GOVERNMENT of PHILIPPINES

DEPARTMENT of AGRICULTURE

EUROPEAN COMMISSION

UPLAND DEVELOPMENT PROGRAMME
in SOUTHERN MINDANAO (ALA-97/68)

SUSTAINABLE AGRICULTURE GROUP

TRAINING MANUAL on SOIL and WATER CONSERVATION for the MUNICIPAL EXTENSION STAFF

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Overall Objective: Developing awareness among municipal extension staff on the detrimental effects of soil erosion, how erosion features can be recognized in the field and which simple and cost effective measures farmers can be carried out to reduce or stop the erosion process.

Participants from the Municipal Project Team (MPT), LGU staff:

- Team leader
- Agriculture Extension Specialist
- Agriculture Technician
- Municipal Support Officer (UDP staff)

from the Provincial Project Office (PPO), UDP hired staff:

- Provincial Manager
- Resource Management Specialist
- Agriculture Extension Specialist

from DENR

- Provincial LGU staff member (resource person)

from the farmer community

- Key farmer from each barangay (resource person)

Total number of participants for each province:

PPO1, CV : 6x 4 MPT staff + 3x PPO staff + 1x DENR + 6x farmers = 34
PPO2, DO : 9x 4 MPT staff + 3x PPO staff + 1x DENR + 9x farmers = 49
PPO3, DdS: 6x 4 MPT staff + 3x PPO staff + 1x DENR + 6x farmers = 34
PPO4, S : 6x 4 MPT staff + 3x PPO staff + 3x DENR + 6x farmers = 36
PPO5, SC : 3x 4 MPT staff + 3x PPO staff + 1x DENR + 3x farmers = 19
Total 172

Planning	One training per province. Each training lasts for two days including a visit to the field. Implementation of the training will start at PPO3 on 22-23 November 2000, followed by trainings at PPO4 on 5-6 December 2000, at PPO2 11-12 December 2000, at PPO1 on 14-15 December 2000 and at PPO5 on 19-20 December 2000. Follow-up trainings on all modules are envisaged, 3 months after the first training sessions. Optionally, visits to the research farm of ICRAF at Claveria, Misamis Oriental are envisaged.	
Venue	PPO1, Compastela Valley	: Manaklay Beach Resort at Mabini
	PPO2, Davao Oriental	: Tourism Center at Mati
	PPO3, Davao del Sur	: Mindanao Baptist Rural Life Center at Bansalan
	PPO4, Sarangani	: Bodega City at Kiamba
	PPO5, South Cotabato	: Agriculture Training Institute at Tantangan
	Selected Field Plots	
By whom	B.Hur imparts the training, assisted by A.Hamming. During the follow-up training the Agriculture Extension Specialist from PPO will also assist B.Hur.	
Materials	Handouts (in English and Cebuano; one copy for each Agriculture Technician), flip charts, white board, small and big sponge, spoon, bucket with clean water, bucket with muddy water, 2x glasses, towel, banner (in English).	
References	- Technical Notes on SWC, August 2000 - AEZ maps from San Isidro (first draft), November 2000 - Report on GIS Development (1st version), July 2000 - Land Use maps from CWP South Cotabato (first draft), November 2000 - Farming Guide No.3, ICRAF	

MODULE 1

HOW to RECOGNIZE EROSION

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 1: **HOW to RECOGNIZE EROSION**	
Objectives	At the end of the session the participants are able to recognize areas that are effected by erosion
Duration	45 minutes
Material Venue	White board, color markers, flip chart Class room at site, Selected field plot(s)

Topic	**Introduction**	Aids
Introduce	Welcome participants. Let them introduce themselves. Trainers introduce themselves.	
Discuss	The overall objective and the specific aims of each module	Flip Chart
Discuss	Water cycle: clouds, rainfall, transpiration through leaves, evaporation surface water, infiltration, storage in soil, percolation to groundwater, river, lake, see	White Board, Figure 1A
Ask	What do the participants know about erosion? Have they observed erosion features in the field? List features.	White Board
Discuss	Two types of soil erosion: (1) natural erosion = weathering mountains, hill etc., slow process and (2) man-made erosion = soil becomes susceptible to rain and wind after cutting trees and vegetation, quick process. Only man-made erosion is further discussed.	White Board
Discuss	Scope of erosion depends on <u>erosivity of water</u> and <u>erodibility of soil</u>. Erosivity of water depends on intensity of rainfall (duration, amount, kinetic energy raindrops). Erodibility of soil depends on: (1) slope (steep slope, high erodibility) (2) length run-off (long path, high erodibility) (3) tillage practice (ploughing increases erodibility) (4) soil texture (course soil, high erodibility) (5) soil structure (loose soil without structure, high erodibility)	White Board Figure 1B/D

	(6) organic matter (low om, high erodibility) (7) soil moisture (high sm, less infiltration, high erodibility) (8) ground cover (little cover, high erodibility)	
Ask/Discuss	How does erosion effect the environment, in general? Is it effecting the environment in the provinces, in particular? List the answers and discuss them (degrading environment, lower crop yields, sedimentation in rivers, silting up of drains and dam reservoirs, floods in lowlands, damage to roads, degrading coastal lowland etc).	Figure 1D White Board

