stuff.

vii) Cover the piled stuff (compost) with banana leaves or plastic cover.

viii) Build a thatch of a pit to prevent the pit from being exposed to sunlight.

d. Maintenance of compost

i) Leave compost for 3~4 weeks as it becomes very hot during its fermentation process. Nevertheless, check the moisture contents and temperature of compost at times and regularly water compost to maintain moisture contents in compost even during the fermentation process.

ii) When compost cools down maybe in 3~4 weeks after piling, move compost to another pit (if two pits are made in pitting) tuning the inside out and the upside down to decompose all the materials evenly. If there is only one pit made, take out compost and refill the pit after mixing compost well.

iii) Pour sufficient water while moving/refilling a pit with compost.

iv) As compost will be reheated again, leave it cools down again for about 3~4 weeks.

v) When the temperature of compost gets cool, do the activities ii) to iv).

Important Tips

- *You should start producing compost in May/June so that you could collect fresh grasses and weeds in the localities.*
- *You should be careful not to use weeds with mature seeds to reduce weeds after application.*
- *You should keep moisture of compost to facilitate the process of decomposition.*
- *If you produce compost in a compost frame, you should line walls of a frame with banana leaves to protect compost from getting dry.*

(3) Timeframe of Application

In the northern part of the country which is under the monsoon type climate with clear distinction between the wet and dry seasons, the production of compost should start in

May/June so that it can be applied to farms before sowing seeds in October/November. The standard timeframe of FFSs on production of compost is outlined below.

Standard Timeframe of FFS on Compost Production

Activities	Timing	Duration of the Session
i) Selection of the location of a compost pit and pitting	May	A half day for selection
ii) Pitting of a/ hole/s, preparation of materials, piling, and thatching	May/June	Two days for pitting, preparation of materials and piling
iii) Turn-over of compost (1st)	July	One day for the 1st turn-over
iv) Turn-over of compost (2nd)	August	One day for the 2nd turn-over

Source: JICA Project Team (2015)

3.3.2 Delineation of Contour Lines

(1) Objective

The main objective of the technique is to make contour lines using a simple device/tool made of materials locally available so that the participants/farmers could apply the sloping land agriculture techniques to their own farms.

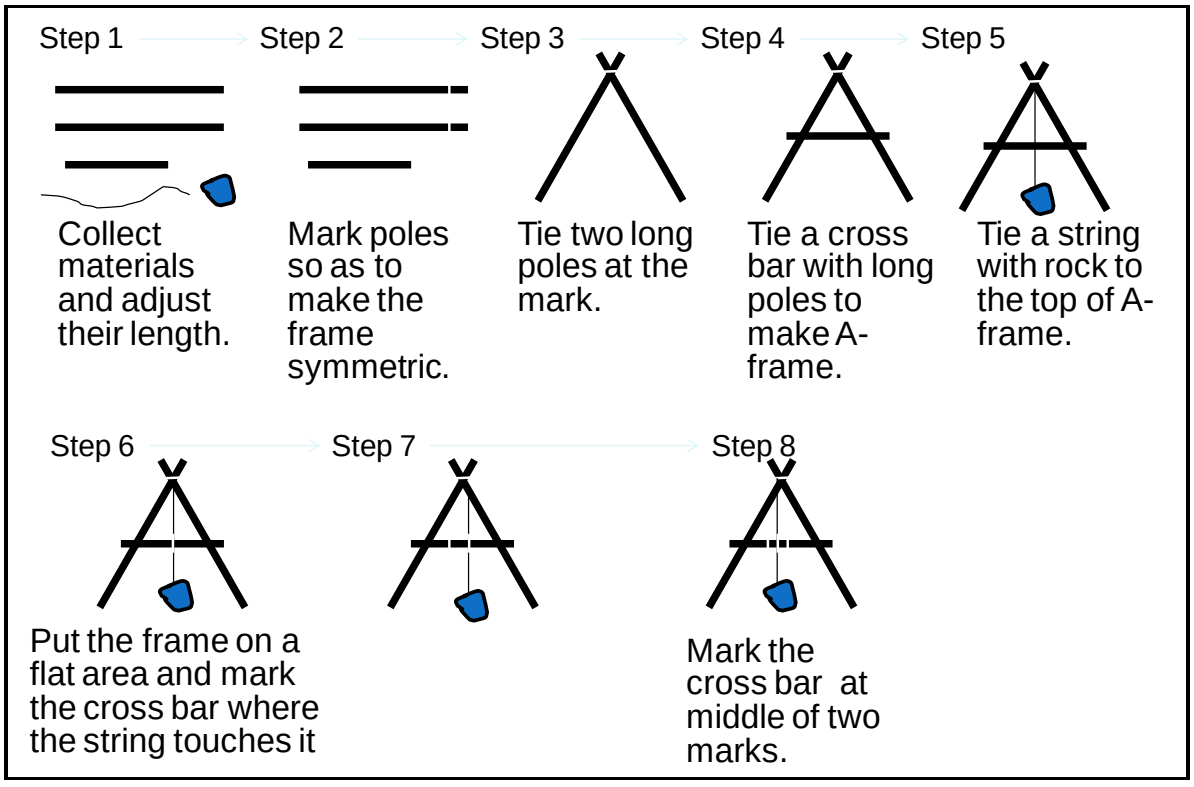
(2) Procedures for Application

a. Making of A-frames with collection of local materials

i) Collect the following materials for making A-frames.

