Manual on
NUTRITION GARDEN

60 ANNIVERSARY igsss
Indo-Global
Social Service Society
Celebrating the Spirit of Humanity

Indo-Global
Social Service Society
Celebrating the Spirit of Humanity

Manual on
NUTRITION GARDEN

Manual on Nutrition Garden

Concept & Language Editing	:	Krushna Chandra Sahu, Amar Kumar Gouda
Consultant	:	Bidyadhar Maharana
Information & Photography	:	IGSSS, Partner agencies and Web source
Layout & Design	:	Ramakrishna Maharana
Publisher	:	Indo-Global Social Service Society, New Delhi
Source of reference	:	Please refer the Acknowledgement
Month & Year of Publication	:	March, 2021

Declaration:

This is a non-commercial publication of IGSSS, and no copyright infringement is intended while using information & images from various internet sources for building societal awareness.

Contents...

Foreword

Nutrition gardens have been an integral part of local food systems in developing countries around the world. These gardens encapsulate perpetual small-scaled subsistence agricultural systems established by the households to obtain and supplement the food and nutrition requirements of the family. Nutrition gardens are mainly intended to grow and produce food items for family consumption, but they can be diversified to produce outputs that have multiple uses including indigenous medicine and home remedies for certain illnesses and for income generation. The broad benefits of nutrition gardening are threefold: (1) social; (2) economic; and (3) environmental benefits.

By the way of nutrition gradens a family in rural and urban area can avail fresh and healthy green vegetables and some fruits and spices by utilizing the available space at the home stead or backyard. Nutrition garden basically utilizes the bare land around the homestead for growing vegetables and fruit crops. The main objective is to produce vegetables and fruits for the family regularly and all the available family members physically contribute time and energy. This improves nutritional intake and standard of living by reducing expenditure as well. Choice of plants is made as per a family's requirements and traditional acceptance.

The manual is a Facilitator's guide for learners and practitioners who are involved in small farming to design as per locally available resources and sustainable agriculture practices. The manual has explained the step-wise practices for laying-out nutrition garden and take up all operations from planting to harvesting and preservation. In important practices have been displayed in pictures for easy understanding and follow-up. I hope the manual will be useful for the target group for whom it has been designed.

Executive Director
Indo-Global Social Service Society

PREFACE

With my past fifty Kitchen garden has been one of the common-most promotional activities of non-government organizations in their endeavour to safeguard the life and livelihood of the disadvantaged, with particular focus on women. IGSSS too has supported such initiatives across India. However nutrition garden is a step forward because it needs more careful planning than for kitchen garden and is also more target-oriented and ensuring in terms of the food and nutritional security of poor families. The present manual has been designed to orient the beginners as well as practitioners for a better understanding of the concept for practical application.

Although not exhaustive in itself we are hopeful that it has covered all major aspects of nutrition gardening and hence will be quite useful for the stakeholders. We look forward to the translation and publication of this manual in regional languages for direct access of its contents by the target people.

Both the author and the editor have made use of various relevant secondary information in this manual and all those sources are hereby acknowledged. Web-sources of images have been listed out separately whereas direct reproductions from research articles have been duly cited in the annexure.

K. C. Sahu
Thematic Lead
Sustainable Livelihood
Indo-Global Social Service Society

Acknowledgement

With my past fifty five years of experience in the field of agriculture and consultancy on Natural Resource Management and Rural Development I have prepared several technical and operational manuals for the field functionaries. The present Manual on Nutrition Garden was prepared with the funding support of Indo Global Social Service Society (IGSSS) for which I am highly indebted to the organisation. It would not have been possible without the kind support of the officers of IGSSS for which I would like to extend my sincere thanks to all of them.

While preparing the manual I have referred standard manuals on Nutrition Garden, research documents, reports, findings of my own studies on Nutrition Sensitive Agriculture & Food and Nutrition Security of tribal women in Odisha and information available in internet, Government of India guidelines and several books of relevant subjects. I have tried my best to make the manual lucid and user-friendly which can be used by the field functionaries, trainers and trainees.

I would like to express my special gratitude and thanks to Sri Amar Kumar Gouda of IGSSS for giving me all types of support I needed during the course of preparation of the manual in spite of corona pandemic.

I would like to invite suggestions and comments through IGSSS for improvement of this manual in next edition.

Bidyadhar Maharana
Consultant, Agriculture & NRM

Introducing the Manual

India ranks 94 out of 117 countries in the 2020 Global Hunger Index. The country continues to grapple with a high rate of under nutrition, and managing it continues to be a massive challenge. While India's malnutrition rates have improved over the recent years, the country is still home to the largest number of stunted and wasted children in the world.

The Global Nutrition Report 2020 notes that India is among the 88 countries that will miss their global nutrition targets of 2025. India has the highest rates of domestic inequalities in malnutrition, and the biggest disparities in children's heights. Poor nutrition in the first 1,000 days after birth leads to stunted growth, leading to an inter-generational cycle of malnutrition. Malnutrition keeps people from reaching their full potential, affecting not only their health, but also their social and economic development.

Nutrition gardens can play an important role in supplementing essential nutrients. Such gardens like home garden enhance dietary diversity by providing micro-nutrients through constant supply of fruits and vegetables sufficient to meet the family's requirements. Nutrition garden is primarily intended for continuous supply of safe, fresh vegetables and fruits for family use. Fruits and vegetables from the kitchen/home gardens are good source of micro-nutrients especially in the poor households. Rural areas have ample space and establishing a kitchen garden is far simpler as farm families are involved in agriculture.

Due to lack of comprehensive kitchen garden planning guideline at village, gram panchayat and department level; nutrition sensitive kitchen garden is not happening in planned way. Most of the time frontline workers lack technical knowledge. Hence they are not able to guide farmers and community for production of safe, clean and green vegetables.

Based on this context a Manual on Nutrition Garden has been developed under Suposhan Project for use by staffs, volunteers, frontline worker and institution leaders for promotion of nutrition garden in project villages.

This manual is divided into 14 sections; (I) Understanding nutrition , (ii) Need for a comprehensive manual, (iii) Role of nutrition garden and its benefits, (iv) Selection of site and lay-out, (v) Selection of fruits, vegetables, varieties with rotation of crops, (vi) Step-wise cultivation practices of fruits and vegetables, (vii) Seed treatment and sowing/ planting techniques, (viii)Nutrient management, (ix) Water management by suitable climate resilient practices, (x) Pest management, (xi) Mulching and inter-cultural operations and use of trellis for climbers, (xii) Harvesting, preservation including zero energy cooling chamber, (xiii) Preservation of fruits and vegetables for all seasons, (xiv) Seed production and storage.