Topic	**Symptoms of Erosion**	Aids
List	List different symptoms of erosion as they are visible in field (pedestals, stones on surface, exposed root systems, rills and gullies, sedimentation in rivers, muddy colored water, crop performance)	Flip Chart
Discuss	Occurrence of pedestals. Soil is washed out around roots. Stones and similar items protect soil from erosive raindrop, little mounds develop (page 5 reference report).	Flip Chart, Figure 1E and 2
Demonstrate	Show typical pedestals in demo-plot or under drip area of leaves from trees.	Field
Discuss	Occurrence of stones on surface and shallow topsoil. If whole layer of soil is washed away, stones will remain behind. Finer particles are removed. Big stones or hardpan become exposed (page 5/6 reference report).	Flip Chart, Figure 3, 4 and 5
Ask	Do participants think that shallow soil effects agriculture? How? In case all topsoil has disappeared, will it ever come back?	White Board
Demonstrate	Show exposed stones in field. Dig a hole till hardpan or bedrock. Explain that roots will not penetrate in hardpan and that its development is confined to shallow topsoil. Explain that with thicker topsoil, crop produce will be higher.	Field
Explain/Discuss	Occurrence of exposed roots. Root systems have ability to retain soil and water. If a part of the topsoil is washed out, the water holding capacity reduces.	Flip Chart, Figure 7
Demonstrate	Fill both sponges with water, squeeze them and collect water in glasses. Explain difference in water holding capacity between shallow, root free topsoil and thick topsoil with dense root system. Explain that shallow topsoil looses water more rapid than thicker topsoil and, hence, crops that grow on thicker topsoil can easier cope with dry spell.	Small + big sponge, bucket with water, two glasses
Ask/Discuss	Have participants ever observed natural fissures in soil? What do they indicate? Discuss difference between rills and gullies. Point out development of rills, starting start as small fissures around soil matrixes, usually present in fallow land or maize/cassava fields. Rills may develop at slopes < 15%. They rapidly develop into bigger fissures and end up in large,	Flip Chart, Figure 6, 8, 9, 10, 11, 12 and 13

	deep cut, drains, that are able to transport large amounts of water during and just after a heavy shower (page 6/7 reference report). Point out the devastating effects to crops, roads and other infrastructure.	
Show	Rills and gullies in field and in road.	Field, Road
Ask/Discuss	Have the participants ever noticed the yellowish color of water in gullies or in rivers? Have they ever observed mud plains after severe flooding? What does it indicate? Where does it usually appear, highlands or lowlands? Topsoil that is washed away collects in rills, gullies and eventually in rivers/sea. When flow velocities drop (lowlands) sediments deposit.	White Board, Figure 12, 14 and 15
Show	Stir muddy water in bucket. Fill one of the glasses and let it stand for 1 hour. Then fill other glass with same muddy water and compare color of water from both glasses. Explain the process of sedimentation once more.	Spoon, Bucket + muddy water, Glasses,
Discuss	Poor crop performance at higher slopes may be caused by loss of nutrients (organic matter) and clay particles. Low organic matter may indicate low fertility whereas soils with low organic matter and/or course structure are more susceptible to drought.	Figure 16 White Board
Demonstrate	Identify topsoil with low organic matter content and/or course structure. Crumble soil at different locations. Explain differences in organic matter (color topsoil, presence root and leave debris) and structure (clay versus sandy soil).	Field
Ask	Have the participants ever observed slides of gully slopes or road embankments? And land slides? What is the reason for this? How can it be prevented?	White Board
Explain	Point out that excess run-off may cause instability in shallow, sloping soils without vegetation cover. Water saturated, sloping soils start to collapse or slide under the weight of water. Technical interventions are discussed in Module 6.	White Board
Ask	Do participants think that environment has degenerated over time? If so, what are indicators? Do they think that it can be restored? How?	White Board

Discuss	Point out typical indicators of degenerated uplands: removal of forests at expense of less sustainable agriculture (maize, cassava), slash and burn, bare slopes, land slides, pasture lands with cogon (= low protein containing sturdy grass that out competes other weeds and grasses, not suitable for fodder).	White Board, Figures 17, 18, 20, 21, 22 and 23A

MODULE 2

EROSION PROCESS

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 2: **EROSION PROCESS**	
Objectives	At the end of the session the participants are able to understand the basics of the erosion process
Duration	30 minutes
Material Venue	White board, color markers, flip chart Class room at site, Selected Field Plot(s)

Topic	**Splash Erosion**	Aids
Ask	How is soil moved away? By wind? By rain? What will be effect on soil removal when rain shower is short-lived? And what if shower is long? Does it matter how much rain falls in a certain time period? Have you ever noticed soil dripping from leaves or from a rain gutter on the bare soil? What sort of impact does falling raindrops have on soil?	White Board
Explain/ Draw	Falling raindrops loosen topsoil. Smaller particles settle in between larger particles. A crust is formed that is not easily penetrated by water. Water flow is surface run-off. A vegetation cover reduces/prevents this process. The closer the cover the lesser the topsoil is loosened. Other factors that determine effect of splash erosion are (i) organic matter content (more OM, stronger binding soil particles, less impact), (ii) moisture content (very dry and very wet soils are more susceptible to raindrop impact) and (iii) type and texture (course soil is less susceptible to splash erosion; clods break impact of rain drops, after ploughing clods disappear and soil becomes more susceptible).	White Board, Figure 1E, 2 and 24
Ask/Discuss	How can splash erosion be prevented? List the options. Discuss briefly effects of ground cover on splash erosion: multi-store/fruit integration, forest trees, (pasture) cover crops and mulching.	White Board

