



**Food and Agriculture  
Organization of the  
United Nations**



## **Handbook for Farmer Field School**

**on**

## **Climate Smart Agriculture**



**in**

**upland/hill zone of Chin State**

**Myanmar**

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**“Sustainable Cropland and Forest Management in Priority Agro-  
ecosystems of Myanmar (GCP/MYA/017/GFF)”**

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## Foreword

The Food and Agriculture Organization of the United Nations (FAO) is implementing a project entitled “Sustainable Cropland and forest management in priority agro-ecosystems of Myanmar (SLM-GEF)” in coordination with the Ministry of Natural Resources and Environmental Conservation (MoNREC) and the Ministry of Agriculture, Livestock and Irrigation (MoALI) with funding from the Global Environment Facility (GEF).

The project aims to facilitate and strengthen sustainable land management (SLM), sustainable forest management (SFM), and climate-smart agriculture (CSA). The project facilitates the adoption of CSA policies and practices that will help to sustainably increase productivity, enhance resilience, reduce/remove GHGs and enhance achievement of national food security and development goals. At field level, the project is active in five pilot Townships from three different agro-ecological zones implementing various relevant CSA initiatives mainly using Farmer Field Schools (FFS) models.

- Upland/hill Pilot Site: Mindat and Kanpetlet Townships, Chin State
- Coastal/Delta Zone Pilot Site: Laputta Township, Ayeyarwady Region
- Central Dry Zone Pilot Site: Kyaukpadaung and Nyaung U Townships, Mandalay Region

AVSI Foundation was contracted as a Service Provider to develop the FFS curriculum and FFS Handbook for each of the above mentioned three agro-ecological zones. Accordingly, FFS curricula/modules on CSA techniques/practices for the prioritized agricultural crops and cropping systems under each of the three agro-ecological zones have been developed incorporating solutions to the major problems identified during the need assessments and also considering the findings of value chain analysis. After finalizing the FFS curricula, a FFS Handbook has been developed for each agro-ecological zone both in Myanmar and English version. This handbook is intended to help the Extension Workers, FFS Facilitators and FFS Committee/farmers to implement FFS on CSA techniques and practices in upland/hill zone of Chin State and scaling up the learnings in similar areas of Myanmar.

Ms. Xiaojie Fan  
FAO Representative in Myanmar

## Abbreviations

AESA	Agroecosystem Analysis
AVSI	Association of Volunteers in International Service
BMP	Best Management Practice
CA	Conservation Agriculture
CSA	Climate Smart Agriculture
DoA	Department of Agriculture
EM	Effective Microorganisms
FAA	Fish Amino Acid
FAAB	Farming as A Business
FAO	Food and Agriculture Organization of United Nations
FFS	Farmer Field School
FYM	Farm Yard Manure
GAP	Good Agricultural Practice
GEF	Global Environmental Facility
GFF	Global Financing Facility
GHG	Green House Gas
IMO	Indigenous Micro Organism
IPM	Integrated Pest Management
MoALI	Ministry of Agriculture, Livestock and Irrigation
MoNREC	Ministry of Natural Resources and Environmental Conservation
MRL	Minimum Residue Levels
MYA	Myanmar
NFTS	Nitrogen Fixing Trees and Shrubs
PTD	Participatory Technology Development
QSMAS	Quesungual Slash and Mulch Agroforestry System
SA	Sustainable Agriculture
SALT	Sloping Agriculture Land Technology
SFM	Sustainable Forest Management
SLM	Sustainable Land Management

# 1. Pre-Farmer Field School Introductory Meeting

<b>Month:</b>	April
<b>Week/Date:</b>	First Week
<b>Time/Duration:</b>	Two Hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture, Mindat and Kanpalet)
<b>Material:</b>	Flipcharts, Marker pens, Training handout

## Topics to be covered:

1. Objectives of FFS, guiding principle, FFS Farmers selection, FFS Committee formation, selection of Lead Farmer, etc.
2. Introduction of participants: facilitator, technical specialist, participants from villages
3. Site selection for establishing demonstration plot (in Lead Farmer's Field) also discussion and agreement on size (one acre), treatment to be included and layout of the demonstration plot.
4. Introduction of crops that will be covered in FFS training (Avocado, Coffee, Yam).
5. Collection of soil samples for soil analysis that will be sent to soil lab to get the base line data of pH, soil texture, electrical conductivity, organic carbon, nutrient contents (N, P, K, Ca, Mg, S, Zn, B) and Na and related radicals (Cl, CO<sub>3</sub> and HCO<sub>3</sub>).

## Related Training Reference Materials:

### 1.1 Introduction and Objectives of Farmer Field School

The **Farmer Field School (FFS)** is a learning process whereby a group of farmers come together and engage in a process of hands-on field-based learning process over a season/production cycle. FFS is a time-bound learning by doing activity with a beginning and an end and aims to solve the problems related to cultivating crops.

FFS is a platform for holistic learning and should address issues and aspects that directly or indirectly contribute to the performance of the local farming system, even if these issues are not agriculture-based as such.

All FFS programmes need to integrate programming on gender equality and nutrition concerns in FFS development. Gender norms, roles and customs are very relevant for FFS implementation



such as assessment and targeting of the specific needs of male and female farmers, selection and gender awareness of facilitators, and composition of an FFS group (with adequate representation of women and girls) and targeting the specific needs and priorities of men and women.

This module of FFS has been designed to increase agricultural productivity of the priority crops in Mindat and Kanpetlet Townships, Chin State (Upland/Hills) by addressing the challenges identified during the needs assessment analysis conducted based on knowledge systems and practices by FAO with support of AVSI as a Service Provider. During the need assessment cultural barriers for FFS implementation, gender norms, traditions, etc. were considered. Generally, it's been observed that farmers, both men and women, have low knowledge of climate smart agriculture (CSA). The learning objectives of this module are to:

- Empower farmers with knowledge and skills to improve the productivity of the priority crops.
- Sharpen the farmers' ability to make critical and informed decisions that render their farming profitable and climate-smart.
- To sensitize farmers in new ways of thinking and problem solving regarding climate challenges.
- Help farmers learn how to organize themselves and their communities, with a focus on women and girls.

## **1.2 Key Steps of FFS Implementation**

FFS implementation follows a following three phases approach in a crop season depending upon the duration of the crop cultivation.

### **I. Preparatory Phase**

- a. Situation Analysis,
- b. Village selection for FFS implementation,
- c. Farmers selection for FFS,
- d. FFS group formation and organization,
- e. Selection and training of facilitators,
- f. Selection of learning activity/enterprise, and
- g. Design and setup of the FFS experimental field (demonstration plots). This is to compare current practices with improved/alternative practices.



## **II. Basic FFS Cycle**

- a. Regular learning cycles/sessions,
- b. Evaluating participatory technology development (PTD) activities,
- c. Gender-sensitive monitoring and evaluation to assess the different impacts on men and women.
- d. Conducting field day (at the end of the season),
- e. Organizing exchange visits (Exchange visits with other FFS), and
- f. Organizing graduation ceremony.

## **III. Post-graduation Phase**

- a. Follow up activities,
- b. Networking, and
- c. Income generation and setting up second generation FFS, especially when new livelihood opportunities or challenges arise.

### **1.3 Pre-FFS Preparation**

#### **(a) Village Selection for the Establishment of FFS**

There will be one FFS organized in each of the selected villages. FFS villages should be selected considering the following criteria:

- The villages should represent the specified agro-ecological zone.
- The villages should fall in the given pilot Township.
- The villages should be selected in such a way that they should represent the various variabilities within the given agro-ecological zone.
- The community in the village must be interested in and willing to take part in FFS activities. The community in the village should be informed about the FFS to be established in order to obtain formal consent and interest to partake in FFS activities.
- Sufficient number of men and women must be identified for the FFS Committee and to run the FFS to represent the interests and priorities of both male and female farmers. Additional knowledge created by women differs from men's due to their life experience; ensuring that both co-create the FFS thus significantly enriches the entire group.

As a general rule, to avoid duplication, FFS will only be established in villages where there are not already similar FFS activities supported by other organizations. However, if there is scope of complementarity and synergies with existing initiatives, FFS can be established in the same village.

### **(b) FFS Committee Formation**

Facilitate the community in forming a FFS Committee comprising of 20-30 members, either through the formation of new group or strengthening of existing groups, ensuring an adequate number of women and girls. The gender dimensions should be analyzed and if men and women are generally involved in the farming activities, mixed FFS groups should be formed.

The main criteria applied for selection of participants should be as follows.

- Group (FFS Committee) of 20-30 farmers,
- Observe the gender, age and experience balance and encourage women and youth participation as far as possible,
- Farmers having experience of local production and livelihood system and to grow the crops, which are included in the FFS (elephant foot yam in this case);
- Must be resident from the same village;
- Smallholder farmers (owning no more than 10 acres of land) or land users who are resource-poor and often have limited access to education, information, extension services, market access and financial capital;
- Farmers demonstrate interest and commitment to the full FFS cycle;
- Farmers demonstrate good attitude: eager to learn and share knowledge and experience, keen to work in the group, help to clean the site after the FFS session, etc. and
- Should continue for at least two subsequent crop cycles to see the results.

Facilitate FFS Committee to select a Chairperson, a Vice Chairperson, a Secretary, a Treasurer and a **Lead Farmer**. The Lead Farmer will host and take lead to establish study/learning/experiment/demonstration plot and will gradually take over the responsibility of FFS Facilitator from DoA Extension Officer from the second year onwards. Rest should be considered as general members. The other members of the FFS Committee will be responsible for taking part actively in the regular FFS meetings/training to contribute, to learn and to replicate the learning in their own field and to disseminate to other farmers.

### (c) Selecting Lead Farmer (FFS Facilitator)

The FFS Facilitator is a technically competent person who facilitates hands-on exercises. The Lead Farmer/Facilitator should possess the following skills/characteristics.

- Must be a member of the FFS Committee of the respective village.
- **Social skills:** ability to engage everyone in the group into productive learning and exchange process, good communication and presentation skills.
- **Interpersonal skills:** non-judgmental, supportive attitude, sensitivity to group dynamics processes (e.g. managing dominant behavior).
- **Technical skills:** ability to lead the group through the process of improving the crop production according to CSA principles, prior experience (or education) in farming and agriculture, understanding of market economy.
- **Organizational skills:** ability to guide the process for setting up the demonstration field and ability to keep records.
- Gender awareness: ability to address potential gender barriers as well as to be familiar with concepts of social inclusion and social vulnerability. Qualified female member should be given priority as far as possible to become Facilitator/Lead Farmer. The FFS ToT programme will include gender mainstreaming issues/topics.

In the first year, while a Lead Farmer will be selected from among the FFS Committee Members, there will be a FFS Facilitator assigned by the respective Township DoA for each FFS who will be a technically competent person and will lead the group members through the hands-on exercises. From the second year onwards, the DoA Extension Officer will take a back seat only offering guidance when there is a need and the Lead Farmer will take over the responsibility of FFS Facilitator. Both the FFS Facilitator from the DoA Office and the Lead Farmer from the FFS Committee should ensure an adequate involvement of women and girls since the FFS is set up.

## **1.4 Collection of relevant information/data:**

A village profile will be developed for each FFS village prior to the FFS implementation using a standard format. The village profile will include geographical information, demographic information, available resources and livelihoods opportunities, livelihoods profile of the people, major crops grown in the village, cropping patterns/calendar, major problems associated with priority crops, major needs of the community and analysis of the gender roles and the division of tasks of men and women for each of the selected crops, assessing their capacity and needs.

All the relevant information from the standing crops and post-harvest information will be obtained using a standard template. The tools, methods, and indicators/questions used will be gender-sensitive, i.e. they do not exclude women from being able to give their opinions, and by including questions that directly address gender inequalities in the context of implementation. Gender-disaggregated data/information will also be collected on FFS attendance and gender-sensitive indicators will be created accounting for the diversity of ethnicity, gender, age, class, religion, and culture in the impact assessment. Specific indicators will be developed that are able to measure the achievement of gender equality among programme participants. This may require disaggregation of data by sex and their analysis to identify functional relations and effects.

## **1.5 Guiding Principles of FFS in Upland/Hills Zone:**

As per the initial need assessment and value chain analysis done by FAO with AVSI Foundation as a Service Provider, Elephant Foot Yam, Coffee and Avocado have been identified as the priority crops in the area based on technical feasibility, the crops already being grown in the area and have high market demand and contribute to improved nutrition of men and women and their households, especially children, the elderly and the disabled. Gender considerations will cut across all indicators for data collection to ensure that information can be easily gender disaggregated. Therefore, the FFS module and FFS activities will cover those three prioritized crops.

## Cropping Calendar of the Potential Crops (Elephant Foot Yam, Coffee, and Avocado) in Upland/Hilly Areas

Crops	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Elephant Foot Yam	Growing time								Harvesting time			
Coffee			Growing time						Harvesting time			
Avocado			Growing time						Harvesting time			

Source: Department of Agriculture, Mindat and Kanpetlet Townships (Nov, 2017)

Similarly, the project focus in the upland/hilly areas is to promote **agro-forestry practices** and hence, the above mentioned prioritized crops will be grown as a mix/inter crop i.e. Elephant Foot Yam and Coffee (or) Elephant Foot Yam and Avocado on the same plot. Saplings of multipurpose *Gliricidia sepium* or *Grevillea robusta* will also be planted as windbreaks. *Gliricidia sepium* tree species can also offer fuelwood, nutrient-rich mulch, erosion control and soil stabilizer and high-quality forage for ruminants. The FFS Committee can also select any other suitable tree species to be planted in consultation with Department of Agriculture and/or Forest Department Offices.

The crops will be planted in upland fields, using one of the following land management practices, based on the financial capabilities and fit-for-purpose criteria:

- **Terracing Method:** Terracing method refers to the method of producing crops on the sides of mountains or hills with the help of graduated steps or terraces builds into the slopes. As this method of farming is labor intensive but has been employed effectively to maximize the growing area, in variable terrains. It is mainly operated to reduce soil erosion and water loss.
- **Sloping Agricultural Land Technology (SALT) Method:** SALT is a package of technologies for soil conservation, crop cultivation and sustainable food production that includes hedge row contour planting, alley cropping and terrace improvement through formation of bunds and contour planting among others.

The guiding principles for this FFS module are:

- Working in groups (15-30 farmers),
- Season-long activities (following the season of crops),

- Regular meetings/sessions during the season. The formal meeting/training has been planned in the curriculum to be one time in a month however, the FFS Committee meet informally as and when needed,
- Study/learning demonstration plots/experiments to compare current practices with improved/alternative practices,
- Using group knowledge to solve problems – e.g. learn from farmers, who are practicing terracing methods or sloping agricultural land technologies (SALT),
- Role of facilitator: to facilitate group work, rather than impose knowledge,
- Technical expert to provide input on CSA techniques and practices related to: a) high resistance seeds to the adverse factors, b) soil testing practices, c) land preparation techniques, d) soil nutrients and water management, e) proper application of crop protection and crop nutrition substances, f) integrated pest management, g) post-harvest techniques (storage) and prospects for processing,
- Keep regular schedule of the meetings as specified in the FFS curricula for the Central Dry Zone presented in Annex 1,
- Observe the demonstration plot regularly after every FFS meetings and also outside the FFS meetings, as much as possible, to see the changes and any problems in the demonstration plot, and
- Keep the crop records during the whole cycle. Also analyse and keep record on how male and female farmers are actually benefitting from these crops and the new techniques and practices.

