Modules for Farmer Learning Sessions
Module 1. Climate Change and Climate Smart Agriculture concepts and principles

Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

1. Acquired basic understanding about the relationship of climate change and agriculture
2. Learned basic knowledge and skills in climate smart practices related to:
   a. Field crops including seed multiplication and management
   b. Small livestock production
   c. Small-scale aquaculture
   d. Vegetable production including home gardening
   e. Integrating trees (fruit and non-fruit) into farming systems
   f. Legume production
3. Identified farmer specialists among them who will share skills and knowledge to other farmers in the village and outside the village

General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationary before session
- Activate each participant in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

1. What is Climate Change?
2. What causes Climate Change?
3. What is GHG gases?
4. How agriculture contributes GHGs gas?
5. What are concepts of CSA?
6. What are the practices of CSA?

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

- Understand the components, drivers, and interactions of climate
- Analyze causes and effects of climate change
- Explain the relationship between agriculture and climate change
- Climate Smart Agriculture concepts
- Identify potential responses and solutions to climate change challenges
Targeted Participants

All the beneficiaries who are involving in home gardening activity and other farmers who interested to learn but the maximum numbers of participants should not be exceeded above 25 persons.

Trainer
Field researcher assigned for each CSV

How and why the climate is changing?

What is climate Change?
Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external factors such as persistent changes to the atmosphere or changes in land use. Climate change refers to significant, long-term changes in the global climate. E.g. Average temperature increase; Changing in rainfall pattern

What is climate Variability?
Climate Variability is defined as variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events.
The term "Climate Variability" is often used to denote deviations of climatic statistics over a given period of time (e.g. a month, season or year) when compared to long-term statistics for the same calendar period. Climate variability is measured by these deviations, which are usually termed anomalies. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external factors (external variability).

**What causes climate Change?**

Energy from the sun drives the earth’s weather and climate by heating the earth’s surface. To balance this the earth has to radiate energy back into atmosphere. Atmospheric gases such as water vapor and CO2 trap some of the outgoing energy, so the Earth retains more heat than it would without atmosphere. If it were not for this natural “greenhouse effect”, the Earth’s temperature will be much lower than current temperature. I

Climate has always changed according to natural processes interacting with the sun such as the water and energy cycles. In the past these changes were natural and caused by phenomena such as slow shift in the Earth’s orbit and changes in solar and volcanic activity. However, human has caused a sudden shift in the climate by releasing billions of tons of carbon dioxide into the atmosphere and adding sustainability to the greenhouse effect.
What is global warming?

Global warming is the slow increase in the average temperature of the earth’s atmosphere because an increased amount of the energy (heat) striking the earth from the sun is being trapped in the atmosphere and not radiated out into space. Global warming leads to melting ice from north and south poles which leads to sea level rise, rising temperature and increased in precipitation (rain and snowfall) and some regions are experiencing severe drought. Moreover, strong surges and more frequent of flooding period are being encountered.

How does agriculture contribute to climate change?

Modern agriculture, food production and distribution are major contributors of greenhouse gases: Agriculture is directly responsible for 14 per cent of total greenhouse gas emissions, and broader rural land use decisions have an even larger impact. Deforestation currently accounts for an additional 18 per cent of emissions. These contributions are resulted from

1. deforestation
2. Biodiversity loss
3. Soil erosion
4. Loss of soil organic matters
5. Salinization of soil
6. Costal water pollution

Land use changes can also significantly contribute to climate change. Large scale changes such as deforestation, soil erosion or machine-intensive farming methods may all contribute to increased carbon concentrations in the atmosphere. Soil erosion by water, wind and tillage affects both agriculture and the natural environment. Soil loss, and its associated impacts, is one of the most important (yet probably the least well-known) of today’s environmental problems.
The agriculture sector was the second largest emitter in 2011. It is estimated around 10-12% of total annual GHG emissions and 75% of global deforestation come from agriculture, mostly in developing countries. Southeast Asia (SEA) emits almost 315-627 million tons of carbon dioxide equivalent annually, with Indonesian agriculture as the largest contributor. In general, livestock contributes a large part of the agricultural emissions. According to the United Nations Food and Agriculture Organization (FAO), around 40% of agricultural emissions came from methane produced by livestock.

The use of synthetic fertilizers contributes 13% to agricultural emissions worldwide. Rice paddy fields emit methane through decomposing organic matter in the fields and contribute 10% to agricultural emissions. Other agricultural activities, such as burning vegetation biomass and cultivating organic soils, emit lower amounts of GHGs.

![Shares of Greenhouse Gas Emissions from Economic Sectors in 2010](image)

**Climate Change impacts on Agriculture**

In many regions, agricultural production is already being adversely affected by rising temperatures, increased temperature variability, changes in levels and frequency of precipitation, a greater frequency of dry spells and droughts, the increasing intensity of extreme weather events, rising sea levels, and the salinization of arable land and freshwater. As climate change impacts on agriculture intensify, it will become increasingly difficult to grow crops, raise animals, manage forests and catch fish in the same ways and in the same places as we have done in the past. (FAO)

**What is Climate Smart Agriculture?**

Climate-Smart Agriculture (CSA) is one way to achieve short- and long-term agriculture development priorities in the face of climate change. It anchors on three pillars: food security through agricultural productivity, adaptation by managing climate variability, and mitigation by reducing GHG emissions from agricultural activities.

CSA can be simply understood as environment friendly and sustainable agriculture that takes climate variability and climate change factors into consideration. Agriculture and climate change are closely linked. While agriculture is part of the climate change problem, it is also part of the solution offering many opportunities for mitigating greenhouse gas (GHG) emissions. The agriculture sector is expected to suffer the most from the serious impacts of climate change. Food security, nutrition and livelihoods will be greatly affected if we don’t act soon.

Climate change is expected to adversely affect lives, livelihoods, nutrition and food security in the future. However, if we start NOW, we can:

- do a lot to reduce the impacts of climate change;
• build resilience in our food systems; and
• reduce risks and vulnerabilities of farming communities.

Key Objectives of CSA:

• Increase agriculture productivity and income in a sustainable, environmentally sound manner.
• Build the capacity of households and food systems to adapt to climate change.
• Reduce GHG emissions and increase carbon sequestration.

Some practices of Climate Smart Agriculture

**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. (FAO) CSA practices are not solely new technologies and practices, some traditional and cultural practices from ancestors would be already smart that should be encouraged to be widely used. The below practices are some CSA techniques to be adopted in various agro-ecological zones.

1. Conservative agriculture
2. Agroforestry
3. System of rice Intensification
4. Good Agricultural practices
5. Integrated soil and nutrient management
6. Use of varieties tolerant to adverse factors
7. Water conservation and management, water harvesting
8. Crop cycle management
9. Harvesting and post-harvest technologies
10. On-farm storage techniques
11. Business model for commercialization (Improved financial management, production marketing and business)

The following table is some practices of CSA (GIZ)

### Climate-smart agricultural practices

<table>
<thead>
<tr>
<th>Crop management</th>
<th>Livestock Management</th>
<th>Soil and water management</th>
<th>Agroforestry</th>
<th>Integrated food energy system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Intercropping to maximise space, pest control &amp; cash crop</td>
<td>• Improve feeding strategies (e.g. cut 'n carry)</td>
<td>• Conservation agriculture (e.g. minimum tillage)</td>
<td>• Boundary trees, wind breaks</td>
<td>• Biogas</td>
</tr>
<tr>
<td>• Crop rotations should include legumes</td>
<td>• Rotational grazing</td>
<td>• Contour planting</td>
<td>• Nitrogen-fixing trees on farms (e.g. legumes)</td>
<td>• Improved stoves</td>
</tr>
<tr>
<td>• New crop varieties (e.g. drought, wind &amp; flood tolerant)</td>
<td>• Grow suitable crops (with proper management) to feed animals (e.g. Leucaena &amp; gliricidia)</td>
<td>• Use mounds to plant on slopes</td>
<td>• Multipurpose trees (e.g. fruit trees used as windbreaker)</td>
<td>• Solar power</td>
</tr>
<tr>
<td>• Improved storage and processing techniques</td>
<td>• Manure treatment (well-rotted/decomposed)</td>
<td>• Grass barriers (e.g. kush grass)</td>
<td>• Fruit orchards</td>
<td>• Ram pumps for irrigation</td>
</tr>
<tr>
<td>• Greater crop diversity</td>
<td>• Improved livestock health</td>
<td>• Stone barriers</td>
<td>• Gravity-fed irrigation system</td>
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</tr>
<tr>
<td>• Underground crops (e.g. yams, dasheen)</td>
<td>• Animal husbandry improvements</td>
<td>• Check dams</td>
<td>• Improved irrigation (e.g. drips)</td>
<td></td>
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<tr>
<td>• Stake plants to reduce wind damage</td>
<td>• Contour planting</td>
<td>• Use bench/eyebrow terraces to plant on slopes</td>
<td>• improved irrigation (e.g. drips)</td>
<td></td>
</tr>
<tr>
<td>• Composting and organic fertilizer</td>
<td>• Rainwater harvesting, irrigation, composting, contour planting, check dams, terraces to plant on slopes, etc.</td>
<td>• Encase beds (pallets, bamboo)</td>
<td>• Water storage (e.g. rainwater harvesting)</td>
<td></td>
</tr>
<tr>
<td>• Mulching crops</td>
<td>• Flood tolerant plant varieties, rainwater harvesting, irrigation, mulching, composting, contour planting, check dams, terraces to plant on slopes, etc.</td>
<td>• Water storage (e.g. rainwater harvesting)</td>
<td>• Multiple uses (e.g. fruit trees used as windbreaker)</td>
<td></td>
</tr>
<tr>
<td>• Shade house</td>
<td>• Flood tolerant plant varieties, rainwater harvesting, irrigation, mulching, composting, contour planting, check dams, terraces to plant on slopes, etc.</td>
<td>• Composting and organic fertilizer</td>
<td>• Fruit orchards</td>
<td></td>
</tr>
</tbody>
</table>

Source: Neufeldt et al., 2011 and Phillips, 2014

### For Crops:

<table>
<thead>
<tr>
<th>Climate change signal</th>
<th>Appropriate CSA practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Increase: heat stress or increased disease could reduce yields, leading to increased production costs.</td>
<td>Heat tolerant varieties, mulching, water management, shade house, boundary trees</td>
</tr>
<tr>
<td>Extreme weather events: more frequent heat waves, strong winds, and storms lead to top-soil erosion, reduced yields, and damages to trees, infrastructures and equipment (e.g. hurricane).</td>
<td>Flood tolerant plant varieties, rainwater harvesting, irrigation, mulching, composting, contour planting, check dams, terraces to plant on slopes, etc.</td>
</tr>
<tr>
<td>Rising sea level: 3% of agricultural land could be lost due to 1 m, including widespread loss of agricultural land from saline intrusion into coastal aquifers.</td>
<td>Saline water tolerant plant variety in coastal areas</td>
</tr>
<tr>
<td>Weeds, Pests and Disease: It is also possible that increases in temperature, moisture and carbon dioxide could result in higher populations of destructive pests.</td>
<td>Intercropping, crop diversity, mulching, container gardening and encased beds</td>
</tr>
<tr>
<td>Irrigation and Rainfall: Changes in climate may also impact the water availability and water needs for agriculture. Rain shortage leads to extended dry spells, and excessive rains leads to erosion and loss of soil fertility.</td>
<td>Rainwater harvesting, efficient irrigation, mulching, composting, treated manure and nitrogen fixing trees</td>
</tr>
</tbody>
</table>
**Sessions exercises**

Step 1. Set up the training place

Step 2. Prepared all flip charts and IEC and handouts for lessons

Step 3. Brief explanation on the above sessions.