This manual provides step-wise practices to grow different fruits and vegetables to meet the family requirement. It will be of immense help for the staff, facilitators, volunteers and frontline workers to suitably guide the farmers for successfully raising nutrition garden both in rural and urban areas.

Amar Kumar Gouda
Indo-Global Social Service Society

Chapter-1

Understanding Nutrition

What is Nutrition?

Food meets caloric need of a person, while nutrition is required for health. Nutrition is the nourishment or energy obtained from the food consumed. Satisfying hunger or taste doesn't necessarily mean meeting the nutritional requirements of the body. Nutrition is essential for meeting the requirement.

Good nutrition is the foundation of good health. Well-nourished children grow and develop properly, are sickless often, achieve more at school and grow up to be healthy and productive adults who in turn produce healthy children. Healthy people are the basis of successful and productive families, communities and societies.

What is Malnutrition?

Malnutrition' implies an overall and marked nutritional deficiency in the body. However, excess of nutrition can also cause health issues such as obesity. Malnutrition occurs when we do not get enough of the right kinds of food to maintain good health.

What is Balanced Diet?

Balance diet is food which contains required quantity of carbohydrates, protein, fat, minerals and vitamins required for good health. The concept of 'balanced diet' is promoted which is essentially based on the nutritional requirements that may vary individually according to age, gender, profession, and the like. A common balanced diet for Indians is a combination of rice/chapatti, dal, vegetables, fruits, milk, curd, egg or meat.

Food Pyramid

What are Macro and Micro Nutrients, and Vitamins?

Macro-nutrients are Carbohydrates (rice, wheat, sugar, roots and tubers), proteins (dal, egg, meat, milk, and cheese), fats (edible oil, ghee, and butter), and dietary fibre (vegetables, whole grain and fruits). Carbohydrates supply instant energy; protein helps body building and repair of cells including producing enzymes and hormones; fats supply energy, supports cell growth, keeps the body warm and protects organs: and fibre protects from gastrointestinal problems, and even against type-2 diabetes.

Micro-nutrients are minerals like iron, sodium, calcium, and potassium etc. which help our body maintain the bone & tooth health, nerve & muscle function and immune system. We get micro-nutrients from nuts, beans & lentil, dark green leafy vegetables, milk (calcium) and small fish.

Vitamins (A, B, C,D, E, K etc.) are organic substances required by the body to maintain the normal process of metabolism. Their deficiency can cause various diseases (like night blindness due to deficiency of Vitamin-A). The important sources vary according to the vitamin, like citrus fruits for Vitamin-C and Cod Liver Oil for Vitamin-A.

Which are Critical periods from Nutrition point of view?

The period from conception to 2 years of age (the first 1,000 days) is the most important time in a person's life for good nutrition. Under-nutrition at this time can lead to problems which cannot be reversed. Because good nutrition is also necessary before a baby is born it is very important that women have a good diet, since healthy mothers produce healthy babies. In order to stay healthy and grow into healthy, productive adults we must have a balanced and varied diet.

Nutrient and Food Groups

All food contains important substances called nutrients which our bodies need in order to function properly. Nutrients help us grow properly, give us energy to think, work and play and keep our bodies strong and healthy. Different foods contain different amounts of nutrients. We can group foods according to the amounts of different nutrients which they contain.

Chapter-2

Need for a comprehensive manual

What is a Nutrition Garden?

Cultivation of vegetable and fruit crops by gardening in a systematic manner in small pieces of land available in households is known as "Nutrition Garden". The nutrition garden ensures access to healthy diet with adequate macro and micro-nutrients at doorstep. The value-added nutrition garden is far healthier than out-dated homestead vegetable garden. By having a nutrition garden, one can avoid eating vegetables which are tainted with pesticides. More importantly, this will improve our health as well as we can save money too.

Why a Manual is required for a Nutrition Garden?

The objective of this manual is to promote the nutrition garden in order to strengthen the food security of the disadvantaged families in general, and to address the issue of malnutrition and anaemia among women and children.

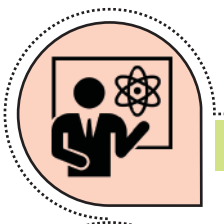
A nutrition garden is different from kitchen garden or home garden. It follows a scientific pattern. There are many technologies available now for growing the crops in the nutrition garden by adopting organic methods, particularly for nutrient and pest management. It is highly essential

for the facilitators and village volunteers as well as the trainers to guide the farmers/farmwomen in successfully laying out the garden, selection of crops, rotations, varieties, cultivation practices and post-harvest management. A user-friendly manual will be required to adopt the exact practices and options.

Who will use this Manual?

The manual will be exclusively used by the facilitators, trainers and village volunteers who are supposed to work with the farm families/farmwomen to promote Nutrition garden in rural and urban areas. With the help of this manual they can guide the teachers and students in developing school gardens.

Users of this Manual



Facilitators

The facilitators of IGSSS who are working with community

Village Volunteers

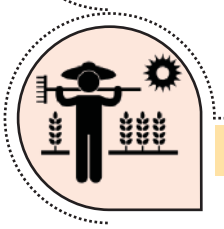
The volunteers who are working with the community on behalf of IGSSS

Extension Workers

Technical staff from state departments and universities

NGOs

Field level workers who can train farmers/farm women



Farmers

Leading or progressive farmers who act as village training facilitators

How to use this Manual?

The manual contains guidelines for facilitators, village volunteers, trainers and resource persons as well as extension workers. It includes 14 Chapters as per the contents.

- ☑ The user can use this Manual in whichever way suits his/her own situation.
- ☑ The user can go through the manual step by step.
- ☑ The detailed instructions have been given in the manual right from the selection of site to harvest and post-harvest management in 14 chapters as stated above.
- ☑ The user can refer to the relevant step of the manual and provide handholding training to the farmers/farm women in the field itself following the instruction and pictures given in the manual.
- ☑ In case of doubt the user can refer to the Acronyms and Glossary of Technical Terms.
- ☑ Each chapter begins with a statement of the aim and then gives information on a particular topic. Important information is highlighted in boxes which can be considered as impact points.