Once the FFS has started and demonstration plot has been established, each FFS meeting/session should include the following steps as much as possible (this should be reflected for each FFS meeting occurring after establishment of the crops till harvesting):

- Agro-ecosystem analysis (AESA),
- A group dynamics exercise,
- Special topic, and
- Feedback on the session. The feedback will include the views and perceptions of both men and women.

After the completion of the one cycle of FFS, the FFS Committee will need to continue the FFS on longer run on their own with minimum support from the project only for second year. The respective Township DoA Office will provide necessary technical supports as and when needed and will be responsible for the follow up activities. The DoA will also be responsible for monitoring the extent of adoption of newly acquired practices and how these are being scaled up in other neighboring communities.

The implementation of FFS in Upland/hill Zone of Chin State will follow the FFS Curriculum attached in Annex 1.

The main CSA techniques that could be used for FFS implementation in Chin State/Hilly Region are described in the following sections of this handbook.



## 2. Farmer Field School Session – 1

### Concept and Practices of Climate Smart Agriculture

<b>Month:</b>	April
<b>Week/Date:</b>	Third Week
<b>Time/Duration:</b>	Three hours in the morning and practical exercises in the afternoon
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Flipcharts, marker pens, handouts of subject matters

#### Topics to be covered:

1. Introduction to CSA and its practices
2. Introduction to GAP and its practices
3. Introduction to SALT and its practices
4. Introduction to CA and its practices
5. Analysis of existing farming systems
6. Practical exercises on site clearing and use of residues as soil cover, making of A-Frame, finding out contour lines, establishment of contour bunds with available materials on the slope, such as waste bamboos and logs, stones, etc. (Agro-ecosystem practices) (Burning of organic residues, such as logs and twigs, weed residues, crop residues, must be avoided: no more smokes from the fields)
7. Establishment of small check dams with stones if available on the sites to prevent gully erosion
8. Collection of seeds and seedlings of hedgerow plants from available sources: *gliricidia*, *leucaena*, *tephrosia*, *flemingia*, *vertiver* grass.
9. Introduction of yam, coffee, and avocado (Theory) – varieties and their characteristics, growth stages, nursery raising, transplanting, life periods, etc.
10. Sowing of seed materials of yam (bulbils and/or small corms) in the Demo Plot with proper spacing based on the size of seed material (April is right time of sowing yam)
11. Mulching sown pits with available organic residues
12. Collection of soil samples for soil analysis that will be sent to soil lab to get the base line data of pH, organic carbon and nutrient contents
13. Keeping records on crop managements for each crop and data entry in every training session
14. Open discussion on whole training session of the day and recording of participants feedbacks

15. Production of plans of actions for individuals to undertake at their own farms

## Related Training Reference Materials:

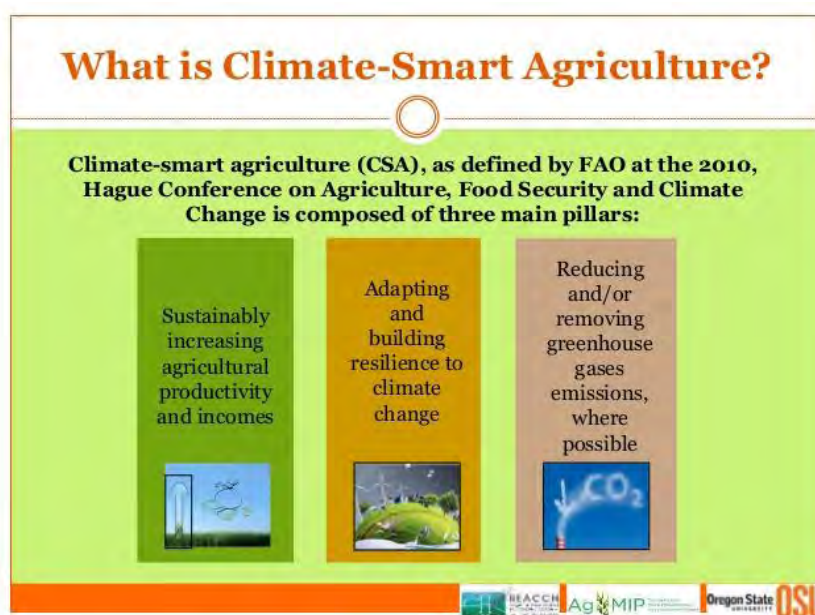
### 2.1. Climate Smart Agriculture

Climate-smart agriculture (CSA), as defined and presented by FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, contributes to the achievement of sustainable development goals.

CSA aims to sustainably improve agricultural productivity, enhance food security, boost farmers' adaptive capacity and resilience to climate shocks and contribute to Green House Gas (GHG) mitigation. Given limited understanding of farmers about CSA, the module aims to raise awareness of the principles of CSA. CSA approach integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges.

It is composed of three main pillars:

1. Sustainably increasing agricultural productivity and incomes;
2. Adapting and building resilience to climate change and
3. Reducing and/or removing greenhouse gases emissions, where possible.



Source: Adopting policies and priorities to encourage climate-smart agricultural practices: Susan Capalbo, Professor and Department Head, Applied Economics at Oregon, 2015

CSA is an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. FAO foresees a broader approach, working to build synergies among social protection and climate change to achieve sustainable growth and eliminate rural poverty. FAO uses a “twin-track” approach, on the one hand taking immediate steps to protect and support agriculture, food and nutrition, and on the other addressing in the longer term the underlying factors driving risks, disasters and crises. FAO’s work focuses on developing, protecting and restoring sustainable livelihoods so that the integrity of societies that depend on farming, livestock, fish, forests and other natural resources is not threatened by crises. CSA uses a comprehensive approach in seeking to improve rural livelihoods, increasing the productivity and resilience of poor communities, including rural women and girls, while also providing mitigation benefits.

### **Why is climate-smart agriculture needed?**

Between now and 2050, it is estimated that the world’s population will increase by one-third. Most of these additional 2 billion people will live in developing countries. At the same time, more people will be living in cities. If current income and consumption growth trends continue, FAO estimates that agricultural production will have to increase by 60 percent by 2050 to satisfy the expected demands for food and feed. Agriculture must therefore transform itself if it is to feed a growing global population and provide the basis for economic growth and poverty reduction. Climate change will make this task more difficult under a business-as-usual scenario, due to adverse impacts on agriculture, requiring spiraling adaptation and related costs.

Agriculture lies at the crossroads of climate-change mitigation and adaptation efforts. The agricultural sector is currently responsible for an estimated 13.7% of global GHG emissions and is also a key driver of deforestation which contributes an additional 7-14% of global emissions. At the same time, climate change will have significant negative impacts on many agricultural communities, particularly smallholders and poor farmers who have limited capacity to adapt to adverse shocks, further exacerbating global poverty and food insecurity. Thus, both mitigation efforts to reduce GHG emissions and adaptation measures to maintain crop yields are of global significance.

### **Impact of Climate change on small holder farmers:**

Many smallholder farmers in developing countries are facing food insecurity, poverty, the degradation of local land and water resources, and increasing climatic variability. These vulnerable farmers depend on agriculture both for food and nutrition security and as a way of

coping with climate change. If agricultural systems are to meet the needs of these farmers, they must evolve in ways that lead to sustainable increases in food production and at the same time strengthen the resilience of farming communities and rural livelihoods.

**Necessary interventions:**

Bringing about this evolution involves introducing productive climate-resilient and low-emission agricultural practices in farmers' fields and adopting a broad vision of agricultural development that directly connects farmers with policies and programs that can provide them with suitable incentives to adopt new practices.

CSA seeks to increase farm productivity in a sustainable manner, support farming communities to adapt to climate change by building the resilience of agricultural livelihoods and ecosystems, and, wherever possible, to deliver the co-benefit of reduced GHG emissions.

CSA is an approach that encompasses agricultural practices, policies, institutions and financing to bring tangible benefits to smallholder farmers and provide stewardship to the landscapes that support them.

On the ground, CSA is based on a mix of climate-resilient technologies and practices or integrated farming systems and landscape management.

CSA also aims to strengthen livelihoods and food security, especially of smallholders, by improving the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods.

This work is creating a better understanding about the trade-offs that may need to be made when striving to meet the interconnected goals of food security, climate change adaptation and climate change mitigation, and about the synergies that exist between these.

To ensure sustainable and long-term adoption of CSA practices, farmers need to receive immediate and long-term benefits from these practices in terms of improved food security, food production and income.

Because the adoption of CSA practices is largely determined by training sessions and farmer-to-farmer learning, it is important to support sustainable approaches for delivering extension services.

Adoption of CSA is very important for adaptation and mitigation of the adverse climate impact. There are two ways by which agricultural production can contribute to mitigate climate change:

- Reducing GHGs emissions per unit of land and/or agricultural products
- Enhancing soil carbon sinks.

**Some of CSA practices:**

CSA is an umbrella term that includes many approaches, built upon geographically-specific solutions and characterized by a continuum of choices all aiming at making the agricultural sector better suited to handle the changes of a new climate. Some of the examples of CSA techniques to be adopted in various agro-ecological zones are presented below of which relevant topics for Upland/Hills Zone will be described in detail in the following sections.

1. Sloping Agriculture Land Technology (SALT)
2. Conservation Agriculture (CA)
3. Agroforestry
4. Integrated Pest Management (IPM)
5. Good Agricultural Practices (GAP)
6. Integrated soil and plant nutrient management
7. Use of varieties tolerant to adverse factors
8. Water conservation and management, water harvesting
9. Water saving agriculture techniques
10. Crop Cycle management
11. Harvesting and post-harvest technologies
12. On-farm storage techniques
13. Business model for commercialization (improved financial management, product marketing and business planning).

Given limited understanding of farmers about CSA, the module aims to raise awareness of the principles of CSA, as part of theoretical input. CSA approach is embedded in all activities of this module and will be discussed throughout the whole training sessions in FFS.

**2.1.1 Conservation Agriculture (CA)**

Conservation Agriculture is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. CA is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with, or disrupt, the biological processes. CA is characterized by three principles which are linked to each other, namely:

1. Continuous minimum mechanical soil disturbance;
2. Permanent organic soil cover; and
3. Diversified crop rotations in the case of annual crops or plant associations in case of perennial crops.



Source: Top 5 need-to-knows about CA; (© FAO, 2014)

### **1. Continuous minimum mechanical soil disturbance**

Conventional "arable" agriculture is normally based on soil tillage as the main operation. The most widely known tool for this operation is the plough, which has become a symbol of agriculture. Soil tillage has in the past been associated with increased fertility, which originated from the mineralization of soil nutrients as a consequence of soil tillage. This process leads in the long term to a reduction of soil organic matter. Soil organic matter not only provides nutrients for the crop, but it is also, above all else, a crucial element for the stabilization of soil structure. Therefore, most soils degrade under prolonged intensive arable agriculture. This structural degradation of the soils results in the formation of crusts and compaction and leads in the end to soil erosion. The process is dramatic under tropical climatic situations but can be noticed all over the world. Mechanization of soil tillage, allowing higher working depths and speed and the use of certain implements like ploughs, disk harrows and rotary cultivators have particularly detrimental effects on soil structure. Excessive tillage of agricultural soils may result in short term increases in fertility but will degrade soils in the medium term. Structural degradation, loss of organic matter, erosion and falling biodiversity are all to be expected.





Mechanical soil tillage by moldboard ploughs and disc harrows (© Disc-plough-MASCHIO-2)  
© Yucheng Machinery Manufacturing Co., Ltd.

Soil erosion resulting from soil tillage has forced us to look for alternatives and to reverse the process of soil degradation. The logical approach to this has been to reduce tillage. This led finally to movements promoting conservation tillage, and especially zero-tillage. Over the last two decades the technologies have been improved and adapted for nearly all farm sizes, soils, crop types and climatic zones.



Severe soil erosion in thoroughly ploughed plots

Left: Northern Shan, Myanmar (2014) (© FAO/U.Theinsu, 2014, Myanmar).  
Right: Mandalay Division, Myanmar (2017) (© FAO/U.Theinsu, 2017, Myanmar).

Experience has shown that these techniques, summarized as conservation agriculture (CA) methods, are much more than just reducing the mechanical tillage. In a soil that is not tilled for many years, the crop residues remain on the soil surface and produce a layer of mulch. This layer protects the soil from the physical impact of rain and wind, but it also stabilizes the soil moisture and temperature in the surface layers. Thus, this zone becomes a habitat for several organisms, from larger insects down to soil borne fungi and bacteria. These organisms macerate the mulch,



incorporate and mix it with the soil and decompose it so that it becomes humus and contributes to the physical stabilization of the soil structure. At the same time this soil organic matter provides a buffer function for water and nutrients. Larger components of the soil fauna, such as earthworms, provide a soil structuring effect producing very stable soil aggregates as well as uninterrupted macro pores leading from the soil surface straight to the subsoil and allowing fast water infiltration in case of heavy rainfall events.

Keeping the soil covered and planting through the mulch will protect the soil and improve the growing environment for the crop.



This process carried out by the edaphon, the living component of a soil, can be called "**biological tillage**". However, biological tillage is not compatible with mechanical tillage and with increased mechanical tillage the biological soil structuring processes will disappear. Certain operations such as moldboard or disc ploughing have a stronger impact on soil life than others as for example chisel ploughs. Most tillage operations are, however, targeted at loosening the soil which inevitably increases its oxygen content leading in turn to the mineralization of the soil organic matter. This inevitably leads to a reduction of soil organic matter which is the substrate for soil life. Thus, agriculture with reduced, or zero, mechanical tillage is only possible when soil organisms are taking over the task of tilling the soil. This, however, leads to other implications regarding the use of chemical farm inputs.

As the main objective of agriculture is the production of crops, changes in the pest and weed management become necessary with CA. Burning plant residues and ploughing the soil is mainly considered necessary for phytosanitary reasons: to control pests, diseases and weeds.

Burning crop and weed residues destroy an important source of plant nutrients and soil improvement potential. The phytosanitary motives for burning and ploughing can better be achieved by integrated pest management (IPM) practices and crop rotations (FAO).



### **Direct seeding or planting**

Direct seeding involves growing crops without mechanical seedbed preparation and with minimal soil disturbance since the harvest of the previous crop. The term direct seeding is understood in CA systems as synonymous with no-till farming, zero tillage, no-tillage, direct drilling, etc. Planting refers to the precise placing of large seeds (maize and beans for example); whereas seeding usually refers to a continuous flow of seed as in the case of small cereals (wheat and barley for example). The equipment penetrates the soil cover, opens a seeding slot and places the seed into that slot. The size of the seed slot and the associated movement of soil are to be kept at the absolute minimum possible. Ideally the seed slot is completely covered by mulch again after seeding and no loose soil should be visible on the surface.