Step 4. Questions session from participants.

Step 5. Separate the participants in 3 groups and to answer the following questions;
   a. What do you remember and understand on this session?
   b. What are the observed climate changes in your region?
   c. What are the climate change impacts on Agriculture and livestock?
   d. What are the changes in cropping pattern compared to last two decades?
   e. According to the above-mentioned CSA practices, which practices are the suitable coping and doable practices for the region.

Step 6. Presentation by each group’s representative.

Step 7. Questions and answers session

Step 8. Make documentation on all the questions, answers and recommendation
Farmer Learning session module on Pest and Disease Management

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Learning Session Topics

1. Integrated Pest Management
2. Common pests and diseases and control
3. How to prepare organic pesticides and fungicides with locally available ingredients.

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

1. Understand on what is IPM.
2. Understand on nature of pest and diseases
3. Understand to separate the pest and disease infection
4. Able to prepare the bio fungicides and Pesticides

Targeted Participants

All the beneficiaries but the maximum numbers of participants should not be exceeded above 25 persons.

Trainer

Field researcher assigned for each CSV
ဗိသုကာစာအကြောင်း

ဗိသုကာစာအကြောင်းများကို ဖော်ပြသည်မှုကို စဉ်းစားချက်အဖြစ် အချက်အလက်များပြု၍ အချက်အလက်များကို ပြောပြပါသည်။ အချက်အလက်များကို ဖော်ပြသည်မှုကို အခြေခံသော စာအကြောင်းများဖြင့် ဖြင့်လာနိုင်ပါသည်။ အချက်အလက်များကို ဖော်ပြသည်မှုကို ပြောပြပါသည်။
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ပြောက်မှုသီးနားလည်း အခြားသီးနားလည်း ပြောင်မှုဖြစ်သည်။ အခြားသီးနားလည်း ပြောင်မှုဖြစ်သည်။ အခြားသီးနားလည်း ပြောင်မှုဖြစ်သည်။

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(1) အရောင်းအလွန် အုပ်စားပြောင်မှုကို သတ်မှတ်ပြီး ကြိုးစားသည်။

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အရေ္႔တးု႔္နက ံုသ႑ာနင္ာားျ ဖင္ မာားစာာစြျပာားျ ဖငား င ္းပြပ္း ညင္ဆဖင္   းတဖင မာငဆဆားတတငၾာပါသညင။ ပတငဝနငားာမဖငတစဖင ္အစြငတာကူေတစတြ္း ဖငူေသာ္ျ ု္႔စံုေသက ရု ္သကေ္္ေျ ကေ္ီလဲျ ေ သီသဘကဝရနး္ေသကအေ္ီရက္ းုီ္ ကီးနံ္ေကကေ္၊ စသု္တးု႔ျဖစ္ ဂသု္္ပါသည္။

(၂) အေ္ီရက္ းုီ္ ကီ၏ဖ က္ရ ီ ံု

အေ္ီရက္ းုီ္ ကီ၏ဖ က္ရ ီ္နပ ံုစံ္ ကီကးု းကီလု္ရး္ လးုအ ္ ဂသု္္ပါသည္။

(၃) ကီလု္ရး္

ကီလု္ရး္မ်ား၊ ပီး ဖစ္ လောင်းစိုက်ခုံးတို့ ြောင်း (ပင်ကျင်ကောင်း) ြောင်း (ပင်ကျင်ကောင်း) ြောင်း ြောင်း (ပင်ကျင်ကောင်း) အပြားအခင်း အော်စ်ချင် ထဲရှိ ဖျင်စီးတို့တွင် အပြားအခင်း သူစားေသည် မိုးေက်ာင်တို့။ အပြားအခင်း မိုးေက်ာင်တို့။ သူစားေသည် မိုးေက်ာင်တို့။
(၂) ကြားအိမ်ခြင်း

ကြားအိမ်ခြင်းမှအချိန်အထိလည်းကောင်း၊ ကြားခြင်း၏ အတွက်များစွာအရေးကြီးစွာ သို့မဟုတ် ကြားခြင်းသည် နေရာအားဖြင့် အခြားသောစီမံခန့်ခွဲမှုများကို အောက်ပါအားဖြင့် ပြုလုပ်ထားသည်။

(၃) ဓာတ်ပျော်ပျော်

ဓာတ်ပျော်ပျော်မှမိုးမှုများကို ရှာဖွေနိုင်သည်။ ပိုမိုကျော်ကြားပေးသော အခြေအနေများဖြင့် အသိအမှတ်ပေးသော အခြေအနေများကို အများအားဖြင့် ပြုလုပ်ထားသည်။

(၄) အားလုံးအားလုံး

အားလုံးအားလုံးမှာ အရေးရှိသည်။ ယုံကြည်စေသော အရေးကြီးများကို အားလုံးအားလုံးပြုလုပ်နိုင်သည်။ ယုံကြည်စေသော အရေးကြီးများနှင့် အခြေခံတော် အရေးကြီးများကို အားလုံးအားလုံးပြုလုပ်နိုင်သည်။
စီး ျပီးသည်။ စီးစကောသုံးပါသည်။ စီးစကေားးျကီးစုံး ကီစုံးကော်ျကျေတ်းသည်။ အသီးျဖစ်၊ အသီးျဖစ်နေ္း၊ အရကကျေး္ကားးျက်းပါသည်။ အျ ကီစုးျကီးစုံး ကီးနက္းျဖျေ်သည်။ ရံုးတဲုးျဖျေ်သည်။ သရက္ျဖျေ်သည်။ ဖျော်စူးက်းျဖျေ်သည်။ စုးာပုးနားစုံး၊ စုးာအျက်းျဖျေ်သည်။ စီးစကောသုံးပါသည်။ စီးစကေားးျကီးစုံး ကီစုံးကော်ျကျေတ်းသည်။ အသီးျဖစ်ထကးျဖျေ်၊ အျက်းျဖျေ်သည်။ အက်းပီးထက်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ ၉၀ရက္းးနပးးနက်အောက်းပီးထက်းျဖျေ်သည်။ အောက်းပီးထက်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ လူတ်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ (c) အောက်းပီးထက်းျဖျေ်သည်။

(2) အောက်းပီးထက်းျဖျေ်သည်။

အောက်းပီးထက်းျဖျေ်သည်။ စီးစကောသုံးပါသည်။ စီးစကေားးျကီးစုံး ကီစုံးကော်ျကျေတ်းသည်။ အသီးျဖစ်၊ အသီးျဖစ်နေ္း၊ အရကကျေး္ကားးျက်းပါသည်။ အျ ကီစုးျကီးစုံး ကီးနက္းျဖျေ်သည်။ ရံုးတဲုးျဖျေ်သည်။ သရက္ျဖျေ်သည်။ ဖျော်စူးက်းျဖျေ်သည်။ စုးာပုးနားစုံး၊ စုးာအျက်းျဖျေ်သည်။ စီးစကောသုံးပါသည်။ စီးစကေားးျကီးစုံး ကီစုံးကော်ျကျေတ်းသည်။ အသီးျဖစ်ထက်းျဖျေ်၊ အျက်းျဖျေ်သည်။ အက်းပီးထက်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ ၉၀ရက္းးနပးးနက်အောက်းပီးထက်းျဖျေ်သည်။ အောက်းပီးထက်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ လူတ်းျဖျေ်သည်။ ဥကျေ်တ်းသည်။ ဥကျေ်တ်းသည်။ (c) အောက်းပီးထက်းျဖျေ်သည်။
(၁) အချက်အလက်များ:

အချက်အလက်များ၊ အချက်အလက်ကြပ်များနှင့်သာပြောသိမ်းပေးသည်။ အချက်အလက်များကို သက်သားအနေဖြင့် အလွယ်တကူ လေ့လာရေးသားနိုင်သည်။

(၂) လေ့လာမှတ်ချက်များ:

လေ့လာမှတ်ချက်များကို အလွယ်တကူ လေ့လာရေးသားနိုင်သည်။ လေ့လာမှတ်ချက်များကို သက်သားအနေဖြင့် အလွယ်တကူ လေ့လာရေးသားနိုင်သည်။
(၃) စိုက်ပျိုးပုံစံအကြောင်း

စိုက်ပျိုးပုံစံအကြောင်း အချက်အလက်များအနေဖြင့် အခြေအနေအရာရှိများ
စိုက်ပျိုးပုံစံးကြောင်း ဗိုလ်ချုပ်ထောင်ပို့ချက်တစ်ခု ဖြစ်သည်
စိုက်ပျိုးပုံစံးကြောင်း ဖြစ်သည်

(၄) လွတ်လပ်စွဲခွင့်ပြုချက်အကြောင်း

လွတ်လပ်စွဲခွင့်ပြုချက်အကြောင်း အကြောင်းအရာများအနေဖြင့်
စိုက်ပျိုးပုံစံးကြောင်း အခြေအနေအရာရှိများ
စိုက်ပျိုးပုံစံးကြောင်း ဖြစ်သည်
စိုက်ပျိုးပုံစံးကြောင်း ဖြစ်သည်
(၃) စာရင်းခွဲခြားမှုစွမ်းအား

ကျွန်ုပ်တို့၏ သေသည်းအား စာရင်းခွဲခြားမှုစွမ်းအား သံကြက်စွမ်းအား အစွမ်းအရွယ်အစား အချိန်ကျော်လှုပ်ရွေးချယ်ပြီး လျှောက်လွှာများကို ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။ တူညီသော စာရင်းခွဲခြားမှုစွမ်းအား ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။

(၄) စာရင်းခွဲခြားမှုစွမ်းအား

ကျွန်ုပ်တို့၏ သေသည်းအား စာရင်းခွဲခြားမှုစွမ်းအား အစွမ်းအကြောင်း အချိန်ကျော်လှုပ်ရွေးချယ်ပြီး လျှောက်လွှဲများကို ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။ တူညီသော စာရင်းခွဲခြားမှုစွမ်းအား ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။

(၅) စာရင်းခွဲခြားမှုစွမ်းအား

ကျွန်ုပ်တို့၏ သေသည်းအား စာရင်းခွဲခြားမှုစွမ်းအား အစွမ်းအရွယ်အစား အချိန်ကျော်လှုပ်ရွေးချယ်ပြီး လျှောက်လွှဲများကို ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။ တူညီသော စာရင်းခွဲခြားမှုစွမ်းအား ကူးယူကြသော စာရင်းခွဲခြားမှုစွမ်းအား ပြုလုပ်နေပါသည်။
Materials required

1. Glasses, maks, Waterproof gloves, Boots for demonstration of spraying
2. A0 papers and maker pens
3. Handouts for participants

Session procedure

1. Set the location for training.
2. Orientation and lecture the above session with figures
3. Demonstration of spraying materials.
4. Separate the participants in three groups to answer the following questions.
   a. What control measure are included in IPM.
   b. What materials are required during spraying the pesticides or fungicides?
   c. How aphid destroy the crops?
d. How armyworm destroy the crops?

e. How leaf binder and miner destroy the crops?

f. Which stage of the complete life destroy the crops?

g. What is PHI? If we eat the foods without waiting the PHI, what will be happened?