- Materials needed for making an A-frame
  - 2 pieces of 2 meter long wood or bamboo
  - 1 piece of 1 meter long wood or bamboo
  - 1 fist-sized rock
  - 2 m of string or thin rope
  - Nails/wires/binding strings
- Tools to be used for making A-frames
  - Hammer/Machete/Saw/Knife

ii) Make A-frames according to the following procedures.



b. Delineation of contour lines using A-frames

i) Stick the first stake at the middle edge of a farm (such as a demonstration plot) and put the left leg of an A-frame at the first stake.

ii) Adjust the right leg to make the string pass through the midpoint of the crossbar and stick another stake at the right leg.

iii) Move the A-frame to the right by placing the left leg at the stake where the right leg previously was put.

iv) Adjust the left leg again until the string passes through the midpoint, and again stick the stake at the right leg.

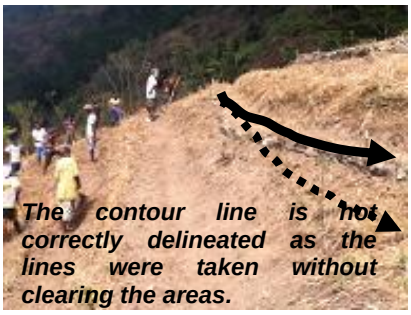
v) Follow this procedure up to the other side of a farm.

vi) Take another point 1 meter downwards in a vertical direction in the slope using a 1 m long stick. Do the activities from i) to v) to take the contour line.

vii) Repeat the activities i) to vi) until all the contour lines are delineated in a farm.

Important Tips

- *You should take out all grasses in a farm before using an A-frame, or you cannot delineate contour lines correctly.*
- *You should use a 1 m-long stick to measure the vertical interval between contour lines.*



The contour line is not correctly delineated as the lines were taken without clearing the areas.

A one-meter stick should be used to check the vertical distance between contour lines.

(3) Timeframe of Application

The FFS sessions on these topics should be held according to the following timeframe.

Standard Timeframe of FFS on Contour Line Delineation

Activities	Timing	Duration of the Session
i) Making of A-frames with collection of local materials	July	One day for making A-frames using local materials
ii) Delineation of contour lines using A-frames	July	One or two (2) days for delineation of contour lines using A-frames

Source: JICA Project Team (2015)

3.3.3 Application of Contour Composting (Contour Canalling)

The following four (4) types of soil conservation measures have been introduced and demonstrated in sloping farmlands by the JICA CB-NRM Project.

i) Contour composting / contour canalling
ii) Bench terracing
iii) Stone wall terracing
iv) Vegetation strips

Each measure has advantages and disadvantages as shown below.

Effectiveness an Features of Soil Conservation Measures adopted in Timor-Leste

Type of measures	Applicable conditions	Effectiveness in conservation	Features (Disadvantage)
Contour composting	Gentle to steep sloping	Moderate	Easy to apply but not highly effective in prevention of surface soil erosion
Bench terracing	Moderate sloping	High	Laborious Structurally unstable when being installed in steep sloping areas
Stone wall terracing	Moderate sloping	High	Laborious Dangerous when being installed in steep sloping areas
Vegetation stripping	All types of sloping	Moderate	Time consuming until it becomes effective.

Source: JICA Project Team (2015)

The experiences of the JICA CB-NRM Project revealed that it was not easy for communities to apply bench terrace and stone wall terrace to their own plots as they required significant labor force to introduce the measures, even though they were aware of the effectiveness of the same measures in the prevention of soil erosion through trial application of those measures in the field. Vegetation stripping was also not strongly recommended as it would take time to become effective. Contour composting is considered as the recommended technique that can be introduced and applied to a wide range of areas in the country.

(1) Objective

The main objective of the technique is to make contour canals/ditches at an interval of 1 meter in a vertical direction in a sloping farm to prevent surface soil erosion and maintain soil fertility in a farm.

(2) Procedures for Application

This technique shall be introduced after delineation of contour lines in the entire part of a farm. In the application, the following steps shall be taken.

a. Dig a canal about 50 cm wide and 30 cm deep along each contour line.
b. Make a contour bund on the downward edge of each canal using the excavated soils.
c. Dig diversion canals on the edges of a farm to drain excess water.