Land preparation for seeding or planting under no-tillage involves slashing or rolling the weeds, previous crop residues or cover crops, and seeding directly through the mulch. Crop residues are retained either completely or to a suitable amount to guarantee the complete soil cover, and fertilizer and amendments are either broadcast on the soil surface or applied during seeding.





Slashing of weeds (© FAO 2006, what is CA?)



Mowing of weeds  
(© FAO/U.Theinsu, 2017, Myanmar)



Ripping of sowing lines with no tillage (© FAO/U.Theinsu, 2017, Myanmar)



Seeding in sowing lines  
(© FAO/U.Theinsu, 2017, Myanmar)



Manure and organic fertilizer application in  
sown lines (© FAO/U.Theinsu, 2017, Myanmar)





**Heavy mulching of sown lines**  
(© FAO/U.Theinsu, 2017, Myanmar)



**Whole field completely mulched**  
(© FAO/U.Theinsu, 2017, Myanmar)



**Diversified crops growing  
in the plot under heavily mulched**  
(© FAO/U.Theinsu, 2017, Myanmar)



***Leucaena* Hedgerow in the plot under heavily  
mulched** (© FAO/U.Theinsu, 2017, Myanmar)



**Conventional (left) and mulched (right)**  
(© FAO/U.Theinsu, 2012, Myanmar)



**Effect of Mulching on crop growth, shorter height  
in conventional (front) and longer height at the side  
under mulched (back)**  
(© FAO/U.Theinsu, 2014, Myanmar)

## **2. Permanent soil cover**

A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots. Cover crops need to be managed before planting the main crop. This can be done manually or with animal or tractor power. The important point is that the soil is always kept covered.

### **The effects of soil cover:**

- Improved infiltration and retention of soil moisture resulting in less severe, less prolonged crop water stress and increased availability of plant nutrients.
- Source of food and habitat for diverse soil life: creation of channels for air and water, biological tillage and substrate for biological activity through the recycling of organic matter and plant nutrients.
- Increased humus formation.
- Reduction of impact of rain drops on soil surface resulting in reduced crusting and surface sealing.
- Consequential reduction of runoff and erosion.
- Soil regeneration is higher than soil degradation.
- Mitigation of temperature variations on and in the soil.
- Better conditions for the development of roots and seedling growth.

### **Means and practices:**

- Use of appropriate/improved seeds for high yields as well as high residue production and good root development.
- Integrated management and reduced competition with livestock or other uses e.g. through increased forage and fodder crops in the rotation.
- Use of various cover crops, especially multi-purpose crops, like nitrogen fixing, soil-porosity-restoring, pest repellent, etc.
- Optimization of crop rotations in spatial, timing and economic terms.





Soybean grown after paddy with no tillage and mulched (© FAO/U.Theinsu, 2017, Myanmar)



Emergence of soybean plants through straw mulch (© FAO/U.Theinsu, 2017, Myanmar)



Vigorous growth of soybean  
(© FAO/U.Theinsu, 2017, Myanmar)



The whole field covered with soybean, straw mulch seen inside (© FAO/U.Theinsu, 2017, Myanmar)



Rice bean soil cover under rubber  
(© FAO/U.Theinsu, 2017, Myanmar)



Grass soil cover in Thanat-kha plantation  
(© FAO/U.Theinsu, 2017, Myanmar)

### 2.1.2 Crop rotations

The rotation of crops is not only necessary to offer a diverse "diet" to the soil microorganisms, but as they root at different soil depths, they are capable of exploring different soil layers for nutrients. Nutrients that have been leached to deeper layers and that are no longer available for the commercial crop can be "recycled" by the crops in rotation. This way the rotation crops function as biological pumps. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna, as the roots excrete different organic substances that attract different types of bacteria and fungi, which in turn, play an important role in the transformation of these substances into plant available nutrients. Crop rotation also has an important phytosanitary function as it prevents the carryover of crop-specific pests and diseases from one crop to the next via crop residues.

Crop rotation interrupts the infection chain between subsequent crops and making full use of the physical and chemical interactions between different plant species. Synthetic chemical pesticides, particularly herbicides are, in the first years, inevitable but have to be used with great care to reduce the negative impacts on soil life. To the extent that a new balance between the organisms of the farm-ecosystem, pests and beneficial organisms, crops and weeds, becomes established and the farmer learns to manage the cropping system, the use of synthetic pesticides and mineral fertilizer tends to decline to a level below that of the original "conventional" farming system.

#### **The effects of crop rotation**

- Higher diversity in plant production and thus in human and livestock nutrition.
- Reduction and reduced risk of pest and weed infestations.
- Greater distribution of channels or bio-pores created by diverse roots (various forms, sizes and depths).
- Better distribution of water and nutrients through the soil profile.
- Exploration for nutrients and water of diverse strata of the soil profile by roots of many different plant species resulting in a greater use of the available nutrients and water.
- Increased humus formation.
- Increased nitrogen fixation through certain plant-soil biota symbionts and improved balance of N/P/K from both organic and mineral sources.

#### **Means and practices**

- Use of appropriate / improved seeds for high yields as well as high residue production of above-ground and below-ground parts, given the soil and climate conditions.



- Design and implementation of crop rotations according to the various objectives: food and fodder production (grain, leaf, stalks); residue production; pest and weed control; nutrient uptake and biological subsurface mixing / cultivation, etc.



**Rice bean after maize harvest**  
(© FAO/U.Theinsu, 2016, Myanmar)



**Mix cropping of maize and rice bean**  
(© FAO/U.Theinsu, 2014, Myanmar)



**Maize residues after harvest**  
(© FAO/U.Theinsu, Myanmar, 2011)



**Broad bean after maize harvest**  
(© FAO/U.Theinsu, 2011, Myanmar)



**General landscaping seen in Chin Hills**  
(© FAO/U.Theinsu, 2013, Myanmar)



**Residue of maize and cowpea in Chin**  
(© FAO/U.Theinsu, 2013, Myanmar)





**Mix cropping of sunflower, sweet corn and chickpea (© FAO/U.Theinsu, 2017, Myanmar)**



**Sequential cropping of peanut (three varieties), upland rice (two varieties), and maize (two varieties) (© FAO/U.Theinsu, 2017, Myanmar)**



**Mix cropping of sesame and green gram (© FAO/U.Theinsu, 2017, Myanmar)**



**Mix cropping of peanut and pigeon pea (© FAO/U.Theinsu, 2017, Myanmar)**

## **Future Food Demand and Conservation Agriculture**

Conservation Agriculture offers a powerful option for meeting future food demands while also contributing to sustainable agriculture and rural development. CA methods can improve the efficiency of input, increase farm income, improve or sustain crop yields, and protect and revitalize soil, biodiversity and the natural resource base. (Conserving resources above – and below – the ground).

“Conservation agriculture (CA) aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustained agricultural production.” CA is a way of growing crops that is both good for farmers and good for the environment. Now *that's* sustainable!

### **2.1.3 Sloping Agricultural Land Technology – SALT**

Sloping Agricultural Land Technology (SALT) is a package technology on soil conservation and food production, integrating different soil conservation measures in just one setting. Basically, SALT is a method of growing field and permanent crops in 3-meter to 5-meter-wide bands between contoured rows of nitrogen fixing trees. The nitrogen fixing trees are thickly planted in double rows to make hedgerows. When a hedge is 1.5 to 2 meters tall, it is cut down to about 75 centimeters and the cuttings (tops) are placed in alley-ways to serve as organic fertilizers.

#### **The eight steps of sloping agricultural land technology**

##### **Step 1: Make an A-frame**

Making the A-frame in SALT, the first step you need to do is to make an instrument to locate the contour lines of your field. This is a simple yet effective tool which looks like the letter A, thus its name.

The A-frame is so simple that you make your own using materials generally found in your farm. To make the A-frame, three sturdy wooden or bamboo poles, a saw or knife, an ordinary carpenter's level, and string or rope are needed. Cut two pieces of wood at least one meter long to serve as the legs of the A-frame. Cut the third piece at least one-half meter long to be used as the crossbar of the frame.

## Assembling the A-frame

Tie together the upper ends of the longer poles. Let the lower ends of the legs stand on level ground. Spread the legs about one meter apart to form a perfect angle. Brace horizontally the shorter pole to become a crossbar between the two legs. Tie the carpenter's level on top of the crossbar.



Making A-Frames (© FAO/U.Theinsu, 2008, Myanmar)

## Use of A-frame

The A-frame is used to find the contour lines of the land. Soil erosion can be prevented by plowing and planting following the contour lines. The contour line is a level line from one end of the field to the other and is found around the hill or mountain.

### Step 2: Locate the contour lines

#### Finding the Contour Lines

The next step is to use the A-frame to locate the contour lines in the field. Tall grasses and/or any obstructions must be removed so that it can move easily and mark lines. When using the A-frame, two people will make the work much easier and faster. One will operate the A-frame while the other marks the located contour lines with stakes.

The area for which contour lines are to be determined is first studied. Contour lines must begin near the highest point. Let the A-frame stand on the ground. Without moving the rear leg, lift the front leg. Then put the leg down on the ground that is on the same level with the rear leg.

The two legs of the A-frame are on the same level when the air space in the carpenter's level stops in the middle. When this happens, it means that you have found the contour line which is a level line between the two legs of the A-frame. Mark with a stake the spot where the rear leg stands.



## Length of Contour Lines

Move the A-frame forward by placing the rear leg on the spot where the front leg stood before. Adjust the front leg again until it levels with the rear leg. For every two to three meters of contour line you find mark it with a stake. Follow this procedure until you reach the entire length of the contour line which is the other side of the mountain or hill.



Finding out contour lines by A-Frame  
(© FAO/U.Theinsu, 2017, Myanmar)

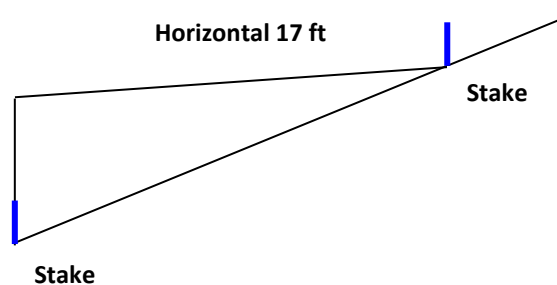
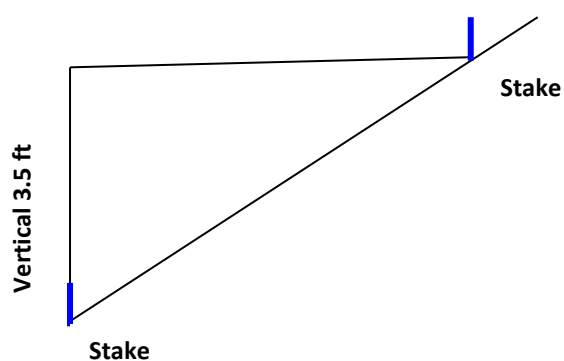


Marking contour lines by bamboo pegs  
(© FAO/U.Theinsu, 2017, Myanmar)

## Distance of Contour Lines

Try to locate as many contour lines as possible. Remember, the closer the contour lines to each other, the more potential erosion control occurs. Also, more nutrient rich biomass is produced and made available to the crops growing in the alley.

There are two criteria for determining the distance between contour lines: vertical drop and surface distance. Generally, no more than a one-meter vertical drop is desirable for effective erosion control. Therefore, the steeper the slope, the closer the contour hedgerows. Conversely, the flatter the slope, the wider the spacing of hedges. However, on the flatter slopes, it is recommended that contour hedgerows be spaced no further apart than 5 meters in order to maximize the benefits of the nitrogen fixing trees/shrubs on soil fertility management.



In determining a one-meter vertical drop, the "eye-hand" method is a simple procedure to use. If using a transit or home-made transit, the one-meter vertical drop can be obtained very quickly.

### **Step 3: Prepare the contour lines**

After contour lines have been found and marked, contour bunds could be made by materials easily collected in the plot such as logs, twigs, bamboos, and stones. Check dams can be made in gully parts.



Placing of bamboos, logs, and stones readily available in the plot along the contour lines (© FAO/U.Theinsu, 2013, Myanmar)



Small check dam (© FAO/U.Theinsu, 2013, Myanmar)

### **Step 4: Plant seeds of nitrogen fixing trees and shrubs**

#### **Planting Nitrogen Fixing Species**

On each prepared contour line make two furrows at a distance of one-half meter apart. Sow the seeds in each furrow to allow for a good, thick stand of seedling. Cover the seeds lightly and firmly with soil.

#### **Importance of Leguminous Hedgerows**

The ability of nitrogen fixing trees to grow on poor soils and in areas with long dry seasons makes them good plants for restoring forest cover to watersheds, slopes and other lands that have been denuded of trees. Through natural leaf drop, they enrich and fertilize the soil. In addition, they compete vigorously with coarse grasses, a common feature of many degraded areas that have been deforested or depleted by excessive agriculture.



Growing *Tephrosia* along contour line  
(© FAO/U.Theinsu, 2014, Myanmar)



Growing *Gliricidia* along contour line  
(© FAO/U.Theinsu, 2014, Myanmar)

### Examples of Nitrogen Fixing Trees and Shrubs (NFTS)

*Flemingia macrophylla*, *Gliricidia sepium*, and *Tephrosia spp.*, are the best examples of nitrogen fixing trees for hedgerows on the SALT farm. Other examples of nitrogen fixing trees and shrubs (NFTS) which may be suitable for SALT hedgerows are *Indigofera tyesmane*, *Leucaena leucocephala*, and *Leucaena diversifolia*. Tree species of *Millettia* and *Acacia* can also use as hedgerow plants.

### Step 5: Planting permanent trees and seasonal crops in the strips (alleys)

The space of land between the thick rows of nitrogen fixing trees where the crops are planted is called a strip. Other names for the strip are alleyways or avenues.

### Cultivating Alternate Strips

If you wish to prepare the soil for planting before the NFTS are fully grown, do it alternately, on strips 2, 4, 6, 8 and so on. Alternate cultivation will prevent erosion because the unplowed strips will hold the soil in place. When the NFTS are fully grown, you can proceed with cultivation on every strip.



Mix Cropping at the slopes  
(© FAO/U.Theinsu, 2014, Myanmar)



Growing of maize and peanut in the strips  
(© FAO/U.Theinsu, 2009, Myanmar)



Permanent perennial plants such as Avocado, Coffee, Orange, Citrus, and Banana should be planted in every third or fourth row. Tall trees are planted at the bottom of the slope to avoid shading effect while short ones are at the top. At the early stage of permanent trees while not covering with full canopy, seasonal crops can be grown in the plot. Suggested short and medium-term crops are pineapple, ginger, taro, castor bean, sweet potato, peanut, mung bean, sorghum, corn, upland rice, etc. To avoid shading, short plants are planted away from tall ones.