Chapter-3

Role of Nutrition Garden and its benefits

Role of a Nutrition Garden

Nutrition garden is an improved form of kitchen garden where select vegetable/fruit crops are grown systematically so as to meet the nutritional requirements of the family and sell the surplus in the market. Whereas a normal kitchen garden may have randomly selected crops chiefly based on external factors of preferences such as palatability and feasibility, a nutrition garden takes into consideration more internal preferences & needs (nutrition). Essentially it produces nutrition in the field.

Roles

- ☑ A well-developed nutrition garden contributes significantly to daily food and nutrition needs such as carbohydrates, proteins, minerals and vitamins.
- ☑ It can supply households with nearly all the non-staple foods they need, such as fruit, vegetables, legumes, coconuts and root crops as well as spices, tea, coffee, medicines and flowers for ornamental purposes or for sale.

- ☑ It produces enough nutritious food, including some staple foods, for all the family year round.
- ☑ This also includes extra food stocks for processing and sale to obtain income, and a reserve for special occasions or emergencies.
- ☑ Sale from nutrition garden produce can make a substantial contribution to a family's income (to buy daily essentials and farming inputs that cannot be produced on the family's farmland as well as other goods and services).
- ☑ The nutrition garden is also a place for trying out new crops and farming techniques.

What are the benefits of a Nutrition Garden?

- ☑ **Access to Nutrition:** It is a source of fresh and nutritious vegetables for the family throughout the year.
- ☑ **Availability of safe food:** Helps ensure a quality control in the production so as to maintain the food and nutritional safety of the products. For instance, it is easy to go for a fully organic home garden. Availability of perennial crops like drumstick leaves can meet the requirement even at the odd hours of the day.
- ☑ **Reduction of family expenditure:** It reduces the expenditure in buying vegetables.
- ☑ **Resource use:** Helps in effective use of the available land and kitchen waste.
- ☑ What's more, working in the garden refreshes the mind and inspires a positive attitude.

School Nutrition Gardens have many advantages; some of them are as under:

- ☑ **Good for learning:** School Nutritional (Kitchen) Gardens are good for learning: they are highly practical and a direct form of education, where children can learn how to grow good food, which not only improves health, but also provides opportunities for livelihood and increased self-sufficiency.
- ☑ **Essential for children's health:** These gardens are good for children's health and education: School nutrition gardens are not just for food, but for better eating and they can make a direct and immediate improvement in children's diet.
- ☑ **Improve environment:** Organic gardening conserves the soil, protects the environment and works with nature rather than against it. It uses natural methods to keep the soil fertile and healthy and to control insects, pests and diseases. Organic methods can help keep our water sources clean and free of chemicals. It is also safer for children because there are no dangerous chemicals.

Why do we need nutrition gardens?

- ☑ Growing our own healthy food can help us to make sure that our families have healthy, balanced diets for optimum health and growth.
- ☑ Having our own nutrition garden can help us save money and generate an income from selling surplus produce.
- ☑ Nutrition gardens can also act as demonstration areas where we can show others how to develop their own gardens, using minimum inputs to produce a wide range of healthy food.

Chapter-4

Selection of Site and Layout

Selection of Site

Sites selection is very crucial for success of a nutrition garden or kitchen garden. Usually it is established in backyard of house or on an open space, near water source receiving plenty of sunlight. Size and shape of garden depends on availability of land, number of persons in family and spare time available for its care.

- ☑ Choose an open area (fairly level ground) that will allow the plants to receive full sunlight (not shaded) at least half of the day.
- ☑ The size of a nutrition garden depends upon the availability of land and number of persons for whom vegetables are to be provided.
- ☑ There is no restriction in the shape but if the houses are on hilly terrain, it is suggested to go for terrace farming.
- ☑ Nearly five cents of land (200 square metres) is sufficient for a family of five members.
- ☑ A rectangular plot is preferred to a square plot or a long strip plot
- ☑ The site should have good soil, water source and plenty of sunlight.
- ☑ South and western side should be reserved for vegetables as sunlight will be available for required hours
- ☑ Northern side should be used for fruits
- ☑ The site should have good soil, irrigation facility, drainage and compost facility

Size of the Garden

Nearly five cents of land (200 square m) is sufficient to provide vegetables throughout year for a family consisting of five members. The area may be modified if the aim is to meet the family need and selling the surplus in the market. A rectangular garden is preferred to a square plot or a long strip of land.

Layout

Layout of garden and selection of crops suited to each season depends on agro-climatic conditions prevailing in the area. Depending on climatic and seasonal changes, modifications are to be done in layout and crop allotment.

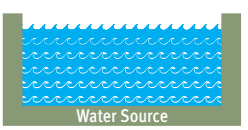
General principles to be followed

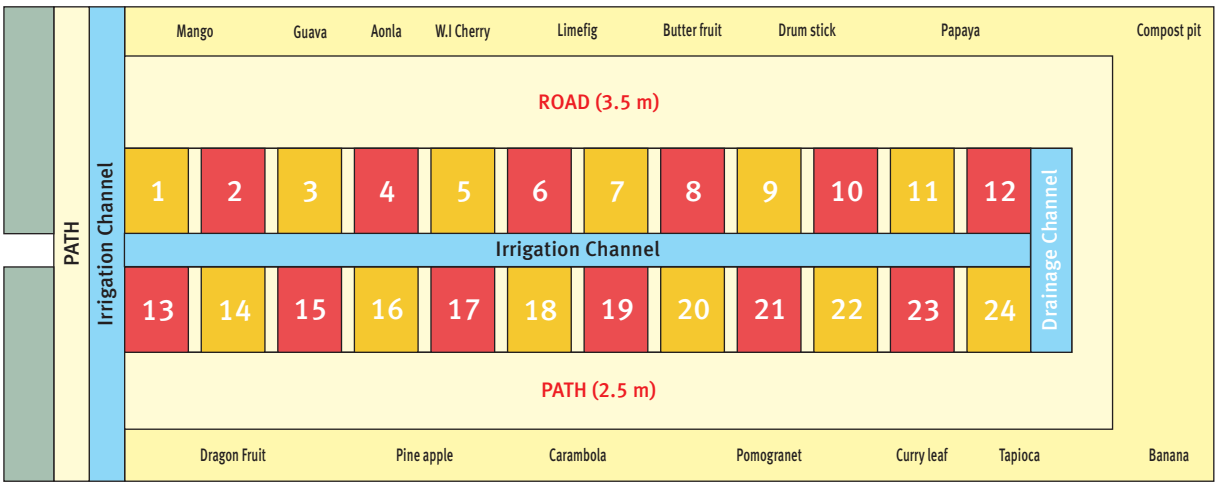
- ☑ Perennial vegetables like drumstick, curry leaf etc. should be allotted to one side of the garden so that they may neither shade remaining plants nor they interfere with intercultural operations.
- ☑ Shade loving vegetables like water leaf may be planted in perennial plot.
- ☑ One or two compost pits may be provided on one corner ofnutrition/ kitchen garden for effective utilization of farm / kitchen waste.
- ☑ Fences on all sides should be made with barbed wire or with live fence to protect from pilferage and .animal menace. Fence may be made strong by planting agasthi (Sesbania grandiflora) at 1.0 m. distance along the fence.
- ☑ After allotting areas for perennial crops, remaining portion may be divided into 6-10 equal plots for raising annual vegetable crops. By following scientific crop rotation, three annual crops can be raised in the same plot. Companion cropping or accession cropping, inter cropping and mixed cropping can be followed for effective utilization of space.
- ☑ Provide walking path at centre as well as along four sides for movement and agricultural operations.
- ☑ Utilize ridges, which separate individual plots for growing root and tuber crops.
- ☑ As intensive and continuous cropping is done in a nutrition/kitchen garden, fertility and texture of soil may be maintained by applying adequate quantities of organic manure frequently.
- ☑ Since fresh vegetables are directly utilized, follow clean cultivation, mechanical removal of pest / disease affected plants, planting of resistant varieties, biological control and use of bio-pesticides or bio-fungicides for pest and disease control in a kitchen garden.
- ☑ In a nutrition garden, preference should be given to long duration and steady yielding varieties than high yielding ones, which require constant care.
- ☑ While allotting or arranging crops in each sub-plot, care should be taken to plant varieties / crops at ideal time of planting or season. Principles of crop rotation also should be followed in continuous cropping.