Topic	**Stream Erosion**	Aids
Ask	What happens if water cannot penetrate into soil? Where will it go? Will water be clear or muddy?	White Board
Explain	The process of stream erosion. Soil particles loosen by raindrop splash. Are carried away by streaming water to lower grounds. With fine particles washed away, fields become stonier. The faster the flow, the less water will infiltrate in the soil. High stream velocities cause for scouring and rills start to develop. Stream erosion may cause high sediment load in run-off.	White Board, Figure 3, 25, 26 and 27
Ask	How can stream erosion by prevented? What sort of measures do you propose, agricultural and/or non-agricultural? List the options.	White Board
Discuss	Effects of contour farming, hedgerows and grass strips on stream erosion	
Discuss	Effects of technical interventions on stream erosion (pole barriers, bench terraces, wattling in rill, dam from boulders in gully or river). Refer to Module 6.	Flip Chart

Topic		Aids
Demonstrate	Install a wooden peg in ground and mark it there where it meets the ground surface. Remove little soil around the peg (stick). Explain how the layer of eroded soil can be measured using the stick.	Figure 23B
Demonstrate	Show the soil trap at the MBLRC test plot (if applicable). Explain the function of soil strap.	Figure 23B, 23C
Demonstrate	To illustrate how splash and stream erosion correlates, the following example is given:	
	Imagine an unexpected rain shower. From the shelter of a house the clatter of raindrops can be heard on the roof giving an indication of the force with which it is hitting the soil too. Venturing outside, an interesting comparison can be made. It will of course be noticed that the roof remains impeccably intact owing to the resistance it offers to the force of the rain. If rain is falling on the bare soil, however, it will be washed away, something you might actually see.	Rain Shower, House
	The force of the falling raindrops can be made visual at	Rain

	places where rain has dropped from a fairly tall height, such as from a roof or a solitary banana palm. Small hollows are formed in the soil surface. Look also at the stems of plants (or at the side of a house where rain splashes down from the roof).	Shower, Banana Tree
	Notice the height to which the soil particles are spattered by the force of the rain. This can be demonstrated by holding up a piece of white paper and see how mud-splashed it becomes. Notice soil particles on the lower sides of maize stalks. To illustrate the force of the rain: Look at the water in a puddle of a few millimeters where the rain is beating down. This is reddish or brown, because of the soil particles.	Rain Shower, Piece of White Paper, Rain Shower, Water Puddle
	The structure of the soil remains much better in condition if the soil is protected from the direct force of the raindrops (by a crop cover or a stone for example). Water can penetrate more easily into the pores of the soil, which have not yet been clogged up by the rain washed particles.	
	To illustrate protection of the soil against the erosive force of rainfall: During a shower; put a coin on the soil and leave it there for a while. Look at it later and you may see it lying, as it were, on a little mound. Not only have the pores in the surrounding soil become pressed together (which slows down infiltration), but also a quantity of soil will have been transported from the field. If the coin cannot be found again this will convince you that erosion costs money! Remember that this thin layer of soil, which covered the whole field once is a considerable amount, has disappeared now as a result of the combined action of splash and stream erosion.	Rain Shower, Coin
	It is interesting to know whether the rainstorm that you have just experienced was an exceptionally heavy one. Or that heavier showers can be expected which are even more disastrous for the soil, especially at a time that the field lies bare, awaiting the next downpour. Note: A heavy rainstorm is just as erosive as rain falling less heavily over a longer period.	

MODULE 3

AGRONOMIC METHODS

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 3: **AGRONOMIC MEASURES**	
Objectives	At the end of the session the participants have an understanding of a number of simple and cost effective agriculture measures to mitigate and stop the erosion process
Duration	4 hours
Material Venue	White board, color markers, flip chart Class room at site, Field

Topic	**Introduction**	Aids
Ask, list	What kind of agricultural measures may mitigate or stop erosion process? Which measures are most effective? List options. Are these feasible in barangays? Which measures are thought to be adopted by farmers more likely than others.	White Board
Explain	Four kinds of proposed agronomic measures: land preparation, contour/strip farming, cover crops/mulching, multiple cropping systems. Emphasize that integration of these measures with arable farming makes it more likely to be adopted. Each measure should be valued on its merits. Some measures are simple and cheap, others require more input (seeds/seedlings, labor).	Flip Chart
Ask	Is there a relation between altitude/slope/rainfall and crop selection?	
Explain	Selection of crop species depend on, among others, on area's slope and altitude as well as rainfall, in particular number of dry months. Refer to Module 4.	White Board