## Step 6: Trim regularly nitrogen fixing trees/shrubs

### Pruning Hedgerows

About once a month, the continuously NFTS are cut down to a height of one to one half meters from the ground. Cut leaves and twigs are always piled at the base of the crops. They serve as a soil cover to minimize the impact of the raindrop on the bare soil. They also act as an excellent organic fertilizer for both the permanent and short-term crops. In this way only, a minimal amount of commercial fertilizer (about 1/4 of the total fertilizer requirements) is necessary.



## **Step 7: Practice crop rotation**

### **Rotating Non-Permanent Crops:**

A good way of rotating is to plant grains (corn, upland rice, sorghum, etc.), tubers (camote, cassava, gabi, etc.) and other crops (pineapple, castor bean, etc.) on strips where legumes (mung bean, bush sitao, peanut, etc.) were planted previously and vice versa. This practice will help maintain the fertility and good condition of the soil. Other management practices in crop growing like weeding and pest and insect control should be done regularly.



Rotating of crops of maize, rice bean, and ginger in different strip alternately  
(© FAO/U.Theinsu, 2015, Myanmar)

## **Step 8: Build green terraces**

### **Maintain Green Terraces:**

Apart from providing you with adequate food and sufficient income, another even more important benefit of using SALT is the control of soil erosion. This is done by the double thick rows of nitrogen fixing trees and the natural terraces being formed along the contour lines. As farmer goes on farming the sloping land, keep gathering and piling up straw, stalks, twigs, branches, leaves, rocks, and stones at the base of the rows of nitrogen fixing trees. By doing this regularly and as the years go by, farmer can build strong, sustainable, naturally green and beautiful terraces which will reliably anchor precious soil in its right place.

## 2.2 Good Agricultural Practices (GAP)

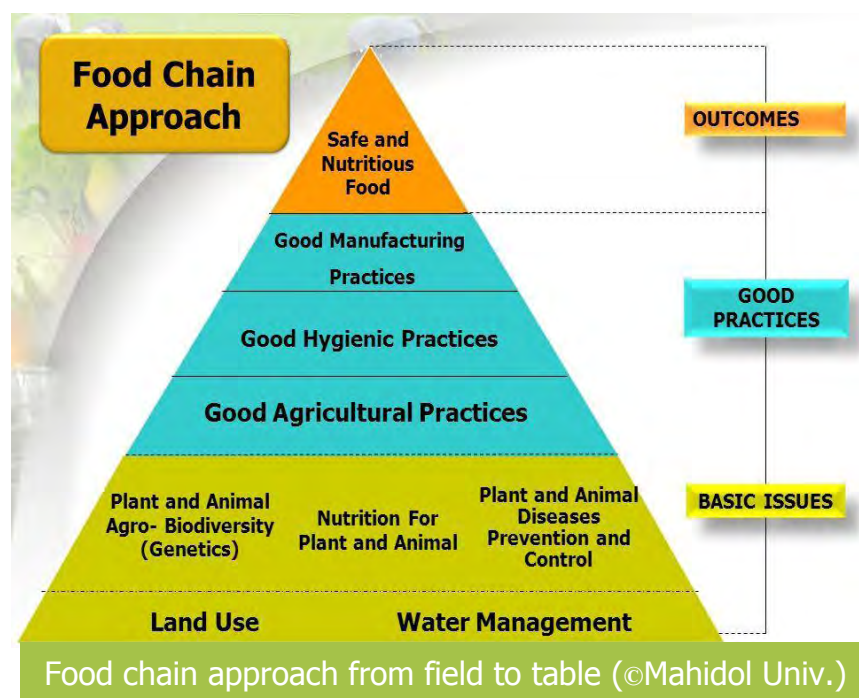
The FAO uses good agricultural practice as a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability.

In other words, good agricultural practices are "practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products"(FAO 2003).

GAPs may be applied to a wide range of farming systems and at different scales. They are applied through sustainable agricultural methods, economically and efficiently produce sufficient (food security), safe (food safety) and nutritious food (food quality).

The objective of these GAP codes, standards and regulations include, to a varying degree:

- ensuring safety and quality of produce in the food chain
- capturing new market advantages by modifying supply chain governance
- improving natural resources use, workers health and working conditions, and/or
- creating new market opportunities for farmers and exporters in developing countries.



**There are four 'pillars' in GAP:**

1. Economic viability
2. Environmental sustainability



3. Social acceptability
4. Food safety and quality

These are included in most private and public sector standards, but the scope which they actually cover varies widely.

Safe produce begins with the production and handling practices on the farm. Produce that is grown and sold with little biological contamination is less likely to result in health hazards caused by poor handling during later preparation stages. Producers and their employees have the critical job of minimizing product contamination by learning about potential sources of contamination and by using Good Agricultural Practices (GAPs).

### **On-farm Food Safety: Guide to Good Agricultural Practices (GAPs)**

Food safety concerns are increasing as once unheard of illness-causing microorganisms become more prevalent and as products previously considered safe cause an increasing number of illnesses each year. Produce, recently thought of as a safe product, has been identified as a cause of major food borne illness outbreaks in recent years. Illnesses are primarily caused by bacteria, viruses, parasites, and fungi.

These microorganisms, often referred to as pathogens or biological hazards, also are associated with ground beef, poultry, eggs, and seafood. Cooking is a common method of easily killing most pathogens in those foods. However, fresh produce is often consumed raw. In addition, produce is exposed to naturally occurring, biological hazards in the soil, water, and air. The potential risk for contamination is increased by production practices using manure for fertilizer and human handling of products. Developing a safety plan helps food producers manage the safety component of their operation by organizing the action steps identified as key to reducing those risks. Documenting of current practices and any changes over time allows for monitoring the safety of the food product.

**GAPs focus on four primary components of production and processing: soil, water, hands, and surfaces.**

#### **Soil:**

Maintaining “**clean soil**” reduces the risk of contaminating produce with illness-causing microorganisms found in soil during stages of growth and harvesting. Illness-causing microbes

always are present in the soil, but their populations and resulting risk of product contamination can be increased tremendously by improper manure management and application. Although manure is a good form of fertilizer, all manure contains pathogens. Some pathogen levels in the soil will decrease over time due to competition from other bacteria in the soil or because of less-than-desirable conditions.

The following steps are recommended to minimize risks from manure.

- Incorporate manure or use cover mulch after application to reduce the risk of physical contamination of product from rain or irrigation splash.
- Allow a minimum of 120 days between manure application and fruit or vegetable harvest.

## Water:

Water used for irrigation, cooling, processing, or for cleaning equipment and facilities should be free of microbial contaminants. Water quality and safety can be dependent on the water source. Municipal water usually has the best quality because of previous testing and safety requirements. Ground or well water will have fewer pathogens than surface water (such as ponds, streams, or rivers) because there is less chance of contamination. Regularly testing water sources provides documentation that the water is not a source of contamination. The frequency of water testing is dependent on the type of water source and the time of year. Water quality becomes more important as harvest approaches and water contact with the product occurs or increases. The method and timing of water use also has an effect on its contribution to product contamination. Using drip irrigation instead of sprinklers helps prevent contamination from soil splash and from product contact.



Putting vegetable on the ground, washing with unclean water causing great contamination  
(© ASEAN GAP, Food safety module, 2007)



Careful handling and washing in clean water for safety food  
(© ASEAN GAP, Food safety module, 2007)

## Hands:

Having “clean hands” refers to the human element involved in food safety during production and processing. The food producer and handler each have an important role in ensuring the safety and quality of foods grown and processed. Poor hygiene and health, unclean clothing or shoes, or unsafe practices on the part of workers can threaten food safety. Providing clean and appropriately stocked restroom and hand-washing facilities to field and processing employees helps prevent product contamination. A lack of restrooms results in unnecessary product contaminants in the field.



Hand-washing facilities already provided  
(© ASEAN GAP, Food safety module, 2007)



Preparing for packaging by  
washed and clean hands  
(© ASEAN GAP, Food safety module, 2007)

### Surfaces:

Produce items will have physical contact with many surfaces during harvest and processing. These may include harvest equipment and containers, transport bins, knives and other utensils, sorting and packaging tables, product packaging, and storage areas. Basic GAPs to help ensure clean surfaces include the following:

- Keep potential contaminants, such as soil and manure, out of the processing area or facility.
- Cull soiled produce in the field and damaged produce prior to processing.
- Use plastic containers and totes that are suitable for routine and efficient cleaning and sanitizing.
- Clean and sanitize equipment and facilities daily.
- Consider including a sanitizer in produce rinse water to reduce bacterial contamination.
- Control animal contamination sources, including pets, wildlife, birds, insects, and rodents.
- Develop guidelines for product storage and transportation.





Caring to be free from soil particles  
in the field at harvest  
(©ASEAN GAP produce quality module, 2007)



Clean packaging tables  
(©ASEAN GAP produce quality module, 2007)



Possible wounds and contamination during  
transportation by this packaging (© ASEAN GAP  
produce quality module, 2007)



Pets and other animals near farm produce  
threatening for safety food (© ASEAN GAP  
produce quality module, 2007)

### Potential benefits of GAP

1. Appropriate adoption and monitoring of GAP helps improve the safety and quality of food and other agricultural products.
2. It may help reduce the risk of non-compliance with national and international regulations, standards and guidelines regarding permitted pesticides, maximum levels of contaminants, minimum residue levels (MRL) in food and non-food agricultural products, as well as other chemical, microbiological and physical contamination hazards.
3. Adoption of GAP helps promotes sustainable agriculture and contributes to meeting national and international environment and social development objectives.



### 3. Farmer Field School Session - 2

#### Agro-ecosystem Analysis and Preparation of Homemade Organic Compounds

<b>Month:</b>	May
<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Three hours
<b>Trainer(s):</b>	Facilitator (Department of Agriculture Staff)
<b>Material:</b>	Handout, flipchart, marker pens

##### Topics to be covered:

1. Concepts of Agro-ecosystem Analysis and practices
2. Sowing of hedgerow seeds along the contour lines (*leucaena*, *tephrosia*, *flemingia*), cuttings of *vertiver* grass if available (Mulching with organic residues available in the field must be done immediately once after sowing of hedgerow seeds)
3. Broadcasting of rice bean (*Phaseolus calcaratus*) seeds to become live-crop cover
4. Staking and digging of pits for growing of *Gliricidia*, coffee and avocado with proper spacing by auger (1.5' apart for *Gliricidia* in line, 4' x 8' for coffee and 20' x 20' for avocado) along the contours in the Demo Plot (yam, coffee and avocado will be planted as inter-cropping pattern with wider spacing for avocado and closer spacing for yam and medium spacing for coffee)
5. Pit filling with organic manures and composts
6. Preparation of home-made organic products (Indigenous Microorganism-IMO, Fish Amino Acid-FAA, Preparation of EM, Tobacco-chili-ginger pesticide, etc.)
7. Compost making exercise (theory and practical)
8. Practical exercise on rearing of earthworms for compost production
9. Keeping financial records on input costs and general expenditures
10. Review on the status of individual's action undertaken according to their plans of previous session
11. Production of individual's action plans to undertake at their farm
12. Open discussion on the whole training session of the day and recording of participants feedbacks.

##### Related Training Reference Materials:

### 3.1 Agroecosystem Analysis (AESA)

**Agroecology** is defined as the study of the interactions between plants, animals, humans and the environment within agricultural systems or the study of relation of agricultural crops and environment. Following this definition, an agroecologist would study agriculture's various relationships with soil health, water quality, air quality, meso and micro-fauna, surrounding flora, environmental toxins, and other environmental contexts.

The health of a plant is determined by its environment. This environment includes physical factors (i.e. sun, rain, wind and soil nutrients) and biological factors (i.e. pests, diseases and weeds). All these factors can play a role in the balance which exists between herbivore insects and their natural enemies. If we understand the whole system of interactions, we can use this knowledge to reduce the negative impact of pests and diseases.

*Agroecology provides the knowledge and methodology necessary for developing an agriculture that is on the one hand environmentally sound and on the other hand highly productive, socially equitable and economically viable.*

#### **Agroecosystem**

An agroecosystem is the basic unit of study in agroecology, and is defined as a spatially and functionally coherent unit of agricultural activity, and includes the living and nonliving components involved in that unit as well as their interactions.

#### **Agroecosystem analysis**

Agroecosystem analysis is a thorough analysis of an agricultural environment which considers aspects from ecology, sociology, economics, and politics with equal weight. Agroecosystem analysis is a tool of the multidisciplinary subject known as Agroecology. Agroecology and agroecosystem analysis are not the same as sustainable agriculture, though the use of agroecosystem analysis may help farming system ensure its viability.

Agroecosystem analysis is not a new practice, agriculturalists and farmers have been doing it since societies switched from hunting and gathering (hunter-gatherer) for food to settling in one area. Every time a person involved in agriculture evaluates their situation to identify methods to make the system function in a way that better suits their interests, they are performing an agroecosystem analysis. Agro-ecosystem analysis (AESA) is a tool to assist farmers to develop skills and knowledge about the ecosystems and consequently, how to make better decisions.

### **AESA can be done by the following steps:**

Step 1: Making field observations - in sub-groups (four to five persons), farmers make observations in the field based on a range of monitoring indicators. Emphasis is on observing the interactions between various factors in the agro-ecosystem. AESA observations should include:

- 1) Agronomic Data (plant height, no. of leaves /plant, no. of flowers/plant, no. of fruits/plant, weight of harvested fruits)
- 2) Plant Protection Data (counting insect pests, counting natural enemies, disease incidence)
- 3) Weed growth (different kinds, prevailing ones, leguminous weeds, weeds leaving high amount of residues)
- 4) General Data (variety, days after planting, weather condition, soil condition)



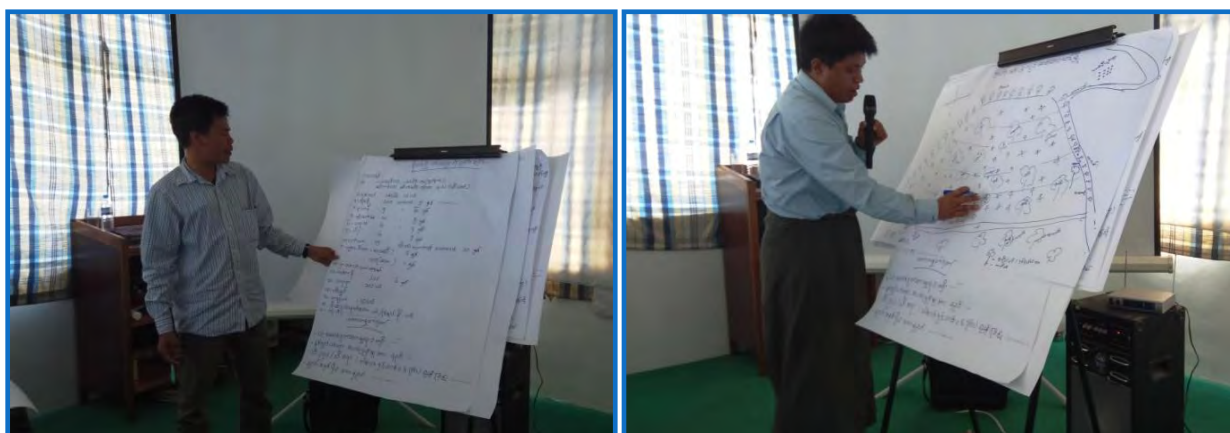
Field observations by sub-groups (Please note the gender) (© FAO, ToT in 2018)

Step 2: Analyzing and recording findings – each sub-group structure, reflects on, records and analyze their findings from the field, including making drawings of the field situation and elaborate decisions and recommendations.



