
Content of Agricultural Life Skills for Teacher Training Centers

Part 3 Organic Gardening

2013

Unofficial translation

Content of Agricultural Life Skills for Teacher Training Centers

Part 3 Organic Gardening

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Preface

Implementation of life skills in agriculture is currently very attractive in the educational sector globally.

Starting from this context, strengthening life skills in agriculture related to daily livelihood is truly essential for student teachers and students in the present and future.

Therefore, in order to understand life skills, teachers who teach agricultural life skills should:

1. Understand the content and objectives, and know how to use materials.
2. Prepare adequate materials for each recommended activity.
3. Pre-practice by themselves before teaching in classes.

I hope all teachers will pay attention to use these materials for teaching and learning in order to improve education.

On behalf of the Ministry of Education, Youth and Sport, I profoundly thank the working group and VVOB's project technical assistance for compiling all documents.

Phnom Penh, 17 June 2013
Minister of Education, Youth and Sport

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The Organic Vegetable Gardening Manual is prepared in cooperation with the Ministry of Education, Youth and Sport and VVOB.

This book is prepared in order to explain about growing vegetables using by natural methods. It covers theories and practices in each lesson. The book will make growing vegetables easier and it requires less money, furthermore it is promoting quality of health and environment education in our country.

This Agriculture manual has been checked for accuracy by Cambodian Center for Study and Development in Agriculture (CEDAC). VVOB wishes to thank CEDAC for the support.

Even though agriculture experts provided technical assistance and materials and a big effort was made to do research of relating documents for this manual, the content may not be complete for teachers to teach their students. However, this manual is a guide for teachers to do more research and prepare lesson plans to fit the actual needs. We hope that this document will enable teachers to prepare teaching materials more effectively. We look forward to seeing your constructive comments and suggestions.

Authors Group

Note

This is the translation of ឯកសារបំណិនការអប់រំបំណិនជីវិត ផ្នែកទី ៣ ការដាំដំណាំបន្លែសរីរាង្គ (the training manual Content of Agricultural Life Skills for Teacher Training Centers Part 3 Organic Gardening) which was issued in 2013 by the Ministry of Education, Youth and Sport (MoEYS).

This translation was made by VVOB (the Flemish Association for Development Cooperation and Technical Assistance and is not an official translation.

We hope it may be useful to External Development Partners of MoEYS and Teacher Training Centers who wish to consult the original Khmer manual in English.

INTRODUCTION TO CONTENT MANUAL OF AGRICULTURAL LIFE SKILLS

This Agricultural Life Skills Content Manual is a tool to provide future teachers background information that can be used to teach agricultural life skills.

The manual consist of three parts:

- Part 1 Chicken raising
- Part 2 Fish raising
- Part 3 Organic gardening.

Together with the Agricultural Life Skills Teaching Manual and accompanying teaching aids, this set provides you with a range of ideas and methods that are suitable for your agriculture lessons. The lessons in this book provide ideas to practice skills of organic gardening. By

Definition of Life Skills

'The intellectual, personal, interpersonal and vocational skills that enable informed decision-making, effective communication, and coping and self-management skills that contribute to a healthy and productive life to ensure successfully solving daily problems'.

Policy for Curriculum Development
2005 – 2009, MoEYS

using hands-on practice and experiential based learning as the main methodology, student teachers learn how to apply these methodologies with students in their future primary schools. The lessons promote a deeper understanding of issues related to organic gardening, develop skills for problem solving, decision making, persuading and critical thinking. They also provide opportunities for raising awareness of the existence of agricultural problems and ideas for actions which can lead to behaviour change to avoid these problems, for example change to use natural fertilizers (compost fertilizer) and apply natural pest management in gardening.

Objectives of agricultural education

According to the Training-Program for primary-level teachers, taken from the MoEYS curriculum, Agricultural education aims for students to:

- Obtain knowledge and life skills for daily livelihood; for example, skills in planting crops and farming animals to enhance families' living standards.
- Grasp skills and methodologies to impart them to primary school students through practice and experimentation
- Change attitudes and address social and economic challenges through life skills, problems solving skills, thinking skills, decision making skills, cooperation, and accountability.

Some guiding principles for agricultural education

To meet the above mentioned objectives, we propose a number of guiding principles that should be taken into account in agricultural education:

- Installation of a garden, a fish pond and chicken houses in the PTTC is strongly encouraged, because student teachers will benefit most when they are asked to practice what they learn in a real situation.
- Agricultural education should encourage natural ways of growing crops, reducing the use of chemical pesticides and chemical fertilizer.
- In chicken and fish raising natural ways of feeding, natural ways of prevention and treatment of diseases should also be encouraged as much as possible.

Definition of Life Skills Education

"Life Skills based education is used to empower young people in challenging situations. It involves an interactive process of teaching and learning, which enables learners to acquire knowledge and develop attitudes and skills to support the adoption of healthy behaviours."

UNICEF

-
- The methodology used should focus on action-oriented, project-centered and participatory processes leading to self-confidence, positive attitudes and personal commitment. The process should be implemented through an interdisciplinary approach. This means it should be integrated in a different range of subjects (Science, social study, agriculture, general knowledge,...) and through extra-curricular learning opportunities such as project work, Green Clubs, Local Life Skills projects (LLSP) for primary and secondary education.
 - For curriculum based lessons as LLSP, the relationship between school and the communities is very important for agricultural Life Skills. The community is a valuable resource for teaching about agricultural issues and involvement of the community by projects that aim to improve the environment in the community is essential.

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CHAPTER 1 CHEMICAL PESTICIDES

1.1 INTRODUCTION

What are chemical pesticides? They are chemical substances used to kill, lure or get rid of devastating animals or weeds.

There are many kinds of chemical pesticides:

- Insecticide
- Herbicide (weeds...)
- Chemical pesticide for killing rodents (rat...)
- Chemical pesticide for killing fleas
- Chemical pesticide for getting rid of bacteria
- Chemical pesticide for getting rid of fungi
- Chemical pesticide for killing snails
- Chemical pesticide for killing nematodes

When pesticides leak into the environment, chronic poisoning can affect entire communities. Symptoms of chronic poisoning include numbness or weakness of arms, legs feet or hands, lethargy and loss of memory and concentration and anxiety.

Because farmers in developing countries often don't have the training or the equipment to handle pesticides safely, FAO recommends that pesticides classified as Ia, Ib and, preferably, II should not be used in developing countries. Nevertheless, extremely hazardous pesticides continue to be distributed and used in these countries and constitute a large percentage of the obsolete pesticide stocks.

1.2 IMPACT OF PESTICIDE USE

Problems	Because
Over use of pesticides	<ul style="list-style-type: none">– It damages the environment– It will make insects resistant– It will kill natural enemies (spiders, wasps), who eat the insects– It creates pollution
Over use of chemical fertilizer	<ul style="list-style-type: none">– Crops are more attractive to insects– Crops will have higher water content and spoil easily– Micro-organisms cannot eat chemical fertilizer, so there will be no humus– The soil will become harder– It creates pollution
Do not make the soil smooth and fine when it is wet	It will make the top soil hard and the crops will have difficulties absorbing water, air and nutrients
Do not use too much water	The crop roots will rot or wash away
Do not use too many seeds for planting	Crops will be small, because they have no room to grow
Do not catch snakes, toads, frogs and spiders in your field	They are natural enemies that will eat the pests
Do not use compost that is not well decomposed	Poorly decomposed compost holds on to nutrients and air, so it can not go to the plants



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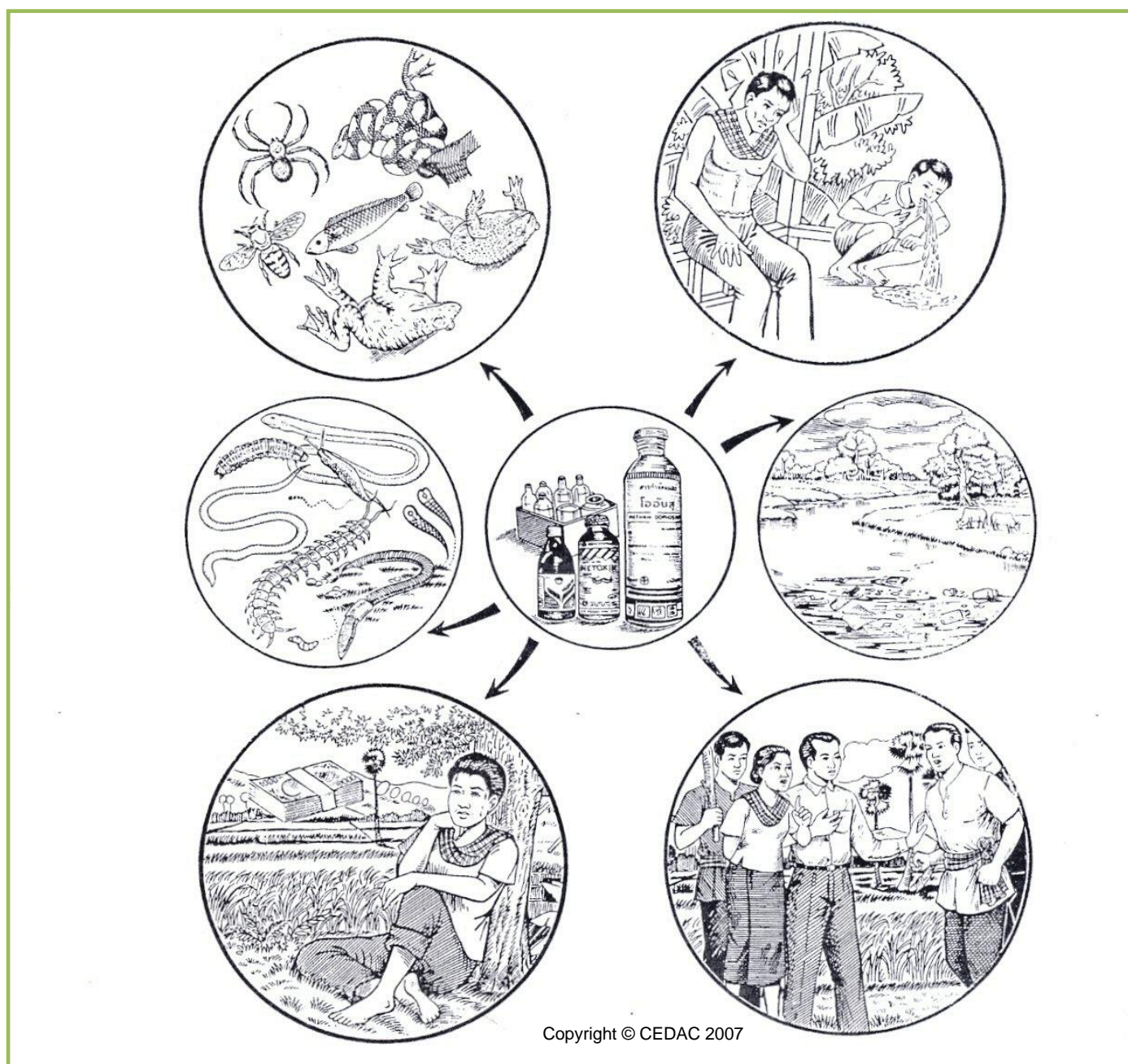
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ប្រយ័ត្នត្រោះថ្នាក់

MAFF-JICA/Poster #2

Picture 1 Prohibited agricultural pesticides



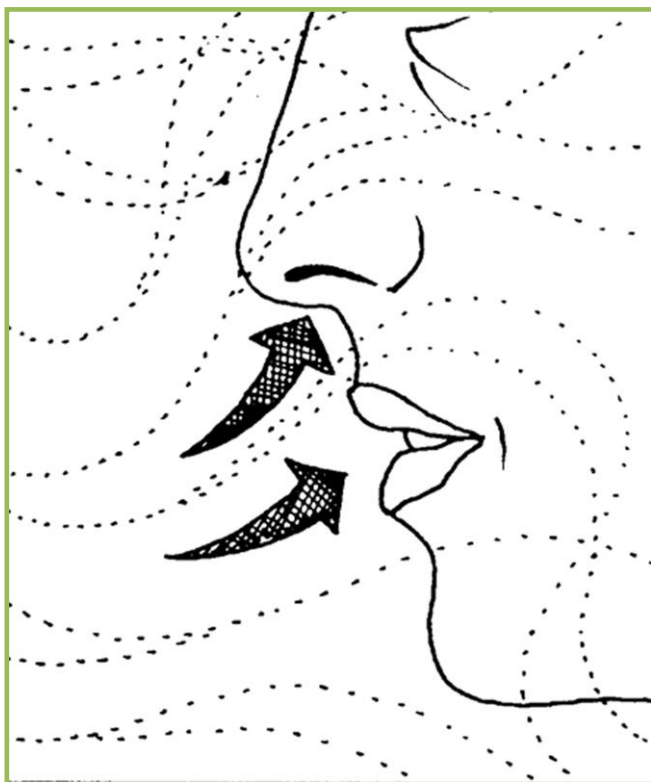
Picture 2 Influence of chemical pesticide

There are 2 kinds of effects that chemicals have on our health.