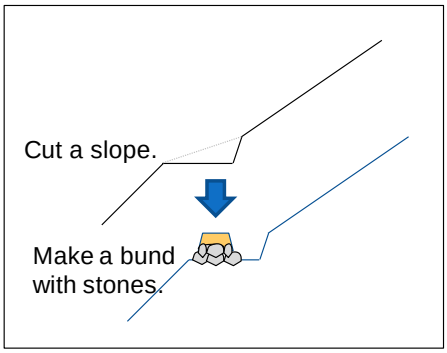
d. Put crop residues/grasses/weeds in the canals.

e. Plant king grasses/vetiver grasses/lemon grasses on contour bunds as hedgerows and gamal/caliandra in front of the bunds in the rainy season to strengthen the stability of contour bunds.

Important Tips

- *In case that the contour bunds are fragile, wattles should be applied until hedgerows and leguminous trees grow enough to support the bunds.*
- *In case that a farm has many stones, you should use stones as bases of the bunds.*

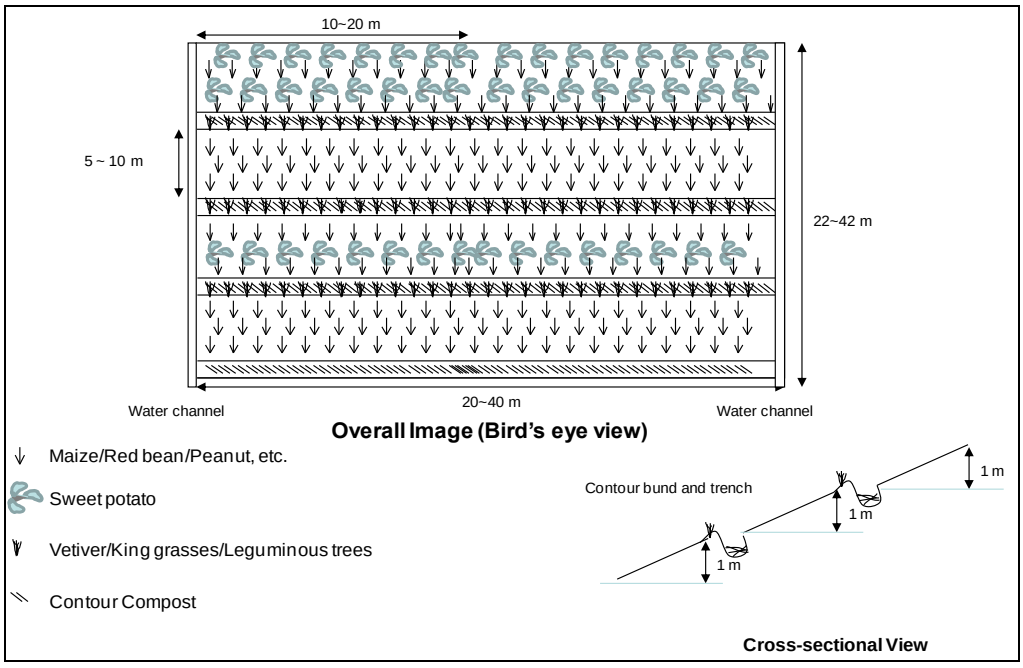
Wattles should be applied when soils are too fragile to make bunds.



Stones should be used as bases of bunds.

(3) Standard Design of a Farm with the Technique

The standard design of a farm to be established is shown below.



(3) Timeframe of Application

The FFS sessions on these topics should be held according to the following timeframe.

Standard Timeframe of FFS on Contour Composting

Activities	Timing	Duration of the Session
i) Making of contour canals and bunds	August	One day for making of contour canals and bunds
ii) Making of stone bunds or wattles (optional)	August	Additional one day for making of stone bunds or wattles
iii) Planting of hedgerows and leguminous trees	November	One day for planting of hedgerows and leguminous trees on the bunds

Source: JICA Project Team (2015)

3.3.4 Plowing with Compost Application

(1) Objective

The main objective of the technique is to plow a farm with application of compost in a proper manner so as to ensure the sufficient growth of crops.

(2) Procedures for Application

a. Clear/Cut grasses in the plot in August.

b. Plow the plot with a hoe and incorporate remnants of weeds into soils in September/October.

c. Apply compost to a farm efficiently following the methods described below.

i) Line application

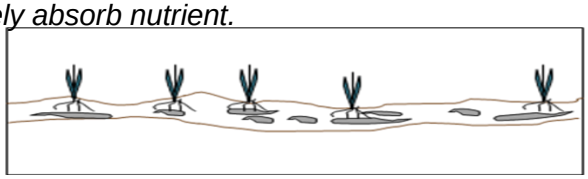
- Dig thin furrows (10 cm wide and 20 cm deep) along the lines where maize and other seeds are sown;
- Put compost evenly in the furrows in the site (The recommended amount of application to a 50 m-long furrow is 50 kg or two (2) sacks of compost.)
- cover compost with surface soils.

ii) Hole application

- Dig small holes (10~20 cm in diameter with 20 cm deep) where corn seeds are sown;
- Put compost which is equivalent to about 100~200 grams to each hole; and
- cover compost with surface soils.