Recording, reflecting, analyzing, and depicting on findings by groups (©FAO, ToT in 2018)

Step 3: Presenting the feedback - In plenary each sub-group presents their results and conclusions. Feedback and questions from the other groups require the group to defend their decisions with logical arguments.



Sub-group presentations and responding feedbacks from participants (© FAO, ToT in 2018)

Step 4: Discussing actions to take - In a plenary the participants synthesize the presentations and collectively agree and decide what actions to implement based on the decisions they have taken.

## 3.2 Preparation of Homemade Organic Compounds

### 3.2.1 Indigenous Micro Organism (IMO)

This method is widely used by farmers in Pakistan and India and called *Jiv Amrit* or *Amrit Pani*. By using this method the urine and dung of one cow is enough to inoculate IMO for 30 acres. It is not meant to fertilize but rather to culture effective micro-organisms that will improve soil ecosystem and fertility.

#### Objective

To improve and sustain soil ecosystem, fertility and crop yield in the long run but also escape from dependency on non-renewable external inputs by using *Jiv Amrit* because no further application of other fertilizers is needed after application of two consecutive cropping seasons.

#### Preparation of Indigenous Micro-organism (IMO)

##### Ingredients

- Fresh cattle dung
- Fresh cattle urine
- Jaggery (toddy or sugarcane)
- Chickpea power

##### Amount

6.5 vissees  
10 liters  
1.5 vissees  
1.5 vissees



- Soil from 4" depth, underneath bamboo trees                      0.5 visses
- Water    50 gallons

All ingredients are put into the 53 gallon plastic-barrel and stirred thoroughly. The barrel is covered with bamboo tray. In dry season, the color turns to ample color with fermented odor in 12 days. In cold season, it takes about 20 days. The liquid can be applied directly to the root zone of the growing plants and also can be used as foliar spray.



IMO after 8 days (left) and after 12 days (right) (© FAO/U.Theinsu, 2017, Myanmar)

Apply at least 6 times during one crop season, starting from the initial stage. The more you use the better because it is not a nutrient solution but it contains about 75,000 types of micro-organisms that will help improve the soil ecosystem of your farm and nutrient availability to the crops. Remember that mineral or nutrients are abundant (*See that 78% of atmospheric gas is of N<sub>2</sub> and accounting to 8 tons of N<sub>2</sub> on 1sq. meter. No input comes from outside of the farm in Sustainable Agriculture (SA)*) naturally which are made easily available for the plant with microbial action. Don't go for mono-cropping, better go for multi cropping -mix cropping pattern. After using this method for 2 years you need not to apply any fertilizer.





Collection of fresh cow urine on cement floor with a small channel (© FAO/U.Theinsu, 2017, Myanmar)

### 3.2.2 Fish Amino Acid (FAA)

Commercially available fertilizers are a cost-effective means of supplementing soil with nitrogen (N) for plant growth and high crop yields; however, improper or excessive use of N fertilizer can lead to nitrate pollution of ground or surface water. Producers can minimize this predicament by implementing Best Management Practices (BMPs) for fertilizer use that reduce nutrient losses and avert runoff and leaching from agricultural lands. Natural Farming incorporates the use of indigenous microorganisms (IMO) and fish amino acid (FAA) to increase N availability in soils and improve crop yields while sustaining water quality. This fact sheet addresses the production and use of FAA in Natural Farming.

Fish fertilizer is an awesome product for promoting plant growth. It's high in Nitrogen for growing plants, can be naturally produced, and is an awesome food for microbes! Fungi love this stuff. Fish fertilizer can be expensive in the store, but it is easily produced at home.

#### Preparation of Fish Amino Acid (FAA)

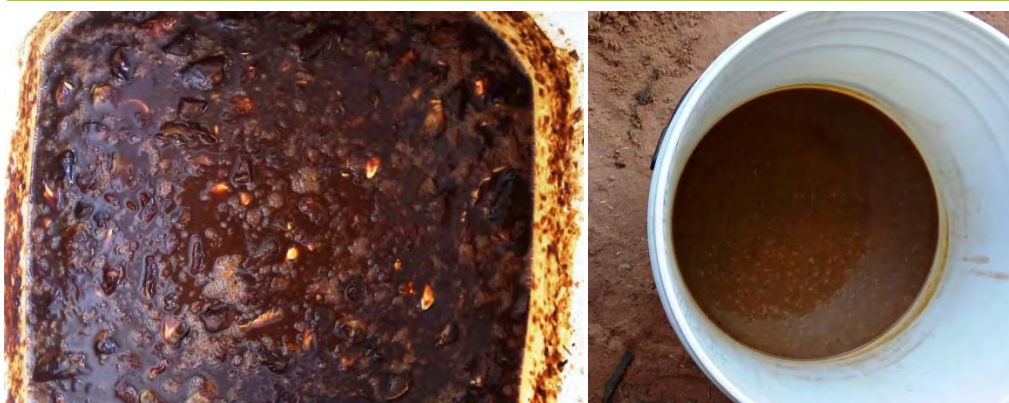
In the recipe, fish heads, skins, guts, and meat are broken down by wild microbes in a semi-controlled setting that nurtures positive microbes and turns the fish into a golden liquid fertilizer that is rich in nitrogen and trace minerals. It can take 21 days to be ready for use.

Ingredients	Amount
1. Fish waste	5 visses
2. Jaggery/Moases (Toddy, Sugarcane)	5 visses

Fresh fish wastes and visceral organs are put in a plastic bucket. The same weight of jaggery or molases is put in the bucket and the two are mixed thoroughly. At least one-third of the portion inside the bucket is left to prevent the overflow of the liquid during the fermentation process.



Cutting of fishes and mixing in toddy jaggery (© FAO/U.Theinsu, 2017, Myanmar)



Fermenting (left) and FAA syrup ready to use (© FAO/U.Theinsu, 2017, Myanmar)

### Use of FAA

FAA is applied as a source of nitrogen during the early or vegetative stage of development to boost growth and size. Do not apply FAA if plants are at the reproductive stages of their production cycle when flowering or fruiting is desired.

FAA is diluted with water (1:1,000) or (2-5 ml in one liter of water) or 2 table-spoons in one gallon of water. It can be used in a “cocktail” with other Natural Farming inputs and applied as a light foliar spray or soil drench. For leafy vegetables, spray weekly to improve yields, fragrance, and taste. Avoid spray applications during full sunlight hours to prevent foliar burning and evaporation of the solution before the plant has had a chance to absorb it.

Like all fertilizers, it's most effective to apply fish products when the microbes are active and able to use the nutrients you're providing them. This means warm temperatures and sufficient moisture.

Fish fertilizers can be applied directly to soil, or make great additions to foliar spray, especially when mixed with Effective Microorganisms.

Liquid forms can also work well in hydroponic applications. Dilution rates vary widely, so it's best to check the specifics of the product you're using.

### 3.2.3. Tobacco-chili- ginger pesticide

#### Preparation of Tobacco-chili- ginger pesticide

Ingredients	Amount
1. Tobacco (Dried leaves)	0.5 visses
2. Ginger	0.5 visses
3. Chili	0.5 visses
4. Effective Microorganism-EM	1.0 liters
5. Water	50 liters

Tobacco, ginger, and chili are grinded separately and all are put in plastic barrel. One liter of EM and 50 liters of water are added in the barrel and then they all are stirred thoroughly. The barrel is covered with a piece of cloth. After about 10 to 15 days, it can be used to apply for pest control. The liquid extract is sieved and the residues can be used as fertilizer. The liquid is diluted at the ratio of 200 ml in 4 gallons of water.

It can prevent army worms, white fly, thrips, aphids, hairy caterpillar, cut worms, and pod borers, etc.



**Dried tobacco leaves**  
(© FAO/U.Theinsu, 2017, Myanmar)



**Ginger rhizomes**  
(© FAO/U.Theinsu, 2017, Myanmar)





**Fresh Chili**  
(© FAO/U.Theinsu, 2017, Myanmar)



**EM concentrate**  
(© FAO/U.Theinsu)



**Under processing**  
(© FAO/U.Theinsu, 2017, Myanmar)

### 3.3 Group Dynamic Exercise

Group dynamics is the part of the FFS activities which helps to strengthen group cohesion and enhance cooperation. Various ways could be formulated that help the group to become enlivened and motivated, such as role playing, brain teacher, case story and short drama. The message contained within the group dynamics should compromise of communication, leadership mobilization, and problem solving and planning. Below are examples of group dynamic that can be used for FFS:

- Nine dots
- Landing on the moon
- Broken square
- Sale of sheep
- Handcuff
- Story telling

### 3.4. Special Topics

Special topics offer support to the AESA, where very simple demonstrations will carried out, either in the field or at the meeting place. The topic could be selected from the list provided, but the facilitator can develop more innovative and creative topics relevant to the farmer's needs. The special topics proposed in general covers the following:

- Climate Resilient Crop and Varieties in upland farming
- Climate-smart agricultural ecosystems/soils and their management for CSA



- Appropriate Farming Techniques
- Life Cycle of Pest and Testing on Integrated Pest Management Practices
- Economic Analysis on Cropping Intensification for farming

## 4. Farmer Field School Session - 3

### General Discussions and Observations in Demonstration Plots

<b>Month:</b>	June
<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Four hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Handout, flipchart, marker pens

#### Topics to be covered:

1. Introduction of concept of CA
2. Observation on the growth of plants in the Demo Plot and effects of mulching on crop and weed growth
3. Manual weeding and placing of uprooted weed residues in the plot (mulching again) (Herbicide application is strictly prohibited)
4. Analysis of varietal differences of yam and their market prices
5. General discussion on the changes of weather conditions of present and the past, and its effects on crops and environment and outputs recorded
6. Observation and analysis on the performances of activities undertaken in the previous sessions
7. Recording of crop management and crop performances in crop record book
8. Presentation of individual actions undertaken
9. Production of individual's action plan
10. Open discussion on the whole training session of the day and recording of participants feedbacks

## 5. Farmer Field School Session - 4

### Agro-forestry

**Week/Date:** First week

**Time/Duration:** Morning three hours and afternoon two hours

**Trainer(s):** Facilitator (Staff from Department of Agriculture)

**Material:** Handout of Agro-forestry, flipcharts, marker pens

**Topics to be covered:**

1. Introduction of Agro-forestry
2. Planting of avocado seedlings in the pits already dug with spacing of 20'x20' (feet)
3. Planting of coffee seedlings in the pits already dug with spacing of 4' x 8' (feet)
4. Planting of *Gliricidia* seedlings in the pits 1.5 feet apart
5. Heavy mulching of planted seedlings at their bases with available organic residues in the field (plastic mulching will not be encouraged)(yam, avocado and coffee are already grown in the same plot as intercropping pattern and Agro-forestry system, and also along the contours)
6. Agroecosystem Analysis Exercise – Groups comprising of five participants will study and make records on the following in Demo Plot
  - 1) the effectiveness of SALT practices and erosion control measures, 2) effects of mulching, 3) soil organic matter and soil moisture conditions, 4) crop performances and incidences of pest and diseases, 5) performance of different varieties of yam
7. Recording of findings by groups
8. Group presentations on their findings and responding to questions raised by other groups
9. Making decisions and recording of important points for further actions for improvement
10. Recording of expenditures for crops in financial record book
11. Presentation of individual actions undertaken
12. Production of individual's action plan
13. Open discussion on the whole training session of the day and recording of participants feedbacks

**Related Training Reference Materials:**

## Agroforestry

Agroforestry is a land use management system in which trees or shrubs are grown around or among crops or pastureland. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use systems. Agroforestry systems can be advantageous over conventional agricultural, and forest production methods. They can offer increased productivity, economic benefits, and more diversity in the ecological goods and services provided.

Agroforestry blends farm and forest. It's about growing more with less.

### **Five Features of Agroforestry:**

1. Diversity. By using a wide range of species, farmers create higher yields, with fewer resources in a more sustainable fashion.
2. Layers. Stacking plants (some small, some tall and everything in between) allows farmers to make use of vertical space to grow more with less lateral space.
3. Relationships. Living things can also protect and complement each other. Farmers plant companion crops that are friendly and non-competitive.
4. Microclimate. An agro forest creates its own little climate systems — areas that are cooler, warmer, wetter or drying than the surrounding environment. It's important for farmers to understand and predict how plants will create and respond to these microclimates.
5. Cycling. My moving biomass and planting patterns, farmers are able to create better soil, increase production and ensure the longevity of the land. They may mulch, fertilize, collect fire wood and rotate crops within a small plot of land.

### **Applications:**

Agroforestry represents a wide diversity in application and in practice. One listing includes over 50 distinct uses. The 50 or so applications can be roughly classified under a few broad headings. There are visual similarities between practices in different categories. This is expected as categorization is based around the problems addressed (countering winds, high rainfall, harmful insects, etc.) and the overall economic constraints and objectives (labor and other inputs costs, yield requirements, etc.). The categories include:

#### **1. Hillside systems**

A well-studied example of an agroforestry hillside system is the Quesungual Slash and Mulch Agroforestry System (QSMAS) in the Lempira Department, Honduras. This region in Honduras



has historically been used for burn subsistence agriculture. Due to heavy seasonal floods, the exposed soil was washed away, leaving the now infertile barren soil exposed to the arid drought season. Farmed hillside sites had to be abandoned after several years and new forest was burned. As an alternative to this unsustainable system, the FAO helped introduce a system incorporating local knowledge consisting of the following steps:

1. Hillside secondary forest is thinned and pruned, ensuring that individual specific beneficial trees, especially nitrogen-fixing trees are left. They help reduce soil erosion, maintain soil moisture, provide shade and supply an input of nitrogen-rich organic matter in the form of litter.
2. Maize is planted in rows and left to grow. This is a traditional plant to Honduras which local farmers have a lot of previous knowledge about.
3. Maize is harvested from the dried plant and beans are simultaneously planted. The dead remaining maize stalks provide an ideal structure for the climbing bean plants. Bean is a nitrogen-fixing plant and therefore helps introduce more nitrogen to the system.
4. Pumpkin can also be planted during this time, its large leaves and horizontal growth providing additional shade and moisture retention for the soil. It does not compete with the beans for sunlight since these grow vertically on the maize stalks.
5. Every few seasons, the crop rotation is fulfilled by allowing cattle to graze in these areas, allowing grass to grow and the build-up of soil organic matter and nutrients in the soil. The cattle prevent total reforestation of the light agroforestry system by grazing around the individual trees and bring additional nutrients through their manure.
6. Maize is grown again and the cycle is repeated. Thus, the same location can be used for long-term agriculture, helping to reduce the pressure on natural forest ecosystems and preventing land-use change with high carbon losses.