- *Immediate effect* This can happen when the pesticide touches the skin, or is absorbed into the body of the user at high dose at a short period of time
- *Long term (Chronical) effect* It happens gradually when the user touches or absorbs the chemicals into the body in small dose for a long period of time.

There are serious consequences of the chemicals for our body. It can cause the user to vomit, it causes headaches and dizziness, skin problems, muscle cramp, feelings of suffocation, spasms and it may lead the early death

In case of chronic effects the nerve system gets damaged, the antibody and hormone system are disturbed and it can cause different kinds of cancer.



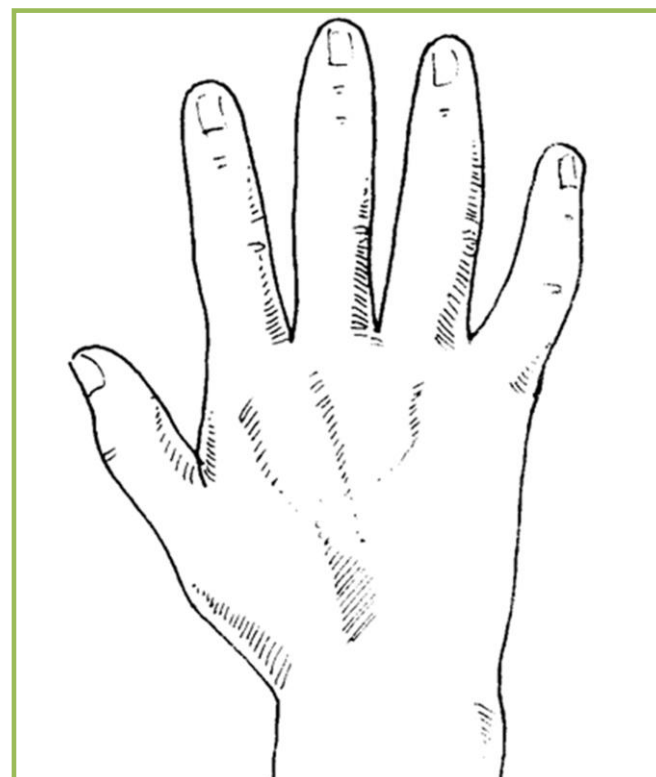
Picture 3 Chemicals can be inhaled



Picture 4 Chemicals end up on our food



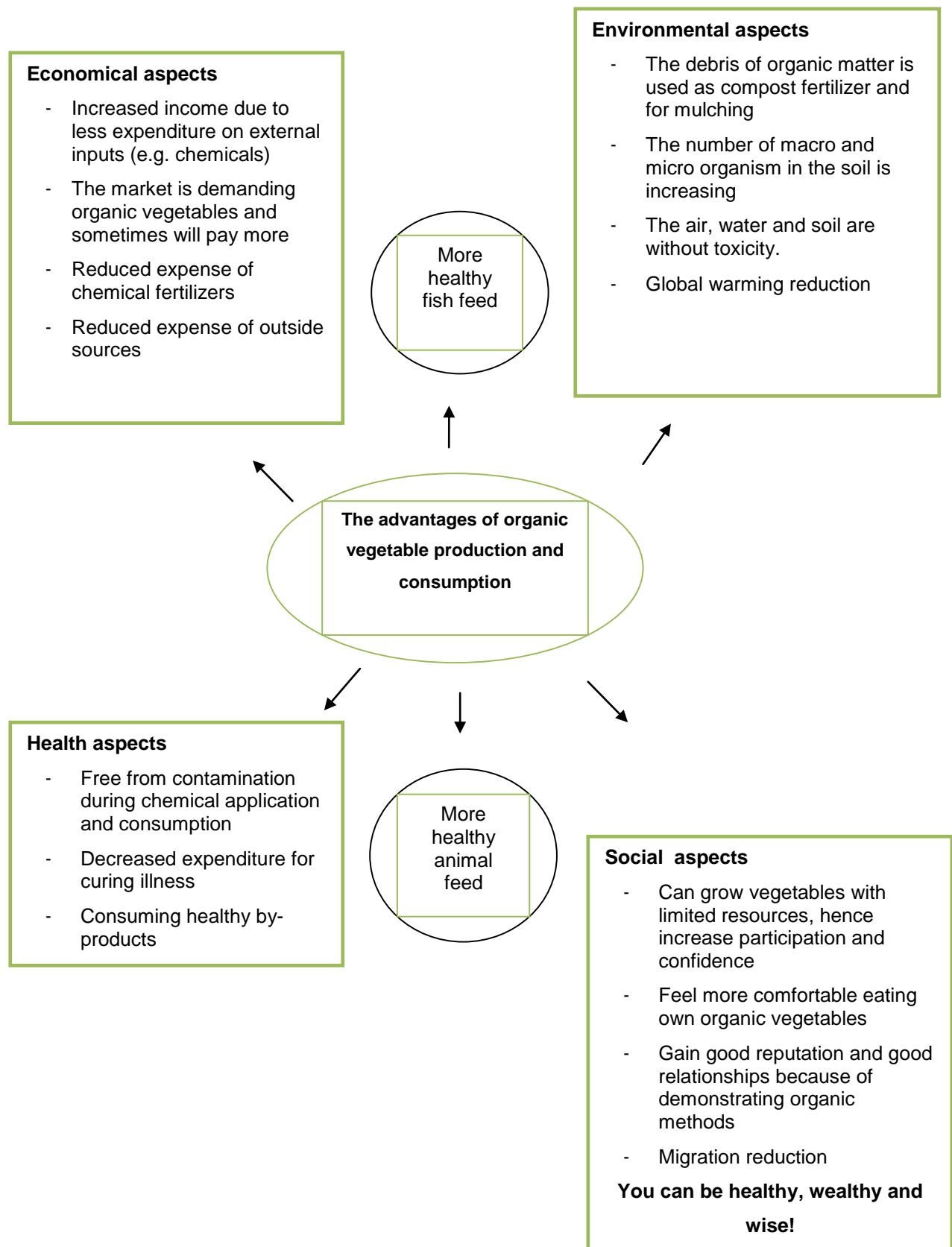
Picture 5 Chemicals in our drinking water



Picture 6 Chemicals can affect our skin

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1.3 ADVANTAGES OF ORGANIC VEGETABLE GROWING AND CONSUMING



1.4 CHALLENGES AND SOLUTIONS

 Challenges	 Solutions
The market is not always willing to pay a higher price for organic vegetables	Raise awareness (spreading information, communication)
Growing organic vegetables requires a lot of labour	Apply labour-saving methods e.g. mulching
It requires a long time before you can see the benefits of organic farming	Diversified cropping, for examples, mixed cropping, inter-cropping, and crop rotation
Sometimes it is difficult to find enough raw materials for organic compost making	Start growing green manure crops or multi-purpose trees
Organic vegetables can be damaged by pests and diseases	Apply natural pesticides, mixed cropping techniques and crop rotation
Low yield at the beginning	Start with a small portion of the field to practice organic methods and enlarge
Not enough proof that products are organic	Internal control system and Certification of organic products



Main considerations for vegetable gardening:

- ❖ Soil fertility control
- ❖ Appropriate water control and use
- ❖ Appropriate growing system
- ❖ Naturally based vegetable growing techniques
- ❖ Seed selection and storing
- ❖ Knowledge of seasonal crop selection
- ❖ Well-organized and good practice of crop growing

CHAPTER 2 NATURAL FERTILIZERS

2.1 INTRODUCTION

Natural fertilizers can be collected from animal wastes, green leaves, grass, hay, kitchen waste, ground fish powder and bean family. These materials are used to make very good natural fertilizers for all kinds of crops. Natural fertilizers are classified into 3 types as below:

- Animal waste fertilizer
- Compost fertilizer
- Green manure crops

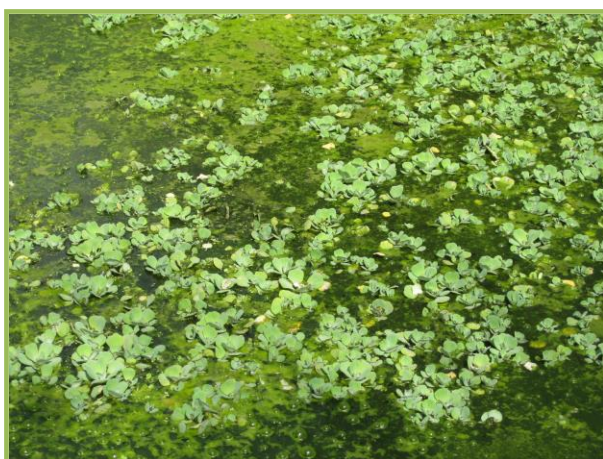
2.2 HOW TO MAKE DRY-COMPOST

A. Materials

Raw materials: there are three types of raw materials: wet material is fresh leaves full of nitrogen (*Tontreankhet* leaves [*chromolaena odorata*], water hyacinth, *Chak* [*pistia stratiotes*], *Angkanh* [*cassia siamensis*], etc.), animal urine; dry materials: including hay and ash; and dry faeces rich in carbon (of cow, pig, chicken, duck, buffalo) and humus.



Picture 7 Water hyacinth



Picture 8 Chak



Picture 9 Angkanh

Place: The site can be on high ground, under tree shadow, within an open shed, under the house or near cattle stable.

The fertilizer enclosure or hole: should be made into 3 parts to make rotating fertilizer;

B. How to make compost in 14 days

- Chop up leaves or small plants (fresh and dry) and mingle with manures in equal quantity.
- Place the mixture in the fertilizer enclosure or hole and water it to be wet enough. In case of nonexistence of such open shed structure, banana leaves or old bags can be used as a cover.
- After 3 or 4 days, the temperature of the fertilizer pile will increase. If it is still cool, add more animal's waste.
- Stir and water the fertilizer in every 2 days to make it quickly decomposed and, hence, become dry compost.
- It can be used after 14-16 days.

C. How to make compost in 3 or 4 months

We can make compost by piling the raw material in layer as follows:

- Lay coconut shells or stones at its bed for good ventilation;
- Place the materials in several layers and water them;
- Cover dry hay or leaves on the top of the pile. The compost layers should be turned up once a month to make them decomposed. After a period of 4 months, the fertilizers will become dark and ready for use.
- It should be noted that the pile of compost is stored in an enclosure made of pieces of wood or bamboo. The number of its layers depends on your choice. You can make up to 4 or 5 layers of the compost if you wish.