Topic	**Land Preparation**	Aids
Ask, list	What are common land preparation practices? What is effect of ploughing on soil erosion?	White Board
Explain	Tillage loosens soil and makes it more susceptible to splash erosion. Ploughing is not advisable on slopes > 18%. At slopes < 18% minimum tillage is recommended. Minimum tillage: (i) Ploughing in between the stubbles of the previous crop, (ii) Only ploughing were crops will be planted, (iii) Reduce number of tillage operations, (iv) Plough short before planting of new crop, (v) After ploughing, cover soil with mulch before new crop has established.	White Board, Figure 28, Figure 30
Ask, Discuss	Do the participants envisage resistance among farmers when they convey this message? Explain that farmers can save substantially in labor by reducing the number of tillage operations.	White Board

Topic	**Contour and Strip Farming**	Aids
Ask	Do participants know what contours are? Have they heard about contour farming?	White Board
Explain	Contour farming is combination of contour ploughing and contour planting. Ploughing and planting along contours (Figure 31 A-B-D and Figure 32) and not downslope. Why? Water is prevented from run-off down slope. Reduction in both quantity and velocity of run-off. It increases water absorption.	White Board, Figure 29, 31 and 32
Ask	Do farmers plough along the contours usually? If not what is reason for not doing so? Ignorance? Difficulties in finding contours? Size and shape field plots?	White Board
Explain	Contours can be set using the A-frame, in an easy and cost effective manner. Point out that guidelines are provided	Last three pages of Hand-Out
Ask	Have they observed contour hedges of leguminous species in barangays? What is purpose of these rows regarding soil conservation? What other advantages have hedgerows? Are there any setbacks? List them.	White Board
Explain	Concept hedgerows/alley crops. Recommended spacing and thickness. Dense planting creates a vegetative barrier that intercepts water and soil particles forwarded by run-off. Hedgerow cuttings provide for (i) mulch (stop splash erosion), (ii) fodder (cut & carry), (iii) nutrients (after decomposition of leguminous leaves). Hedgerow seeds can be sold. By ploughing parallel to hedgerows, plough ridges follow contours. Setbacks are expensive establishment (dense spacing), labor-intensive maintenance, loss of area for alley crops (25-35% depending on spacing), shading effect on alley crops and non-production of food or cash crop.	White Board, Figure 33, 34, 35 and 36
Ask	Which hedgerow species do participants know? Are they effective regarding soil erosion?	White Board
Explain	Extensive research at MBLRC research farm shows leguminous hedgerows species such as Ipil-ipil, Flemingia, Madre de Cacao, Flemingia and Rensonii are effective to	White Board, Figure 37,

	stop run-off. Cuttings are effective organic fertilizers or are used as fodder or mulch. Technique has not been adopted at a large scale due to lack of seeds and high labor input.	38, 39 and 40
Ask	Are there alternatives to hedgerow species?	
Discuss	Grass strips as alternatives. Use indigenous species (NVS, Natural Vegetative Strips) or plant Elephant or Guinea grass. Advantages: stops run-off, effective trap for soil particles, rapid establishment, seeds easily available, rapid propagation, low maintenance input, prevents rats (Guinea grass), few shading on alley crops, good fodder. Disadvantages: in-effective organic fertilizer, less suitable for mulch.	White Board,, Figure 41, 42, 43, 44A and 44B
Discuss	Concept of strip farming. Different types of crops planted in separate strips. Works well with crop rotation. Strips, which do not stand up to erosion well, are alternated with strips, which can withstand erosion (buffer strips). Common combinations are (1) corn and grass, (2) grass mixtures and leguminous cover crops (pastures), (3) coconut/coffee and corn/vegetables, (4) ploughed strips with crops and unploughed strips where natural vegetation establishes. Here, over time natural terraces develop, as soil particles are trapped.	White Board, Figure 44C

Topic	**Cover Crops and Mulching**	Aids
Ask	What is advantage of using cover crops for soil conservation? Are participants familiar with any cover crop? What is effect on erosion? Does it mitigate splash or stream erosion?	White Board
Explain	Cover crops provide for protective cover to mitigate or stop raindrop splash. Temporary or permanent covers of fast growing annual or perennial plants. Advantages: (1) minimizes erosion and soil loss, (2) adds organic fertilizer to topsoil, (3) controls temperature (favorable for seed germination, crop's root growth, growth micro organisms), (4) releases phosphate, (5) limits weed growth, (6) edibles: beans, peas, peanuts, (7) use as pastures (Kudzu, Centro, forage peanut, Green leaf desmodium and Stylo).	White Board Figures 45, 46, 47, 48
Discuss/Ask	Selection criteria for cover crops are: (1) rapid propagation, (2) green manuring (preferably nitrogen fixing, leguminous),	Table A