Important Tips

- *Compost should be applied at least two weeks before planting to prevent crops from nitrogen deficiency when compost is not well decomposed.*
- *It is important to incorporate compost into soils (under the surface) so that root systems of crops (such as maize) can effectively absorb nutrient.*



(3) Timeframe of Application

The FFS sessions on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Plowing with Compost Application

Activities	Timing	Duration of the Session
i) Clearing of a farm	August	One day for clearing
ii) Plowing	September	One to two (2) day/s for plowing
iii) Application of compost	October	One to two (2) day/s for application

Source: JICA Project Team (2015)

3.3.5 Selection of Seeds/Planting Materials and Identification of Plots for the Improved Varieties of Maize

(1) Objective

The main objective of the technique is to select and collect quality seeds and planting materials of upland crops to secure high germination and ensure high crop productivity.

(2) Procedures for Application

Selection of Seeds of Maize and Beans

a. Procure seeds of the improved varieties of maize (i.e., Sele and Suwan 5) from MAF or seed production farmers.[1]

b. Spread seeds on a flat basket and select large and good shape grains without any insect or fungus damages (i.e., insect holes and discolored stains) one week before planting.

c. Put them into a jerry can or a large-size plastic bottle of mineral water separately and firmly cap the container.

Selection of Planting Materials of Cassava and Sweet potato

a. Procure planting materials of improved varieties of cassava and sweet potato from MAF if possible.

b. If it is difficult to get support from MAF and planting materials need to be collected from the surrounding farms, follow the procedures described below.

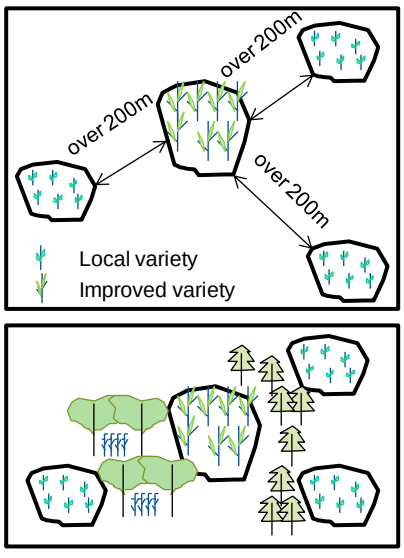
   i) Select cassavas and sweet potatoes which show vigorously growth and/or are expected to produce quality tubers;
   iii) One day before planning,
   - Cut stems of the selected cassavas and divide them into 20 cm long sticks; and
   - Cut runners of the selected sweet potates, bundle them, and wrap the cut edges of runners with a wet cloth or tissue.

Identification of Farms where Improved Varieties of Maize are planted

a. Identify and select farms isolated from other farms where local varieties of maize might be planted in either of the following ways:

   i) A farm is isolated from other farms at a distance of more than 200 m; or

   ii) A farm is surrounded by natural barriers, such as coffee plantations and forests.



[1] Farmers who have made contracts/arrangements with MAF on the production of improved seeds.

Important Tips

- *Improved varieties of sweet potato and cassava can be planted in anywhere as long as they are not mixed with other varieties (local varieties) in the same plot, as they are self-pollinated types.*

(3) Timeframe of Application

The FFS sessions on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Selection of Seeds and Planting Materials

Activities	Timing	Duration of the Session
i) Selection of seeds	October	A half-day for selection of seeds of maize and beans
ii) Selection of planting materials	October	One day for selection of cassavas and sweet potatoes in a farm and prepare the materials for planting
iii) Selection of farms where improved varieties of maize can be introduced	October	One day for selection and identification of farms

Source: JICA Project Team (2015)

3.3.6 Sowing/Planting

(1) Objective

The main objective of the technique is to sow and plant crops in a semi-intensive manner to improve the productivity of crops while maintaining the diversity of crops in a farm so that communities can have resilience to adverse impact caused by climate change. Specifically, this manual introduces the following crop combinations as recommendable planting models for this purpose.