Note: Good quality compost that is ready for use can be identified as follow:

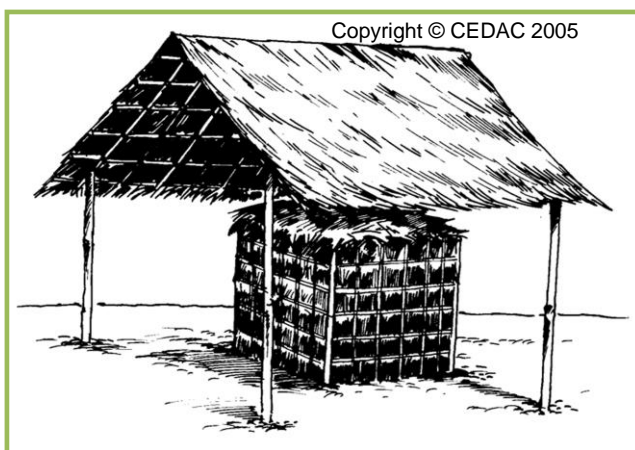
- Good smell, not hot, fine and thoroughly mixed (we cannot observe the separate materials of the compost)

D. Additional instruction to improve good quality of dry compost fertilizer

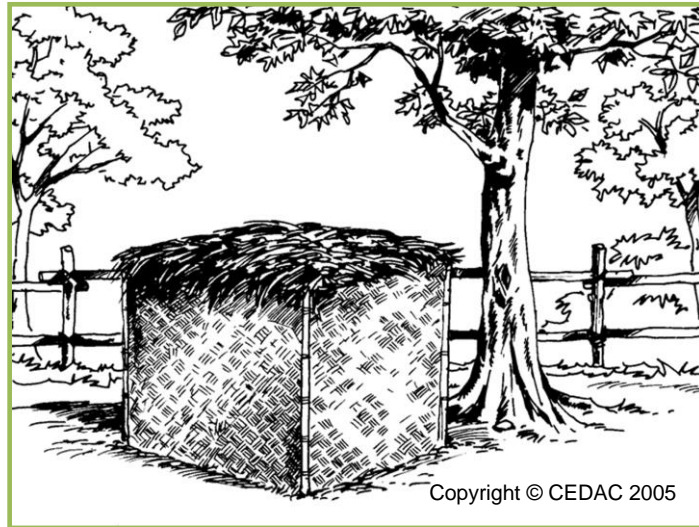
- The compost hole or pile should be properly covered to prevent nutrients diminishing when they are overexposed to sunlight or rainfall.
- Use multiple types of organic materials to make the compost.
- Balance the dry and wet materials, ensuring that they are not too much dry or wet. In dry season, if it is too dry, watering is needed.
- The enclosure made of pieces of wood or bamboo must be guaranteed of good ventilation.
- If there are many layers of the compost, a bamboo tube should be stuck upright to the middle part of the compost for good ventilation.
- Store the compost in extreme hot or cool places, like under trees.



Picture 10 Compost pit covered with leaves



Picture 11 Compost pits covered by a roof



Picture 12 Compost pit under the tree

E. How to use dry compost

- The compost is used as a layer of soil bedding before growing any plants. The quantity to use is 1kg/m^2 for fertile land and 2kg/m^2 for barren land.
- It is also used for spreading around the stump of crops while they are growing.
- It is also used to mix with soil in nursery bags (3 portions of fertilizer and 7 portions of soil)
- It can be dissolved with water (1kg of fertilizer with 10 litres of water) to spray young crops for their healthier growth and when they are about to bear flowers.
- It can be spread in fish raising ponds to spur the growth of aquatic plants, which are the feed for fish, and to feed the fishes themselves.



Picture 13
Put compost or dry cow dung before sowing



Picture 14
Put compost or dry cow dung in between small plants

2.3 HOW TO MAKE LIQUID COMPOST

A. Materials

Liquid compost is the liquid obtained from soaking of organic materials, in particular the wastes of chicken and duck, fresh leaves, plant cinders and cow urine, etc.

Liquid compost, when properly produced, is rich in microorganisms that will promote soil fertilization. Meanwhile, the liquid contains existing mixed nutrients, making it easy for the crops to absorb. If the plants with strong odour are saturated, it can drive away the pests harmful to the crops.

- Process to make liquid compost: Finely chop the leaves and components;
- Pack the components—leaves and manures—with the specific quantity (depending on individual experience of the farmers.
- Put it in a jar, and then add urine and water. Tightly cover the jar. In the event of no cover for the jar, tree leaves can be used. The water must be equal to 20 times of fertilizer quantity.
- Properly cover the jar to prevent flies from laying eggs and the wide spread of bad smells.
- Stir up the fertilizer twice per day. Each stir must last 5 minutes to churn the fertilizer. The churning fertilizer is very important because it can bring the oxygen into the water and make conditions for micro- organisms to be more active.
- Avoid adding more materials into the jar. Wait until they run out.



Picture 15 How to stir liquid compost

B. How to use liquid compost

- After a period of 3 weeks, the liquid is ready for use as the bad smell vanishes.
- 1 litre of the liquid compost is used on 1m² of land. To spray the fertilizer on the leaves of the crops, however, it needs to be mixed with water of 1 to 1.
- The fertilizer should be used on crops once a week. If the crops experience serious lack of fertilization, however, we can water them up to 2 or 3 times per week.
- While the nursery crops are growing
- Before the crops bear flowers
- When the crops are infected, such as change in their leaf colour or signs of poor fertilization are noticed;

2.4 ADVANTAGES OF COMPOST

- Compost can provide multiple nutrients to the plants in long term; moreover, it can make the soil loose.
- Compost attracts many kinds of insects into the soil. Generally, the insects can improve soil quality.
- Compost does not attract the harmful plants such as grass, germs, and diseases into the soil because they will die during the decomposing procedure.
- Compost does not cost us any additional materials.
- Making fertilizers by collecting plant materials and animal wastes enables us to save a lot of fertilizer and can keep the environment clean in the local area as well.
- Liquid compost can be immediately used and provide immediate results in addition to its protection of crops from some kinds of insects.

2.5 GREEN MANURES CROPS

A. Definition and process

Green manure crops are crops grown to add nitrogen to the soil and to important crops that we grow. Green manure crops can be grown before or after the planting of main crops, or, sometimes, grown on farming land when they are free from the cultivation. After growing the green manure crop for 40-50 days, it can be ploughed to bury them in the soil for growing main crops. The plants for use to be green manure crops can be grown on barren land, and they can live in such unfavourable conditions as flooded or dry land, resisting insects and diseases, and are easy to be ploughed for burial.

B. Types of green manure crops

Cropping species	Advantages
Soya Bean	<ul style="list-style-type: none">○ The growing period takes from 90 to 110 days.○ Provide nitrogen from 40 to 50kg/ha
Big Mung Bean	<ul style="list-style-type: none">○ The growing period takes from 80 to 90 days.○ Provide nitrogen of 55kg/ha
Black Mung Bean	<ul style="list-style-type: none">○ The growing period takes 70 days, and it provides nitrogen up to 60kg/ha
Green Mung Bean	<ul style="list-style-type: none">○ The growing period takes from 60 to 65 days, and it provides nitrogen 55kg/ha
Cow pea	<ul style="list-style-type: none">○ The growing period takes 45 days for string beans and 60 days for ripe beans;○ Provide nitrogen of 60kg/ha
Angre bean	<ul style="list-style-type: none">○ Straight stem stands from 1 to 4 meters; its growing period takes 100 days and 45 to 50 days for fertilizers.○ Provide nitrogen of 60-70kg/ha
Dragon's tail stalk	<ul style="list-style-type: none">○ Ivy plants with growing period of 100 days. 45-50 days for green manure crops.○ Provide nitrogen of 60-70kg/ha.
Rice bean	<ul style="list-style-type: none">○ Grow in ivy root base with the growing period of 60 days for animal feed of 100 days for crops.○ Provide nitrogen of 90kg/ha
Green manure crops for long term, Kanthom The small thorny shrub	<ul style="list-style-type: none">○ Long term growing plants, standing stem of 4-8m high.○ Provide nitrogen of 125kg in 5 tons of biomass


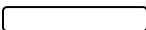



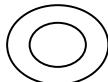
CHAPTER 3 SOIL PREPARATION AND MANAGEMENT

3.1 TYPES OF SOIL

The soil can be classified into 3 types such as sand, clay, and silt (alluvial soil)

- Sand is soil particles with diameters from 0.05 to 2.0 mm
- Silt is soil particles with diameters from 0.002 to 0.05 mm
- Clay is soil particles with diameters < 0.002 mm

3.2 METHODS OF SOIL TYPE IDENTIFICATION

Type of soil	Appearance of soil	When rolled into a sausage		The soil is
Very sandy	Very rough	Cannot be rolled into a sausage		Very sandy
Quite sandy	Very rough	Can be rolled into a sausage, but it cannot bend without breaking.		Sandy
Half sandy and half smooth	Rough	Sausage can bend a little before cracking		Sandy loam
Partly smooth	Finer with a little sand	Sausage can bend about half way around		Loam or silt loam, sandy clay
Mostly smooth	Quite smooth and sticky	Sausage can bend more than half way round		Clay loam
Smooth	Very smooth and sticky	Sausage can bend into a ring		Clay

3.3 COMPONENTS OF SOIL

Soil: There are three types such as sand, alluvial soil, and clay.

Water: Water contents in the soil play an important role because it can dissolve and transport the nutrients from one place to another place. When the soil is wet enough, the plants can easily absorb the water. When there is lack of water in the soil, the crops will be damaged.

Humus:

- Organic waste such as corpses (earthworm, worm, rats, etc)
- Plant wastes (leaves, branches, flowers, stalks, roots, etc)
- Compost is the black or gray organism attached with soil. Compost has ability to hold water and nutrients for the roots of the plants.

Micro-organism: There are two types of organisms micro-organisms which can only be seen with a microscope: bacteria, fungi, nematodes, protozoa and macro-organisms that can be seen by eye: earthworms, snails, beetles, ants, centipedes, millipedes. The land for cultivation is full of millions of living microbes, called micro-organism. Micro-organism plays important roles in producing nutrients by consuming the organic waste into small particles. When the micro-organism dies, the nutrients in its body become the nutrients for crops.

Minerals: The land contains a lot of minerals such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) ... etc.

3.4 PH OF SOIL

A. Definition

The pH is a scale of measuring bas or acidity of soil.

B. Scale of Soil pH

- pH < 7 is called acidic soil (sour)
- pH = 7 is called neutral soil
- pH > 7 is called basic soil (salty)

The soil which is good for growing crops has pH between 5.5 - 8. Most of types of vegetable need soil pH between 5.5-6.5. Soil acidity does not hurt the plants directly, but rather, it affects the availability of nutrients to the plant. It also affects population growth and species diversity of soil microbes. The farmers must know how to adjust the pH scale according to the requirement for crop, so they will get a good result. The table below indicates the quantity of lime to reduce pH scale of each types of soil.