	(3) edibility and (4) forage. Do participants recognize any of the cover crops in Table A and/or Figures?	
Explain	Recommended applications: (1) Non-leguminous cover crops are grasses (see also "Grass Strips"). For pastures in combination with leguminous cover crops; (2) Soybean after velvet bean (legume). Velvet beans produces edible seeds rich in protein and carbohydrates and green manure. Soybean yield significantly increases; (3) Lablab (legume) intercropped with corn (Southern Luzon). Edible pods, fodder and green manure. Sown together with corn to avoid insect attacks. By the time lablab shades corn, corn cobs are due to harvest; (4) Cowpea (legume) for acid soils, prior to corn or upland rice; (5) Centro (slow starter legume) and kudzu (fast grower) under coconuts. Other combination is Calopo (fast grower) and Siratro (drought tolerant).	White Board, Figure 49
Ask	Are the participants familiar with <u>mulching</u>? What is effect on erosion? Is it applied in barangays. If not, why?	White Board
Explain	Mulching is soil cover with organic residues (straw, corn, stalks). Very effective to cope with splash erosion. Optimum covers 70-75%. Advantages: see (1)-(5) under cover crops. Disadvantage: risk for pests, in particular for corn and sugar cane when they are not grown in combination with other crops. Mulching before on-set of rainy season, sowing in openings in mulch or in rows, cleared by removing mulch.	White Board, Figure 50, 51 and 52
Discuss	Mulching practices in Southern Mindanao: (1) cuttings hedgerow species, much biomass for mulch or fodder; (2) rotation two corn crops with a legume like corn, cowpea and soy bean, cuttings equally spread (corn stubbles ploughed under, peanut plants are pulled and ploughed under after picking the pods	White Board
Explain	For young fruit trees better to use more persistent mulch like vetiver grass. Slow decay. More durable cover. Vetiver grass in strips to block run-off. Cogon less suitable for mulch as the cuttings easily start growing and spread rapidly.	White Board

Topic	**Cropping Systems**	Aids
Ask	Are the participants familiar with crop rotation? Is it applied in barangays? Examples? What are the advantages? List.	White Board
Discuss	Crop rotation follows a system of alternating grain crops with legumes. Legumes provide soil with nutrients that are consumed by grains. Other advantage: breaks cycle of building up pests and diseases. Point out the five-group plantation rotation cycle, which is effective in breaking the cycle of pests and diseases (see page 30 Technical Notes).	Flip Chart
Ask	Are the participants familiar with relay planting? Is it applied in barangays? Examples? What are advantages? List.	White Board
Discuss	Relay planting is planting/sowing of second crop before the harvest of first one. Advantage: reduce demand for soil cultivation and weeding. No fallow period. Example: corn with a legume crop e.g. peanut or mungbean.	White Board
Discuss	Bush fallow allows farmland to rest after continuous cultivation. Leguminous trees like Ipil-ipil are appropriate. It prevents invasion of weeds like cogon and Hagonoy weed. Ipil-ipil propagates rapidly, produce N, dense stand facilitates soil conservation, shades out weeds. Is it applied in barangays. Examples?	White Board
Ask Ask/Discuss	Are the participants familiar with multi-store cropping? Is it practiced in barangays? Examples? What are advantages? List.	White Board
Discuss	Perennial fruit trees with industrial crops. Advantages: long term protection against erosion, long term source of income, prevents weed invasion, stabilizes soil (deep roots). Smaller trees are shade tolerant. Examples see page 32 Technical Notes.	White Board, Figure 53 and 54
Ask	Are there examples of integrated pasture cover crops and grasses underneath permanent crops?	White Board
Discuss	Shade tolerant cover crops or grasses such as Green leaf Desmodium, Stylo, forage peanut, Guinea grass under coconut, rubber or coffee. Beware of overgrazing and	White

Explain	indiscriminate trampling of ruminants (goats, cattle). <u>Integration of fruit trees with annual crops</u>. Mono cropping of annual crops to be replaced by gradual introduction of perennials like fruit trees. More sustainable, cash generating practice, better protection against erosion. Discuss Table B. Point out that crop choice depends on availability seedlings, rainfall, elevation and maintenance requirements. Further elaboration in Module 4.	Board, Figure 55 Flip Chart, Figure 56, Table B

MODULE 4

CROPS, AGRO-ECOLOGICAL ZONING and COMMUNITY WATERSHED PLAN

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 4: **CROPS, AGRO-ECOLOGICAL ZONING and COMMUNITY WATERSHED PLAN**	
Objectives	At the end of the session the participants know how to practically use AEZ in their extension to the farmers.
Duration	30 minutes
Material Venue	White board, color markers, flip chart Class room at site

Topic	**Crops, Agro-ecological Zoning and Community Watershed Plan**	Aids
Ask	What do participants know about AEZ? How do they think it can be effectively used in extension on SWC?	White Board
Discuss	What is AEZ? Altitude and slope classes as major ingredients. Other features like rainfall, soil texture, soil depth, parent material (sub classes, see Notes Resource Management). Crop selection versus AEZ. Slope and altitude class boundaries for AEZ are rigid but are indicative for crop selection. Flexible interpretation.	Flip Chart, Table C and D
Explain/ Discuss	Base maps and AEZ maps at municipal and barangay level. Ingredients: province/municipality/barangay boundaries, water shed boundaries, rivers, roads, barangay halls, sitio centers etc, contour lines, AEZ classes.	White B., Figure 57, 58, 59, 60, 61
Explain/ Discuss	Rainfall versus crop selection. Annual rainfall varies between 1,000-3,000mm in S.Mindanao. More important are number of dry months. Defines crop choice. Refer to Tables to B.	Table E, Figure 64
Explain	CWP maps. Sketch from sitio, prepared by community. It shows present and proposed land use (agriculture, grassland, forest, locations with landslides, tracks etc).	White Board, Figure 65 and 66
Ask	Participants to study the CWP existing and proposed land use maps from Handout. What is the community's	