Recommendable Planting Models

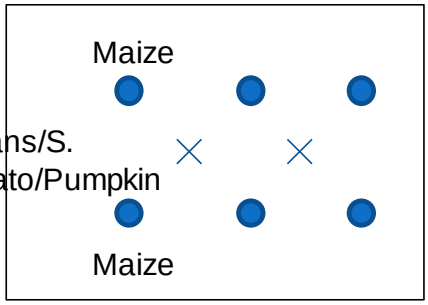
Planting model	Spacing	Remarks
1. Maize & Beans	Main crop: Maize: 1.0 m x 0.5 m Inter crop: Beans (red bea): 1.0 m x 0.3 m	Suitable for gently sloping farms and farms with bench terraces
2. Cassava & Beans	Main crop: Cassava: 1.0 m x 1.0 m Inter crop: Red beans (climbing type): 1.0 m x 0.3 m	ditto
3. Peanut	Peanut: 0.3 m x 0.3 m	ditto
4. Maize & Sweet potato/Pumpkin	Main crop: Maize: 1.0 m x 0.5 m Inter crop: Sweet potato/pumpkin: 1.0 m x 0.5 m	Suitable for sloping farms and farms with contour canalling terraces
5. Cassava & Pumpkin	Main crop: Cassava: 1.0 m x 1.0 m Inter crop: Pumpkin: 1.0 m x 0.5 m	ditto

Source: JICA Project Team (2015)

(2) Procedures for Application

a. Determine the planting models to be introduced in a farm.

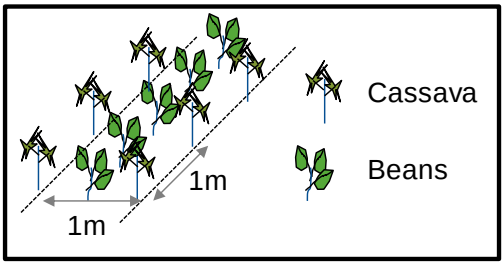
b. Sow seeds according to the standard designs of the respective recommendable planting models using a scaled stick/string (such as a 1-meter-long stick/string or a stick/string with scale). The standard designs of the respective models are as follows:



Maize and Beans

i) Plant maize seeds in line at the distance of 1 m x 0.5 m (1 m between lines and 0.5 m between seeds in a line).

ii) Plant beans (e.g., soybean and red bean) along the middle lines between those of maize at the distance of 0.3 m between seeds in a line.



Cassava and Beans

i) Plant cassava sticks in line at the distance of 1 m x 1 m (1 m between lines and 1 m between seeds in a line).

ii) Plant beans (e.g., soybean and red bean) along the middle lines between those of cassava at the distance of 0.3 m between seeds in a line.

Peanut

i) Plant peanut in line at the distance of 20 cm x 20 cm or 30 cm x 30 cm without mixing with other crops.

Maize and Sweet potato/Pumpkin

i) Plant maize seeds in line at the distance of 0.7 m x 0.5 m (0.7 m between lines and 0.5 m between seeds in a line).

ii) Plant runners of sweet potato or pumpkin along the middle lines between the lines where maize seeds are sown at the distance of 0.5 cm between runners in a line.

Cassava and Sweet potato/Pumpkin

i) Plant cassava sticks in line at the distance of 1 m x 1 m (1 m between lines and 1 m between seeds in a line).

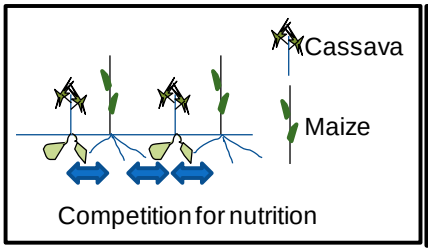
ii) Plant runners of pumpkin along the middle lines between the lines where cassava sticks are planted at the distance of 0.5 cm between seeds in a line.

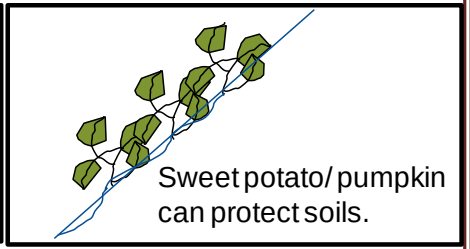
c. Average volumes of seeds/planting materials of each crop without mixing with other crops.

- Maize: 25 ~ 30 kg/ha
- Beans: 40~60 kg/ha
- Peanut: 100 ~ 150 kg/ha
- Cassava: 10,000 cutting/ha
- Sweet potato: 20,000~40,000 runners/ha

Important Tips

- *Do not plant maize and cassava in the same plot as they compete with each other for soil nutrition.*
- *Beans (red bean/soy bean) should be mixed with maize and cassava to complement soil nutrients.*
- *Sweet potato and pumpkin can be used in a sloping farmland as cover crops.*





(3) Timeframe of Application

The FFS sessions on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Sowing and Planting

Activities	Timing	Duration of the Session
i) Sowing of seeds of maize and beans	November	One day for sowing maize and beans
ii) Planting of cassava, sweet potato / pumpkin	November / December	One day for planting cassava, sweet potato or pumpkin
iii) Sowing of peanuts	December	One day for sowing peanuts

Source: JICA Project Team (2015)

3.3.7 Preparation of Liquid Fertilizer

(1) Objective

The main objective of the technique is to make liquid fertilizer for additional fertilization using materials locally available, so as to keep crops healthy and ensure high crop productivity.