5. Presentation from each group what they have answered for the questions.
ဖက္ရီးလကၡဏက္ ကီ္ပါသည္။

္ပါသည္။

းီ ကေ့္တကေ္က္ေရကက္ဖက္ရီ ဂက

အသီးတားးုေ္ျေီကုး ျဖစ္ေစီးုေ္သု္္ပါသည္။

အရကက္္က္ီးနကျေ္္ေ ၚတကေ္က္ေရကက္ ဂက

အရကက္္ က္ီးနကျေ္္ေ ၚတကေ္အစးးီ္ေရကေ္္ကီ

ရနး္ေတက့ ဲ

အျဖဴ္ေရကေ္အကကကက္ကီကုး္ေတက်႔ီးုေ္သု္္ပါသည္။

၃္ပါသည္။

ံုုနေ္ီ္ေ ဂေ္ုိး္႔ထးုီ းုီ္ပါသည္။

ံု္ပါသည္။

းုီ္ေးထးုေ္ ံု္ပါသည္။

းုီ္ပါသည္။

အလြ္္နထကက္လက္ေသက္ဵက္အကကကက္းုီ

ု္္န ေ္္ ကီထဲတကေ္းသု္္ပါသည္။

စကီ္ေသကက္ဖက္ရီ

ံု္ပါသည္။

းုီ ေ ဂေ္ုိး္႔တကေ္းုီ ု္္န ေ္္ ကီထဲတကေ္

ထးု ု္္န ေ္္ ကီထဲတကေ္

အရကက္္ ကီကးု

စကီ္ေသကက္သု္္ပါသည္။

ကကကကကြ္ီးနး္းေ္ီးု္ီ္ပါသည္။

းုီ္ေ ဂေ္ုိး္႕ထဲတကေ္

အရကက္္ကီစတေ္္ေတ႔ကရနး ဂက

လက္ီးနေ့္ ္ေကကက္ြူဖြ္ရနကီ ဂ္ပါသည္။

၄္ပါသည္။

ရကက္ထကေ္ီ းုီ
ဝန်ကြီးဌာန

သော့ခ်စျေးနှင့်ကိုက်ညီပေသည်။ ဗိုလ်ချုပ်ရှင် နောက်ကိုက်စားပါသည်။ နောက်ပိုင်းမှာ လူနေပါသည်။ အခြားသောလူနေပါသည်။ ဗိုလ်ချုပ်ရှင် နောက်ရှိခဲ့ပါသည်။

ပြည်ထောင်စုသိန်း

တယ်လစ်ဝေးအိမ်ရှိ ယောင်းလွန်ရှိသည်။ မိဘကြီးများသည် သော့ခ်စျေးနှင့်ကိုက်ညီပေသည်။ သော့ခ်စျေးနှင့်ထိုက်အကြား နောက်ပိုင်းလွန်ရှိခဲ့ပါသည်။

အောက်ပါစက်ကူး

ထိုက်သည် ယောင်းလွန်ရှိသည်။ ဝါကျောင်းသို့ ရိုးရိုးနေရာမှ ထိုက်သည် သော့ခ်စျေးနှင့်ကိုက်ညီပေသည်။ နောက်ပိုင်းမှာ လူနေပါသည်။ အခြားသောလူနေပါသည်။ ဗိုလ်ချုပ်ရှင် နောက်ရှိခဲ့ပါသည်။
ကကကကြ္ီးနး္္းေ္ီးု္ီ္ ကီ္ပါသည္။

္ပါသည္။

္ိကီ ေ့္ကူး က ္ေရကက္ဲးု္ီ ဂကး္႔ဓဂတ္ ဂ္ေသက ္ေရီကး္႔ဓု

းုးေ္သု္္ပါသည္။

၆္ပါသည္။

ေ္ေျ္နကေ္ ေတကေ္ းထ္ုေ္ ံု္ပါသည္။

းထ္ုေ္သု္္ပါသည္။

အ္ေကကေ္ႀက ီ ဂက အးး္းုီတဝးုက္ းုီစကက ဲ္ ကီ္ေအကက္တကေ္ းထ္ုေ္သ

္းက ီ္ဲလကၡဏက္ ကီ္ပါသည္။

းထ္ုေ္သု္္ပါသည္။

အ္ေကကေ္ႀက ီလက ဂက အရကက္္ ကီကးုက္ျဖတ္ဝဂီစကီသု္္ပါသည္။

ရုးီရကကီစကက ္ေရကက္ ဂက တစ္ ေ္ းထ္ုေ္သု္္ပါသည္။

စကီ္ေသကက္ ံု္ပါသည္။

ကကကကြ္ီးနး္္းေ္ီးု္ီ္ ကီ္ပါသည္။

းထ္ုေ္သု္္ပါသည္။

းထ္ုေ္သု္္ပါသည္။

ဖုးီလ္ေ္ီက ပးေ္ီ(းုီတ ၊ ျတက)

းထ္ုေ္သု္္ပါသည္။

စု ပူးသားပါး (ပူးကား)

းထ္ုေ္သု္္ပါသည္။

စု ပူးသားပါး (ပူးကား) အားကောင်းပါးတင်မည် (ကောင်း)အားကောင်းပါး
အားလုံးကို လူထုအတွက် သာသာလာရေးနှင့် စိုးရိမ်းခြင်းနှင့် စိုးရိမ်းခြင်းအဖွဲ့အစည်းအတွက် သီချင်းဖြစ်ရာ မျိုးစုံစနစ် ပြုလုပ်မှုကို ဖျင်ချင်သည်။

လူးသောက်ကိုက်ားရေး

ကျွန်ုပ်တို့ကို လူးသောက်ကိုက်ားရေး တာဝန်ဖြစ်ရာ လူးသောက်ကိုက်ားရေးကို ကျော်လွှေ့မှုအတွက် သာသာလာရေးနှင့် စိုးရိမ်းခြင်းအဖွဲ့အစည်းအတွက် သီချင်းဖြစ်ရာ မျိုးစုံစနစ် ပြုလုပ်မှုကို ဖျင်ချင်သည်။

သီချင်းဖြစ်နေသော လူးသောက်အား အားလုံးကို လူးသောက်ကိုက်ားရေး တာဝန်ဖြစ်ရာ လူးသောက်ကိုက်ားရေးကို ကျော်လွှေ့မှုအတွက် သာသာလာရေးနှင့် စိုးရိမ်းခြင်းအဖွဲ့အစည်းအတွက် သီချင်းဖြစ်ရာ မျိုးစုံစနစ် ပြုလုပ်မှုကို ဖျင်ချင်သည်။

ကျွန်ုပ်တို့ကို လူးသောက်ကိုက်ားရေး တာဝန်ဖြစ်ရာ လူးသောက်ကိုက်ားရေးကို ကျော်လွှေ့မှုအတွက် သာသာလာရေးနှင့် စိုးရိမ်းခြင်းအဖွဲ့အစည်းအတွက် သီချင်းဖြစ်ရာ မျိုးစုံစနစ် ပြုလုပ်မှုကို ဖျင်ချင်သည်။
Session procedure

1. Orientation and lecture the above session with figures
2. Separate the participants in three groups to answer the following questions.
   a. How many types of above-mentioned insects you see in your field?
   b. What are the common pests in your field?
   c. Please identify how they destroy the crops?
3. Presentation on what they have prepared.
၄ပါသည်။
လစတစ်
ေရ
၂
ေရ
၅ပါသည်။
ေြကေ္ီ္သးု႔သစ္သကီ္ေ္ိတံတုး႔ျဖစ္သု္္ပါသည္။
(၁) ္ေဖက္စ္းု္ီက္ေတက့
ထ္ရံုီ္ေရ
၅လတကကးု
လစတစ်
ံုီထဲသးု႔ထု့္ဂ္ပါသည္။
ထုး႔္ေးကက္ုတက
(၆၀)
ာရ္္ကးုထု့္ျ မ္ေးကက္္ေရတက္္္ေ
က္ဝေ္္ေအကေ္္ေ္ိ္ေ　ရ္ု္္ပါသည္။
(၂) ုတးြအရေ့္အ္ေးျဖေ့္
ထ္္ေဖက္စ္ထကီ္ေသက္ေဖက္ရု္ကုး
္ေဖကက္ထံုီ္ေဖက္ထကီ္ေသက္ေடကေ္ီသးု႔ျဖု္
ီုေ္ီစကက္ေလကေ္ီထု္
့ျမုေအကေ္းျဖစ္သု္္ပါသည္။
ထးု႔္ေးကက္္ေဖက္စ္ထကီ္ေသက႔္ေသက႔းးး္းကီတကေ္သက
က္ဖး္ီရ္ု္္ပါသည္။
(၃) တတးြအရေ့္အ္ေးျဖေ့္
ထ္္ေဖက္စ္ထကီ္ေသက္ေရီရု္ကးုဖ း္ီ္ု္ရုး ဂက္းက္းျကက္းကက္
ေ္ျက္ကက္
ေးျပပီးုးေ္ျ ျဖစ္သု္္ပါသည္။
္ေရီဖး္ီစဥ္တကေ္လု္ီးၶကကုးြ္အတကက္
အကကအကကြ္ဝတ္ရေ္ရးျပရ္ု္္ပါသည္။
း္းအသံုီျပ္ေသက္ေရီဖး္ီ ံုီ
းနေ့္ ္ေရီဖး္ီ္ေ ဂဿမီးနေ့္
အးု္ီထုးေ္ျ ကက္
သံုီႀကး္္ း္႔ ္ေရျဖေ့္္ေရီ္ေၾကက္ေ ီရ္ု္္ပါသည္။
(၂) တ္က္ေစ့္နျ ပလု္းု္ီအ္ ပးီ္ ပးီရနးသု္္ပါသည္။
တ္ကရကက္္နျ ပလု္ျေ္ီ
တ္က္ေစ့ႀကးတ္ဖတ္္နျ ပလု္ျေ္ီ
သုံးရာအတွက် (အခြားသော်လည်း)
သုံးရာအတွက် သူတို့သောက်ကီးရွယ်ပြီးနောက် ကြည့်ပြီး သုံးရာအတွက်
အသံုးပြုသောစာသီးထောင်ပြီးနောက် အပါဝင်ပေးသည်။

၁။ သုံးရာအပိုင်း (၂ လက်မှ ၈ လက်များ)
၂။ ကြည့်ပြီးနောက် (၂ လက်မှ ၆ လက်များ)
၃။ အပါဝင်ပေးသည် (၁ လက်)
၄။ သားလုံးမှ (၄) လက်

နေ့စဉ် အလုပ်ထုတ်လုပ်ခြင်း

သူတို့၏ သိပ္ပံ (၂ လက်မှ) ကို သူတို့အလွန်ကြည့်ပြီး သားလုံးကတည်းကပြီး သုံးရာအတွက် သုံးရာအပိုင်းကို သုံးရာအပိုင်း
ကြည့်ပြီးနောက် သုံးရာအတွက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက်

သူတို့၏ သိပ္ပံ (၂ လက်မှ) ကို သူတို့အလွန်ကြည့်ပြီး သားလုံးကတည်းကပြီး သုံးရာအတွက် သုံးရာအပိုင်းကို သုံးရာအပိုင်း
ကြည့်ပြီးနောက် သုံးရာအတွက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက်

သူတို့၏ သိပ္ပံ (၂ လက်မှ) ကို သူတို့အလွန်ကြည့်ပြီး သားလုံးကတည်းကပြီး သုံးရာအတွက် သုံးရာအပိုင်းကို သုံးရာအပိုင်း
ကြည့်ပြီးနောက် သုံးရာအတွက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက် သားလုံးမှ (၄) လက်
တ္က းုီသတ္္ေရီကးု
္ေး္ေ အီ္ေသကအ  းး္ီးနေ့္ ု္ေး္ေစကေ္ီ္ ကီတကေ္သက က္ဖ း္ီရ္ု္္ပါသည္။