	preference for forest trees (species) or for agriculture (annual/perennial, crop species) area wise. Why forest trees along sitio boundaries?	
Ask/Discuss	How to use AEZ and the CWP for planning on agronomic soil measures?	Flip Chart
	Methodology: Look in Table C and D for preferred trees and crops. See in which altitude class and slope class it falls. Look at AEZ map for altitude and slope of the envisaged field plot or sitio. Cross check with field measurements (alti meter and clino meter readings).	Figure 63B
	The contour maps of the watershed (100 m contours) and sub-watersheds (20 m contours) can be used to double-check altitudes and slopes in the field. For determining the altitude and slope in a particular field plot it is advised to use the actual clino and alti -meter readings.	Figure 62 and 63A
	Verify actual altitude and slope readings with altitude and slope recommendations in Table C and D.	
	Look at Table B for more detailed info on crop specific info on altitude. Verify actual altitude once more with altitude. Does it match?	
	Look at Table B for the crop's rainfall requirements and verify with Table E and Figure 64. Does it match? Point out that Table E and Figure 64 are only indicative providing average data, excluding dry spells that may occur every 3-4 years.	
Case	Split participants into groups. Select a location on AEZ barangay map. Farmers plan to plant mahogany, coconut with arabica coffee, citrus, avocado integrated with Madre de cacao (hedgerows), forage peanut and corn. Actual clino and alti meter readings are given. Ask participants to determine feasibility of cultivating envisaged crops based on maps, tables and actual readings.	Flip Chart

MODULE 5

WATER CONSERVATION

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 5: **WATER CONSERVATION**	
Objectives	At the end of the session the participants understand that water conservation can be achieved by soil conservation, in general and by small scale integrated fishponds, in particular.
Duration	1 hour
Material Venue	White board, color markers, flip chart Class room at site, Selected field plot(s)

Topic	**Introduction**	Aids
Ask	The importance to conserve water in uplands? Why? Is water storage sufficient at present? Where? What are effects on environment if water cannot be stored sufficiently? Are there ways to increase water-holding capacity of uplands?	White Board
Explain	Water storage versus run-off. Tree roots promote soil conservation and hence water conservation. Thick topsoil stores more water than shallow topsoil (refer to sponge test). In uplands, water-holding capacity has gradually decreased due to logging and slash & burn. Water conservation through soil conservation on long term.	
Explain	Short term measures with direct effect: water conservation by blocking water flow in streams or by creating ponds. Infiltration increases. Intercepts run-off and reduces flow velocities, so less scouring. Excess drainage water used to fill pond. Use pond for breeding fish to make it more attractive for farmers. High protein source and extra revenue.	White Board

Topic	**Fishpond, an Integrated Model**	Aids
Ask	How can fishpond be integrated in existing agricultural or husbandry practices?	White Board
Discuss	Concept of integrated fishpond: Breeding of tilapia and/or catfish can well be integrated with animal husbandry and (goats, pigs) and vegetable gardens. Integration with vegetable gardens and animal husbandry is based on	White Board, Figure 67 and 71

	principle to maximize use of all available water and land resources: Goat, pig and poultry manure as nutrients for algae and aquatic weeds. Algae and weeds are food for fish (when algae growth is limited add in-organic phosphate fertilizer, in porous bag, suspending in water, hanging from a pole. Or use termite mounds placed on mounts. Slices from mounts drop in water). Construct housing for animal husbandry next to pond to save on labor. Excess water to irrigated vegetable garden (or young orchards) dry spells. Sludge from pond is fertilizer for vegetable garden.	Figure 68, 69 and 70 Figure 67

Topic	**Site Selection, Soil Investigations and Water Sources**	Aids
Discuss	Site selection: Land to be used should be of marginal utility for regular cropping. Not productive land. Vicinity of water sources i.e. perennial surface flows or springs. Not prone to flash floods. Selected area without hard rocks, anthills, cracked or broken soil (difficult to seal bottom), no shading from surrounding vegetation (hampers algae growth, less dissolved oxygen). Rectangular ponds. North to south in order to maximize sunlight hitting pond. Sunlight is good for plankton production.	White Board
Ask	Have the participants experience and knowledge about soil texture, structure, organic matter content etc?	
Discuss	Soil Investigations: Importance of examining soil up to 2 meters. Exclude soils with different layers. Preferably medium heavy soils (clay-loams) to minimize water loss. Make 2-meter deep pit, fill with water and determine how much water is lost over a certain period. Clay soils are less suitable as they cause excessive turbidity. pH 4-11.	White Board
Ask	What are the perennial water sources in barangays, if any? Will it provide enough water for small fishponds?	White Board
Discuss	Water source should maintain water depth of 0.5-1.0 meter throughout the year. Streams, springs. If inflow is too high then large amounts of algae may be flushed from pond. When inflow is too low, water quality may suffer from oxygen depletion and/or accumulation of toxic substances. Fill pond by gravity. Favorable topography allows for gravity filling and draining. If diverted stream water is used, construct dam in stream to	White Board

	lift water and create buffer. Perennial flows are required. Diverting water through unlined channels, and drop structures (when velocities are too high). If diverted spring water is a used use open, interconnected bamboo pole supported by beams. (consistent volume of high quality water, low discharges, large distances that are to be bridged between spring and pond). Construction concrete intake box recommended to facilitate interception of spring water, so to avoid day light point to collapse or silt up.	Figure 73