(2) Procedures for Application

a. Procure or prepare a large-sized plastic bucket or drum can and clean it.

b. Collect ingredients of fertilizer: 5-10kg of cow dung or other animal manure, 30-40kg of crop residues/grasses and leaves of leguminous trees, micro organism (tua mutin, tempe or EM), and 200 liter of water.

c. Put a net sack filled with animal manure into a drum can. If a net sack is not available, put animal manure into a drum can directly.

d. Put chopped crop residues/grasses and leaves of leguminous trees and micro organism (tua mutin, tempe or EM) into a drum can.

e. Pour water until the container is filled.

f. Cover the container to protect the contents from contamination/dilution or insects.

g. Stir the contents with a long stick for 5 to 10 minutes every day for 2~3 weeks to facilitate the fermentation process.

h. After 2~3 weeks fermentation process, scoop up clear water in the surface and dilute the scooped water (liquid fertilizer) with 20 times of water.

i. Apply liquid fertilizer to maize and other crops on times (every 2~3 weeks).

Important Tips

- *Use fresh manure since fresh one has more nutrients.*
- *If possible, mix different types of manure. Chicken droppings are more nutritious.*
- *Put one (1) shovel of ashes to add minerals (especially potassium) to liquid fertilizer.*

(3) Timeframe of Application

The FFS session on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Preparation of Liquid Fertilizer

Activities	Timing	Duration of the Session
i) Making of liquid fertilizer	November	One day for making liquid fertilizer

Source: JICA Project Team (2015)

3.3.8 Weeding, Mulching, and Application of Liquid Fertilizer

(1) Objective

The main objective of the technique is to facilitate the growth of crops by reducing weeds in a farm and applying additional fertilizer to crops.

(2) Procedures for Application

a. Weed grasses in a farm (3) weeks after planting of maize (1st weeding).

b. Apply liquid fertilizer to maize immediate after the 1st weeding.

c. Mulch the soil surface around crops with weeded grasses to prevent the growth of weeds and maintain soil moisture contents.

d. Repeat weeding, application of liquid fertilizer, and mulching (items a. to c.) one (1) month after the 1st weeding (2nd weeding) and another one month after the 2nd weeding.

Important Tips

- *Weeding is essential not only to the increase of production, but also the protection of crops from infection of pests and diseases.*
- *Mulching is effective in restraining the growth of weeds, protecting soil surfaces from being dried, and preventing surface soil erosion.*
- *If there are leguminous trees in and around a farm, use the leaves of leguminous trees as mulching materials which can function as green manure at the same time.*

(3) Timeframe of Application

The FFS session on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Preparation of Liquid Fertilizer

Activities	Timing	Duration of the Session
i) 1st weeding, mulching, and additional fertilization	December	One day for weeding, mulching, and applying liquid fertilizer
i) 2nd weeding, mulching, and additional fertilization)	January	ditto
iii) 3rd weeding, mulching, and additional fertilization)	February	ditto

Source: JICA Project Team (2015)

3.3.9 Post-harvesting and Storage of Seeds of Maize

(1) Objective

The main objective of the technique is to store quality seeds of maize without any damage caused by insects and fungi while storing.

(2) Procedures for Application

a. After harvesting maize cobs, spread them on a plastic sheet and dry them under the sun to make its moisture contents less than 12 %.

b. Remove small and damaged cobs and select big-cum-good shape cobs for seed collection.

c. Shell and collect maize grains from the central parts (1/3) of the selected cobs for seeds.

d. Put the collected maize grains into the following airtight containers depending on the volume of seeds to be stored.

   i) Drum can for more than 100 kg of seeds.

   ii) 5 lit of plastic jerry can for less than 5 kg of seeds

   iii) Aqua plastic bottle for less than 1 kg of seeds

Important Tips

- *You should not dry maize cobs hanging them on a tree but dry them under the sun to minimize its insect damage.*
- *When using a dram can as an airtight container, you should put a candle in a can after filling a can with corn seeds to deoxidize the container.*
- *Do not mix the improved maize seeds with other local seeds.*

(3) Timeframe of Application

The FFS session on this topic should be held according to the following timeframe.

Standard Timeframe of FFS on Preparation of Liquid Fertilizer

Activities	Timing	Duration of the Session
i) Drying of maize cobs	April	One day for drying of maize cobs
i) Storing of maize seeds	April/May	One day for selection of cobs, collection of corn grains for seeds, and storing of seeds into airtight containers.

Source: JICA Project Team (2015)

4. Standard Training Modules

The following table shows the standard training modules for the respective techniques introduced in Section 3.3. All the training courses are assumed to be conducted at the demonstration plot for FFS.