ရကသ တကေ္ဖ း္ီ ဂက အကးးသေ္ တကရနု္္ ံသျဖေ့္ အႀကး္္ေရ းု္းု က္ဖ း္ီရ္ု္ ျဖ စ္သ
ု္္ပါသည္။ ္ေရက ေ္ ီရကသ ီးနေ့္ ္ေီးကာ ဲးသတ္္ေရီတစ္္ ပးီအ္ေးျဖေ့္ လက် တးရစာကး္ ီးနေ့္ တ္ဝး္ီက ေ္ကးု ္းထး ုးက္္ေစီးုးေ္္ေသက

(၃) လူကလ္ဖက ုေးကက္တ္ ပးီအ္ေးျဖေ့္ လက် တးရစာကး္ ီးနေ့္

လးုေ္ီရကလ္ဖက ရုးသု္္နက ထံုီ、ကး္႔ ီးနေ့္ သစ္သကီျ က ုေတက ကးု အ ပးီအစကီ အတကက္ အု ္ ဲ ၄္ပါသည္။ ထံုီ (၂၅၀ ာရ္္) (၁၅ က သကီ) ၈္ပါသည္။

လုးအ ္္ေသက စပု္ီ္ ကီ္နက ၁္ပါသည္။

(၄) ချစ်ချစ် (ဌာရီ မြော့ တိုင် အထူး)

ချစ်ချစ် (ဌာရီ မြော့ တိုင် အထူး) ဆိုသည်မှာ ဌာရီစ်နှင့် ကျန်စ်စ်စ် အကောင်အထည်အဖြစ် လုံလောက်ကျော်မှု့အဖြစ် ရှေ့နေသည်။ ချစ်ချစ် (ဌာရီ မြော့ တိုင် အထူး) ကို သိမ်းဆည်းနေသည်။

(၅) ဗုဒ္ဓဟူး (ဌာရီ မြော့ တိုင် အထူး)

ဗုဒ္ဓဟူး (ဌာရီ မြော့ တိုင် အထူး) ဆိုသည်မှာ ဌာရီစ်နှင့် ကျန်စ်စ်စ် အကောင်အထည်အဖြစ် လုံလောက်ကျော်မှု့အဖြစ် ရှေ့နေသည်။ ဗုဒ္ဓဟူး (ဌာရီ မြော့ တိုင် အထူး) ကို သိမ်းဆည်းနေသည်။
၁. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၂. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၃. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၄. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၅. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၆. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၇. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၈. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၉. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

၁၀. အသက်ရှားအခြေခံကြည့်ရှုနိုင်မည်ဖြစ်ပါသည်။ ဤသဘောသရာတွင် အရေးပါသည်။

အောက်ပါအရာများကို အသုံးပြုနိုင်သော ကြည့်ရှုရန် အရေးပါသည်။
**Materials Required**

1. Lime, Sulphur, Neem leaves, copper
2. Mortar for grinding the neem leaves
3. Big pot or cookware to boil the solvent
4. 1 litre plastic bottle
5. Fennel
6. Sifter
7. Spoon

**Sessions Procedure**

1. Orientation on the procedure of each pesticide and fungicide process
2. Demonstration and working together on the above three process of preparing pesticides and fungicides
3. After finished all the activities, document all the presentations by participants and questions raised during session.
Farmer Learning session module on Small Scale Livestock Production

Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

1. Acquired basic understanding about the relationship of climate change and agriculture
2. Learned basic knowledge and skills in climate smart practices related to:
   a. Field crops including seed multiplication and management
   b. Small livestock production
   c. Small-scale aquaculture
   d. Vegetable production including home gardening
   e. Integrating trees (fruit and non-fruit) into farming systems
   f. Legume production
3. Identified farmer specialists among them who will share skills and knowledge to other farmers in the village and outside the village

General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationery before session
- Activate each participant in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

1. Small scale animal husbandry – goat
2. Small scale animal husbandry – native poultry rearing
3. Small scale animal husbandry – duck
4. Small scale animal husbandry – pig

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

1. Understand on how to prepare proper feeds for livestock
2. Understand on how to build the low cost and effective Housing for Livestock
3. Understand and follow on Proper Management
4. Understand how to choose the quality breeds

Targeted Participants

All the beneficiaries who are involving in Livestock farmers and other farmers who are interested to learn about animal husbandry.
Systematic Goat Rearing

- The important fact to achieve access in goat rearing is to reduce the feeds cost with easy way of accessing supplement feeds.

Objective:
1. To support Family income
2. Meat purpose
3. Animal manure

Husbandry practices
1. Free Grazing/ Extensive system
   freely grazed in pasture to promote good health, but can’t suitable well with too much rainfall regions.
2. Semi-intensive System – best practice, housings can be cleaned during grazing and proper feeds are available from the pasture and support tot good health.
3. Intensive system – practices in too much rainfall regions and cold climate regions. The important things to be considered is to separate the based on different size, sufficient supply of foods and water and sufficient spaces for animals.

Things to be considered in Goats rearing
1. Must have and select good character breeds.
2. Must have pasture where grass, legumes and spines bush are available.
3. Must have proper ratio of nutritious foods ratios
4. Must have regular vaccination and medication.

Strengthens of Goat rearing
1. Available of meat, milk and skin
2. Low investment
3. Adaptable with rough climate
4. Animal can survive themselves
5. High profit in short duration
6. Can be reared in different soil quality
7. Can eat some grass and leaves which cattle can’t

Local breeds
1. Htein Sam
2. Jate Ni
3. Wai Thar li

Characteristics of good breeds
1. Good growth and wider chest
2. Good Growth rate
3. Strong body parts
4. Good fertility and good lactation
5.

Characteristics of good health
1. Good appetite, and good rumination
2. Bright skin color and soft hair
3. Bright eyes and pink eyelids
4. Active and no dullness
5. Live in group
6. Strong legs and stand tight
7. Regular lactation, reproduction and growth rate
8. Regular respiration and good pulse rate

**Climate** – Dry, hot and low rainfall climate

**Site selection criteria for farm**
1. Must have sufficient supply of clean water
2. Must have sufficient pasture land
3. Must be a little high land to avoid flooding
4. Must have shades
5. Must separate from human buildings

**Things to be considered for Housing** – For every rearing practices, housing is necessary.
1. Housing should be along the way of sun
2. Roof should be at least 6 feet – 10 feet.
3. Good Ventilation area
4. Must have dried floor and clean easily
5. Must have sufficient foods and water cans
6. Must have 10 square feet for ever adult

**Feeds in Supplement** – generally, there is no feeding practices for goat rearing in common practice of village, just giving water. For proper growth of goat, there should be feedings supplement foods.
1. Systematic practice of feed and water for rapid growth of goat
2. Two times per day of feeding in morning and evening
3. Concentrate feeds should also be supplied
4. Feeds should be cleaned with fungus and must be fresh
5. Feedings should be together with raw and supplement feeds

**Common disease problems in Goat**
1. Foot and mouth disease
2. Black quarter
3. Anthrax
4. Haemorrhagic septaecemie
5. Cold
6. Parasitic infection
7. Mange

**Vaccination**
1. It should be carried especially in virus disease which have no medicine and spread rapidly
2. Anthrax vaccination should not be conducted in the areas of no disease infection regions

<table>
<thead>
<tr>
<th>Sr</th>
<th>Vaccine</th>
<th>Age</th>
<th>Booster time</th>
<th>Regular vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foot and mouth disease</td>
<td>3 months</td>
<td>1 month after vaccine</td>
<td>Every 6 month</td>
</tr>
</tbody>
</table>
Native Chicken rearing

Objective:
1. To support Family income
2. Meat purpose
3. Animal manure

Husbandry practices
1. Free Range
2. Semi-Intensive
3. Small-scale confined rearing or intensive system
4. Large-scale confined rearing or intensive system

Weakness of present local practices for native chicken rearing
1. Poor management in terms of housing to prevent from dogs, birds and human attacks, from weather, loss of eggs because of without nest, difficult to conduct regular health care vaccination and medication.
2. Poor management in terms of feedings – no sufficient clean water source and feeds, poor growth rate, poor egg laying rate, poor hatching rate and more disease problem
3. Poor management in terms of health care – diseases can be easily spread, and difficult to control.
4. No breeds selection and no proper breeding practices – can’t maintain good egg laying rate and growth rate hem.

Benefits of Native chicken rearing
1. Low cost
2. No special techniques are required
3. Native chickens are already adaptive with local climate and environment
4. Can survive themselves without feedings
5. Eggs can be hatched by themselves
6. Good taste of meat and eggs
7. Good Market demand than boiler

Husbandry practices of native chicken in Villages
1. Extensive – freely grazed in the field and forest without housing for sleeping and laying eggs
2. Semi-Intensive – Housing in the compound for sleeping and laying eggs, and grazed in the house’s compounds.
3. Intensive – totally keep the chicken in the housing and other activities also conducted in the housing such as feeding, laying eggs and grazing.

Benefits of Semi-intensive system
1. It can support family income
2. Can feed locally available source foods
3. Can support not only for income and both for home consumption
4. Low cost for simple housing
5. 10-20 gm of growth rate per day
6. Moderate death rate
7. Most suitable practice for village community

**Feeding Practices**
- The nutritious feeds are essential for proper growth, egg production, disease resistance and good health.
- As native chicken can search their own foods, semi-intensive system is the best husbandry practice for village if there are good source of raw foods for chicken
- As a green feed, various vegetables such as tomato, morning glory, algae, water hyacinth, azola, banana leaf, banana trunks, taro leave, taro stalks and other vegetables waste products of market
- Rice, rice bran, broken rice, waster product of kitchen can also be fed to chicken
- Other sources are maize, corn, sorghum, rice, broken rice, leguminous crops, pigeon pea, cow pea, roots and tubers crop.
- Other wild leaves include lucaena, papaya leaves can be used as feeds
- Small insects, earthworm, terminate, larva, snail and tiny fishes can also be used as protein sources
- Searching foods by themselves, minerals can be obtained
- Locally available cheap feeds can be mixed with Commercial feeds to save feeding cost
- To save the commercial feed cost, more vegetables should be included in feed formulation
- By adding organic manure and fertilizers to the farm, chicken can get required source of minerals and protein
- Organic manure and fertilizer should be broadcast inside the farm 2 times per week.

**Male and female ratio** – one to two roosters is sufficient enough to control 10-15 chickens but the quality of rooster should be carefully selected. One thing needs to be considered is that the quality of breeds will be going down if there are reproduction under the same generation.
Rooster selection criteria - Should be chosen from other village and to be sure that breeds are from the current systematic growers.

**Housing** – things to be considered for native chicken housing. Housing is the important requirement of semi-intensive system to protect form climate condition, wild animals, for easier access of vaccination and to reduce the losses from waste of eggs.
1. Good ventilation place, and be aware not to face the wind direction
2. Good drainage location and sandy loan is better.
3. Must have sufficient direct sunlight.
4. Space should be wide enough for the number chicken you are going to add
5. Any locally available materials can be used as roofs and shelters and should be built at a little away from house.
6. 6’ x 8’ housing size can be added about 12 – 16 chicken.