## **2. Parkland**

Parklands are visually defined by the presence of trees widely scattered over a large agricultural plot or pasture. The trees are usually of a single species with clear regional favorites. Among the beaks and benefits, the trees offer shade to grazing animals, protect crops against strong wind bursts, provide tree pruning for firewood, and are a roost for insect or rodent-eating birds.



Shaw-Phyu (*Sterculiaversicolor*) and peanut as parkland system  
(© FAO/U.Theinsu, Myanmar, 2016)

There are other gains. Research with *Faidherbia albida* in Zambia showed that mature trees can sustain maize yields of 4.1 tones per hectare compared to 1.3 tons per hectare without these trees. Unlike other trees, *Faidherbia* sheds its nitrogen-rich leaves during the rainy crop growing season so it does not compete with the crop for light, nutrients and water. The leaves then regrow during the dry season and provide land cover and shade for crops.<sup>[17]</sup>

### 3. Shade systems

With shade applications, crops are purposely raised under tree canopies and within the resulting shady environment. For most uses, the understory crops are shade tolerant or the over-story trees have fairly open canopies. A conspicuous example is shade-grown coffee. This practice reduces weeding costs and improves the quality and taste of the coffee. Just because plants are grown under shade does not necessarily translate into lost or reduced yields. This is because the efficiency of photosynthesis drops off with increasing light intensity, and the rate of photosynthesis hardly increases once the light intensity is over about one tenth that of direct overhead sun. This means that plants under trees can still grow well even though they get less light. By having more than one level of vegetation, it is possible to get more photosynthesis, and overall yields, than with a single canopy layer.



Strip cropping of soybean and maize in Shan State (© FAO/U.Theinsu, 2014, Myanmar)

#### 4. Alley cropping or Strip cropping

With alley cropping, crop strips alternate with rows of closely spaced tree or hedge species. Normally, the trees are pruned before planting the crop. The cut leafy material is spread over the crop area to provide nutrients for the crop. In addition to nutrients, the hedges serve as windbreaks and eliminate soil erosion.

Alley cropping has been shown to be advantageous in Central Dry Zone, particularly in relation to improving maize yields in the sub-Saharan region. Use here relies upon the nitrogen fixing tree species *Sesbania sesban*, *Tephrosia vogelii*, *Gliricidia sepium*. In one example, a ten-year experiment in Malawi showed that, by using the fertilizer tree *Gliricidia* (*Gliricidia sepium*) on land on which no mineral fertilizer was applied, maize yields averaged 3.3 tons per hectare as compared to one tone per hectare in plots without fertilizer trees nor mineral fertilizers.<sup>[20]</sup>

#### 5. Taungya

Taungya is a vastly used system originating in Myanmar. In the initial stages of an orchard or tree plantation, the trees are small and widely spaced. The free space between the newly planted trees can accommodate a seasonal crop. Instead of costly weeding, the underutilized area provides an additional output and income. More complex taungya use the between-tree space for a series of crops. The crops become more shade resistant as the tree canopies grow and the amount of sunlight reaching the ground declines. If a plantation is thinned in the latter stages, this opens further the between-tree cropping opportunities.



Taungya system (© FAO/U.Theinsu, Myanmar, 2011)

### **The Benefits of Agroforestry:**

Over the past two decades, a number of studies have been carried out analyzing the viability of agroforestry. The combined research has highlighted that agroforestry can reap substantial benefits both economically and environmentally, producing more output and proving to be more sustainable than forestry or agricultural monocultures. Agroforestry systems have already been adopted in many parts of the world.

Agroforestry systems can include the following benefits:

1. They can control runoff and soil erosion, thereby reducing losses of water, soil material, organic matter and nutrients.
2. They can maintain soil organic matter and biological activity at levels satisfactory for soil fertility. This depends on an adequate proportion of trees in the system- normally at least 20% crown cover of trees to maintain organic matter over systems as a whole.
3. They can maintain more favorable soil physical properties than agriculture, through organic matter maintenance and the effects of tree roots.
4. They utilize solar energy more efficiently than monoculture systems different height plants, leaf shapes and alignments all contribute.
5. They can lead to reduced insect pests and associated diseases.
6. They can be employed to reclaim eroded and degraded land.
7. Nitrogen-fixing trees and shrubs can substantially increase nitrogen inputs to agro forestry systems.



8. Trees can probably increase nutrient inputs to agro forestry systems by retrieval from lower soil horizons and weathering rock.
9. The decomposition of tree and pruning can substantially contribute to maintenance of soil fertility. The addition of high-quality tree pruning leads to large increase in crop yields.
10. In the maintenance of soil fertility under agro forestry, the role of roots is at least as important as that of above-ground biomass.
11. Agro forestry can provide a more diverse farm economy and stimulate the whole rural economy, leading to more stable farms and communities. Economics risks are reduced when systems produce multiple products.

## 6. Farmer Field School Session - 5

### Integrated Pest Management

<b>Month:</b>	August
<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Four hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Training handout of IPM, flipcharts, marker pens

#### Topics to be covered:

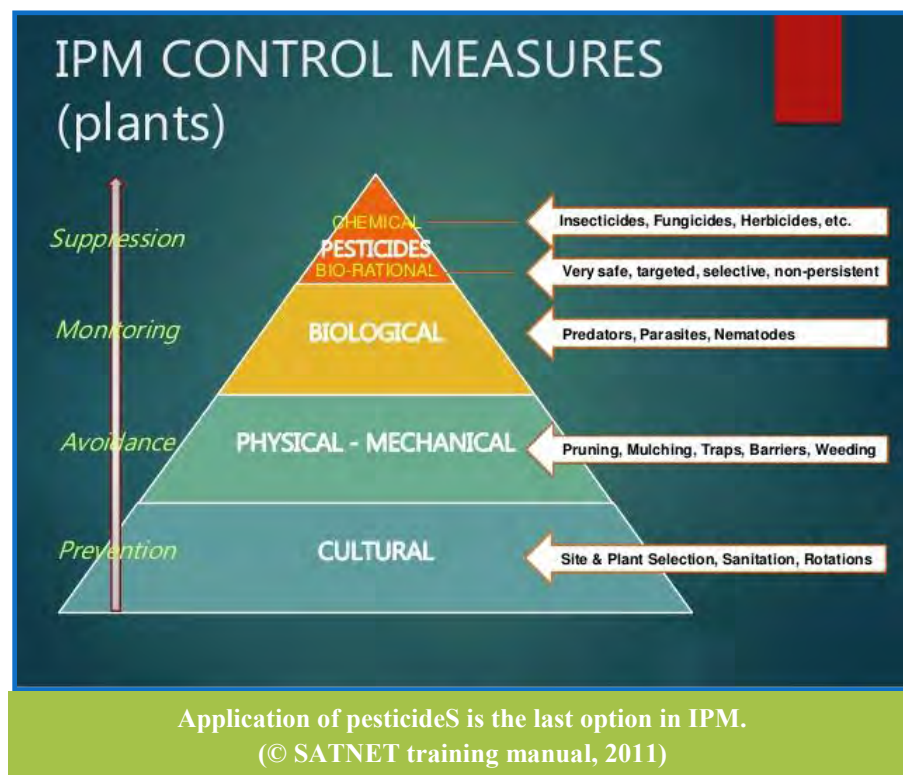
1. Concepts of Integrated Pest Management-IPM
2. Survey and collection of insects and classification of beneficial insects and pest
3. Concept of weed management
4. Manual weeding and placing of uprooted weed residues in the plot as mulch
5. Practical application of organic fertilizers, EM solution and pesticide on the plants including hedgerow plants
6. Recording of crop performances in each crop management record books (Yam, Rice Bean, Coffee, Avocado, *Gliricidia*, *Leucaena*)
7. Presentation of individual actions undertaken
8. Production of individual's action plan
9. Open discussion on the whole training session of the day and recording of participants feedbacks

#### Related Training Reference Materials:

## Integrated Pest Management (IPM)

“Integrated pest control is a pest management system that, in the context of associated environment and population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains pest populations at levels below those causing economic injury” (FAO, 1967).

IPM is a systematic strategy for managing pests which considers prevention, avoidance, monitoring and suppression. Where chemical pesticides are necessary, a preference is given to materials and methods which maximize public safety and reduce environmental risk.



The control measures that are involved in this management are generally classified as:

- (1) Physical control,
- (2) Cultural control,
- (3) Biological control, and
- (4) Chemical control.

Recently, genetic control – meaning the use of genetically-resistant varieties -- has been highly promoted.

### 1. Physical Control

Traps (Light traps, Sticker traps), barriers, weeding, mulching, and pruning)

### 2. Cultural Control

Site and plant selection, sanitations, rotations

### 3. Biological Control

Predators, parasites, nematodes

### 4. Chemical Control

Insecticides, fungicides, herbicides (Very safe, targeted, selective, non-persistent)

The IPM concept is based on the principle that it is not necessary to eliminate all the pests but to suppress the pest population to a level at which these pests do not cause significant losses. An integrated strategy for crop pest management includes use of resistant varieties modifying agronomic practices to reduce pest incidence, biological control and other novel approaches for pest suppression and only need based judicious use of chemical pesticides.

### Five steps in implementing IPM





**a. Inspection and identification**

Not all insects found in the farm are pests, some are beneficial insects. It is crucially needed to identify these two types wisely. Even though the pests are found in the farm, if their numbers are not at the threshold level, it does not need any control measures.

**b. Findings and recommendations (in written)**

All findings are noted and documented in the record book. Suitable recommendations will be provided based on findings.

**c. Client communication**

Farm owner will be communicated and informed the findings and recommendations for further follow up actions.

**d. Implementation**

Four levels of control measures will be applied when infestation is above the threshold level.

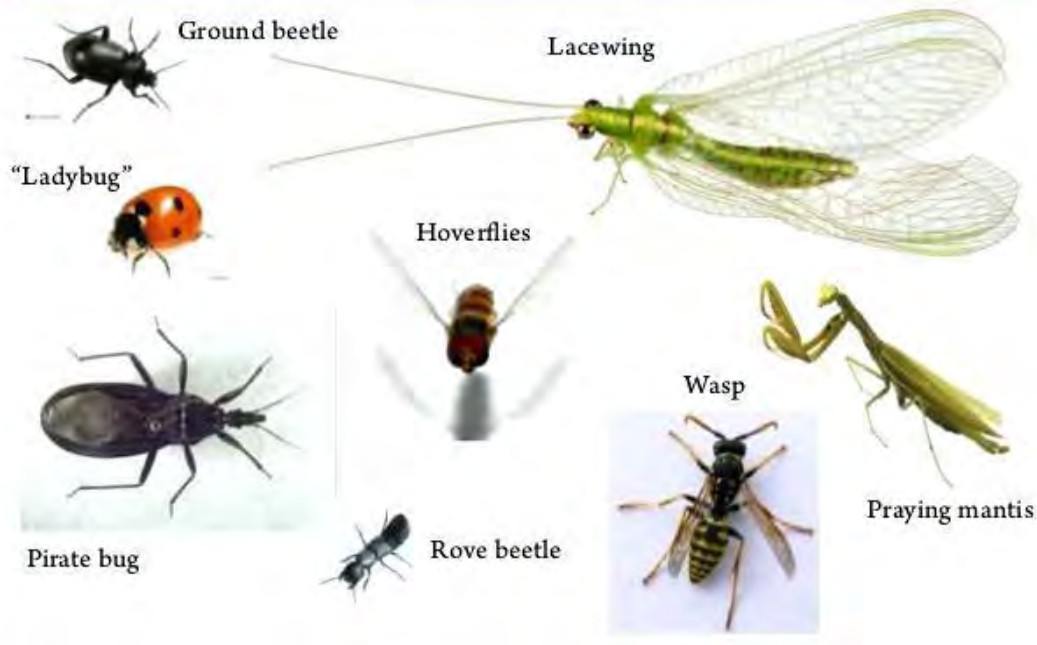
**e. Documentation and follow-up**

All the activities of control practices taken in the farm will be documented in farm record book. There will be necessary follow-up actions throughout the whole cropping season constantly.

**Practical exercise in the farm in FFS**

**Step 1:** Making field inspections - in sub-groups (four to five persons with gender balance), farmers make observations in the field and insect collection will be made using insect collection nets. Sub-group members count the insects collected and identify the pests and beneficial insects by the aid of Beneficial Insect Chart.

## Beneficial insects

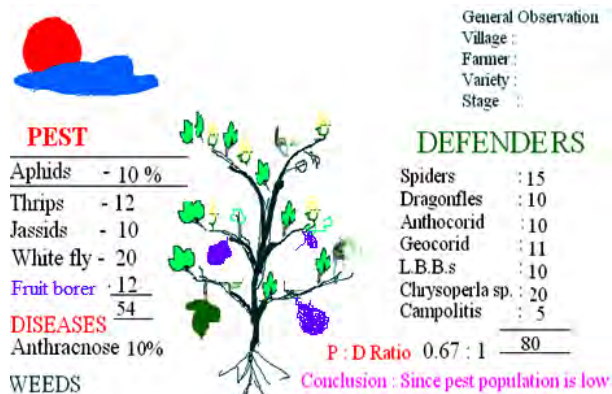


(© Fotsos.com, 2018)

- Step 2:** Analyzing and recording findings – each sub-group structure, reflects on, records and analyze their findings from the field, including different pests and their population, different beneficial insects and their population, and making drawings of the field situation and elaborate decisions and recommendations.
- Step 3:** Presenting the feedback - In plenary each sub-group presents their results and conclusions. Feedback and questions from the other groups require the group to defend their decisions with logical arguments.
- Step 4:** Discussing actions to take - In a plenary the participants synthesize the presentations and collectively agree and decide what actions to implement based on the decisions they have taken.



Pest (© SATNET training manual, 2011)



Beneficial insects



Presentation by sketch pictures  
(© SATNET training manual, 2011)



Finding with the ratio of (1.0:1.5) pest and pes  
(© SATNET training manual, 2011)

Presentation by group's finding and suggestion

## 7. Farmer Field School Session - 6

### Agroecosystem Analysis II

<b>Month:</b>	September
<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Three hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Flipcharts, marker pens

#### Topics to be covered:

1. Repetition of Agroecosystem Analysis Exercise; Groups comprising of five participants will study and make records on the following in the Demo Plot: 1) the effectiveness of SALT practices and erosion control measures, 2) effects of mulching, 3) soil organic matter and soil moisture conditions, 4) crop performances and incidences of pest and diseases, 5) performance of different varieties of yam
2. Recording of findings by groups
3. Group presentations on their findings and responding to questions raised by other groups
4. Making decisions and recording of important points for further actions for improvement
5. Recording of crop performances in each crop management record books (Yam, Rice Bean, Coffee, Avocado, *Gliricidia*, *Leucaena*)
6. Recording expenditures in financial records book
7. Presentation of individual actions undertaken
8. Production of individual's action plan
9. Open discussion on the whole training session of the day and recording of participants feedbacks.