Standard Training Module for the Techniques in FFSs

Training course	Items	Descriptions
Compost Production	Objectives	To enable the members to produce organic fertilizer (compost) using materials locally available.
	Timeframe	1st training in making compost (2 days) a. Collection and chopping of materials (0.5 day/1st day) b. Pitting (0.5 day/1st day) c. Piling of materials (1 day/2nd day) 2nd training in maintenance of compost (1 day) a. Turn-over of compot (1 day)
	Materials	Farm tools (Iron stick, machete, shovel), materials for compost (grasses, weeds, stalks, manures, soils/ashes), banana leaves, thatching materials (4 pcs of 1~2 m pole and coconut leaves)
	Expected Results	2~3 ton of compost will be produced.
Delineation of contour lines	Objectives	To enable the members to properly delineate contour lines using materials locally available.
	Timeframe and process	2 days training in delineation of contour lines a. Collection of materials (0.5 day/1st day) b. Framing of an A-frame (2 hours/1st day) c. Preparation of sticks (1 hours/1st day) d. Delineation of contour lines (1 day/2nd day)
	Materials (for 3 units of A-frame)	6 pcs of 2 m pole, 3 pcs of 1m pole, 3 pcs of 1.5 m string, 3 pcs of handful stones/blocks, and wires or nails
	Expected Results	Contour lines will be delineated in the demonstration plot.
Application of contour composting technique	Objectives	To enable the members to apply contour composting technique
	Timeframe	2~3 days training in applying contour compost a. Digging of contour canals (1 day) b. Making of contour bunds or stone bund(1 day) c. Making of wattles (optional) (1 day)
	Materials	Farm tools (iron stick, hoe, pickax, and shovel), bamboo poles for wattles
	Expected Results	Contour composts will be developed in the demonstration plot.
Plowing with compost application	Objectives	To enable the members to cultivate a farm with application of compost in a proper manner
	Timeframe	2 days training in plowing with compost application a. Cultivation (1 day) b. Application of compost (1 day)
	Materials	Farm tools (machete, hoe, pickax) and compost
	Expected Results	The demonstration plot is ready for planting.
Selection of seeds/ planting materials	Objectives	To enable the members to understand how to use improved seeds and select quality seeds before planting.
	Timeframe	2 days training in selection of seeds & plots for improved ones a. Introduction of the use of improved seeds (0.5 day/1st day) b. Selection of quality seeds of maize, beans and planting materials of cassava and other crops (0.5 day/1st day) c. Selection of plots for improved maize (1 day/2nd day)
	Materials	Seeds and planting materials of crops (e.g., maize, beans, cassava, etc.)
	Expected Results	Quality seeds and planting materials of major upland crops will be selected.

Training course	Items	Descriptions
Sowing/Planting	Objectives	To enable the members to sow/plant crops in line at the recommendable spaces of the respective crops
	Timeframe	1st training in planting maize and beans (1 day in Nov.) a. Sowing of maize by measuring the distance (0.5 day) b. Sowing of beans by measuring the distance (0.5 day) 2nd training in planting cassava, pumpkin, beans (1 day in Dec.) a. Planting of cassava /sweet potato / pumpkin by measuring the distance (0.5 day) b. Sowing of beans by measuring the distance (0.5 day) 3rd training in planting peanut (1 day in Dec.) a. Sowing of peanut by measuring the distance
	Materials	Seeds/planting materials 1~2 m of rope/stick with 10 cm scales
	Expected Results	Upland crops will be planted in line in a systematic manner in the demonstration plot.
Preparation of liquid fertilizer	Objectives	To enable the members to prepare liquid fertilizer using materials locally available.
	Timeframe	1 day training in preparing liquid fertilizer a. Collection of local materials (0.5 day) b. Mixing of materials (0.5 day) 2~3 weeks OJT in stirring liquid fertilizer by core members a. Stirring (10 min/day x 2 ~3 weeks)
	Materials	Animal dung (2 sacks), Grasses/weeds (2 sacks), Soils (2~3 shovels), Ashes (1 shovel), and water
	Expected Results	A can of liquid fertilizer will be prepared and ready to use at the demonstration plot.
Weeding, mulching, and application of liquid fertilizer	Objectives	To enable the members to properly maintain farms to keep crops healthy and improve/stable crop productions in farms.
	Timeframe	1st training in maintaining crops (1 day in Dec.) a. Weeding/cultivation and mulching (0.5 day) b. Additional fertilization using liquid fertilizer (0.5 day) 2nd training in maintaining crops (1 day in Jan.) a. Weeding/cultivation and mulching (0.5 day) b. Additional fertilization using liquid fertilizer (0.5 day) 3rd training in maintaining crops (1 day in Feb.) a. Weeding/cultivation and mulching (0.5 day) b. Additional fertilization using liquid fertilizer (0.5 day)
	Materials	Farm tools (machete and hoe), a water can, and liquid fertilizer
	Expected Results	Crops planted in the demonstration plots will grow well and produce high yields.
Post-harvesting and storage of seeds of maize	Objectives	To enable the members to properly dry, select, and store corn grains for seeds of maize for next season's cropping.
	Timeframe	1st training in drying maize (1 day in Mar./Apr.) a. Spreading of maize cobs (0.5 day) b. Drying of maize (0.5 day) 2nd training in storing maize (1 day in Apr.) a. Selection of cobs and collection of grains (0.5 day) b. Storage of grains in airtight containers (0.5 day)
	Materials	Plastic sheet, baskets, and airtight containers (drum can, jerry cans, and bottles of aqua)
	Expected Results	Quality seeds of maize for next cropping season will be properly stored.