**Common disease problem in Chicken**
1. Newcastle
2. Fowl Cholera
3. Fowl Pox
4. Coccidiosis
5. Pullorum disease
6. Infectious bursal disease
7. Infectious coryza
8. Infectious Bronchitis disease
9. Chronic respiratory disease
10. Avian colibacillosis

**Vaccination schedule for native chicken rearing**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Age</th>
<th>Boosting</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2, Newcastle disease</td>
<td>10</td>
<td>After 2 weeks</td>
</tr>
<tr>
<td>Fowl cholera</td>
<td></td>
<td>Every 4 months</td>
</tr>
<tr>
<td>Fowl pox</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Anthelmintic</td>
<td>6</td>
<td>weeks</td>
</tr>
</tbody>
</table>

**General Management practices**

1. **Chicks – 0-1 weeks**
   - Baby chicks should be kept together with mother for about 4-7 days within the cage or baskets
   - Provide high protein feeds and clean water sufficiently
   - There should be litters, paper or plastic sheet under the cage or baskets
   - Cage and litter should be cleaned everyday

2. **Chick – 1-3 weeks**
   - Chicks should be kept under cage or baskets for both day and night
   - Mother should be freed on day time for searching foods
   - Provide high protein feeds and clean water sufficiently
   - Mother should be kept under cage together with chicks at night time

3. **Chick – 3-6 weeks**
   - Chicks should be kept under cage or baskets together with mother in night time
   - Free them on day time
   - Provide high protein feeds and clean water sufficiently
   - Cage and litter should be cleaned everyday

4. **Chicks – above 6 weeks**
   - Not necessary to keep with cage or baskets
   - Freely grazed for foods searching
   - Feeds them with supplementary feeds if necessary, at the evening

**Small scale Duck Rearing**

Duck is the more successful animal with small investment and not necessary to know special techniques and management livestock among others small animals in delta region. For ducks, big housings are not necessary to build like other livestock and duration of duck last for 10 years.

The farmers who raised duck should be carefully considered weather condition. During summer (April-May) hatching should not be done because of high day temperature and it leads to high death rate.

It is possible for small number of duck owner to raise ducks without feedings, but for commercials scale farmers, proper feed formulation and feeding practice is essential.

**Benefits of small-scale duck rearing**

1. Easily manageable without knowing modern technique and practices
2. Not necessary of special care like other livestock
3. 50-100 ducks are sufficient for home consumption and can support income
4. Housing can be constructed easily with locally available materials
5. Small requirement of supplementary feeds as they can search their foods in farms, canals and ponds

Requirements of duck rearing
1. Safe housing or farm
2. Housing should be cleaned
3. Must have sufficient supply of clean water
4. Must have sufficient supply of nutritious foods
5. Good Sunlight
6. Prevention from Disease problem

Site selection for farm or housing
1. Must close or near with water sources such as rive, creeks and ponds
2. Must have grazing area and grass fields
3. Must prepare the bank of creeks and ponds for easier access of going down and up
4. The water should be changed regularly two times per week

Housing
1. Must be on the high land area where can’t be flooded
2. Must have sufficient space for duck at least 3 sq feet for 1 adult
3. The roof must be covered with straw, rice husk, sand and must be changed regularly
4. 15’ x 20’ area is sufficient enough for 100 ducks
5. The eggs will be clean if there are nests in the farm

Feeding practices
1. Regular on-time feeding is more important than feeding commercials feeds
2. If there is sufficient supply of nutritious feeds, ducks can lay eggs for many days.
3. Feeding at the early morning about 6-7 am is very important as they have good appetite by that time.
4. Eggs also will be good weight and big about 2.5 to 3 ounce per egg.

Recommended Feeding rate for Duck

<table>
<thead>
<tr>
<th>Sr</th>
<th>Age</th>
<th>Quantity (Kyatthar/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Under 6 week</td>
<td>3.5</td>
</tr>
<tr>
<td>2</td>
<td>6-12 week</td>
<td>5-8.5</td>
</tr>
<tr>
<td>3</td>
<td>Above 12 week</td>
<td>10.5</td>
</tr>
<tr>
<td>4</td>
<td>Duck with good egg laying rate</td>
<td>Above 10.5</td>
</tr>
</tbody>
</table>

Duck above 4 months old should have sufficient space of 3 square feet per female duck. There should be partial shade to prevent from hot temperature. Ducks usually lay eggs before 10 am, so grazing should not be done before this time. Nests should be provided at least 1 nest for 8 ducks and the size should be 1’ x 1’ x 0.5 depth and covering with rice husk and straw. The important to be considered is that ducks should not be violent at night time because it can affect egg laying rate. Male and female ratio should be 1 : 5.

Feed Formulation for adults

| Rice chaff | 40 % |
Rice bran 15 %  
Broken rice 25%  
Prawn dust 10  
Fish dust 5  
Snail dust 5 %

**Recommended vaccination schedule**

<table>
<thead>
<tr>
<th>Sr</th>
<th>Age</th>
<th>Vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 week</td>
<td>Duck Plaque</td>
</tr>
<tr>
<td>2</td>
<td>2 week</td>
<td>Duck Septicaemia</td>
</tr>
<tr>
<td>3</td>
<td>3 weeks</td>
<td>Colibacillus bacteria</td>
</tr>
<tr>
<td>4</td>
<td>4 weeks</td>
<td>Duck Plaque</td>
</tr>
<tr>
<td>5</td>
<td>5 weeks</td>
<td>Duck Septicaemia</td>
</tr>
<tr>
<td>6</td>
<td>6 weeks</td>
<td>Colibacillus bacteria</td>
</tr>
<tr>
<td>7</td>
<td>20 weeks</td>
<td>Duck Plaque</td>
</tr>
<tr>
<td>8</td>
<td>22 weeks</td>
<td>Colibacillus bacteria</td>
</tr>
</tbody>
</table>

**Small-scale Pig rearing**

Native pigs are important sources of income, foods and manure for small farms. Native pigs are sold to friends, neighbors, used during special occasions or serve as profitable part-time jobs for family members. These pigs are considered sturdy and are more resistant to various diseases. They can survive on kitchen waste, and farm-grown feeds or farm by-products.

**Low cost housing/ pen of native pigs**

Pigs need protection from extreme cold and heat. They are housed on many different ways depending upon the local practices.

If possible, pig pens should be built on higher ground, preferably near water sources. Orient the house in an east-west direction. This orientation keeps the floor of the pen dry by allowing the sun to dry the pen floor as the sun crosses the sky during the day.

**Site -- Elevated, near water source**

**Roofing Materials**

1. Bamboo, 2. Nepa palm leaves, 3. Iron sheet, 4. Some locally available roofing materials such as Toddy Leaves

**Siding/ Wall Materials**

The walls should be approximately ¼ built and ¾ left for ventilation.


**Flooring Materials**

The floor should be dry all the time. Ideally it should be made of concrete. In absence of resources, remove the top black soil and harden the ground by pounding


**Spacing Requirement** – 18 sqm for two heads of pig

**Feeding and watering trough materials used:**

1. cement 2. wood 3. bamboo
Site Selection for Pigsty

1. The place should be under direct sunlight and a little bit high to avoid flooding
2. Must have sufficient supply of clean water
3. Floor should be hard enough if the floor is earth layer
4. It should be far away from houses
5. The housing should have good ventilation and must be constructed to prevent cold and hot temperature.
6. It also should be constructed to easily clean animals dungs.
7. To get the morning sunlight the front side should be faced with east or northern east.
8. The shelter should be wood and concrete materials to prevent from Pig chewing.

Three system of Pig husbandry

1. Intensive system
2. Extensive system
3. Semi Intensive system

Management practices

1. Remove poor growth rate pigs and substitute with potential breeds
2. Breeds selection should be carried out carefully to get strong and good health breed
3. The biggest piglets from the good reproduction rate mother, should be selected.
4. Poor appetite piglets, diarrhea and coughing piglets should not be selected

Feeds management

Since pig eats everything, all the kitchen waste such as cooked rice, curry, and bones can be used as feed. Moreover, rice chaff, rice bran, oil cake, sesame cake, corn, waster cabbage leaves, grass and lucaena leaves can be fed them. One thing to be considered is to feed the primary or main foods and other greens should be later.
The quantity of feeds should be suited well with pig’s appetite and adjust the amount not to waste the feeds. There should be sufficient supply of clean water for everyday.

The primary sources of nutrition that pig required are similar with human. These are protein, carbohydrate, oil and vitamins and minerals. The ingredients that used in feed formulation for pig are corn, broken rice, bran, oil cake, prawn dust, fish dust.

**Vaccination and medication**

<table>
<thead>
<tr>
<th>Sr</th>
<th>Vaccine</th>
<th>Age – Days</th>
<th>Effective duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diarrhoea</td>
<td>45</td>
<td>1 year</td>
</tr>
<tr>
<td>2</td>
<td>Pig Plaque</td>
<td>65</td>
<td>6 months</td>
</tr>
<tr>
<td>3</td>
<td>Foot and mouth disease</td>
<td>60</td>
<td>1 year</td>
</tr>
<tr>
<td>4</td>
<td>Tetanus – After castrating and injured</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sessions Procedure**

Step 1. Set up the training place
Step 2. Prepared all flip charts and IEC and handouts for lessons
Step 3. Brief explanation on the above sessions.
Step 4. Questions session from participants.

Step 5. Separate the participants in 3 groups and to answer the following questions;
   a. What have you learnt from this session?
   b. What are the common diseases in the village for livestock?
   c. When did they occur?
   d. What are the criteria of site selection for housing?
   e. What materials should be included in feed formulation?

Step 6. Presentation by each group’s representative.
Step 7. Questions and answers session
Step 8. Make documentation on all the questions, answers and recommendation
Farmer Learning session module on Small-Scale Fish Culture

Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

1. Acquired basic understanding about the relationship of climate change and agriculture
2. Learned basic knowledge and skills in climate smart practices related to:
   a. Field crops including seed multiplication and management
   b. Small livestock production
   c. Small-scale aquaculture
   d. Vegetable production including home gardening
   e. Integrating trees (fruit and non-fruit) into farming systems
   f. Legume production
3. Identified farmer specialists among them who will share skills and knowledge to other farmers in the village and outside the village

General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationery before session
- Activate each participant in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

1. Site selection
2. Pond preparation
3. Water management
4. Feeding practice and Management

Expected Learning Outcomes

By the end of the learning session the participants should be able to;
1. Understand on how to select location for fish ponds and preparation
2. Understand and follow on Proper Management
3. Understand the feeding practice and management

Targeted Participants

All the beneficiaries who are involving in Livestock farmers and other farmers who are interested to learn about animal husbandry.
Small Scale Fish culture

Site Selection

1. The place should be sufficient enough and level
2. The slightly slope lands are suitable for fish pond
3. Must select the place where can hold the water
4. Clay and clay loam are the best to hold the water
5. The fish pond should not be far away from market and must have access of transportation
6. The place should not be flooded area
7. Fish pond should be established near continuous water sources such as rivers and creeks for sufficient water supply

Pond Preparation

1. Depth of fish pond should be 4-6 feet
2. Pond should be in square
3. The boundary should be slope
4. For old ponds, drying the pond with sunlight should be carried out once for every 4-5 years.
5. Water should be completely taken out and show with sung
6. This duration should be about one month but three months is better to enrich oxygen level in soil, to kill the eggs of wild fish and other insects and to move out other poisonous materials
7. Regular check on the wall of ponds
8. Don’t allow cattle and pigs to go through the boundaries

Water Management

1. If the water color is very dirty and pH is low, quick lime should be added. By adding 14-15 bags of lime can help to clean the water and increase pH level
2. By adding lime, it can help as follow;
   a. To increase alkalinity of soil
   b. To kill other wild fishes
   c. To kill other insects and fungus and parasites
   d. To remove the poisonous gas such as hydrogen sulphate, and salts
   e. To balance the pH level of water

<table>
<thead>
<tr>
<th>Sr</th>
<th>pH Level</th>
<th>One acre</th>
<th>Small pond – 50x20 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>300 viss</td>
<td>6.5 viss</td>
</tr>
<tr>
<td>2</td>
<td>6.5-7</td>
<td>212 viss</td>
<td>5.5 viss</td>
</tr>
<tr>
<td>3</td>
<td>Above 7</td>
<td>125 viss</td>
<td>4 viss</td>
</tr>
</tbody>
</table>

All the water must be moved out and showed with the sunlight for 1-3 months and the floor of the pond must be covered with recommended rate of quick lime and show with sunlight again for two weeks. Another way of water treatment is adding urea which can help to increase the pH level and to grow more algae which is the food source of fish.