## 8. Farmer Field School Session - 7

### Farming As a Business and Post-harvest Handling

<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Four hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Training handout of Farming As A Business

#### Topics to be covered:

1. Group discussion on the following (Groups comprising of five participants); 1) what is agriculture as a business? 2) How can agriculture be done as a business? 3) What is the difference between food crop and cash crop? 4) Why intercropping can optimize output per acre?
2. Group presentations of their outputs and defending feedbacks from participants
3. Documentation of important points for further actions
4. Group discussion on essentials of agriculture as a business (plans of production, keeping of financial record book, keeping the cash flow, knowing of cost of production, main cost drivers and alternatives)
5. Group presentations of their outputs and defending feedbacks from participants
6. Documentation of important points for further consideration
7. Group discussion on their understanding of the market system (role of brokers and traders, price variation in market systems, importance of linkages for market information, market prospects for a crop as recommended in value chain analysis)
8. Group presentations of their outputs and defending feedbacks from participants
9. Determination of ways to improve market system to benefiting to individual farmers and documentation of important points for further actions
10. Presentations of individuals on their activities undertaken in between the FFS sessions
11. Production of individual's action plan
12. Open discussion on the whole training session of the day and recording of participants feedbacks.

#### Related Training Reference Materials:

## **8.1. Farming as a business (FAAB)**

Most of the FFS participants will be subsistence farmers and whatever they grow, they eat. While subsistence farming helps farmers meet their basic food needs, it's a vulnerable lifestyle. If the crop fails, the farmers have no safety net. They will need to get help from outside sources. The FFS approach emphasizes the value of moving from subsistence farming to commercial farming. If the participants make good management decisions, they can feed themselves and create their own safety net. The next time a crop fails, the farmers will remain financially secure because they will have learned how to select the right crops/commodities/enterprises, diversify their activities, save money and maximize profits.

The starting point of the FFS process is a small plot of land that farmers can use to experiment and practice farming techniques. The goal, however, is for the FFS to use this practice and the knowledge it has gained from the learning programme to develop a sustainable commercial activity. The FFS method treats farming as a business. The goal of Farming as a Business is profit maximization. There are three major factors that contribute to profit maximization:

### **1. Minimum Costs**

In order to increase profit, a farmer must first reduce production and marketing costs. Often costs can be reduced without sacrificing crop health or environmental sustainability.

### **2. Maximum Yield**

The farmers will develop good agricultural practices from their study plots. They must use these practices to maximize yield. The farmers will attain higher yields if they:

- Plant in a timely manner,
- Use improved/suitable inputs,
- Properly manage soil and water use
- Keep the fields free of weeds,
- Control pests and disease,
- Harvest promptly.

### **3. Higher Prices**

Farmers can add value to their products by adding features. Even though the farmers want to cut costs they should be willing to spend on product improvements that will bring higher prices. For example, packaging the product costs money but adds value because consumers will pay more for a clean, easy-to-handle product. Simple agro-processing like rice hurling or maize grinding almost doubles the price at which farmers can sell their product. Alternatively, if the FFS groups are organized under a network, they can decide to hold their produce during the slump period until after harvest-when the prices rise.

#### **The Right Combination**

The goal is to balance the 3 elements to achieve profit maximization. Of course, it is easy to lower costs-a farmer could simply not buy anything! However, this is not a very good business practice because farmers cannot earn profit if they do not invest in their business. Farmers can add value to most products, but they can only charge high prices if consumers are willing to pay for such improvements.

#### **Session Plan**

Goals of the Session: For the group to understand the value of moving from subsistence farming to commercial farming

Materials: Flipcharts, markers

Time: 90 minutes

#### **Step 1: Begin with farmers' thoughts about the farming system in their community.**

Facilitator should lead them to talk about general observations about farmers in the village, which might include:

- They usually have small plots,
- They have difficulty controlling diseases and pests in the field,
- They lack modern farming skills, making production sustainable,
- There is little economic importance attached to farming,
- They do not attach any cost to the factors of production.

#### **Step 2: Discuss their understandings of farming and business.**

Do they see them as separate ideas? Do they know anyone who has a commercial farming business?

Ask them to contrast farming and business. Do most rural farmers approach farming like a business? What are the common businesses in their community? Is farming one of them?

**Step 3: Present the objectives of FAAB:**

- For farmers to appreciate that farming is a form of business,
- For farmers to gain the business management skills necessary for a successful FFS business enterprise, and
- For farmers to be able to adapt what they have learned from the FFS process to a successful enterprise.

**Step 4: Define and discuss the methods of FAAB.**

Explain the three keys for maximizing profit: low costs, maximum yield and high selling prices. What ideas does the group have about how to keep costs low, maximize yield and attain high prices?

This session will take the group through the stages of developing and maintaining a commercial enterprise. First, the group will select its enterprise. Second, it will analyze the profitability and risk associated with the enterprise it has selected. Next, it will create a budget for the enterprise. Last, it will begin planning the business with the goal of profit maximization.

**Essentials of Farming as a Business:**

- a. Keeping the cash flow,
- b. Knowing your cost of production, main cost drivers and alternatives,
- c. Getting initial investment or loan scheme when most farmers have lack of investment,
- d. Understanding the market system: role of brokers and traders, price variation in market systems, principles of contract farming,
- e. Discussing and exploring the potential business opportunities for women and the most marginalized farmers to ensure their participation and equal benefits,
- f. Business linkage and getting market information, and
- g. Determining market prospects for a crop.



## 8.2. Postharvest Handling

In agriculture, **postharvest** handling is the stage of crop production immediately following harvest, including cleaning, grading, cooling, packing, transporting, and marketing. The instant a crop is removed from the ground, or separated from its parent plant, it begins to deteriorate. Postharvest treatment largely determines final quality, whether a crop is sold for fresh consumption, or used as an ingredient in a processed food product.

### 8.2.1 Goals

The three main objectives of applying postharvest technology are:

- (1) to maintain quality (appearance, texture, flavor and nutritive value)
- (2) to protect food safety, and
- (3) to reduce losses between harvest and consumption

The most important goals of post-harvest handling are keeping the product cool, to avoid moisture loss and slow down undesirable chemical changes, and avoiding physical damage such as bruising, to delay spoilage. Sanitation is also an important factor, to reduce the possibility of pathogens that could be carried by fresh produce, for example, as residue from contaminated washing water.

### 8.2.2 Post-harvest losses (grains)

Grains may be lost in the pre-harvest, harvest, and post-harvest stages. Pre-harvest losses occur before the process of harvesting begins, and may be due to insects, weeds, and rusts. Harvest losses occur between the beginning and completion of harvesting and are primarily caused by losses due to shattering. **Post-harvest losses** occur between harvest and the moment of human consumption. They include on-farm losses, such as when grain is threshed, winnowed, and dried, as well as losses along the chain during transportation, storage, and processing. Important in many developing countries are on-farm losses during storage, when the grain is being stored for auto-consumption or while the farmer awaits a selling opportunity or a rise in prices. Losses can be low when the operation is done carefully but high with carelessness.

Grains are produced on a seasonal basis. In many places there is only one harvest a year. Thus, most production of maize, wheat, rice, sorghum, millet, etc. must be held in storage for periods varying from a few days up to more than a year. Storage therefore plays a vital role in grain supply chains. For all grains, storage losses can be considerable but the greatest losses appear to be of maize. Losses in stored grain are determined by the interaction between the grain, the storage environment and a variety of organisms.

#### **Post-harvest losses**

1. Harvesting/field drying	4-8 %
2. Transport to homestead	2-4 %
3. Drying	1-2 %
4. Threshing/shelling	1-3 %
5. Winnowing	1-3 %
6. Farm storage	2-5 %
7. Transport to market	1-2 %
8. Market storage	2-4 %
Cumulative loss from production	10-23 %

### Post-harvest loss summary

Crop	% Loss, minimum	% Loss, maximum
1. Cereals	3.9	6.0
2. Pulses	4.3	6.1
3. Oilseeds	2.8	10.1
4. Fruits	5.8	18.0
5. Vegetables	6.8	12.5

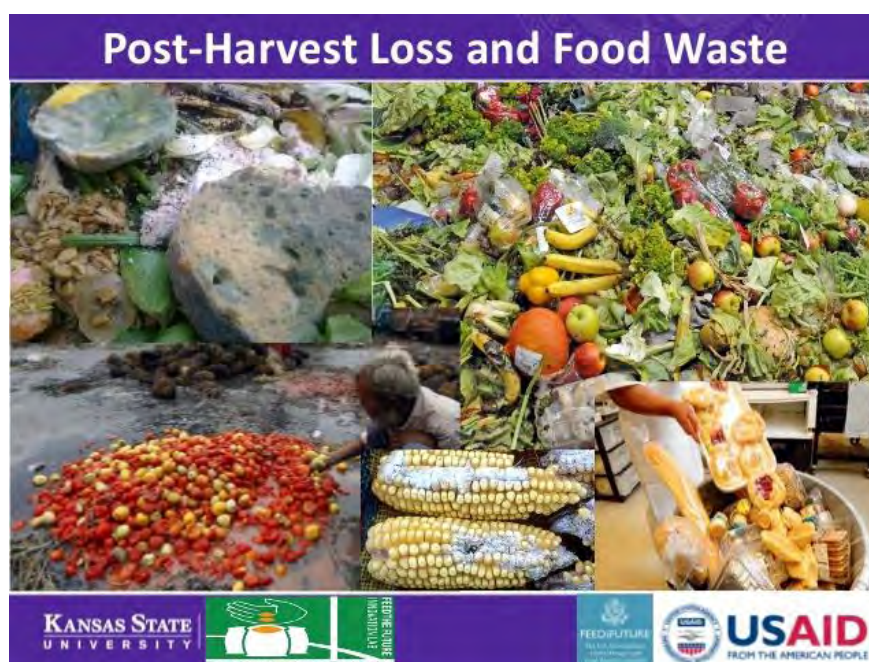
### 8.2.3 Attempts for loss reduction

There have been numerous attempts by donors, governments and technical assistance agencies over the years to reduce post-harvest losses in developing countries. Despite these efforts, losses are generally considered to remain high although, as noted, there are significant measurement difficulties. One problem is that while engineers have been successful in developing innovations in drying and storage these innovations are often not adopted by small farmers. This may be because farmers are not convinced of the benefits of using the technology. The costs may outweigh the perceived benefits and even if the benefits are significant the investment required from farmers may present them with a risk they are not prepared to take. Alternatively, the marketing chains may not reward farmers for introducing improvements. While good on-farm drying will lead to higher milling yields or reduced mycotoxin levels this means nothing to farmers unless they receive a premium for selling dry grains to traders and mills.

In one of its studies assessing losses of perishable products through handling or post-harvest operations, the special FAO loss-prevention programme presents the following conclusions: if harvest operations, storing (stacking and/or packaging in warehouse), storage and transport are defective, losses are separated as follows:

Harvesting	5-8 percent
Storing operation	15-20 percent
Storage	5-10 percent
Transport	10-12 percent
i.e. a theoretical total of	35-50 percent

Loss occurs at the front of the food chain—when food rot in fields, or is lost as a result of poor transportation networks, or spoils in markets that lack proper storage and preservation equipment and practices. Post-harvest loss is particularly acute in less-industrialized countries where it claims as much as 50% of fruits and vegetables. As the world's population grows and our available resources shrink, each pound of food produced that goes uneaten is a wasted opportunity to improve the health of people, the environment, and economies.



Reducing post-harvest loss strengthens livelihoods for farmers and families who depend on agriculture for their income. It can also ensure more food gets to more people. If unsustainable food production trends continue, the world will require a 70 percent increase in agricultural yield by 2050. With a global population expected to reach 9 billion by 2050, reducing inefficiencies associated with post-harvest loss will be critical to feeding the population of the future.

### **Avoiding loss**

Losses can be avoided by following good practices. There is also a wide range of post-harvest technologies that can be adopted to improve losses throughout the process of pre-harvest, harvest, cooling, temporary storage, transport, handling and market distribution. Recommended technologies vary depending on the type of loss experienced. However, all interventions must meet the principle of cost-effectiveness. In theory it should be possible to reduce losses substantially but in practice this may be prohibitively expensive. Especially for small farms, for



which it is essential to reduce losses, it is difficult to afford expensive and work-intensive technologies.

Effective management during the postharvest period, rather than the level of sophistication of any given technology, is the key in reaching the desired objectives. While large scale operations may benefit from investing in costly handling machinery and high-tech postharvest treatments, often these options are not practical for small-scale handlers. Instead, simple, low cost technologies often can be more appropriate for small volume, limited resource commercial operations, farmers involved in direct marketing, as well as for suppliers to exporters in developing countries.

The objective of post-harvest handling is, therefore, the creation of an understanding of all the operations concerned from harvesting to distribution so as to enable people to apply the proper technology in each step and in such a way to minimize losses and maintain quality as high as possible during the distribution chain. The farmer must give, among others, special and careful attention to the following steps of the post-harvest chain:

- Market demand for the produce they are planning to grow;
- Market requirements and buyers;
- Knowledge of the fresh produce;
- Cultivation practices;
- Factors affecting post-harvest deterioration;
- Harvesting and field handling;
- Packing in the field;
- Handling and packing in the packing house;
- Common storage and refrigeration;
- Transport;
- Sale to agents, traders or consumers;
- Market handling, and
- Self-life of the produce.

## 9. Farmer Field School Session - 8

### Exchange Visit

<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Four hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Transportation arrangement

#### **Topics to be covered:**

1. Visits to other FFS in the Township (Building up the relationship among farmer groups)
2. Observation on the progress in other FFS and making comparisons with each other.
3. Sharing of experiences among farmer groups.
4. Dissemination of new findings to other farmer groups.
5. Specific discussion during the exchange visits is on CSA based on their experiences in FFS and why the practices in FFS are relevant to CSA

#### **Related Training Reference Materials:**

#### **Exchange Visit**

An exchange visit is an important part of the FFS. The purpose is to build up the relationship within the FFS group. During the exchange visit, the farmers can compare progress, achievements and even constraints. To some extent, exchange visits also disseminate new findings to other farmers for their benefit. An adequate participation of women and girls in the exchange visits should be ensured.

The exchange visit could be organized based on the local situation as follow:

- FFS to FFS within district;
- FFS to FFS within region;
- FFS to FFS inter region, and
- FFS to FFS inter-country

## 10. Farmer Field School Session - 9

### Farmer's Field Day

<b>Month:</b>	December
<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Four hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Flipcharts, marker pens

#### Topics to be covered:

1. Visitors observation on the performances and achievements undertaken in FFS
2. Presentations on the activities undertaken in FFS by FFS trainees (putting emphasis on CSA)
3. Sharing of technologies and ideas to visitors by FFS trainees
4. Presentations of FFS participants on their experiences throughout the whole school session, emphasizing on why Climate Smart Agriculture becomes important in their farming, climate change effects on the crops, resilience of crops grown in the Demo Plot to the climate changes are because of proper crop and soil management practices.
5. Contribution of opinions, ideas, comments and suggestions from visitors and recording of contributions

#### Related Training Reference Materials:

##### Field Day

At the end of each FFS, the participants organize a field day to share their new knowledge with the local community members (from within the village and from neighboring villages), local politicians, government agriculture workers and other concerned stakeholders. Learning booths are prepared and FFS graduates present the FFS topics and findings to the visitors giving an opportunity to share technologies and ideas as well as to reinforce the topics learnt and their benefits.