Topic	**Design and Construction Fish Pond**	Aids
Ask	Have the participants any idea about the size of a fishpond? What are the considerations?	White Board
Discuss	Design pond. Size depends on use. Source for supplementary source of food or for extra revenue. Generally, small farm family easily manages pond measuring 2,000- 3,000 square meters. Larger ponds will likely require additional expenditures (hiring of outside labor for maintenance and harvest activities). Ponds smaller than 2,000 square meters do not usually produce enough fish, except in unusual circumstances, to be harvested for profit. These ponds are for food source for one family only. Farmers with little or no experience with fresh water aquaculture, start with 200-300 m2. Over time new basins can be constructed or existing ones expanded. Pond depth should vary from 0.5 to 1 m.	White Board
Discuss	Construction: Clear trees, shrubs and vegetation from inside pond (decomposition of vegetation will contribute tannic acid to water, thereby causing water acidity). Pond embankments are constructed large and strong enough to withstand floods. Before construction, clean embankment area of rocks, vegetation and other debris, and remove and save top 10 cm of topsoil for pond bottom. Construct each embankment gradually, about 20 cm at a time. Compact each layer before next layer is put down. Slope of inside embankment (facing the water) should be 1:2 (vertical over horizontal) if soil is mostly clay and 1:3 if it is	White Board Figure 74

	silty or sandy. Outside slope ratio should be 1:1.5. In small ponds (less than 0.2 ha) there is a tendency to construct embankments of much steeper slopes to maximize pond's surface area and volume but not recommended as this practice, however, results in constant maintenance problems (collapsing slopes). Plant embankments with grass in order to prevent erosion. Ideally, type of grass selected should be fast growing so it may be harvested and fed to the herbivorous fish. Thick, heavy grass cover is a potential source of habitation for vermin, such as rats and snakes. Planting of *kangkong* is also recommended as it provides fish food.	

MODULE 6

TECHNICAL METHODS

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 6: **TECHNICAL METHODS**	
Objectives	At the end of the session the participants understand the basic design of a number of simple, technical measures to reduce run-off that are related to protect slopes and embankments from erosion.
Duration	30 minutes
Material Venue	White board, color markers, flip chart Class room at site, Selected field plot(s)

Topic	**Technical Methods**	Aids
Discuss	Purpose of technical measures. Controlling run-off by non-agricultural measures. Reduction in velocity and quantity run-off in field plots, embankments and streams. Same principle already discussed under vegetative barriers (hedgerows and grass strips). Measures can be implemented at (1) farm level, (2) slope level and (3) watershed level. (1) Beneficiary is farmer. Implementation by farmers himself. Reduction overland flow. Result: prevent soil loss and development rills. Benefits farmer's land. Measures: pole barriers, bench terraces; (2) Beneficiaries are farmer or group of farmers. Implementation by beneficiaries or contractor. Reduction and guidance run-off in streams, and slope/embankment protection. Result: prevent scouring, water storage behind dams (source for irrigation), and prevent collapse of slopes and embankments, control gully development. Benefit for dwellers down slope. Measures: wattling, dam in streambed, gabions, stone pitching and bamboo planting. (3) Beneficiaries are watershed community, in general and lowland community, in particular. Implementation by whole community or government, based on development plan. Works are large scale and expensive, through self-help or contractor. Improve water conservation. Results: water holding capacity topsoil improves, maintain topsoil, stop development rills and gullies, and reduce risk of silting up	Flip Chart

	streams/flooding/damage. Measures: reforestation, improvement of streams/rivers to prevent flooding in lower regions, terracing on large scale. Possibility for farmers to receive aid from UDP in terms of design and funding for preventive and repair works. Procedure: farmers identify problem spots (land slide, slope/embankment collapse, scouring gully eats road etc).	
Discuss	Farmers + LGU staff assess scope of works, LGU staff present plan for preventive/rehabilitation works and submit to PPO. PPO informs Agriculture Infrastructure Coordinator for follow up	White Board
Discuss	Pole barriers. Constructed on contours. Prevent soil loss by blocking overland flow. Soil piles up before the barrier. Gradually terraces are built up. As slope decreases so will the velocity of running water. Branches, tree poles are placed along the contours, fastened together by rope and kept in place by stakes. Select appropriate materials. Try on smaller area before expanding. Termites may eat stakes.	White Board, Flip Chart, Figure 75
Disuses	Terraces. Prevent water to flow too quickly over a sloping field. Terraces may form in a natural way by planting hedgerows, grass strips or pole barriers. Or by leveling out soil. Is labor intensive. Use of plough. Size terraces depends on slope. Steep slopes allow for small terraces only. Rule of thumb: 40% slope terrace width 5-10 m, 10% slope width 10-20 m. Length varies according local situation, obstacles, land ownership etc. Not too long to avoid scouring in drain. Terraces boarded by earthen bunds or benches made form boulders and cement. Up slope drains run parallel bund/bench, to drain excess water so to avoid flooding and building up high water pressure (terrace collapse in steep areas). Size drain depends on size terrace, experience will tell.	White Board, Flip Chart, Figure 76
Discuss	Check dams. Slows down force of water in drainage ditches, streams or natural watercourse. Made from (1) branches (wattling) or (2) boulders/cement. (1) For small flows use wattling. Strong pegs or stakes are driven into ground across canal, in a straight line, extending one meter outside canal on both sides. Use plant that is propagated by cuttings (bamboo, Madre de cacao) so cuttings will grow and form living barrier. Weave branches	White Board, Flip Chart, Figure 77 and 78