- ☑ A bee-hive may be provided for ensuring adequate pollination of crops besides obtaining honey.
- ☑ By following scientific crop rotation, three annual crops can be raised in the same plot.
- ☑ Companion cropping or accession cropping, inter cropping and mixed cropping can be followed for effective utilization of space.
- ☑ Utilize ridges, which separate individual plots for growing root and tuber crops.

Model Lay-outs of Nutritional Gardens

Dimension of Area: 37.5m x 14.00m (525.5 Sqm)





Plot number 1-24 is of the size of 5 x 2 m for growing different seasonal vagetables, medicinal and spice crops

Source: ICAR

Design of Nutrition Garden

Designing a nutrition garden is part of its proper planning. The design is to be based on the following factors:

- ☑ Available space
- ☑ Water source available
- ☑ Crops needed to be grown,
- ☑ Human resources available to take care
- ☑ Perceived risks (such as theft, animal grazing, etc.).
- ☑ Market demand

Design of a nutrition garden depends upon availability of space and water. Usually vertical and horizontal designs are preferred.

Vertical Garden:

If there is more vertical space (such as the boundary wall or house wall) available than the horizontal space, then vertical gardens can be developed in various ways, as shown in the images. For the hanging type, crops comfortable in that positions are to be selected such as bitter gourd or ridge gourd etc. Raising bottle guard and pumpkin, etc. by wall-side and diverting their growth to the thatched roof is a common traditional practice in rural India that also corresponds to the concept vertical gardening.

Horizontal Garden:

Raised beds are preferred to avoid soil compaction, where the area often gets waterlogged during the wet season. The preferable size is 5-6 ft X 2-3 ft with a height of 1-1.5 feet. The beds combine crops/ vegetables with different root depths and light requirements. Spread of rice husk/ hull, and vermi-compost on top of the bed is advisable. Nutritionally rich and multi-season, multi-use plants are given priority. Bricks can be used to make the structure for such beds, but timber can also do if termite is not an issue. Raised beds help in easier maintenance of the garden. The inter-bed spaces can be kept clean either through cement flooring or through gravel-spreading. Each such bed can be used either for a single crop or for multiple crops.

Rectangular Garden:

Rectangular garden is idea where flat land is available. All sub-plots are laid-out as per requirement and facilities like walking path, irrigation and drainage system, fencing are provided in such garden.

Circle Gardens:

The basic purpose of such a design is to harvest vegetables from different patches on a rotation basis. If there are seven major segments (called pathways) in the circle, and one starts from harvesting in pathway number 1, then he/she will harvest in pathway number 2 the next day, and accordingly will come back to pathway number 1 after seven days.

An ideal size for Circle Bed is 750 sq ft. to 800 sq ft. A circle of radius 15 ft is then drawn with a stump at the centre. The layout is marked with lime or ash. The 15 ft long radius can be divided into segments at 1 ft, 1.5 ft, 2 ft, 3.5 ft and 5.5 ft (one can decide this according to preferences) and circles are to be drawn with each radius-segment.

It has a number of patches to grow multiple crops. However, if there is less space, then the structure can be modified according to the need and feasibility. The target is to have at least 14 beds (2 patches per pathway) in place.

Chapter-5

Cropping pattern and selection of fruit and vegetables crops

Criteria for selection of fruits and vegetables for a nutrition garden

The family requires a mixed meal to provide balanced diet to all members. The mixed meal is a balanced combination of water, staple cereals, vegetables, fruits, legumes, sugar, oil, milk, fish/meat and egg.

Food item	What they supply:
Cereals	Energy, protein, vitamin B & E
Roots and Tubers	Energy and vitamins
Legumes (dal)	Energy, protein, fat,. vitamin E, calcium, iron and zinc
Oil and nuts	Energy, vitamin E,and A
Vegetables and fruits	Minerals and vitamins for protection of body
Animal foods	Protein, minerals like iron, zinc, calcium and vitamin A & D
Water	Body contains 80% water which is required for all metabolic activities and removal of

While we can get cereals, dal, oil, sugar and non-veg items from the market, we can get vegetables and fruits from our garden. Different fruits and vegetables supply different nutrients. We can divide them into four broad categories as per group by using a colour wheel (developed by Gardens for Health International) as shown in Chapter-1. The food groups are indicated in the following table .