Depth of water level – Minimum water level should be 4 feet
Temperature – 28 to 32 Degree Celsius of water temperature is the best for fish

Water Transparency – 30 – 45 cm visibility/purity is the best situation

pH level

- Under pH 4-5 fish and prawn can’t survive,
- Between pH 5-6.5, fish can’t be growing well and growth rate will be slow
- Between 9-11.5 is also stunting the growth rate
- The best pH range for aquaculture is between pH 7-8.5

Symptoms of irregular situation in Fish pond

1. Seeing dead fishes along the boundary
2. Not active in the morning and can easily catch
3. Water color changing (red brown, deep green and red) and transparency is under 20 cm
4. Fishes are swimming at the top surface of the ponds
5. Bubbles on water surface

If these symptoms are founded in the ponds the following procedure should be carried out immediately.

a. Stop feeding
b. Cleaning the trashes and decomposed branches and leaves
c. Cleaning the organic waste
d. Changing new water
e. Monitoring the growth of fishes

Feeding Practices

Most of the fish’s species except cat fishes can survive by eating natural foods which derived from river, creeks and ponds. Although there are many types of natural feed, phytoplankton and zooplankton are the common foods. These feeds sources can be easily got by irrigating the water from river and creeks. Therefore, changing water to the pond is not only improve the water quality but also improving foods sources.

Supplementary feeds

Rice brans, wheat brans, wheat chaff, sesame cake and oil cake are used as supplementary feeds. By mixing equal ratio of rice brans and sesame cake or oil cake, this mixture can be fed to fish to improve the rapid growth rate and the feed rate should be 4 % of Fish size.

Low Cost Feeding formulation

- 90 % of rice bran + 10 % of groundnut or sesame cake
- 70 % + 10 Soy bean + 20 % coconut waste after extracting the milk
- Urea application to the pond
- The quantity of feeds should be adjusted based on the size of the fish
**Sessions Procedure**
Step 1. Set up the training place
Step 2. Prepared all flip charts and IEC and handouts for lessons
Step 3. Brief explanation on the above sessions.
Step 4. Questions session from participants.

Step 5. Separate the participants in 3 groups and to answer the following questions;
   a. What have you learnt from this session?
   b. What things should be considered for site selection?
   c. What is the unusual symptoms of the ponds?
   d. What materials can be used for feeds?

Step 6. Presentation by each group’s representative.
Step 7. Questions and answers session
Step 8. Make documentation on all the questions, answers and recommendation
Module 9: Field Observation, Recording and Data Management

Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

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General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationery before session
- Activate each participant in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

- Field Observation on PVS, new crop introduction and Crop Performance Trials
- Data Recording

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

1. Identify the best performance variety
2. Identify the strengthens and weakness of the varieties
3. Practice the record book keeping

Targeted Participants

All the beneficiaries who are involving in home gardening activity and other farmers who interested to learn but the maximum numbers of participants should not be exceeded above 25 persons.
Facilitator
Field researcher assigned for each CSV

Materials Required
1. A0 Paper
2. Marker Pen
3. Books for data recording
4. Pens

Session Procedure
1. Set up the learning sites at the place of PVS and Crop performance Trial plots
2. Explain the objective of the learning sessions.
3. Give the following tables to each farmer to fill out during discussion.
4. Discuss what the farmers observed in trial.
5. Discuss which variety is the best performance and suited well with Local situation.
6. Keep all data discussed during the session.

Sample Data recording on field observation for PVS

<table>
<thead>
<tr>
<th>Description</th>
<th>Variety 1</th>
<th>Variety 2</th>
<th>Variety 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sowing date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day After Sowing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather condition during sowing time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolerant to Drought</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolerant to Flood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pests resistant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Bad/Fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease Resistant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetative Growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop duration How many days for harvesting after sowing</td>
<td>e.g 110 days, or 150 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmers’ observation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Sample Data recording on field observation for Crop Performance Trial

<table>
<thead>
<tr>
<th>Description</th>
<th>Variety Name – e.g Sinpadaythar - Groundnut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>e.g Nyaung U DAR</td>
</tr>
<tr>
<td>Sowing date</td>
<td></td>
</tr>
<tr>
<td>Day After Sowing</td>
<td></td>
</tr>
<tr>
<td>Germination</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Weather condition during sowing time.</td>
<td></td>
</tr>
<tr>
<td>Plant Height</td>
<td></td>
</tr>
<tr>
<td>Tolerant to Drought</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Tolerant to Flood</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Pests resistant</td>
<td></td>
</tr>
<tr>
<td>Good/Bad/Fair</td>
<td></td>
</tr>
<tr>
<td>Disease Resistant</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Vegetative Growth</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Potential Yield</td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
</tr>
<tr>
<td>Crop duration</td>
<td>e.g 110 days, or 150 days</td>
</tr>
<tr>
<td>Farmers’ observation</td>
<td></td>
</tr>
<tr>
<td>Farmers’ recommendation and preference</td>
<td></td>
</tr>
<tr>
<td>What is the difference between Local Exiting variety</td>
<td></td>
</tr>
<tr>
<td>Is it adaptable with local climate?</td>
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</tr>
</tbody>
</table>

### Sample Data recording on field observation for Intercropping Practice

<table>
<thead>
<tr>
<th>Description</th>
<th>Variety Name</th>
<th>Variety 2 name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sowing date</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Day After Sowing

<table>
<thead>
<tr>
<th>Germination</th>
<th>Good/Fair/Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Height</td>
<td></td>
</tr>
<tr>
<td>Disease Resistant</td>
<td>Good/Fair/Bad</td>
</tr>
</tbody>
</table>

### What are the benefits of Intercropping? Farmers Opinions

### What are the constraints for practicing this intercropping practice?

### What Types of Crops can be used as intercropping?

### Is It climate Smart? Why? Farmer’s opinion

#### Sample Data recording on field observation for Fruits Tree Cultivation

<table>
<thead>
<tr>
<th>Description</th>
<th>Fruits tree 1</th>
<th>Fruits Tree 2</th>
<th>Fruit tree 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Growth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pest tolerant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease Tolerant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility with local climate Good/Fair/Bad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are the benefits of intercropping with Fruit tree in Farm?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is it climate Smart?  Why? Farmers’ Opinion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which type of fruit tree is the most adaptable with local climate? Why?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmers’ observation and recommendation</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Legumes as Cover Crops, Green Leaf Manure*
Cover crops shield the soil from sunlight, wind, and heavy rainfall thus improving soil structure, water infiltration, and root penetration while enhancing soil microbial communities. Additional benefits include reduced soil crusting, soil erosion, runoff, and nutrient leaching. Cover crops enhance soil fertility via improved nutrient retention and cycling, while leguminous cover crops add nitrogen from the atmosphere. A cover crop is termed a green manure crop if the residue is incorporated in the soil; in such instances, crops should be selected that produce large quantities of herbage and also contain adequate amounts of nutrients in the correct proportions.

Increasing soil organic matter enhances the capacity of the soil to store nutrients and water. Almost all of the nitrogen and much of soil phosphorus and sulfur resides in the soil organic matter. Organic matter increases soil water holding capacity in sandy soils and improves water percolation in heavy, clay soils.

Erosion, Pest, and Weed Control

Cover crops shade the soil (which reduces weed germination) and also compete with weeds for light, water, and nutrients. Where weed control is important, a cover crop should germinate quickly and develop a rapidly growing and dense herbage that can effectively “shade out” weeds. Some crops, such as winter rye and sunnhemp, also produce natural herbicides (allelopathic substances) that hamper weed germination. For erosion control, a cover crop should establish quickly and form both a solid groundcover and an extensive root system.

- Cut fertilizer costs
- Reduce the need for herbicides and other pesticides
- Improve yields by enhancing soil health
- Prevent soil erosion
- Conserve soil moisture
- Protect water quality
- Help safeguard personal health

Legume cover crops convert nitrogen gas in the atmosphere into soil nitrogen that plants can use. Cover crops improve soil by:

- Speeding infiltration of excess surface water
- Relieving compaction and improving structure of over tilled soil
- Adding organic matter that encourages beneficial soil microbial life
- Enhancing nutrient cycling

What is a GMCC?

Green manure/cover crops (referred to hereafter as GMCCs) are plants used to cover and improve the soil, as well as to positively impact the ecology of the land and other crop plants.

Legumes that can be used as cover crops

1. Lab Lab beans
2. Pigeon Pea
3. Cow peas
4. Horse gram
5. Green gram/ mung beans
Session Procedure

1. Set up the location for Lecture orientation
2. Orientation on Important of Cover crop.
3. Orientation on how benefit for soil fertility.
4. Orientation on what types of crops can be used as cover crops.
5. Discussion and question session.
6. Keep data recording for all of discussions and questions.
Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

1. Acquired basic understanding about the relationship of climate change and agriculture
2. Learned basic knowledge and skills in climate smart practices related to:
   a. Field crops including seed multiplication and management
   b. Small livestock production
   c. Small-scale aquaculture
   d. Vegetable production including home gardening
   e. Integrating trees (fruit and non-fruit) into farming systems
   f. Legume production
3. Identified farmer specialists among them who will share skills and knowledge to other farmers in the village and outside the village

General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationary before session
- Activate each participants in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

1. Pit preparation for Fruits tree cultivation and Mulching
2. Tree Propagation Practices (Grafting and Cutting)
3. Pruning practices

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

1. Understand on how to prepare the proper Pit/hole preparation for tree plantation.
2. Know the objectives of Propagation and do the propagation practices in their own garden.
3. Understand the objectives of pruning practices and do the pruning practices.
4. Understand the important of mulching and follow the practice in their farms.
Targeted Participants

All the beneficiaries who are involving in Fruits tree plantation activity and other farmers who interested to learn but the maximum numbers of participants should not be exceeded above 25 persons.

Trainer

Field researcher assigned for each CSV

Part – 1: Pit preparation for Tree Plantation, Transplanting and Mulching

Proper land preparation is one of the many important practices in tree plantation for suitable plant growth and fruit setting. In this session, the trainer and participants will work together and learn why depth digging, proper transplanting and mulching can improve the vegetative growth of trees. Before demonstration the trainer has to explain the importance of pit preparation, transplanting and mulching practices as per following paragraph.

Every hole for tree plantation should be prepared one month in advance before planting to get exposure with sun and wind. This exposure helps the interior of the holes to get properly heated up and weathered. The size of the hole may vary depends on the size, variety and kinds of the fruits tree and but minimum size of the hole should be 1.5’ x 1.5’. However, 3’ x 3’ size also should be considered for the big tree if farmers able to do.