A field day is an occasion organized by FFS farmers for the purpose of presenting and exposing all activities and achievements to other farmers in the community who did not participate in the FFS. The field day could also be a forum for interactions and sharing experiences. The field day

is also useful in raising willingness and can facilitate increased activities and scaling up in the future. To make the field day more useful, the following should be followed:

<b>Venue</b>	At the FFS site where most of the activities were done
<b>Date</b>	Determined by farmers, but at a time when the crop reaches maturity stage.
<b>Time</b>	Within FFS period, preferably during crop maturing stage.
<b>Location</b>	The FFS group leader should decide on the location and invite farmers from the surrounding community.
<b>Participants</b>	Local community members (from within the village and from neighboring villages), local politicians, government agriculture workers and other concerned stakeholders. An adequate participation of women and girls in the Farmer Field Day will be ensured.



## 11. Farmer Field School Session - 10

### Graduation Day

<b>Week/Date:</b>	First week
<b>Time/Duration:</b>	Three hours
<b>Trainer(s):</b>	Facilitator (Staff from Department of Agriculture)
<b>Material:</b>	Certificates

#### Topics to be covered:

1. Review on the whole FFS training session by participants and their awareness on CSA and its practices
2. Review on the awareness of participants on CA, SALT, Agro-forestry, IPM, and Agriculture as a Business
3. Development of plans of actions to undertake beyond FFS (strengthening of land management practices, caring of avocado and coffee plantation) (Yam harvest can be in January or February)
4. Share lessons learned from the FFS
5. Evaluation of training session by participants
6. Provision of Completion Certificate to participants
7. Ending of FFS successfully

#### Related Training Reference Materials:

##### Graduations Ceremony:

This marks the end of the season-long FFS learning cycle. It is organized by the farmers, facilitators and the coordinating offices. FFS farmers celebrate the day with their achievements and acknowledging time taken by farmers. FFS farmers use this forum to share the results and pass on the lessons learnt during the FFS to the public. They display the harvest obtained from the demonstration plot and other training and visibility materials and sometimes they enjoy with music, dancing and refreshment together with other community members. All the farmers (FFS Committee Members) who took part in the FFS activities by attending all the FFS trainings/meetings (with more than 80% of the attendance) and/or planting the given seeds in their own field will be awarded with a FFS Certificate during the graduation ceremony. By doing so other community members can also be attracted to join and continue FFS in their locality.

## ANNEX 1

### Farmer Field School' Curriculum for Upland/Hill Zone (Elephant Foot Yam, Coffee, and Avocado)

Month	Module	Subject and Competence
March (Last week)	Pre-FFS Introductory Meeting	<ol style="list-style-type: none"> <li>Objectives of FFS, guiding principle, FFS Famers selection, FFS Committee formation, Selection of Lead Famer etc.</li> <li>Introduction of participants: Facilitator, technical specialist, participants from villages.</li> <li>Site selection for establishing demonstration plot (in Lead Famer's Field) also discussion and agreement on size (one acre), treatment to be included and layout of the demonstration plot.</li> <li>Introduction of crops that will be covered in FFS training (Avocado, Coffee, Yam).</li> </ol>
April	Module 1	<ol style="list-style-type: none"> <li>Introduction to CSA and its practices.</li> <li>Introduction to GAP and its practices.</li> <li>Introduction to SALT and its practices.</li> <li>Introduction to CA and its practices.</li> <li>Discussion on the forest cover in the intervention zone, especially regarding the challenges. Analysis of existing farming systems that affect the soil, the crop/plant, and environment from the participant's perspective (putting the points on the flipcharts) and general discussion on that (brainstorming session).</li> <li>Introduction of climate changes and its effects.</li> <li>Practical exercises on site clearing and use of residues as soil cover, making of A-Frame, finding out contour lines, establishment of contour bunds with available materials on the slope, such as waste bamboos and logs, stones, etc. (Agro-ecosystem practices) (Burning of organic residues,</li> </ol>

		<p>such as logs and twigs, weed residues, crop residues, must be avoided: no more smokes from the fields).</p> <p>8. Establishment of small check dams with stones if available on the sites to prevent gully erosion</p> <p>10. Collection of seeds and seedlings of hedgerow plants from available sources; <i>Grevillea robusta</i>, <i>gliricidia</i>, <i>leucaena</i>, <i>tephrosia</i>, <i>flemingia</i>, <i>vetiver</i> grass.</p> <p>9. Introduction of yam, coffee, and avocado (Theory) – varieties and their characteristics, growth stages, nursery raising, transplanting, life periods, etc.</p> <p>10. Sowing of seed materials of yam (bulbils and/or small corms) in the Demo Plot with proper spacing based on the size of seed material (April is right time of sowing yam).</p> <p>11. Mulching of sown pits with available organic residues.</p> <p>12. Collection of soil samples for soil analysis that will be sent to soil lab to get the base line data of pH, soil texture, electrical conductivity, organic carbon, nutrient contents (N. P. K. Ca, Mg, S, Zn, B) and Na and related radicals (Cl, CO<sub>3</sub> and HCO<sub>3</sub>).</p> <p>13. Keeping records on crop managements for each crop and data entry in every training session.</p> <p>14. Open discussion on the whole training session of the day and recording of participants feedbacks.</p> <p>15. Production of plans of actions for individuals to replicate the learning from the FFS Demonstration Plot in their own farm.</p>
May	Module 2	<p>1. Concepts of Agroecosystem Analysis and practices.</p> <p>2. Sowing of hedgerow seeds along the contour lines (<i>Grevillea robusta</i>, <i>leucaena</i>, <i>tephrosia</i>, <i>flemingia</i>), cuttings of <i>vetiver</i> grass if available (Agro-ecosystem practices) (Mulching with organic residues available in the field must be done immediately once after sowing of hedgerow seeds). Discussion on how to maintain and protect tree seedlings growth.</p>

		<ol style="list-style-type: none"> <li>3. Broadcasting of rice bean (<i>Phaseolus calcaratus</i>) seeds to become live-crop cover.</li> <li>4. Staking and digging of pits for growing of coffee and avocado with proper spacing by auger (4' x 8' feet for coffee and 20' x 20' feet for avocado) along the contours in the Demo Plot (yam, coffee and avocado will be planted as inter-cropping pattern with wider spacing for avocado and closer spacing for yam and medium spacing for coffee).</li> <li>5. Pit filling with organic manures and composts.</li> <li>6. Preparation of home-made organic products (Indigenous Microorganism-IMO, Fish Amino Acid-FAA, Preparation of EM, Tobacco-chili-ginger pesticide, etc.).</li> <li>7. Compost making exercise (theory and practical).</li> <li>8. Practical exercise on rearing of earthworms for compost production.</li> <li>9. Keeping financial records on input costs and general expenditures.</li> <li>10. Review on the status of individual's action undertaken according to their plans of previous session.</li> <li>11. Production of individual's action plans to undertake at their farm.</li> <li>12. Open discussion on the whole training session of the day and recording of participants feedbacks.</li> </ol>
June	Module 3	<ol style="list-style-type: none"> <li>1. Introduction of concept of CA.</li> <li>2. Observation on the growth of plants in the Demo Plot and effects of mulching on crop and weed growth.</li> <li>3. Manual weeding and placing of uprooted weed residues in the plot (mulching again) (Herbicide application is strictly prohibited).</li> <li>4. Collection of different varieties of yam available in the areas and growing them in the demo plot.</li> <li>5. Analysis of varietal differences of yam and their market prices.</li> </ol>

		<ol style="list-style-type: none"> <li>6. General discussion on the changes of weather conditions of present and the past, and its effects on crops and environment and outputs recorded.</li> <li>7. Observation and analysis on the performances of activities undertaken in the previous sessions.</li> <li>8. Recording of crop management and crop performances in crop record book.</li> <li>9. Presentation of individual actions undertaken.</li> <li>10. Production of individual's action plan.</li> <li>11. Open discussion on the whole training session of the day and recording of participants feedbacks.</li> </ol>
July	Module 4	<ol style="list-style-type: none"> <li>1. Introduction of Agro-forestry.</li> <li>2. Planting of avocado seedlings in the pits already dug with spacing of 20'x20' feet.</li> <li>3. Planting of coffee seedlings in the pits already dug with spacing of 4' x 8' feet.</li> <li>4. Heavy mulching of planted seedlings at their bases with available organic residues in the field (plastic mulching will not be encouraged)(yam, avocado and coffee are already grown in the same plot as intercropping pattern and Agro-forestry system, and also along the contours).</li> <li>5. Agroecosystem Analysis Exercise – Groups comprising of five Participants will study and make records on the following in Demo Plot. <ol style="list-style-type: none"> <li>1) the effectiveness of SALT practices and erosion control measures, 2) effects of mulching, 3) soil organic matter and soil moisture conditions, 4) crop performances and incidences of pest and diseases, 5) performance of different varieties of yam.</li> </ol> </li> <li>6. Recording of findings by groups.</li> <li>7. Group presentations on their findings and responding to questions raised by other groups.</li> <li>8. Making decisions and recording of important points for further actions for improvement.</li> </ol>



		<p>9. Recording of expenditures for crops in financial record book.</p> <p>10. Presentation of individual actions undertaken.</p> <p>11. Production of individual's action plan.</p> <p>12. Open discussion on the whole training session of the day and recording of participants feedbacks.</p>
August	Module 5	<p>1. Concepts of Integrated Pest Management-IPM.</p> <p>2. Survey and collection of insects and classification of beneficial insects and pest.</p> <p>3. Concept of weed management.</p> <p>4. Manual weeding and placing of uprooted weed residues in the plot as mulch.</p> <p>5. Practical application of organic fertilizers, EM solution and pesticide on the plants including hedgerow plants.</p> <p>6. Recording of crop performances in each crop management record books (Yam, Rice Bean, Coffee, Avocado, <i>Gliricidia</i>, <i>Leucaena</i>).</p> <p>7. Presentation of individual actions undertaken.</p> <p>8. Production of individual's action plan.</p> <p>9. Open discussion on the whole training session of the day and recording of participants feedbacks.</p>
September	Module 6	<p>1. Repetition of Agroecosystem Analysis Exercise: Groups comprising of five Participants will study and make records on the following in the Demo Plot: 1) the effectiveness of SALT practices and erosion control measures, 2) effects of mulching, 3) soil organic matter and soil moisture conditions, 4) crop performances and incidences of pest and diseases, 5) performance of different varieties of yam.</p> <p>2. Recording of findings by groups.</p> <p>3. Group presentations on their findings and responding to questions raised by other groups.</p> <p>4. Making decisions and recording of important points for further actions for improvement.</p>

		<p>5. Recording of crop performances in each crop management record books (Yam, Rice Bean, Coffee, Avocado, <i>Gliricidia</i>, <i>Leucaena</i>).</p> <p>6. Recording expenditures in financial record book.</p> <p>7. Presentation of individual actions undertaken.</p> <p>8. Production of individual's action plan.</p> <p>9. Open discussion on the whole training session of the day and recording of participants feedbacks.</p>
October	Module 7	<p style="text-align: center;"><b>Farming As A Business (FAAB)</b></p> <p>1. Group discussion on the following (Groups comprising of five participants).</p> <p>1) What is agriculture as a business? 2) How can agriculture be done as a business? 3) What is the difference between food crop and cash crop? 4) Why intercropping can optimize output per acre?</p> <p>2. Group presentations of their outputs and defending feedbacks from participants.</p> <p>3. Documentation of important points for further actions.</p> <p>4. Group discussion on essentials of agriculture as a business (plans of production, keeping of financial record book, keeping the cash flow, knowing of cost of production, main cost drivers and alternatives).</p> <p>5. Discuss and explore the potential business opportunities for women and the most marginalized farmers to ensure their participation and equal benefits.</p> <p>6. Group presentations of their outputs and defending feedbacks from participants.</p> <p>7. Documentation of important points for further consideration</p> <p>8. Group discussion on their understanding of the market system (role of brokers and traders, price variation in market systems, importance of linkages for market information, market prospects for a crop).</p> <p>9. Group presentations of their outputs and defending feedbacks from participants.</p>

		<p>10. Determination of ways to improve market system to benefiting to individual farmers and documentation of important points for further actions.</p> <p>11. Discussion and planning on recommendations from Value Chain Analysis such as market information, linkages establishment with inputs/outputs market, financial institutions.</p> <p>12. Introduction to Postharvest Handling.</p> <p>13. Presentations of individuals on their activities undertaken in between the FFS sessions.</p> <p>14. Production of individual's action plan.</p> <p>15. Open discussion on the whole training session of the day and recording of participants feedbacks.</p>
November	Module 8	<p style="text-align: center;"><b>Exchange Visits</b></p> <p>An adequate participation of women and girls in such exchange visits will be ensured.</p> <ol style="list-style-type: none"> <li>1. Visits to other FFS in the Township (Building up the relationship among farmer groups).</li> <li>2. Observation on the progress in other FFS and making comparisons with each other.</li> <li>3. Sharing of experiences among farmer groups.</li> <li>4. Dissemination of new findings to other farmer Groups.</li> <li>5. Specific discussion during the exchange visits is on CSA based on their experiences in FFS and why the practices in FFS are relevant to CSA.</li> </ol>
December	Module 9	<p style="text-align: center;"><b>Farmer's Field Day</b></p> <p>An adequate participation of women and girls in the Farmer Field Day will be ensured.</p> <ol style="list-style-type: none"> <li>1. Visitors observation on the performances and achievements undertaken in FFS.</li> <li>2. Presentations on the activities undertaken in FFS by FFS trainees (putting emphasis on CSA).</li> </ol>

		<p>3. Sharing of technologies and ideas to visitors by FFS trainees.</p> <p>4. Presentations of FFS participants on their experiences throughout the whole school session, emphasizing on why Climate Smart Agriculture becomes important in their farming, climate change effects on the crops, resilience of crops grown in the Demo Plot to the climate changes are because of proper crop and soil management practices.</p> <p>5. Contribution of opinions, ideas, comments and suggestions from visitors and recording of contributions.</p>
January	Module 10	<p style="text-align: center;"><b>Graduation Day:</b></p> <p>1. Review on the whole FFS training session by participants and their awareness on CSA and its practices.</p> <p>2. Review on the awareness of participants on CA, SALT, Agro-forestry, IPM, and Agriculture as a Business.</p> <p>3. Development of plans of actions to undertake beyond FFS (strengthening of land management practices, caring of avocado and coffee plantation) (Yam harvest can be in January or February).</p> <p>4. Lessons learned from the FFS.</p> <p>5. Evaluation of training session by participants.</p> <p>6. Provision of Completion Certificate to participants.</p> <p>7. Ending of FFS successfully.</p>

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