Vegetables under different colour groups

Group	Examples	Main nutrient supplied and function
WHITE GROUP Energy-giving foods	Cereals (maize, sorghum, millet, wheat, rice), Roots and tubers (sweet potatoes, yams, colocasia, cassava, potatoes)	Good source of energy, protein , some vitamins and minerals. Unrefined cereals are also a good source of fibre. Minimises the risk of colon, prostate and breast cancer.
BROWN GROUP Body-building foods	Legumes and oilseeds (Cowpea, pigeon pea, beans, groundnuts, sunflower seeds, soybean, sesame)	Good sources of protein, some vitamins , minerals, fibre and oil
GREEN GROUP Protective foods	Dark green leafy vegetables (spinach, poi, amaranths)	Excellent sources of vitamins, folic acid, minerals and fibre. Protect your body from cancer, cholesterol, regulate digestion and improve immune system
ORANGE GROUP Protective foods	Orange and yellow fruit and vegetables (pumpkin, sweet potato, carrot, turnip, radish, tomatoes, peppers, onions, gourds, green beans, mango, papaya, guava, banana)	Provide vitamins and antioxidants. Protect your nervous system and prevent heart diseases. They play a role in maintaining skin health, eye sight, boosting the immune system and bones.

GREEN		• Iron, Vit-A, Vit-C, Chlorophyll • Fibre • Calcium • Beta-Carotenes	• Under developed fetus • Night blindness • Skin diseases • Scurvy (Vita C)
RED		• Vitamin C • Lycopene	• Memory loss • Cancer • Urinary tract infection
YELLOW & ORANGE		• Vitamin A • Vitamin C • Beta-Caretenes	• Eye sight problem • Skin diseases • Loss of immunity
PURPLE		• Vitamin C • Fibre • Flavonoids	• Ageing • Memory loss • Cancer
WHITE		• Potassium • Beta glucans • Lignans	• High cholesterol • Low pressure

Colour indicators of fruits and vegetables

Cropping Pattern

It is desirable to select vegetables and fruits from the above four groups to meet the nutrition requirement of our family members. A cropping pattern has to be decided for three seasons of the year so as to meet the nutritional needs of the family. A model is shown in following Table.

A cropping pattern for a model nutrition garden

Plots	Kharif (May/June-Sep/Oct)	Rabi (Sep/Oct-Dec/Jan)	Summer (Dec/Jan-May/June)
Main plots	Brinjal, Chilly, Bitter gourd, Ash gourd, Cucumber, Trailing cowpea, Okra, Corn, Cluster bean	Tomato, Brinjal, Cauliflower, Cabbage, Knolkhol, garden pea, French bean, Okra, Spinach, Green veg, Radish, Potato, Onion, Garlic, Beet, Carrot, Turnip, Broccoli	Okra, Pumpkin, Water melon, Cucumber, Amaranths, Yard long bean, Chilli, Brinjal, Poi
Perennial	Vegetables	Papaya, Drum stick, Banana, Curry leaf, pointed gourd	
	Fruits	Papaya, Banana, Lime, Guava, Rose apple, Mango, Aonla, Carambola, Dragon fruits, Passion fruit, Pomegranate	
Inter crop	Fruits	Pine apple	
	Vegetable	Taro, Elephant Foot Yam, Yam, Tapioca	
	Spices	Ginger, Turmeric, Mango ginger, coriander, Mint (Pudina)	
	Border and path	Amaratnths, Cowpea, Dolichos bean	
Fence	Perennial	Agasthi, Drum stick, Bael	
	Rainy	Beans, Other vines and trailing type vegetables	
	Rainy/Summer	Dolichos Bean, Winged Bean	

What are the crops needed to be grown in our nutrition garden?

It may not be possible to grow all food items that are needed in the nutrition garden. Therefore the bare necessities to supplement the family nutrition can be grown. We can put the following questions before selecting the type of fruits and vegetables to be grown in our garden.

The question	How the garden can help?
Are there specific micro-nutrient lacking in our diet?	The garden can contribute fruits and vegetables rich in minerals and vitamins.
Are we getting all types of food and what are lacking?	The garden can supply vitamins, minerals, proteins through vegetables and fruits.
Are we getting well balanced meal?	The garden can supplement carbohydrates, proteins, minerals and vitamins to make our diet balanced as per RDA
Do we get quality foods with taste and flavour?	The garden can supply safe and nutritious food with taste.

Decide what to plant by:

- ☑ Identifying nutritional and dietary needs,
- ☑ Finding the nutritional value of local foods; and
- ☑ Choosing foods to grow which will improve the diet.

Selection of Crops

It is important to grow all kinds of vegetables that the family members like and require depending upon the area and other facilities available. If land is limited, it is advisable to grow crops that produce higher yields per unit area and time. If land is sufficiently available, then crops such as banana, papaya, guava, and lemon can be grown in a nutrition/home garden. It is required to select the varieties of crops as per resource and environment.

Criteria for selection of crops

Criteria	Crop varieties to be selected
Environment and soil	• For shady places: Turmeric ginger and different types of colocasia • For partial shade: Spinach, elephant foot yam, ginger, turmeric, colocasia • Use of high trees as support: Yam, flat beans, black pepper • Use of trellis: pumpkin, pointed gourd, bitter gourd, ridge gourd, little gourd, snake gourd, cucumber etc. • Use of marshy lands: Colocasia, Sunusunia
According to soil pH	• 5.5 to 7.0 : Brinjal, chilli, etc. • 5.5 to 7.5: Tomato, gourds, pumpkin, cucumber etc. • 6.0 to 7.0: Spinach bean, etc. • 6.0 to 7.5 : Bush beans, beet, radish, green peas, etc. • 6.0 to 8.0 :Lady finger, sweet potato, etc.