Source: JICA Project Team (2015)

5. Cost Estimates

This chapter introduces how to estimate the budget required for the conduct of a series of FFS sessions at the suco or aldeia level. The cost estimation is one of the essential skills/techniques to prepare a convincing plan which can get the financial support from a source of fund. The following sections explain the ways to estimate the budgets per training session and per suco/aldeia introducing the major cost items to be considered in the estimation.

5.1 Estimate of Cost for Training

The major cost items for training are: i) materials used for training sessions, ii) food for the members/participants, iii) transportation cost for facilitators, iv) other miscellaneous cost, and v) cost for facilitators if external facilitators (such as NGOs) are used for training. The cost of each cost item is estimated by multiplying its quantity of the item by the unit cost. The following format can be used in the estimation.

Format for Cost Estimation of Training Session

Standard cost item	Quantity (a)	Unit cost (b)	Cost (a x b)
1. Materials for training (for those which cannot be collected in a village)			
2. Snack and food for the participants			
3. Transportation cost for facilitators			
4. Cost for facilitators (payment to facilitators)			
5. Other miscellaneous cost			
Total cost for one training session (1+2+3+4+5)	-	-	

Source: JICA Project Team (2014)

5.2 Estimate of Cost for Other FFSs other than Hands-on Training

After hands-on training, core and some members may need to engage in follow-up activities in the demonstration plot, as one hands-on training session may not be able to apply some of the techniques (e.g., delineation of contour lines, making of contour canals/bunds, cultivation with compost application) to all the parts of the demonstration plot. The major cost items for self-application/practice are: i) snack or food for the members, ii) transportation cost for facilitator, iii) cost for facilitators, and iv) other miscellaneous cost. The same format shown above can be used for estimation.

5.3 Cost Estimate per Suco

The cost for one cycle of FFS in a village is estimated by summing up the costs for all the FFS's sessions mentioned above. In case that FFS is held at aldeia level and several FFS groups are organized in a suco, the total cost should be estimated by multiplying the number of groups by the costs of the respective FFS sessions. Consequently, the following format can be used for the estimation.

Format for Cost Estimation of Training Session in the First Year

Standard cost item	No. of Group (a)	Unit cost (b)	Cost (a x b)
1. Hands-on training on compost production			
2. Hands-on training on contour line delineation			
3. Self-application on delineation			
4. Hands-on training on contour composting			
5. Self-application on contour composting			
6. Hands-on training in cultivation/compost application			
7. Self-application of cultivation/compost			

Standard cost item	No. of Group (a)	Unit cost (b)	Cost (a x b)
application			
8. Hands-on training in selection of seeds			
9. Hands-on training in sowing/planting			
9. Hands-on training in making liquid fertilizer			
10. Self-practice in making liquid fertilizer			
11. Hands-on training in weeding, mulching, and application of liquid fertilizer			
12. Self-practice in weeding, mulching, and application of liquid fertilizer			
13. Hands-on training in harvesting and post-harvesting			
14. Hands-on training in selection, collection and storage of seeds			
Total cost for one training session (1+2+3+4+5)	-	-	

Source: JICA Project Team (2014)

5.4 Unit Costs used for Cost Estimation (as of March 2014)

To simplify the process of cost estimation, the following unit costs of the respective cost items could be used in 2014. However, these costs should be reviewed and revised periodically since the prices will be escalated as years go by.

Sample of Unit Costs of the Cost Items

Category	Items	Unit cost (US$)
Materials	Farm tool (Iron stick)	US$ 7.0/pc
	Farm tool (Machete)	US$ 5.0/pc
	Farm tool (Hoe)	US$ 7.0/pc
	Farm tool (Shovel)	US$ 7.0/pc
	Animal dung	US$ 7.5/sack (25 kg)
	Poly bag	US$ 7.5/kg
	Drum can (from IFAD)	US$ 25.0 /pc
	Jerry can	US$ 5.0 /pc
Food for training	Snack (coffee and sugar)	US$ 1.0/person
	Lunch	US$ 4.0/person
Transportation cost for facilitators	Fuel (5 lit/trip)	US$ 8.0/person
External facilitator	Salary and per diem	US$ 40.0 /person
Other miscellaneous	Fee for cookers	US$ 5.0 /person
	Stationary (flipchart, etc.)	US$ 100.0 /suco

Source: JICA Project Team (2014)