	between stakes. Stones or other material on top structure. Dam is permeable. Water slowed down. Sediments are deposited. Regular cleaning down slope dam. (2) For high forceful flows use boulders + grouting. Collect boulders in riverbed. Allow for overflow by constructing spill (lower part) in dam. For big dams technical assistance is required from UDP.	
Discuss	Slope protection by (1) stone pitching (riprap, with or without grouting) and (2) gabions. (1) Collect stones (not boulders from riverbed) near hillside. Stones are piled up on top of each other against hill slope or embankment. To stabilize structure, grout with mortar from (a) sand/cement, expensive or (b) dehydrated/burned limestone with fine sand (1:4) and water or (c) ash with water. Use loose soil for backfill. (2) Gabions are sold in hardware shops. Use of galvanized wire for gabions is not commonly practiced in Mindanao Enterprising engineers use chicken wire, hog wire (pig fencing) or cyclone wire (fencing). Size standard gabion is 0.5x1.0x2.0m. Place cornstalks/grasses/bamboo stalks and big clumps (10-20cm) from hard soil or limestone against inner side. Fill remainder gabion with soil	White Board, Flip Chart, Figure 79 and 80
Discuss	Embankment protection by bamboo. Bamboo is fast growing grass species. Good source for building materials. Roots stabilize soil earthen embankments of roads and streams.	White Board, Flip Chart, Figure 81

MODULE 7

STRATEGY EXTENSION

Instruction sheet

UPLAND DEVELOPMENT PROJECT TRAINING MANUAL Module 7: **STRATEGY EXTENSION**	
Objectives	At the end of the session the participants understand the methodology of conveying the extension messages to the farmers
Duration	30 minutes
Material Venue	White board, color markers, flip chart Class room at site

Topic	**Strategy Extension**	Aids
Ask	How will participants convey message on SWC to farmers? What is preferable strategy/method?	Flip Chart
Explain	Short term, simple, cost effective interventions and long term interventions:	
Explain	<u>Short term strategies</u> ▪ introduce, promote and reinforce use of cover crops ▪ reinforce minimum tillage along contours ▪ introduce and promote mulching technologies ▪ reinforce use of green manure	Flip Chart
Ask/ Discuss	Are participants happy with these strategies? Discuss alternatives.	Flip Chart
Explain	<u>Medium-long term strategies</u>: ▪ promote cultivation of fruit trees (mango, durian, lanzones, mangosteen, jack fruit, marang etc) integrated with established industrial crops (coffee, coconut, abaca) ▪ introduce and assist in establishment of small scale community and/or individual, farmer managed nurseries with emphasis on cultivation of fruit and forest trees ▪ promote establishment of vegetative barriers such as leguminous or vetiver grass hedgerows and NVS ▪ point out disadvantages of mono-cropping and benefits of crop rotation for pest and disease control, and nutrient balance ▪ point out advantages of organic farming without	Flip Chart

	excluding modest inputs of inorganic fertilizers ▪ introduce planting of fast growing, densely spaced, forest trees at steep slopes (> 30%) keeping an eye on the existing demand and infrastructure of wood processing facilities (e.g. *leucaena* for charcoal, firewood, furniture etc) ▪ promote water impounding structures and maximize use through fish culture) ▪ point out benefits small scale infra structural works (bamboo establishment on road and stream banks, gabions for slope stabilization and protection, dams, stone pitching etc)	
Ask/Discuss	Are participants happy with these strategies? Discuss alternatives.	Flip Chart
Discuss	Integration of SWC measures with CWP and individual farm plan.	White Board
Discuss	Tools and means to convey extension message on SWC: (a) AT's will visit individual farmers frequently and explain SWC measures using extension materials such as "CID's" extension sheet/ farmers' certificate and relevant photo's and sketches from hand-out training; (b) AT's will visit monthly meetings among farmer' communities and/or tribal groups and/or women groups and discuss SWC (c) AT's will bring farmers to demonstration plot on SWC and organize demonstrations on setting contours applying the A-frame (d) AT's will bring farmers to nurseries as developed and strengthened by UDP (e) AT's will use monitoring surveys (every three months) to convey the SWC message (f) AT's will organize inter-sitio or inter-barangay visits, visits to progressive sites where farmers have adopted successfully SWC measures (g) PMO will organize study tours with AT's and key farmers to ICRAF Claveria and MBRLC for exposure to NVS (natural vegetative grass strips) and SALT (leguminous hedgerow) technologies.	Flip Chart, Figure 82

Topic	**Evaluation Training**	Aids
Ask/Discuss	Are objectives of training met? See first sheet flip chart. Do	Flip Chart

	participants think that that can convey the message to farmers? Discuss alternatives/comments.	
Discuss	Point out that follow-up training is envisaged three months later. Point out that Sustainable Agriculture Component is ready to help participants in their extension work when encountering problems.	Flip Chart
Say	Thank participants for attendance and (active) participation (if applicable). Closure.	