Water requirement	• Very Low: Water melon Pumpkin, Ash gourd • Low: Cluster bean French bean, Cow-pea, Pea ,Ridge gourd, Bottle gourd • Moderate: Tomato Chilli, Onion, Potato, Carrot, Cucumber • High: Leafy vegetables Cabbage, Cauliflower Broccoli
According to rooting depth	• Very shallow15-30 cm: Onion, Lettuce, Small radish • Shallow rooted (30-60 cm) :Cabbage, Cauliflower, Celery, Garlic, Leek, Palak, Radish, Cow pea, Potato • Moderately deep rooted (60-90 cm): Beet root, Brinjal, Cucumber, Musk melon, French Bean • Deep rooted: (90-120 cm) Chilli, Turnip, Summer Squash • Very deep rooted (120-180 cm: Water melon, Pumpkin, Winter Squash
According to growing season	• Kharif (June- Oct): Cucurbits, Brinjal, Chilli, Okra, Tomato, Ginger, Cowpea, Cluster bean, Cucumber, Sweet Potato, etc. • Rabi (Oct-Feb): Carrot, Beet root, Radish, Turnip, Cabbage, Cauliflower, Potato, Brinjal, Tomato, Chilli, Okra, Cow pea • Summer(Feb-May): Brinjal, Tomato, Chilli, Okra, Cow pea, Cluster Bean, Cucurbits,
According to light requirement	• Low light demanders: Leafy vegetables • Medium light demanders: Potato, Radish, Turnip, Carrot, Palak, Beet root, Onion, Cabbage, (require at least half a day of sunlight) : Cauliflower • Photo-intensive(require full sun) Tomato, Brinjal, Okra, Chilli, Capsicum, French bean, Cucumber, Cow Pea
Harvest period	• Quick: Leafy vegetables • Long time: Lemon, mango, guava • Annual fruits: Banana, Papaya • Minimum care: Drumstick
According to specific nutrition	• Protein: Cow pea, Cluster bean, French bean, bean, Yard long bean • Starch: Roots and tubers, Banana • Minerals: • Calcium: Beet, Amaranths, Fenugreek, Turnip, Coriander, Pumpkin, Onion, Tomato • Potassium: Sweet potato, potato, Bitter gourd, • Phosphorus: Garlic, Peas, Bitter Gourd • Iron: Bitter gourd, Drumstick, Amaranths, Fenugreek, Spinach, poi • Vitamin A:Carror, Broccoli, Squash, Sweet potato, Pumpkin, Cabbage, Tomato, Coriander, Broccoli • Vitamin B: Citrus, Beans, Avocado, Garlic, Colocasia • Vitamin C: Pepper, Strawberry, Broccoli, Potato, Lime, Turnip, Cauliflower, Bitter gourd, Radish • Vitamin D:Spinach, Okra, Soybean • Vitamin E: Pumpkin, Beet, Spinach • Vitamin K: Leafy vegetables, Broccoli, Cauliflower, Cabbage

Selection of crops

Vegetables	Amaranth leaves, spinach, methi etc., Gourds(pumpkin, bitter gourd, small gourd, pointed gourd, ridge gourd, ash gourd, bottle gourd), roots and tubers (potato, sweet potato, beet, turnip, radish, carrot, yam, colocasia, tapioca, elephant foot yam), cole crops (knolkhol, cabbage, cauliflower, Broccoli), fruit vegetables (okra, capsicum, tomato, brinjal), tree vegetables (moringa, papaya, banana, jack fruit), Beans (French bean, dolichos bean), Sweet corn, Peas etc.
Fruits	Banana, Guava, pomegranate, pine apple, custard apple, lemon, orange, mango, dragon fruit etc.
Spices	Chilli, coriander, fenugreek, ginger, turmeric, black pepper, onion, garlic

Selection of varieties

Seed is the basic and most critical input for nutrition garden. The response of all other inputs depends on quality of seeds to a large extent. It is estimated that the direct contribution of quality seed alone to the total production is about 15-20% depending upon the crop and it can be further raised up to 45% with efficient management of other inputs.

Farmers can collect, exchange or purchase traditional, Open pollinated (OP), High Yielding Variety (HYV) seeds form farmers, different farmers organisations and market suitable for local environment and soil.

Crop Rotation

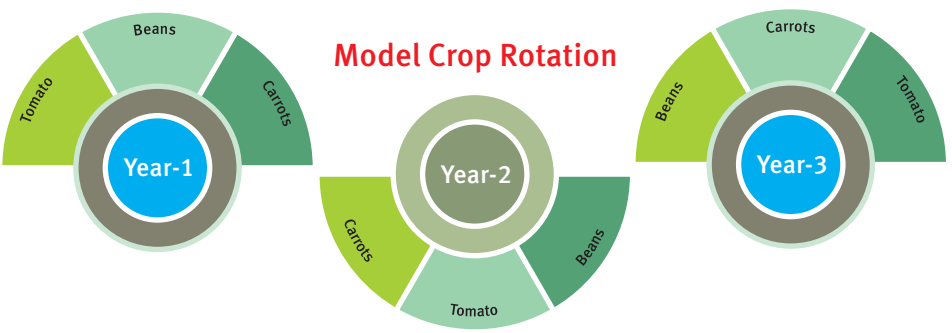
Crop rotation is the practice of growing different crops in succession on the same land. It is commonly used to control diseases and insect pests in the vegetable garden, and to build up the organic matter and soil nutrients that certain plants use during their life cycle.