Proper spacing for various type of fruits tree is also very important for proper vegetative growth and for easier management. Leaving the right amount of space between plants is quite important as each plant needs a certain amount of room for their roots and leaves to maximize growth. Not only this, but leaving enough air to circulate around and in between the plants really helps to prevent diseases from spreading, especially in wet and humid weather. However again, the spacing of the fruit’s trees are not suited fit because it varies from size and types of fruit tree and land availability.

**Mulching** is a process of covering the soil and make more favorable conditions for plants growth development.

**Why we need mulching?**

1. To prevent water evaporation
2. To prevent weed growth
3. To create micro-climate and more favorable condition for plant growth
4. To regulate soil temperature
5. To reduce the soil erosion
6. To promote germination process
7. To provide nutrient with decomposing organic mulch
8. To reduce soil compaction

**What materials can be used for Mulching?**

1. Organic residues (dry hill, grass, straw, saw dust, kitchen vegetable waster, animals’ manure,
2. crop residue such as sesame stock, groundnut shell, pigeon pea stocks
Required Materials

1. Shovel, hoe
2. Half basket of well decomposed manure
3. Half basket of green manure compost (such as leaves compost)
4. 3 seedlings of Good quality grafted fruit tree
5. 1 bag of straw or dried leaves or groundnut shell or pigeon pea stocks or sesame stock or rice husk or straw

Activities

➢ Setting up the suitable location site of farm for every participant accessible
➢ Prepare all required materials for learning session
➢ Gather all participants in selected location site
➢ Orientation on objectives of learning sessions
➢ Orientation on the purpose of the learning session topics
➢ Separate the participants in Three groups
➢ Explanation on procedure of demonstration

Step 1. Set up the location for hole digging place
Step 2. Digging the hole in size of 1.5’ x 1.5’, but separate the topsoil layer and the soil from the under part of the hole
Step 3. Mix the topsoil with well decomposed manure and compost, firstly add ¼ of the soil to the hole. The purpose of adding compost and manure is to give a tree for good start.

Step 4. Place the seedling in the hole and ensure that the seedling is upright and then fill the remaining mixed top soil into the hole and press the base of the root gently. Irrigate the plants immediately after transplanting.
Step 5. For the dry zone and water scarcity area, the base of the tree should be basin shape to collect the rain water for the efficient use of irrigated water but for flooding area the base of the trees should be raised to be escape from flooding. The base should be 2-3 feet height depends on regular flood level.

Step 6. If the soil is too dry after digging the hole, water should be added before transplanting. After irrigation, the base of the plants must be covered with Straw or dried leaves to protect from moisture loss and to protect weeds problem and to enrich the soil nutrient level.
Step 7. Ask participants to practice all steps for two more plants with remaining group 2 and 3.

Part 2 - What is Plant Propagation

Plant propagation is the process of creating new plants from a variety of sources; seeds, cutting, budding and other parts of the plants. There are two types of propagation; sexual and non-sexual propagation.

Sexual propagation is the union of male and female flower and create a new such as seeds. The advantages of sexual propagation are that it may be cheaper and quicker than other methods; it may be the only way to obtain new varieties and hybrid vigor; in certain species, it is the only viable method for propagation; and it is a way to avoid transmission of certain diseases.

Asexual propagation involves taking a part of one parent plant and causing it to regenerate itself into a new plant. The resulting new plant is genetically identical its parent. Asexual propagation has advantages, too. It may be easier and faster in some species; it may be the only way to perpetuate some cultivars. Asexual propagation involves the vegetative parts of a plant: stems, roots, or leaves. The most common method of propagation for fruits trees is grafting and budding a desired variety onto suitable rootstocks. In this session, grafting and cutting will be learnt together with participants with the demonstration of facilitator.

Concept and principle of grafting

Grafting is a technique used to untie ‘parts’ of different plants by bringing the cambium of each into contact to grow together as one plant. The technique involves two important stages: the preparation of the grafting surfaces and the procedures for aftercare.
The advantages of grafting include:
- Reduced height for easy picking
- Good quality fruit from selected varieties
- Early fruiting after only a few years.

Disadvantages
- Trees are less vigorous and short lived.
- The chance of producing new varieties is not given.

There are several types of grafting namely: cleft, side-veneer, bark, splice, whip, tongue, saddle and approach grafting. One of the simplest and most popular forms of grafting is described in this module. It is known as cleft grafting.

Cleft Grafting
- Two plants are involved in grafting: one is called rootstock and the other scion (or mother plant).
- The rootstock is the lower portion of the graft, which provides the root system of the grafted plant. It may be a seedling, a rooted cutting or a layered plant.
- The scion is the upper part of the graft, which forms the fruit bearing top of the tree.
- Cambium is a thin layer of the plant located between the bark and the wood. For successful graft union, it is essential to keep the cambium of the scion in close contact with the cambium of the rootstock.

Requirements of successful grafting
- The rootstock and scion must be compatible.
- The cambial region of the scion must be in intimate contact with that of the stock.
- The grafting operation must be done only when the environmental conditions are favorable.
- Immediately after grafting, all cut surfaces must be protected from desiccation.
- Proper care must be given to the grafts for a period of time after grafting.

Required Materials
1. Grafting knives (3)
2. Branches for practicing
3. Grafting tape
4. Knife

1. Cleft Grafting
   Cleft grafting is a grafting technique which allows the union of a rootstock limb that is much larger in size than the scion piece.

How to do cleft grafting
• Harvest scions from the desired mother tree and cut them about 15cm long. Remove all the leaves carefully.
• With a very sharp knife cut the bottom of the scions with two sloping cuts 3½cm long (A).
• Cut off the top of the rootstock about 30cm above the soil. Make one straight cut about 3cm deep in the top of the rootstock (B) to form a wedge.
• Push the scions firmly into the rootstock cut. Leave ½cm of the cut scions outside the rootstock as shown.
• Use clear plastic tape to wrap firmly around the
• Remove any buds which have grown below the graft.

2. **Splice Grafting**

Splice grafting is used to join a scion onto the stem of a rootstock or onto an intact root piece. This simple method is usually applied to herbaceous materials that callus or "knit" easily, or it is used on plants with a stem diameter of 1/2-inch or less. In splice grafting, both the stock and scion must be of the same diameter.

• **Preparing the Stock and Scion.** Cut off the rootstock using a diagonal cut \(\frac{3}{4}\)-inch to 1 inch long. Make the same type of cut at the base of the scion.
• **Inserting the Scion.** Fit the scion to the stock. Wrap this junction securely with a rubber grafting strip or twine.
• **Securing the Graft.** Seal the junction with grafting wax or grafting paint. Water rootstock sparingly until the graft knits. Over watering may cause sap to "drown" the scion. Be sure to remove the twine or strip as soon as the graft has healed.
Session Steps
Step 1. Orientation on Cleft and Splice grafting practice.
Step 2. Demonstrate the Cleft and splice grafting method.
Step 3. Ask all participants to practice themselves

Part – 3: Layering
There are many types of cutting, budding and layering methods to propagate the mother plants. In this session air layering which is the most common and affordable method for the farmers will be demonstrated.

Required Materials
1. Grafting knives
2. Branches for practicing
3. Knife

What is air layering?
Air layering the method of propagating new trees and shrubs from stems still attached to the parent plants. The stem is wrapped with damp moss to encourage roots to form. It is suitable method for some plants that does not root readily from cutting. Citrus, lime, lemon, guava, lychee, rambutan, longan, Rose, hibiscus, ornamental plants.

It can be propagated throughout the year if the plants can get moisture but the most suitable period for layering is the rainy season that can be supplied with sufficient moisture content.

Selection of branch for layering
The branch should be at least one year old with 0.5 to 1 inch in diameter and should be free from any pest and disease infection.

Procedure
Choose a one- to two-year-old stem that is straight, healthy and vigorous. Trim off side shoots and leaves from a 30cm (1ft) section. Do not leave any snags.

Wound the stem, making a 2.5cm (1in) cut through a leaf bud.

Pack a small amount of moist sphagnum moss under the tongue of the wound.

Wrap the wounded stem section loosely with black plastic, sealing it at one end with weather-proof adhesive tape.

Pack the wrapping sleeve with moist sphagnum moss, to a thickness of 7.5-10cm (3-4in).

Seal the other end of the wrapping sleeve with weather-proof adhesive tape.

Leave the wrapping in place for up to a year. Open and check it occasionally for signs of rooting.

When strong new roots are visible through the moss, remove the plastic sleeve. Cut through the stem just below the rooted section.

Pot up the rooted stem in potting compost suitable for the plant in question. Do not attempt to remove the moss from the roots. Water, label and grow on until large enough to plant outside.

**Air Layering Propagation Method**

- Cut and remove bark
- Cut at red line
- Wrap with growing medium
- Wrap with Saran Wrap or aluminum foil
- After roots are grown, take plastic or aluminum off. Leave growing medium bound in roots.
- Plant into a pot or the ground!
Session Procedure
Step 1. Explanation on the basic of Layering practices
Step 2. Demonstration on Air layering Practices
Step 3. Ask all participants to practice at least once

Part 4 - Pruning Practices
Pruning is the horticultural practices involving the selected removal of certain parts of plant, such as branches, buds and roots. Reasons of pruning include deadwood removal, shaping, improving and sustaining health and for better management during harvesting.

Objectives of Pruning
1. To control size of plant
2. For better quality fruit by better light distribution
3. To remove dried and disease infected branches
4. To remove the non-productive the of the plants

Pruning Types
1. Thinning out
2. Heading back
3. Bulk pruning
4. Thin wood pruning

Thinning out – when the shoot is entirely removed from the point of its origin and no growth is allowed to from the cut end.
Heading back – When terminal portion of branches or shoot is removed and it encourages lateral growth from the remaining shoot.

Bench Cut – removes vigorous upright shoot back to side branches that are relatively flat and outward growing.

Session Procedure
Step 1 – Explanation of pruning
Step 2 – Literature explanation by using diagram
Step 3 – Demonstration
Step 4 – Ask participants to practice by using any type of tree plants.

Questions and Documentation Sessions
In this session, facilitator should encourage participants to raise questions if they have misunderstood and challenges during practicing the session topics. All the questions should be collected and documented. After the session, the field facilitator has to document the session process and document all the participants list, location and date set up and prepare Learning session report.
Module 6: Farmer Learning session module on Small Scale Vegetable Production

Objectives of the Farmers Learning session

The farmer learning sessions are interventions directed at increasing the knowledge and skills of target farmers in the CSVs about climate smart practices in agriculture production. These sessions will support the farmers as they innovate, test and learn from the various CSA options they identified for implementation in 2019. Specifically, at the end of the farmer learning sessions, the farmers have:

1. Acquired basic understanding about the relationship of climate change and agriculture
2. Learned basic knowledge and skills in climate smart practices related to:
   a. Field crops including seed multiplication and management
   b. Small livestock production
   c. Small-scale aquaculture
   d. Vegetable production including home gardening
   e. Integrating trees (fruit and non-fruit) into farming systems
   f. Legume production
3. Identified farmer specialists among them who will share skills and knowledge to other farmers in the village and outside the village

General Instruction for Facilitator

- Please read the entire handbooks thoroughly before training sessions
- Arrange all required materials and stationary before session
- Activate each participant in group work
- Given enough time for practice
- Spend time for reviewing, Questions and feedbacks

Learning Session Topics

1. Plots/land preparation for vegetable gardening
2. Seedlings preparation
3. Spacing and Transplanting practice
4. Mulching and management Practices
5. Seasonal crop calendar

Expected Learning Outcomes

By the end of the learning session the participants should be able to;

1. Understand on how to prepare the proper Pit/hole preparation for tree plantation.
2. Understand how to prepare seedlings
3. Understand the proper ways of transplanting practices and plant spacing
4. Understand the suitable vegetables crops season
5. Understand the important of mulching

Targeted Participants

All the beneficiaries who are involving in home gardening activity and other farmers who interested to learn but the maximum numbers of participants should not be exceeded above 25 persons.