Table of pH level of types of soil

Types of Soil	pH	Lime g/m ²
Clay	6.0	420
	5.5	420
	5.0	820
	4.5	1200
Mixed soil or alluvial soil	6.0	190
	5.5	390
	5.0	680
	4.5	960
Sand	6.0	140
	5.5	240
	5.0	420
	4.5	670

3.5 COMPONENTS OF GOOD SOIL

Components of good soil:

- Mineral substances (45%),
- Organic matter, humus and living things (5%),
- Air (25%)
- Water (25%)

Appearance of good soil:

- Black, brown, yellow and red soil
- Good smell
- Supports strong plant growth
- Rich in micro and macro organisms

Questions	Answers
Where in the soil do you find the organic matter?	In the top layer
In which part of the soil can you find the most macro-organisms?	In the upper layer of the soil, because there is more food, air and water for the organisms (Group 2 should have found more organisms!)
Which soil is more fertile? The one with little or a lot of organisms?	The soil with a lot of micro and macro organisms is the most fertile, because: <ul style="list-style-type: none">- They decompose organic matter, so it can be absorbed by crops- Dead organisms are nutrients for the plants- Living organisms can stimulate plants to absorb nutrients and fix nitrogen from the atmosphere
In which part of the soil are most of the roots growing and why?	The upper layer because it is richer in organic matter, nutrients, air, water and a lot of organisms. The upper layer has loose soil.

3.6 CAUSES OF SOIL DEGRADATION

A. Human factors

- ✓ Not mixing different crops
- ✓ Burning the organic debris on the farm (straw and other organic debris)
- ✓ Using only chemical fertilizer
- ✓ Unreasonable use of pesticides
- ✓ Not adding organic matter to the soil
- ✓ Not growing and incorporating in green manure crops such as mungbean, soy bean...
- ✓ Not covering the soil by planting cover crops and mulching
- ✓ Ploughing too deeply turning surface organic matter down and lifting up the poorer soil

B. Environmental factors

- ✓ Infiltration washing nutrients down
- ✓ Direct contact of sun light to soil surface
- ✓ Direct contact of wind to soil surface causing evaporation

Plants grow well because the garden land is rich in fertility. To manage and maintain the land fertility, they mostly do the following technique:

- If too much sand is used, then some clay dirt is added, but if too much clay dirt is used, then some sand is added.
- If the soil is too wet, they need to arrange the drainage system by digging a small ditch in the garden.
- Use natural fertilizer such as compost which improves land quality.
- Rotate crops based on the season (Crop rotation).
- Cover the soil regularly in order to protect it from sun's heat, and the soil erosion of the upper layer.
- Grow crops for land cover and green herbaceous plants.
- Do not apply chemical fertilizer and pesticide because it can kill micro-organism in the soil.
- Do not hoe the soil upside land, only loosen it up.
- Scatter slaked lime or ash of burned rice husk over acidic land.

In order for the land in your garden to be always fertile, it is required that you do all the above together, especially using compost, covering land, and making the drainage system.

3.7 SOIL PREPARATION FOR VEGETABLES

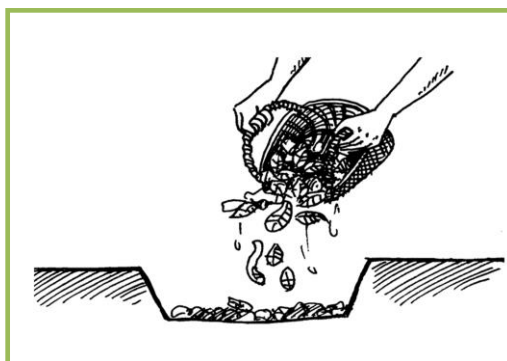
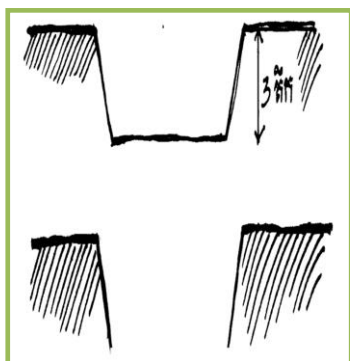
A. Ridge preparation

- Plough the soil 2 or 3 times, and dry it at least 7 days in order to get rid of virus or diseases and insect pest living in the soil.
- Rack the soil as small and level as possible, remove all the grass roots.
- Prepare the layout of garden for different crops in appropriate locations.
- The ridge of vegetables must be facing the sun, so that enough sunlight passes through.
- The ridge must be 10-15 cm high in the dry season and 20-30 cm in the rainy season.
- The dry compost is laid on the ridge bed; that is, 1-2 kg per square meter.

B. How to make ridges with groove in the middle

Famers dig a small but long hole in the middle of ridge. They use this small groove for manure and water. When the plant is growing, its roots gather at that manure and water groove. This helps us fertilize and water crops correctly.

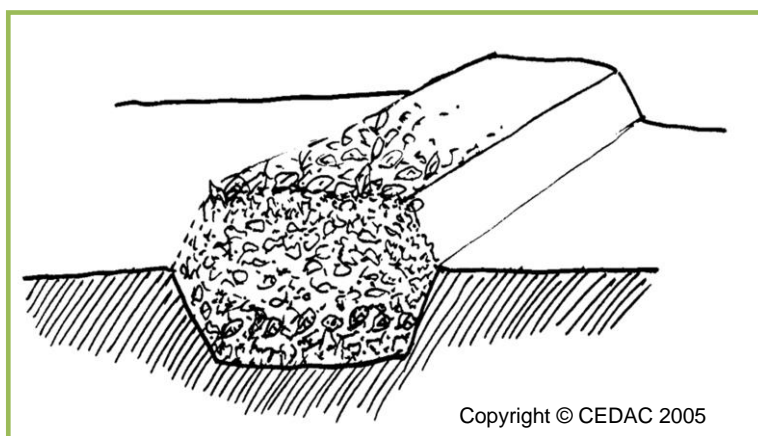
- Earth up the soil to make natural ridge of 0.8-1.5 wide;
- After that, we use the spade to dig the groove in the middle, with the width of 3 decimetres, and the depth of 3 decimetres.
- When digging the groove, we level the soil on both sides. After that, put the manure along the groove, mixed with leaves and other plants' waste (avoid using pour manure).



Picture 16, 17, 18 Groove preparation
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C. Raised or deep ridge



Picture 19 Raised vegetable bed
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Table of information on how to prepare vegetable beds

How to prepare	Advantages
<ul style="list-style-type: none"> – Dig the hole about 3 decimetres, – Removing and storing the excavated dirt somewhere, – After that bury organic materials such as plants and some manure (1/4 of leaves), then pile up the dirt at least as thick as 15 cm (mix compost and rotten manure with the topsoil), 	<ul style="list-style-type: none"> – Plants can take root easily because the soil is loose. – Maintain moisture in the soil long enough, no need for frequent watering (particularly when the root reaches the layer of rotten fertilizer). – Fertilizing gradually through the rotten organic material in the hole or mound.

How to prepare	Advantages
<ul style="list-style-type: none"> – Wet the ridge, and cover the ridge with leaves for 1 to 2 weeks before planting, – The raised ridge follows the same method. Such ridge is most suitable for land that is not loose or too wet. 	<ul style="list-style-type: none"> – Prevent water erosion or corrosion because water impregnates soil quickly. – Can grow vegetable one more time, after the harvest, without the need to raise new ridge; that is, just loosen up the soil. However, the type of crop must be replaced.

3.8 WATER MANAGEMENT

A. General View

Water is imperative to human, animals, and plants. In our globe, salty water contributes 97.2% to the water sources; icecaps, 0.2%; underground water, 0.62%; fresh water of natural lakes, 0.009%; inland seas and salty lakes, 0.008%; water vapours, 0.001%; and rivers and streams, 0.0001%. The total water is 99.8381%.

Characteristics of fresh water related to plants:

- It is found in every part of plants.
- It plays the role of delivering nutrients to feed all parts of plants.
- It is a key component for photosynthesis process in producing food that the plants to grow.

Plants cannot live without water. However, too much water cannot allow plants to live.

B. Appropriate water management and consumption

Water management is intended to keep the water not too dry, not too inundated, nor too wet. It means that soils should be sufficiently humid for growth of crops. The other objective is to use water effectively to irrigate the crops, especially in dry season.

Amount of water for irrigation depend on types of crops, seasons and natures of land.

- Types of crops: root depth and growing stages. Generally, the crops need a great deal of water in growing stage before and during bearing flowers.
- Seasonal changes: heat and light, air moisture and rainfall.
- Soil nature: capacity of soils to absorb water, keep moisture, and discharge moisture for the crops to absorb. Generally, organic soil has high capacity to absorb and keep moisture.

C. Tips for watering during the dry season

The followings are good ideas applicable in dry season:

- Cover the soil with leaves, hays or nets to keep moisture;

- Use organic fertilizer to upgrade the soil's capacity to hold moisture;
- Dig a surrounding or central ditch to make it easy for stocking water to irrigate the crops (water could be accumulated for long period of time);
- Sprinkle or water the soil bed (burying pot or tube with small holes);
- Grow the crops that need less water such as mud bean, wax gourd, tomato, pumpkin, water melon;
- Grow crops on multi-layers of land or in a close manner to make it easy for watering at a single place;
- Apply liquid waste from the kitchen;
- Have bath in the garden but soap water flowing into the garden must be avoided;



Picture 20 Watering plants

D. Tips for watering during rainy season

To avoid the soil from too much wet or accumulated water, the concepts below should be applied:

- Dig the ditch to lead the water out to keep the soil not too saturated or dig small holes in the garden and they should be placed with tree branches to make the water get into the soil.
- Raise high ridge for the crops or make multi-layer ridges;
- Grow crops, which can grow well in the wet soil, water-accumulated soil or lower soil, or need much water such as mint, taro and swamp leaf, etc.

E. Instruction for an easy irrigation system

The water used for crops has its sources from rain, moisture, ponds, wells, etc., with the use of other materials to assist enough and effectively watering through small and large irrigation system, water system, water storage, or pumping machines, etc.

Water supply for crops is very important to get high yields. The lack of water can make the crops not grow well or die. Below are some instructions for irrigation system to irrigate the crops:

- Dig a small ditch surrounding the vegetable garden;
- Dig a small pound or well to water the vegetable garden. The water pumped from the well cannot be directly used on the crops immediately. There should be a basin or jar to store the water at least for a half day before watering the crops because immediate pumping the water containing too much cyst, which can make the crops not grow well;
- Water through waterwheel system, pivots, sprayers. For sprinkling system, jar or pot or tube with small holes are buried between the ridges.
- The watering should be done by 2-3 people per day;

Maintenance of Irrigation Systems:

Regularly control the irrigation system to prevent from water blockage (tube or pipe breaks or is blocked). Control the water speed to ensure that the water can highly effectively reach all crops in the garden on the requirement of water for the crops.

CHAPTER 4 VEGETABLE PLANTING TECHNIQUES

4.1 SEEDS

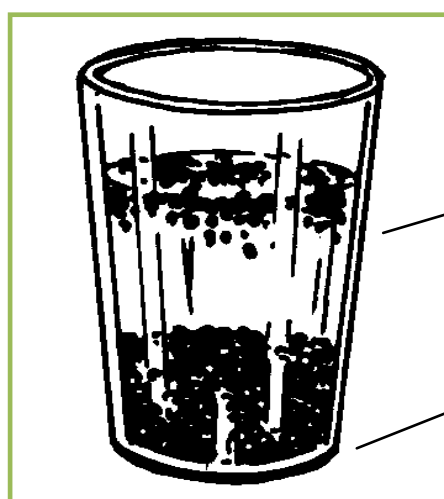
A. Tips for seed selection

There are many methods of planting, such as planting with seeds, branches, stems, and bulb, and nursing seeds and transplanting. For many types of vegetables, they nurse seeds first before planting, as it is better than planting seeds directly.

In order to nurse plants well, we should consider some factors as much as possible such as the preparation of nursery, the mixture of land for nursing, and the pest control.