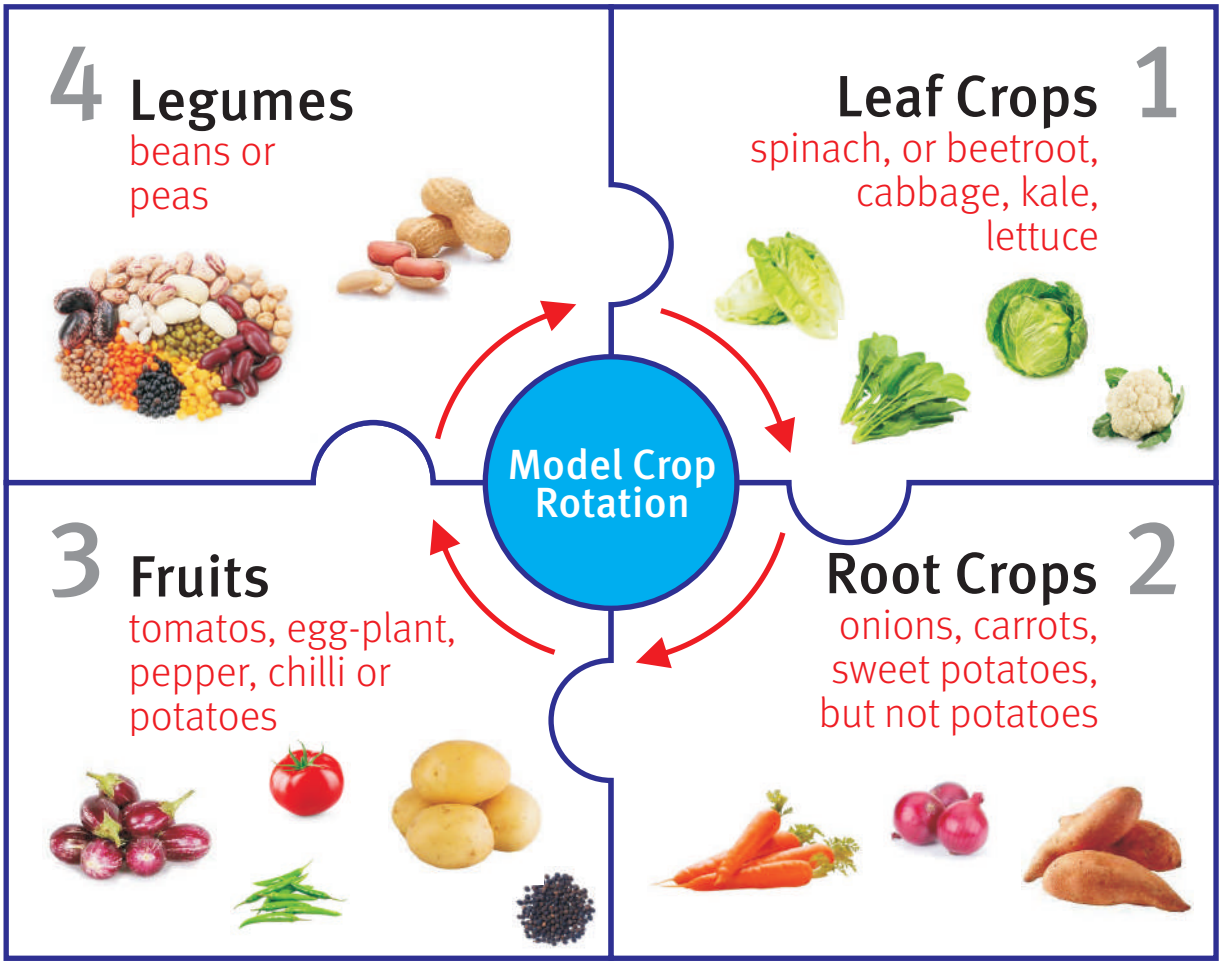
Considerations for a good crop rotation

Crops from same family should not be grown together in the same plot to avoid diseases and pests. Some of the main families are: Cucurbitaceae (cucumber, pumpkin and all the gourds belong to this group; most of these plants need water, but do not like poorly drained soils); Solanaceae (Brinjal, tomato, chilli, potatoes etc. belong to this group); Fabaceae (almost all the beans and peas belong to this family, which usually have deep roots and therefore tolerate drought better); Convolvulaceae (water spinach and sweet potatoes belong to this family); Malvaceae (lady finger and roselle belong to this family); and Chenopodiaceae (beet root and spinaches belong to this family).

How to plan a rotation?

- ☑ Prepare a list of vegetables to be planted in the garden. Divide the vegetables into four groups based on what part of the plant you plan to eat, i.e., plants grown for leaves or flowers (such as amaranth, lettuce, broccoli, cabbage), fruits (such as tomato, eggplant, pepper, cucumber), roots (such as carrot, radish, onion) and legumes (such as beans, peas, cover plants/green manure like alfalfa or clover).
- ☑ Group the plants together in botanical families. This is to help you understand what crops are closely-related. In general, crops in the same family should not be planted in the same field continuously.
- ☑ Heavy feeder should be followed by a light feeder/medium feeders
- ☑ To avoid pests, we can also try to grow aromatic herbs (with strong smell), in-between or around the main crops. Some of these plants are basil, coriander, mint, small marigold, button chrysanthemum, and Indian borage, etc..





- ☑ There are specific inter-crop combinations too for pest control, like Cabbage + Carrot against Diamond Black Moth, Okra + Cowpea against Yellow Vein Mosaic Virus, Tomato + Basil against hornworm, and Cucumber + Radish against cucumber beetles.
- ☑ Keep records of what actually happens, not just what you planned.
- ☑ Use this information when planning for next year. How long should the rotation last? (The longer the better. Normal length is 4 years; if not possible, at least 2 years)
- ☑ If you start by planting a leaf crop in a bed such as spinach, cabbage or amaranths, the next crop to be planted in that bed should be a root crop such as onion, potato or carrot.
- ☑ After the root crop, plant a fruit crop (such as tomatoes, aubergine, pepper or chilli) and finally, plant legumes (peas or beans).

Year	Plot-1	Plot-2	Plot-3	Plot-4
1	Legume	Leaves	Fruits	Roots
2	Leaf	Fruits	Roots	Legumes
3	Fruit	Roots	Legumes	Leaves
4	Root	Legumes	Leaves	Fruits

Inter cropping

Inter-cropping is the planting of different types of plants in the same bed or row. Intercropping within rows in the same bed helps to intensify food production; yields may be lower for some crops, but more nutrients are produced per square metre. It reduces labour and saves space because the crops are closed together, reducing the time spent on watering and compost application. Moisture is conserved because low-growing plants grown between taller plants cover the soil, reducing evaporation. This also reduces the space in which weeds can grow. Pest problems are reduced because pests and diseases prefer plants of the same family and are less interested in mixtures of many different crops.

INTER-CROPPING TIPS

- ☑ Plant heavy feeders (such as cabbage, maize and potatoes) with light feeders (legumes and root crops).
- ☑ Plant leaf crops next to root crops, fruit crops or legumes;
- ☑ Plant the seeds or seedlings according to the recommended spacing;
- ☑ Organise plants according to their different shapes. Tall, thin plants such as carrots, leeks, onion and garlic can be grown next to wide, low-growing plants such as cabbage, bush beans or spinach;
- ☑ Remember that different crops take up beds for different lengths of time. Spinach may stay in beds for months or even years, as they can continue to grow while the leaves are being harvested. Others, such as beans and tomatoes, may only occupy beds for a couple of months.

Chapter-6

Step-wise practices for growing fruits and vegetables

The main objective of a nutrition garden is the maximum output and a continuous supply of vegetables for the household throughout the year. By following certain procedures, this objective can easily be achieved.

Prepare the site and layout

- ☑ If the site is flat and plain, the layout can be done conveniently. In case of hilly slopes, terracing has to be done.
- ☑ Plough the land and level with slight slope so that drainage will be possible.
- ☑ Layout the plots after providing fencing around the site.
- ☑ Remove stones and big pebbles from the site.
- ☑ The main elements are beds, paths, irrigation and drainage channels, plant nurseries, compost pit and garden sheds.
- ☑ If water is not available construct a source (dug-well, bore-well etc.) and connect with sprinkler/drip system, if possible. Otherwise other devices like chain washer pump, surface treadle pump etc. could be arranged for irrigation. Now a days solar pumps are used conveniently. In case of rain-fed land water conservation and water harvesting techniques are adopted.
- ☑ Compost pits or NADEP compost pit or vermi-compost units are to be constructed for supplying organic manure to crops.
- ☑ There should be walking paths in between beds.
- ☑ Loosen the soil in the bed area to a depth of 20cm with a fork or hoe. It is important to avoid turning the soil or mixing the layers. Once the soil has been loosened, use a rake to level it. Make ridges at the edges of the beds to define them. If your soil is heavy (clay or loam), make raised beds. Beds on sandy soil can be sunk to save water. After making the beds add one and a half buckets of well-rotted manure or compost per square metre to the surface of each bed.