Trainer
Field researcher assigned for each CSV

1. Introduction to Vegetable home gardening

Home vegetable garden can make a significant contribution to small scale livelihood sector of every households. Home vegetable garden needs only a small area of land with minimal capital outlay and can provide food access to a valuable food under subsistence conditions but also has the potential condition to provide an initial step towards partial income of the households. Vegetable plays a major role in supplying the essential minerals, vitamins and fiber which are not present in significant quantities in staple starchy foods. Vegetables are usually consumed as a side dish with starchy staple foods to add flavor to a meal.

Objectives

The objectives of vegetable garden in household compound is to produce vegetable to support daily intake for the family members throughout the year. In regards to this point, home garden shall not aim only at increasing the amount of vegetable for a single production, but also aim at constant and sustainable production throughout the year. (JICA)

Step 1. Nursery bed preparation and seedbed preparation

Nursery - A vegetable nursery is a place for raising young vegetable seedlings until they are ready for transplanting.

Direct seedings are the most common methods of sowing vegetables especially for large size seeds. However, some vegetables seeds can’t be grown very well with direct seedings and it performs well if they are sown in containers or seedbeds initially and are later transplanted.

Materials required

1. Any container or basket or trays
2. Sand, soil and manure
3. Small seed (spinach), medium seeds (mustard, roselle), Large seeds (beans and pea)
4. Watering cam or sprayer

Seedlings preparation with containers

1. Select the suitable container – planting in seedbed is cheaper than using container but container allows the gardeners to choose the right medium for growing the seedlings. Any container with sufficient depth and width can be used as for seedlings preparation.
2. **Cleaning the container** – container should be cleaned by rinsing with water and shown with sunlight for one day to be free from fungus spores and insects pests.

3. **Preparing soil medium** – the medium should be free from soil born disease and weeds. It should be sufficiently porous to allow the delicate rootlets to penetrate and admit air and moisture. The mixture of medium should be 1:1:1 ratio of soil: Sand: manure. Then fill the medium into the container and prepare well soaked by watering in advance before seeding.

4. **Sowing Seeds** – fine seeds should be broadcast into the container by mixing with sand to uniform spread but for larger seeds should be sowed separately in the container with drill or by poking. One important in seeds sowing is that the depth should not exceeded more than three times of the seeds size. For example, if the seed size is 1 cm, the depth should not be more than 3 cm, if not, it will take time to see the seedlings come out from the soil. After seeds sowing, the soil surface should be covered with thin layer of mixture and water with mist sprayer.

5. **Care and management** – After emergence of the seedlings, thinning should be carried out if there are too many plants in the line. These thinning plants can be sown in other containers. Regular watering for the seedlings trays is very important to keep sufficient moisture and shading if necessary. Watering of the seedbed should be done very carefully until the seedlings have emerged especially when the seeds are small. Large water drops tend to erode the thin soil covering of the small seeds. Using a fine sprinkler is recommended.
6. **Mulching** - of the seedbed immediately after sowing helps prevent erosion of the soil cover and conserves moisture. The mulch (rice straw, coconut fronds, or even banana leaves) also keeps the soil temperature favorable for germination. Seedlings must be protected from chicken and pigs by fences and/or (fishing-) nets.

7. **Transplanting** – When the seedlings age reach about 21-28 days or 3-4 weeks old which are ready to transplant, the seedlings container should be hardened by gradually increasing exposure to sun and air for one week before transplanting. Transplanting should be carried out usually at the evening and watering immediately after transplanting.

Session procedure
Step 1 – Set up the place for learning session where any beneficiaries have easy access
Step 2 – Prepare all the required materials
Step 3 – Separate participants into two groups
Step 4 – Literature orientation on Seedlings preparation by container
Step 5 – Demonstration of seedlings preparation by container by facilitator
Step 6 – Exercise for participants of two more trays or container
Step 7 – Questions and answer from participants
Step 8 – Continue literature session for care and management, mulching and transplanting.
Step 9 – Question and Discussion sessions

Land preparation for raised bed garden

Properly prepared soil provides a healthy substrate for producing an abundant supply of nutritious vegetables from the home garden. Well prepared soil can enhance following:

- Improved seed germination
- Increased aeration and drainage
- Improved soil texture and structure
- Higher biological activity
- Improved fertility

There are many types of land preparation for vegetables cultivation, but in this session, the raised-bed garden practice will be demonstrated.

Materials required

1. Hoe, Shovel and farming tools
2. Plastic string
3. Animal manure or compost or dry leaves
4. Plastic or nylon strings

Procedure of Raised bed preparation

1. Measure about 3 feet width and length can be altered depending on the availability of land.
2. Before digging the soil, cover the bed area with compost and manure about 1-2 inches thickness.
3. First dig the soil in 1 feet depth and heap the soil in outside of the plot as shown in figure. Then dig another portion of the bed and this soil will take place in the blank of first digging portion. The process is repeated until it reaches another end of the bed. Fill the open trench at the other side of the bed with the soil previously dug out from the first trench.

4. Then place the compost and manure in the bed and mix well with the soil and level it. It is then ready to plant.

5. For flooding area, the plot should be built as raised bed by using permanent bricks, or banana trunks or wood planks. Then fill the bed with soil, compost and manure to the raised bed but ensure to high enough to be free from flooding.

6. For very hard soil, initial digging about 6 inches can be made and then filled with soil from the side to raise the bed.

Session procedure

Step 1 – Set up the place for learning session where any beneficiaries have easy access
Step 2 – Prepare all the required materials
Step 3 – Separate participants into two groups
Step 4 – Literature orientation on plot preparation
Step 5 – Demonstration of seedlings preparation by container by facilitator
Step 6 – Practical works for two plots with two separate groups
Step 9 – Question and Discussion sessions
Spacing and transplanting of veggies

The spacing of fruit trees/crops varies with the kind of vegetables, variety, soil type, rainfall, etc. The spacing should be such that it provides the optimum space for the fruit trees. Close spacing makes trees grow tall and slender without a proper spread. Such trees are weak and liable to injury from strong winds and the fruit borne by them are of low quality.

Proper spacing for vegetable plants are important because:

- plants need enough space to properly develop
- overcrowding can lead to stunted crops and lower quality crops
- sufficient space ensures that plants will get enough sunlight, water, and fertilizer
- optimal spacing can help prevent the spread of pests and diseases from one plant to another

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Plant spacing (Inches)</th>
<th>Row spacing (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Roselle</td>
<td>4 – 6 (inches)</td>
<td>8 – 12 inches</td>
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<tr>
<td>2. Tomato</td>
<td>18 – 24 inches</td>
<td>18 – 24 inches</td>
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<tr>
<td>3. Morning glory</td>
<td>2 – 4 inches</td>
<td>6 – 8 inches</td>
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<tr>
<td>4. Long bean</td>
<td>8 – 12 inches</td>
<td>18 – 24 inches</td>
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<tr>
<td>5. Egg plant</td>
<td>18 – 24 inches</td>
<td>24 – 30 inches</td>
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<tr>
<td>6. Okra</td>
<td>18 – 24 inches</td>
<td>18 – 24 inches</td>
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<tr>
<td>7. Spinach</td>
<td>6 – 8 inches</td>
<td>12 inches</td>
</tr>
<tr>
<td>8. Long bean (Bush)</td>
<td>12 inches</td>
<td>18 inches</td>
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<tr>
<td>9. Cabbage</td>
<td>12 inches</td>
<td>18 inches</td>
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<tr>
<td>10. Radish</td>
<td>4 - 6 inches</td>
<td>8 – 12 inches</td>
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<tr>
<td>11. Carrot</td>
<td>4 - 6 inches</td>
<td>8 – 12 inches</td>
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<tr>
<td>12. Cucumber</td>
<td>18 – 24 inches</td>
<td>18 – 24 inches</td>
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<tr>
<td>13. Corn</td>
<td>12 – 18 inches</td>
<td>12 – 18 inches</td>
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<tr>
<td>14. Chinese Kale</td>
<td>8 – 12 inches</td>
<td>8 – 12 inches</td>
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<tr>
<td>15. Lettuce</td>
<td>8 – 12 inches</td>
<td>8 – 12 inches</td>
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<tr>
<td>16. Sweet Potato</td>
<td>12 – 18 inches</td>
<td>18 – 24 inches</td>
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<tr>
<td>17. Taro</td>
<td>12 – 18 inches</td>
<td>24 – 36 inches</td>
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<tr>
<td>18. Mustard</td>
<td>8 – 12 inches</td>
<td>8 – 12 inches</td>
</tr>
</tbody>
</table>

Instruction for Transplanting

Transplanting

- When the seedlings are about 2-3 weeks depending on types of vegetable, with 2-3 true leaves, it is ready to transplant.
- The seedlings should be hardened by showing sunlight and limited watering one or two weeks in advance before transplanting.
- The seedlings should be watered in nursery bed one hour earlier of uprooting seedlings. It leads to less damage on roots of seedlings.
- Transplant the seedlings in the evening time, and field should be watered one day earlier to transplant the seedlings if the soil is dry. And, it should also be watered to the plants after transplantation.
• While transplanting the seedlings, root should be covered by soil only up to those parts, which part was covered by soil in nursery bed. While doing so, if there is condition of lodging seedlings, it can be staked with small sticks.
• Watering to the plants should be done immediately after transplanting and should be watered regularly depends on the moisture content of the soil.

Mulching and management practices for vegetable cultivation
Mulching in general is beneficial practice for crop production. Mulch is simply a protective layer of a materials that is spread on top of the soil. It enriches and protect soil and provides a better growing environment. On the other hands, it acts as barriers to movement of moisture out of the soil. Mulch support infiltration of runoff and irrigation water as the mulches protect the soil surface from the impacts of raindrops preventing soil crusting.

Mulches are available in many forms but there are only two major types: organic and inorganic mulches. Organic mulches – Decomposed in the soil at different rate depending on the materials, climate and soil microorganisms present. Straw, saw dust, dry leaves, groundnut shell, rice husk, sesame stocks, pigeon pea stocks

Inorganic mulches – don’t decompose and don’t need to replenish often and they don’t improve soil structure and soil fertility. E.g. – polyethylene sheet

Benefits of mulching

1. Protect soil erosion
2. Reduces compaction from the impact of heavy rain
3. Conserve moisture by reducing moisture loss through evaporation. It also reduces the frequent watering.
4. Maintain a more even soil temperature
5. Prevent weed germination and growth
6. Keeps fruits and vegetables clean
7. Insulate soil, protecting roots from extreme summer and winter temperature
8. Can improve soil biology, aeration, structure (aggregation of soil particles) and drainage over time
9. Can improve soil fertility as certain mulches types decompose
10. Insects and pest reduction
11. Minimize the insect vector of viral disease
12. Minimize the other fungal and bacterial disease
Training session procedure
Step 1 – Classroom training on importance of plants spacing.
Step 2 – Classroom training on importance of mulching practice.
Step 3 – Classroom training on the instruction of transplanting
Step 4 - Set up the suitable site to demonstrate the mulching and transplanting practice.
Step 5 – Practical action demonstration on transplanting, direct seeding, spacing recognition and mulching practices.
Step 6 – Practical exercise by participants for transplanting, direct seeding, mulching practices.