Table of information on how to select seed species

Tips	Reasons
Select vegetable varieties the can grow in your area	Some plants cannot grow well in your agro-ecosystem
Select vegetable varieties that are good for your families health	Reduces medical bills
Select vegetable varieties that taste good	This helps your family to enjoy eating vegetables
Select vegetable varieties that you can sell in the market	You get a higher price
Select seed varieties that transport well if you are a long way from the market	Some vegetables do not transport well and you get a low price for them
Select varieties that you know how to grow	Less chance of crop failure
Select varieties that are economic to grow	You would like to make a profit
Select your own seeds from your farm	<i>Positive points</i> Low or no cost You know they can grow on your farm You know how to grow them You have an idea of the yield <i>Negative points</i> They might be of mixed variety and low yield if you don't properly select and store
Buy seeds from a recognized local producer	<i>Positives points</i> They should have been grown by specialist seed producer They are likely to be more pure than your own seed The genetic quality is likely to be better because there should be less cross breeding of plants from other fields. <i>Negative points</i> They are more expensive than your own saved seed
Buy imported seeds	<i>Positive points</i> Often higher yielding <i>Negative points</i> More expensive They may not reproduce so you have to buy new seed each year – you have to check about this! Some imported seeds cannot grow well in Cambodia
Soak the seeds in the water to check the quality	Seeds that float are of bad quality. Seeds that sink to the bottom are of good quality. (see picture)
Soak the seed in water	To make them germinate better



Floating seeds = bad quality seeds

Sunken seeds = good quality seeds

Picture 21 Testing seed quality
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B. Tips for producing seeds yourself

Table of information on how to produce good seed species

Tips	Reasons
November to January is the best time for seed production	The temperature is low
The beds for producing seeds need to be separated from the plot where vegetables are grown for consumption and selling	To avoid infections and pests and cross pollination
Grow vegetables for seed production apart	Insects and the wind are not able to transfer pollen between different food crops that may cross in your garden.
Grow vegetables for seed production at different times	They will not cross with each other because there is no way that insects or the wind can move them between plants
Make the beds fertile	To produce healthy vegetables
Only transplant the vigorous, uniform and strong seedlings	Because these are characteristics we would like to carry forward to the next generation. Vigorous seedlings are also likely to produce a good yield of seed.
Put bags on the flowers	This can be a good way with scrambling cucurbits like pumpkin, watermelon, and cucumber.
Select only good mature fruit for producing seeds	Immature seeds have less germination ability and vigor than mature ones. Another reason is the inability of immature seeds to absorb water and oxygen which are important for germination.
Harvest during sunny weather, not during rain	To avoid spoiling of the seeds by humidity
Expose the mature fruit to sunlight.	To dry the seeds
Do not dry seed too long in direct sun	They can become cooked and are unlikely to germinate and grow

C. Tips for preserving seeds

- Materials and location to store the seeds/grain must be clean and free of other seeds/grain.
- Clean the seeds before drying them, for example, the trash is removed by winnowing
- Seeds need to be stored in a cool, dry and dark places because they breath slowest in these places
- Preserve the seeds in a bottle or glass or bamboo tube, filled (1/3rd) with ash or charcoal to prevent fungus from growing on the seeds
- Store in a smoky kitchen to avoid insect damage
- When you keep the seeds longer than 2 months, take the seeds out of the bottle/glass/tube and put them in the sun to dry up any moisture. Also change the ash or charcoal
- Write the name of the seeds on a label on the bottle/glass/tube, together with the date of packaging
- Always share seeds with others, so if you lose any, then other gardeners will have some spare seeds to give back to you for your gardens.

4.2 NURSERY

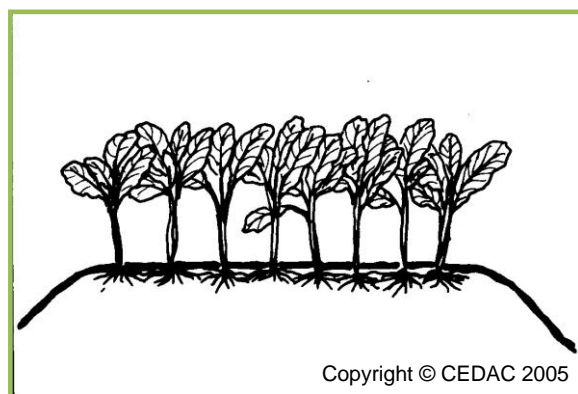
There are many ways of growing plants; growing by using seeds, using the twigs or the stem of a plant, using a bulb, produce seedlings and transplanting them.

Most of the vegetable plants grow by making seedlings first and then transplant the seedlings. It is usually better than sowing the seeds directly into the soil.

To grow the seedlings correctly we should take into account some factors such as preparing the nursery field before sowing, mixing different kinds of soil for the seedlings and and preventive measures to get rid of disruptive pests.

A. Tips for nursery on the land

- Hoe and dry the land or plough 2 to 3 times as deep as 15-20 cm, for 7 to 10 days, in order to loosen up the soil, kill diseases in the land, and get rid of weeds.
- Make the nursery 0.9 – 1 meter wide, 2-3 meter long, and 10-15 cm high during the dry season and 20-30 cm high during the rainy season.
- Scatter ash or slaked lime in order to kill diseases and reduce acid in the soil.
- Use 1 kg per square meter to lay the bed.
- Hoe the soil up and down in order for the compost to be completely mixed with the soil in the ridge, and rake it evenly.

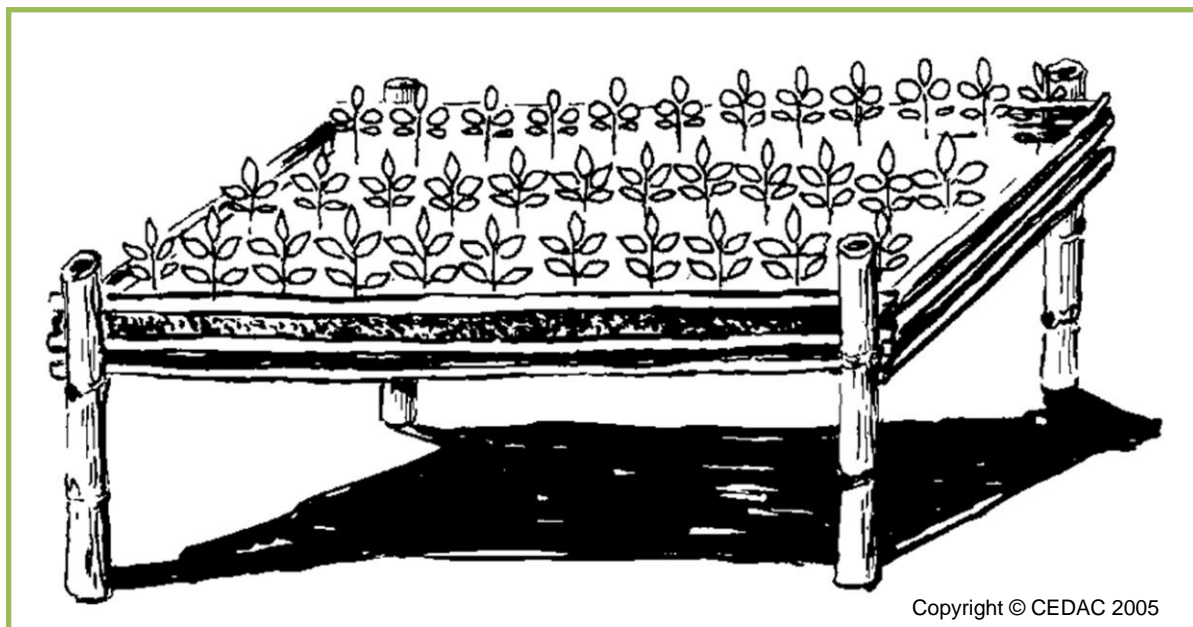


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Picture 22 Disadvantage of sowing many seeds

B. Tips for nursery on a raised platform

- During the rainy season, we mostly nurse plants in a case or wooden box, or on a raised platform,
- Lay tray at the bottom so that the soil cannot fall out, put fertile soil about 15-20 cm thick.
- The support is painted with oil so that ants cannot climb up to eat seeds. The land preparation is also similar to that of the nursery on the land.



Picture 23 Raised platform for seedlings

4.3 SOWING TIPS

- Some seeds need to be soaked in lukewarm water for 1 hour so that they absorb water and the buds grow quickly.
- Sow evenly by mixing seeds with ash or sand 3/1.
- When sowing, the seeds should not be buried deep (the depth depends on the size of the seed).
- Watering the nursery before sowing to make the upper part flat in order to avoid deeply falling of the seed which results in difficulty of germination.
- Mix seed with ash or powder 1) to homogenize the spreading and 2) to protect seeds from damage by ants.
- Sowing should be done in the morning around 7-8 o'clock or in the afternoon around 5 o'clock, this will help reduce hot sunlight on the sown seeds. Homogenous sowing allows seeds to germinate well without competition each other.
- After the sowing, sprinkle fine compost with sand over the soil.
- Cover it with leaves, rice straws or net for 2 to 3 days.
- Thin the nursed plants or remove unhealthy nursed plants.
- Use liquid compost to fertilize.



Heavily water before pulling the seedlings for
transplantation

Picture 24 Watering seedlings



Keeping seedlings in pots in the nursery bed
before transplanting

Picture 25 Nursery

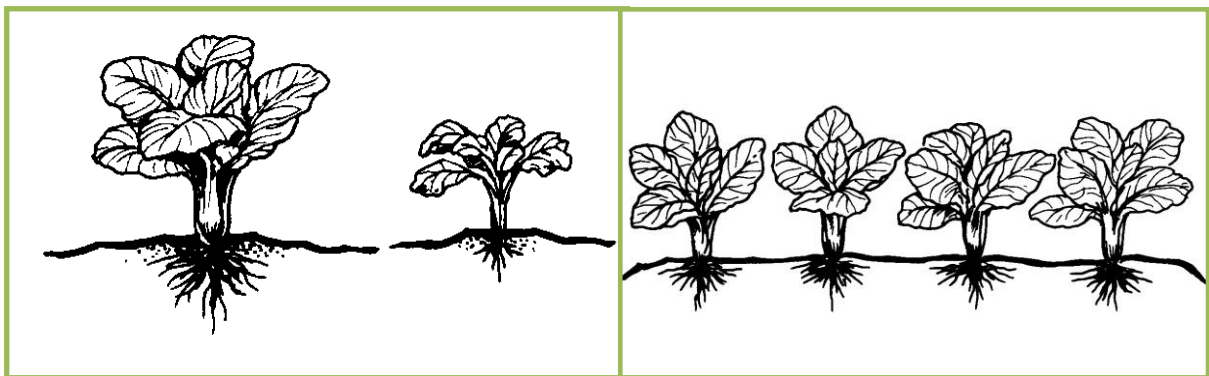
4.4 TRANSPLANTING TIPS

Tips	Reasons
Check the time from sowing to harvest and estimate the time required in the nursery. E.g. 1 month time period from sowing to harvest requires the seedlings to be 10-13 days in the nursery bed; 2 months duration vegetables 15 to 20 days, and 3 months duration 25 to 30 days in the nursery bed.	Different vegetables have different optimum transplanting times. If you leave seedlings too long in the nursery, the shock of transplanting is too high and older seedlings can become too thin if planted closely in the nursery.
Gradually reduce watering the nursery bed 7 days before transplanting.	This reduces leaf and bud (vegetative) growth but continues to promote root growth. This also reduces the shock of transplanting.
Water the nursery bed heavily at pulling.	To make the soil of the nursery bed soft and avoid the roots breaking.
Do not damage the seedling's roots: pull them carefully from the nursery bed at the bottom of the stem and keep some soil around the roots	To enable the seedlings to grow well after transplanting
During transplanting: do not expose the seedlings to sunlight, high temperature or heavy rain	This can make them weaker and increases the risk of mortality
Transplant the seedlings immediately into the main plot (maximum 30 minutes after pulling from the nursery bed)	To enable the seedlings to grow well after transplanting
Do not plant the seedlings too deep in the main plot	This can rot the stem and kill the seedling
Space the seedlings according to the size of the mature vegetable.	<ul style="list-style-type: none"> - No root competition - Reduces competition for light - Lower cost - Enough exposure to air

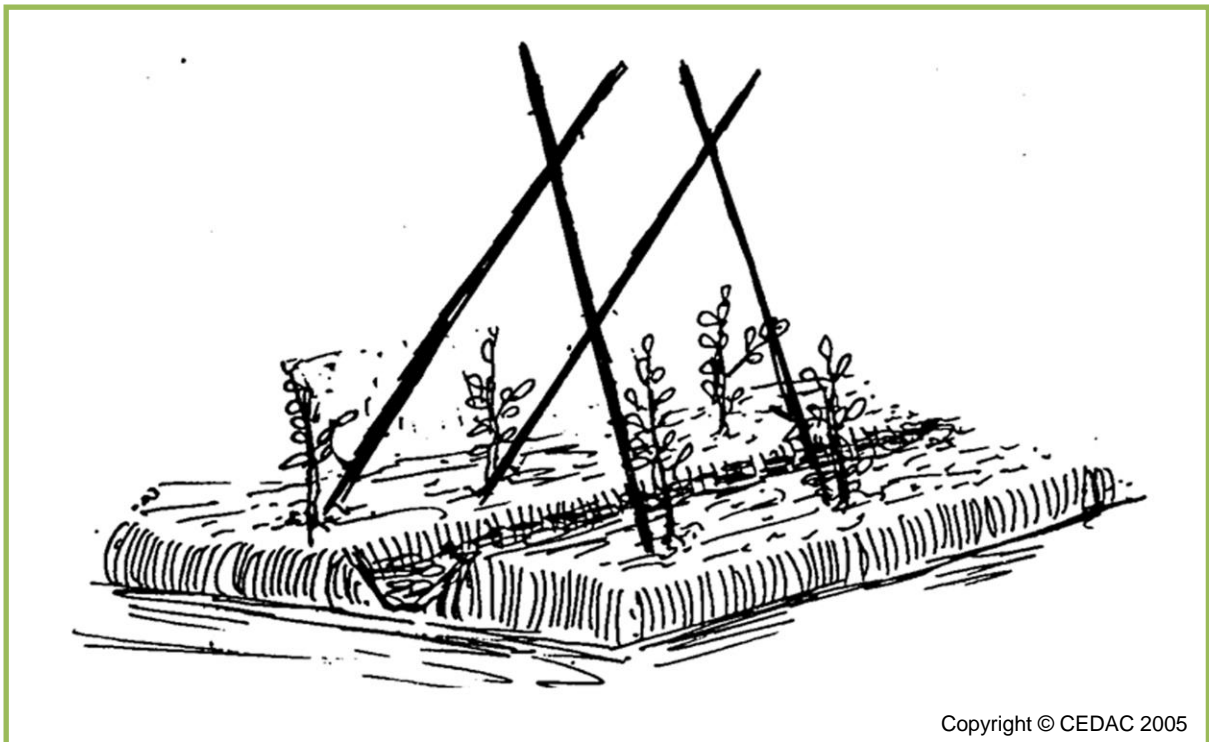
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Picture 26 Replant carefully



Picture 27 Seedlings that have more space grow better
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Picture 28 Lead the plants to grow along sticks

CHAPTER 5 PREPARATION FOR PLANTING VEGETABLES

5.1 INTRODUCTION

Effective planting system gives favourable conditions for growing a variety of vegetables, which is useful for eliminating devastation by pests, diseases and weeds, especially contributing to effective growth, saving money, caring times and fertilizing. Planting systems includes combination of vegetable planting, circle gardening, middle row planting, crop rotation, single and alternative crop planting.

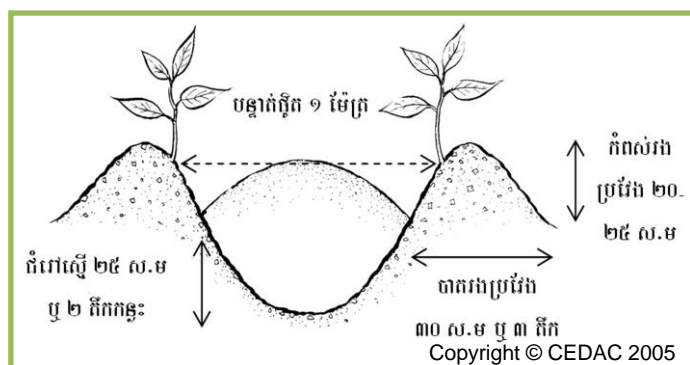
Here are some important crops which can easily be chosen and planted:

- | | | |
|------------------------|--------------------------|-------------|
| - Vinery plant Bas | - Eggplants of all kinds | - Lemon |
| - Asian purple spinach | - Chili | - Banana |
| - Water green | - Popeay Sbek | - Papaya |
| - Chralung | - String bean | - Gourd |
| - Lemongrass | - Bitter melon | - Yam |
| - Basils of all kinds | - Loofah | - Cassava |
| - Ginger | - Finger rhizome roots | - Wax gourd |
| - Taro | - Galangal | - Pumpkin |
| - Daikhla potato | - Saffron | - Cucumber |

5.2 HOW TO PLANT

A. How to plant using circle gardening

Circle garden is suitable for growing vegetable to meet the family's consumption, in the area where there is a lack of water or during the water shortage season. In the area of firm soil or clay, circle garden can make the soil well loose.



Picture 29 View on the circle garden



Picture 30 Circle garden

- Vegetables with long roots like corn, eggplant and papaya etc. are generally planted on the holes of grounds dug in circle shape.
- It is better to grow the vegetables at the edges of drug holes to ease penetration of vegetable roots, absorbing nutrients and water in the holes.
- The holes should be filled with water, manures, compost fertilizers and green manure crops.
- Water and natural fertilizers should be applied before planting to allow natural fertilizers to decompose and to effectively absorb nutrients.
- The application should help save water, fertilizers and caring.

B. How to plant using ridge with groove in the middle

- Young plants should be grown at the interval space of 20-50cm at either side of the rows.
- Rows with a groove in the middle should be filled up with dead leaves of plants, green manure crops, compost fertilizers, manures, and regularly irrigated.
- This method may help reduce water irrigation, and frequency of fertilizer application, and increases effective growth.

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Picture 31 How to grow vegetables in a row with a groove in the middle

C. Alternative crop planting

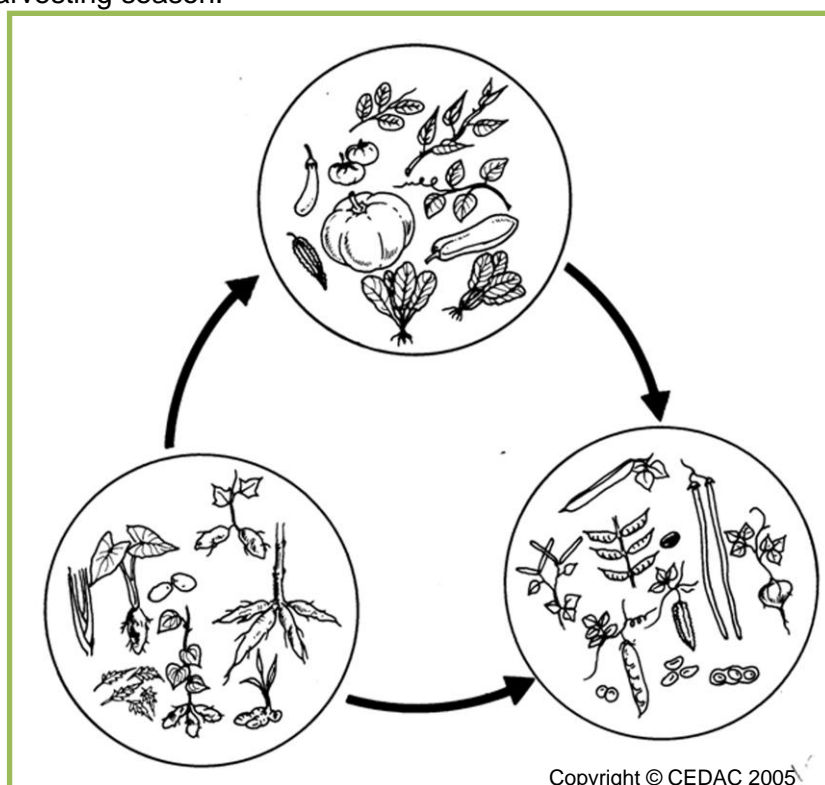
- Water green should be planted on the first ridge, garlic or basil (with strong odour) on the second ridge and other vegetables at plant intervals of 20-40cm and row intervals of 40-50cm.

D. Combined crop planting

- Growing several vegetable at each ridge to discharge bad insects. And the intervals of each bunch is 20 – 40 cm and row intervals is 40-50cm.

E. Rotation planting

- Crop rotating helps improve soil quality and prevents existence of destructive insects, weeds and diseases which are forced to move to other places, due to lack of foods. Through this practice of crop rotation, alternative crops can be planted after the harvest or each harvesting season.



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Picture 32 Crop rotation

5.3 SEASONAL CROPPING

Type of vegetable	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Cabbage	←→											←→
Cucumber			←→									
Chinese Kale	←→										←→	
Cauliflower	←→										←→	
Salad	←→										←→	
Wax gourd	←→								←→			
Egg plant	←→											

The seasons in Cambodia

Seasons	Temperature (° Celsius)	Seasonal rain fall (mm)	Frequency of rain fall (day)
Early dry (Nov-Jan)	21-30	174	13
Late dry (Feb-Apr)	22-36	104	10
Early rainy (May-Jul)	25-34	433	45
Late rainy (Aug-Oct)	21-32	632	55

5.4 FACTORS WHICH HAVE A POSITIVE IMPACT ON GROWTH OF VEGETABLES

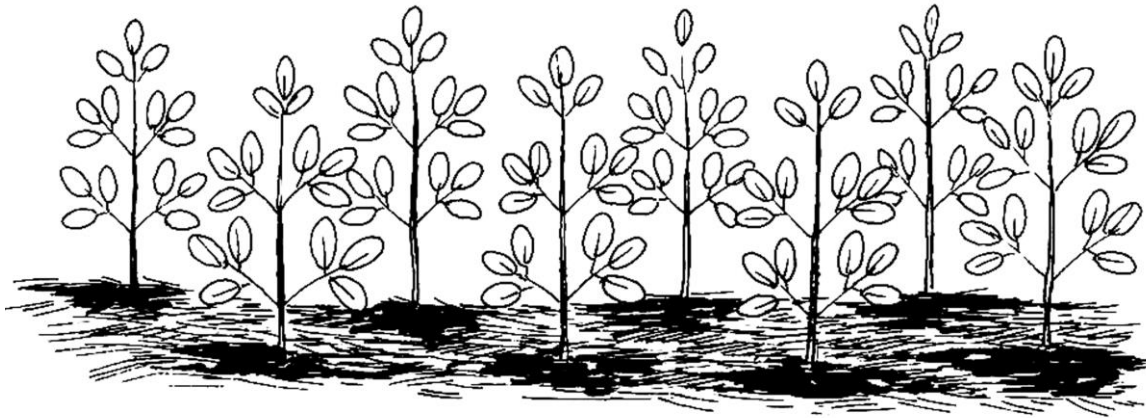
- Focusing on soil improvement and preservation
- Ensuring good start of vegetable gardening
- Selection of suitable place for growing
- Plant interval of 20-80cm and ridge interval of 40-50cm
- Young plants to be covered for 7 days
- Watering for 2-3 times a day

- Natural fertilizers to be added corresponding to the age of crops
- Take out the weed to make the soil loose
- Loosen the soil regularly at least once per week
- Use of natural sprays for protection and eliminating
- Removing unhealthy crops and replace with the healthier ones
- Uprooting any crops destroyed by pests and diseases (regular monitoring of the garden)

5.5 SOIL COVERAGE

Soil coverage provides many benefits such as:


- Long retention of soil moisture
- Give cool shelter for crop stumps and increase growth of crops
- Provide shelter for useful micro-organism to live
- Protects from un-useful weed
- When the cover is degraded it becomes nutrients
- Prevent soil erosion, water drainage and water evaporation



Picture 33 Covering of soil Copyright © CEDAC 2005

The garden soils differ according to its terrain, distances from water sources, exposure to light. Establishing a growing plan, hence, requires consideration of the following factors:

- Growing land with much shadow has to grow shadow-resistant crops as pineapple, saw mint, turmeric, ginger and sago palm.
- Low terrain easily exposed to inundation is favourable for growing such crops as morning glory, taro and swamp leaf.
- Growing land in vicinity of water sources is best for growing crops that need much water or frequent watering, like cabbage, salad, garlic, Chinese kale and head cabbage.
- Besides, the garden soils should be effectively used by applying multi-layer growing method, planting along the fence or growing crops to serve as living fence.

 Do this	Because
Decompose the natural compost well: make sure it is not hot and has a fresh smell.	<ul style="list-style-type: none"> – Good compost can provide nutrients and improve air circulation and water holding capacity
Cover your crops with rice straw, banana leaves, palm leaves, coconut leaves	<ul style="list-style-type: none"> – It will limit weeds by limiting sunlight – The soil will not be compacted by direct rainfall – It will keep the soil moist by limiting evaporation – The soil will be increasingly fertile because it will decompose to become compost.
Plant different crops in one field: intercropping, crop rotation and mixed cropping	<ul style="list-style-type: none"> – This will limit the number of insect pests and diseases, because they prefer mono cropping – This will attract more friendly insects – Some crops can be repellents to insect pests (marigold, garlic, ginger, basil, onion...) – Soil fertility increases especially by nitrogen fixing plant (soybean, mungbean, peanut...)
Grow crops at a favourable time (dependant on the type of crop): when it is not too hot, when there is enough water and when there are fewer pests	<ul style="list-style-type: none"> – Some pests do not like certain times of the year (e.g. cooler temperatures result in slower growth of insect, higher temperatures speed up the growth process. If the season is hot, more generations of an insect may occur than during a cool season) – Water is important for vegetable growing – Different crops have different requirements of temperature and water
Cultivate the soil properly and mix it with compost	<ul style="list-style-type: none"> – It will increase nutrition – It will make the soil more porous – It will improve drainage and prevent root rot
Construct a small canal in and around the field	<ul style="list-style-type: none"> – It will drain the excess water away from the roots – It will prevent the natural fertilizer from washing away
Irrigate the crops with a watering can	<ul style="list-style-type: none"> – The fine spray from the watering can makes less impact to the soil and crops

5.6 FACTORS WHICH HAVE A NEGATIVE IMPACT ON GROWTH OF VEGETABLE

- Not changing soil features
- Application of chemical fertilizers
- Application of toxic substances
- Excessive supply of water
- Substandard ridge preparation
- Improprate spacing of vegetables
- Off-season planting
- Failing to get rid of and protect from pests, diseases and weeds
- Failing to rake the soil and remove weeds
- Natural fertilizers not responding to the age of crops.

CHAPTER 6 NATURE-BASED PEST MANAGEMENT

Presently, most of the people who are cultivating rice and vegetables always face various problems such as plant diseases, growing weeds and pests, which cause their crops to produce low yields. To solve these problems, the vast majority of farmers have spent a lot of money purchasing and applying chemical pesticide for the protection of crops. It is found out that this chemical pesticide not only incurs much cost, but it is also detrimental to the health of users as well as food consumers and the environment.

6.1 PEST ANALYSIS

A. Definition of pest

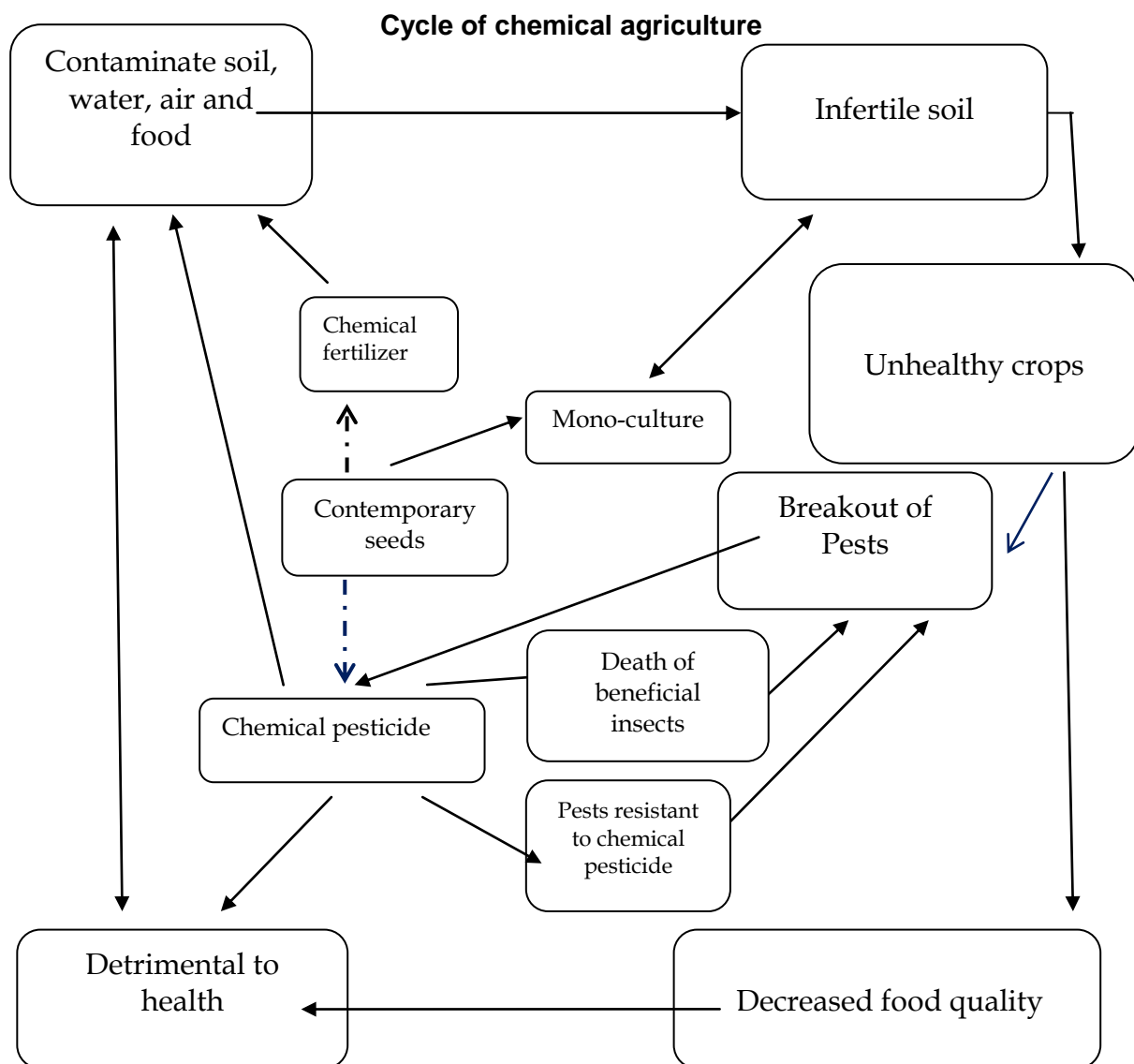
The vegetable's pests are comprised of:

- **Insects** destroy crops and bring diseases to crop, reducing yields, and they are comprised of locusts, Yoltoung worm, flea, ant, Sreung, Kanhjae, thrips, crickets, moles, waung worm, etc.
- **Weeds** absorbing fertility in competition with crops: It competes with crops for fertility, and provides havoc for insects and diseases such as reed ... etc.
- **Disease** agent brings diseases to plants, causing crops to grow bad or damaged, unable to produce much yield. Those disease agents include mold, bacteria, nematode, virus ... etc.

B. Causes of pests

Farmers have to understand and avoid causes that lead to pests, including:

- The monoculture can easily lead to the birth and the growth of various types of insect pests.
- The continued use of chemical pesticide can make insects resistant to pesticide, as well as kill beneficial micro-organism in the nature.
- The climate changes dramatically, too dry or hot, or too much rain.
- Insects attack plants, leaving the damaged spot on the plant that is vulnerable to disease.
- It is fraught with weeds, the haven of insect pests.
- Loss of beneficial macro-organism such as frogs, toads, spiders, snakes ... etc.
- Inappropriate use of chemical fertilizer, particularly too much use of chemical fertilizer such as white fertilizer (Ure fertilizer) can create various insect pests.
- Infertile soil causes crops to grow unhealthily, making them vulnerable to destruction.
- Too much water in the soil causes crops to grow badly, making them vulnerable to the destruction by pests.



6.2 PEST PREVENTION MEASURES

The prevention is very important because it always incurs lower cost and is more efficient than the cure. The followings are some measures used to dispose of vegetables' pests:

A. Growing

It is simple, incurs low cost, and requires no use of pesticide by simply doing the following:

Combined crop planting

Different or combined crops shall be planted because this way of growing is so beneficial that insects cannot destroy all crops; some insects eat and destroy only one type of crop that they like. Strong smelling crops such as lemongrass, herbaceous plants, garlic ... etc, have to be planted in order to drive insect pests away.

For example: *Trachek Kou* or *Tolyoung* worm prefers only cabbage; it does not consume tomatoes, eggplants, or garlic.

Alternative crop planting

Ridge intercropping should be applied between regular and pungent crops because crops with strong smell can drive insect pests away. For example:

- Intercropping garlic or cowpea plants with cabbage; that is, cabbage is to be planted in 2 ridges with one ridge of garlic or bean plants intercropped.
- Intercropping pickle cabbage or Chinese broccoli with ginger; that is, planting cabbage on the front of ginger's ridge.
- Planting tomatoes or green/red pepper or papaya along the edge of cabbage's ridge.
- Planting pungent crops along with vegetables.

Table of crop types to be planted as alternative crop planting

Type of smelly crops	How to plant with cabbage and notes
Marigold	Planted between the ridges of cabbage, and at the fence surrounding the plant garden.
Sweet basil	Planted in a ridge, intercropping, between ridges, or around the garden.
Herbaceous plants	Planted in a ridge intercropped with cabbage
Lemongrass	Planted around the garden, and stripping off and sprinkle its leaves at the crop ridges.
Garlic	Planted in a ridge intercropped with cabbage

Crop rotation

Different types of crops should not be planted next-door, and shall not be planted in the same location for 2 successive seasons. Crop rotation helps reduce the growth of insect pests and diseases.

Trap cropping

In this method, one kind of crop is planted in the garden so as to attract insect pests away from the main crop that farmers want for food or sale in the market. For example, farmers plant mustard in the orchard of head cabbage, to attract insect pests, especially *Toungyoung* worm, because it prefers mustard to head cabbage.

Selecting seeds

Disease normally arises from poor seeds. The selection of good seed could reduce diseases. In order to ensure that we have selected good seeds, we must choose and keep the seeds on our own.

Cleaning seeds before planting

Cleaning seeds by mixing them with cattle's urine or fluid manure ... etc., or drying it in the sunlight for 2 or 3 hours prior to planting, helps make the seeds grow stronger, not vulnerable to insect pests.

Ploughing

Ploughing is so important to get rid of diseases, insect pests, nematodes, and especially dispose of weed that is a haven for insect pests and diseases.

Use of natural fertilizer

Plants catch some diseases because the soil contains existing diseases or it is infertile. The soil with enough air, that is, the loose soil and the use of natural fertilizer are one of the many ways of reducing pests to:

- Increase the number of micro-organism, and movement in the soil, which can reduce the disease spreader and mould.
- Stabilize and improve the soil by enabling air to go through and enabling it to absorb water well, which provides nutrient for crops for their protection.

Planting on time and leaving good gaps between root bases

The timing of planting can often avoid the destruction by insect pests. Planting seeds at the right time in the right season is so important that the phase of growth of vulnerable crops does not concur with the phase of destruction by pests.

Besides, we should leave appropriate gaps between one root base to another, in order to reduce the spread of diseases, since it allows enough air and sufficient sunlight to pass through, making the plant leaves easily dry, which can get rid of the concealment where disease agents can hide and grow.

Water management

The most important thing of the water management is to make the soil not to get too dry, too wet, or watertight.

B. Mechanic measures

- Set snare by placing ripen palms in the bowl, set trap and put up the barrier;
- Use trap of light and glue to get rid of butterfly and rice leaf hopper;
- Enclose fruit with old plastic bag or paper, so as to prevent butterflies and flies from producing worms;
- Keep track of crops and get rid of unwanted things by hand;
- Remove any plants that catch diseases;
- Use sound;
- Use smoke; and
- Use natural fertilizer: made up of plant buds, of ripen fruit, and amino acid.

C. Bio-measure

These measures preserve the beneficial insects such as carnivores that eat insect pests. These include birds, wasps, ladybugs, dragon flies, frogs, toads, green tree frog, spiders and lizards, etc.

6.3 HOW TO PRODUCE AND APPLY NATURAL PESTICIDE

Natural pesticide is made up of plants, and it can kill some insect pests. But if compared with the chemical pesticide, the natural pesticide only produces strong smell to drive insect pests away.

Ingredients for natural pesticides are divided into 4 main categories as follows:

- Bitter plants: Sdav, ivy, grass with bumpy or warty leaves (Brok Plae), Brong, grass with wrinkled leaves (Deum Promath) ...etc.
- Poisonous plants: kernel or bark of strychnine, bark of mallow, Slack, manioc, tobacco ... etc.
- Pungent plants: green/red pepper plants, root of lemongrass, saffron, Galanga, garlic, flower of marigold, leaves and plants of tomatoes ...etc.
- Resin plants: castor oil plant, Truoy Raing.

A. How to produce

Collect ingredients of plants in these 4 categories proportionately, and mince them as small as possible, before storing them in a jar. Afterwards, pour human or animal's urine into the jar, cover it airtight, and then move it out of sunlight. Soak the ingredients for 20 to 30 days, and stir it every day (one or two times per day) until the ingredients becomes rotten, with no more smell, before using them.

B. How to use it

Apply this natural pesticide to the crops, with 1 litre of it added with 10 litres of water. If insect pests do not run away, the quantity of water can be reduced to between 5 and 10 litres. In order to apply this natural pesticide effectively, it should be sprayed in the evening, because if it is sprayed during the day, the sun's heat may get rid of substances of some plants. Farmers usually spray 1 or 2 times per week, or 3 times when there are so many insect pests or when it is time for harvest.

Note: Generally the plant ingredients should be applied for prevention, rather than when insect pests have destroyed the crops.

VEGETABLE INFORMATION SHEETS

LETTUCE

Description	Salad contains much nutrition for human body's growth. It is saleable in the markets, and it can grow all seasons.
Land	It does not require specific type of land.
Time for sowing-planting seeds	If it is sowed in small nurseries for the later planting in the field, 2.5 kg of seeds is needed 1 hectare of land. If it is sowed in the field without being nursed, 4 kg of seeds is needed for 1 hectare of land.
Nursery preparation	The soil must be fine and smooth, without any grass, for nursery.
Planting Method	Before it is planted in nurseries, lime and animal manure must be used to lay the bed. After 5 to 7 days, the small plants shall be removed and replanted in the field on the ridges, with the gap of 20-25 cm between each root base.
Ridge Gap	The ridge must be 1 meter wide or 1.20 meters long from time to time. Each gap between each row must be 20-25 cm.
Planting Depth	From 0.6-1.2 cm deep.
Nursery period	From 4 to 6 days
Type of Seeds	Seeds for Salad are of two types: <ul style="list-style-type: none">- Local: small long leaves, bitter taste, strong central rib- Hybrid: imported, big leaves, less bitter taste, soft central rib. Our farmers mostly prepare the imported seeds or seeds produced at the station.
Fertilizing	We use manure or compost of 1kg/ha, one week prior to the harvest.
Care	Water 2 times per day, do not pour too much water, loosen the soil, and get rid of grass quite frequently.
Harvest	Salad can be harvested after 45 day. If we apply the above planting method, we can harvest about 15 to 20 tonnes per hectare.

HEAD CABBAGE

Description	Head cabbage is popular among Khmer people, and there is much of it sold in the market.
Land	High ground, no flooding, enough sunlight, source of water for irrigation. Farmers prefer growing head cabbage in residential land, or river bank or the better silt land.
Time for sowing-planting seeds	We mix seeds with sand or ash in order to sow easily and evenly. The best time for growing head cabbage is between late rainy season and dry season, from October to February.
Nursery preparation	The soil must be dried up or ploughed many times, to make it as deep as 15 to 20 cm. The nursery is embarked with 0.90 wide, and 1 meter long, according to the number of small, and the height shall be 10-15 cm. The soil must be broken up into small pieces, so that it is loosened up, easy to take root, absorb water, and nutrients.
Planting Method	Small cabbage plants can be replanted when they are 25-30 days. If it is nursed in a leaf bowl, farmers can just dig the hole and plant it. The interval between rows must be 40-50 cm. After the planting, it must be covered for 2-3 days when it is too hot so as not to weaken or damage the small nursed plants.
Seeds	<p>Head cabbage is generally divided into two types based on the leaf colours: Purple and white. Seeds of head cabbage consist of 3 categories.</p> <ul style="list-style-type: none">▪ Heavy, aged 95 to 100 days of cultivation▪ Medium, aged 80 to 90 days of cultivation▪ Light, aged 70 to 80 days of cultivation
Care	Water 2 times per day in the morning and evening, loosen up the root base and get rid of grass, remove insects very often after 15 days of planting. After making the root base, put a handful of compost at each base.
Fertilizing	<p>Fertilize three times:</p> <ul style="list-style-type: none">▪ 1st when laying the bed▪ 2nd after 15 days of planting▪ 3rd when plants start to close its petals.
Harvest	In Cambodia, to plant head cabbage appropriately is to use the 95- to 100-day seeds. Before the harvest, farmers stop watering for 7 days so that head cabbage will close its petals well tight. When cutting, farmers keep two or three layers in order to maintain its quality for long during the transportation.

CHINESE KALE

Description	Chinese broccoli is 2 years old, but farmers grow it for only 1 year.
Land	It can be planted over almost all types of land, especially silt land of Mekong River, red soil, and black soil.
Time for sowing-planting seeds	Chinese broccoli can be grown for one full year, but the period that we grow it and get much yield is between October to April.
Nursery preparation	The soil must be properly moist. It should be raked, ploughed and broken up into small pieces in order to ensure that air can pass through. Especially, the soil must be fine and smooth, with no grass.
Planting Method	Plant seeds directly, and transplant small plants (15 days) when it produces 3 or 4 leaves and it is 8 to 12 cm high.
Spacing	Interval between root base and row is 25 cm x 40 cm, only one plant per each hole.
Planting Depth	From 0.6-1.2 cm deep.
Nursery period	From 4 to 6 days
Type of Seeds	<p>The popular seeds are:</p> <ul style="list-style-type: none">- Round leaf: big leaf, wavy at the end.- Sharp-pointed leaf: smaller leaf, sharp-pointed and straight at the end, not wavy.- Froned leaf: it is similar to Chinese broccoli, sharp-pointed, but fewer leaves grown from the longer midrib.
Thinning	1 st thinning after 7 days of sowing. 2 nd thinning when it is 15 days (for unhealthy small plant).
Fertilizing	Apply manure every 15 days.
Harvest	Our Chinese broccoli can be harvested when it is 45 to 55 days, after the planting; that is, when it is fully grown. Besides, after the harvesting, the fresh Chinese broccoli, called the bud, is left after it is plucked as it is 30 days.

EGGPLANT

Description	Eggplant is very popular particularly in Asia, because it contains many kinds of nutrients such as C, B1, B13, B6, and iron.
Land	Silt of sand mixed with clay is very good for eggplants.
Time for sowing-planting seeds	Eggplants can grow in all seasons. However, to produce seeds, the best time is to sow in November, and transplant in December.
Nursery preparation	The soil must be fine, without grass and diseases. The seed must be sowed as deep as appropriate, and it must be covered to maintain moisture. The small plants must be protected from the sun heat by covering the nursery with plastic or leaves.
Planting Method	We can transplant or just plant small eggplants when it is 21 days after the sowing.
Spacing	The row spacing is 100-120 cm, and the root base spacing is 60-80 cm.
Planting Depth	0.75-1 cm deep. The gap between ditches is 10 cm.
Growing period	5-8 days
Types of seeds	Good seeds are the seeds of long and crisp eggplants.
Care	Disease-infected and unwanted small eggplants are to be removed during all the phases of growth. We must nip the branches or buds in order to make the eggplants big and shiny. Remove old leaves at the lower part of the eggplant.
Fertilizing	Compost or manure is laid at the bed and the row interval. Farmers can fertilize manure additionally from 10 to 20 days after the planting. Water the liquid compost once per week.
Harvest	It can be harvested within 45 days. The harvest can be done two or three times per day. Eggplant yields on average 20 to 30 tones per hectare.

WAX GOURD

Description	Wax gourd is very popular in Cambodia. Two types of wax gourd are big and small wax gourds. It moves up the trellis or over the land.
Land	Wax gourd can be planted in all types of land, but land that is rich with organisms.
Hole preparation	The hole should be 40 x 40 x 40 cm, and lay 5-8 kg of compost and manure in the hole for 10 to 12 days prior to the planting.
Time for sowing-planting seeds	The best time to plant for seeds is November-December.
Spacing	The ridge spacing is 1.50 meter, and the hole is 1 meter long.
Planting Depth	1.5-2 cm deep; 10 seeds per hole.
Growing period	8-12 days
Types of seeds	Good seeds is rice wax gourd.
Disposing	When wax gourd grows 2 or 3 leaves, remove the weak small plants, and keep 4 big small plants per hole. Then when wax gourd is a bit bigger, dispose of plants again by keeping only 2 plants per hole.
Fertilizing and Care	They use compost or manure to lay the bed. When loosening up the roots of small wax gourd plants, put and pound the hole near its roots, and then earth up land a bit. After 20 days, put and pound additional manure at the root again, 3 or 4 times during its life cycle, make bigger trellis.
Harvest	It can be harvested nearly after 3 months. For only 1 month, one root can yield 120 wax gourd.



Picture 34 Wax gourd

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