Selection of Crops

- ☑ Select seasonal vegetables suitable for Kharif, Rabi and summer seasons
- ☑ Select fruit plants as par suitability of the area and climate following the criteria
- ☑ Decide the rotation pattern

Season	Vegetables to be grown
Kharif	Cucurbits, Brinjal, Chilly, Cluster bean, Yam, Sweet potato, Colocasia, Okra, Cow pea, Tomato (off season), Amaramths, Radish, Small gourd, Ginger, Turmeric
Rabi	Cabbage, Cauliflower, Knol-khol, French bean, Cowpea, Mustard, Potato, Radish, Leafy vegetables (spinach, methi, koshla), carrot, turnip, Beet, Broccoli, Brinjal, Tomato, Pointed Gourd, Coriander, Garlic, Onion, Lettuce, Garden pea, Sweet corn
Summer	Cucurbits (Pumpkin, Cucumber, Ridge gourd, Bitter gourd, Ash Gourd, Bottle Gourd), Brinjal, Cowpea, Okra

Very shallow rooted (15-30 cm)	Shallow rooted (30-60 cm)	Moderately deep rooted (60-90 cm)	Deep rooted (90-120 cm)	Very deep rooted (120-180 cm)
Onion, Lettuce, Small radish	Cabbage, Cauliflower, Celery, Gerlic, Leek, Palak, Radish, Cow-pea, Potato	Beet root, Brinjal, Cucumber, Musk melon, French bean,	Chilli, Turnip, Summer squash	Lima bean, Water melon, Pumpkin, Winter squash

Crop arrangement

While allotting or arranging crops in each sub-plot, care should be taken to plant varieties / crops at ideal time of planting or season.

There are two methods of planting for different vegetables as indicated below.

Direct Seeded		Transplanted	
Crop	Duration	Crop	Duration
Okra	60-100	Tomato	60-135
Beans	45-65	Brinjal	60-150
Cowpea	60-90	Chilli	60-150
Radish	40-50	Cabbage	55-70
Carrot	90-100	Cauliflower	55-65
Beet	50-60		
Knol-khol	60-70		
Leafy Vegetables	40-60		

Prepare a crop calendar

Crop calendar has to be carefully planned after deciding the crops to be grown in differed seasons.

Crop	Months											
	Aprii-May	May-June	June-July	July-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan	Jan-Feb	Feb-Mar	Mar-April
Cucurbits												
Leafy vegetables												
Yam												
Sweet Potato												
Cow pea												
Beans												
Garden pea												
Tomato												
Brinjal												
Cauliflower												
Cabbage												
Knolkhol												
Potato												
Onion												
Garlic												
Ginger												
Turmeric												
Radish												
Pointed Gourd												
Bitter gourd												

Land preparation

Land preparation depends upon the type of sowing/planting. Usually three types of planting methods are adopted in vegetables.

Method of planting	Name of crops
Direct sowing	Okra, Potato, Radish, Beans, Cowpea, Field Pea, Corn, Leafy vegetables, Cluster bean, Coriander
Pit method	Cucurbits, Yam, Elephant Foot Yam, Bitter gourd, pointed gourd
Trench method	Colocasia, Sweet Potato, Tapioca, Ginger, Turmeric, Garlic
Transplanting	Brinjal, Tomato, Onion, Cauliflower, Cabbage, Knolkhol, Chilli

- ☑ Prepare the land well by digging soil, harrowing and removing crop residues, weeds, stubbles, clods and pebbles
- ☑ Firstly, a through spade digging is made to a depth of 30-40 cm
- ☑ Ensure tilling, separation of stones, clean weeds and breaks the clods into smaller sizes
- ☑ Add fertile and top soils in the beds if top soil is poor/unfertile
- ☑ The sowing spots or trenched are to be dug to a deeper zone
- ☑ Adequate moisture has to be ensured to facilitate sowing
- ☑ Prepare nursery beds for raising seedlings or use containers for raising seedlings

Apply adequate compost

- ☑ Add enough well decomposed FYM/compost/vermi-compost @ 15 to 20 kg per bed of 10'x5' (one basket)
- ☑ Level properly to avoid water stagnation
- ☑ Add wood ash, if possible.

Propagation

There are two main ways to grow crops: from seed or by vegetative methods (cuttings/rhizomes). In order to grow well, young plants need cool, moist conditions and must be protected from pests and diseases. They need soil which is fertile and soft. Vegetative growing methods involve taking part of a healthy plant (such as the stem, branch, leaf or root) and either 1) planting it in a container to encourage it to produce roots; or 2) attaching it to another plant (as in budding or

grafting). Once it has begun growing the cutting can be planted out into the garden. Only some plants (such as herbs, sweet potato, cassava and fruit trees (avocado and mango)) can be grown by vegetative propagation. Cuttings must only be taken from a productive, healthy plant.

Nursery for Planting

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

Factors to be considered for raising a nursery

Location of the nursery should be:

- ☑ Land close to the house
- ☑ Well exposed to the sun, but protected against severe heat
- ☑ Well protected against animal damage and strong winds

Different types of nursery beds

Raised nursery bed (For rainy season)

- ☑ Raised up beds are made with 15 cm ridges in 1 metre in breadth and length as per need (Maximum 3 metres).
- ☑ While preparing such raised bed, it is better to use paddy field soil or use of fungicide to make the soil free from disease.
- ☑ Well-decomposed compost should be added and mixed properly in soil during bed preparation about 1-2 weeks before sowing seed.
- ☑ Seeds are sown in line 2-3 cm deep with finger at spacing of 5-7 cm between two seeds, and slightly watered the bed by sprinkler or with the help of making hole on lead of bottles.

Sky nursery bed (For rainy season)

- ☑ By elevating the nursery from the ground, the seedlings will not be affected by the water running on the ground surface at times of rain, and it helps to prevent damaging leafs of the seedling from direct rainfall to it, by making the roof of white plastic sheet.

- ☑ The nursery bed is prepared using wooden or bamboo stalks driven on ground and erecting about 60-70 cm above the ground with 1 m breadth and length as per the necessity, and placing 15-20 cm thick layer of soil on the planks or bamboo fibres.

- ☑ If it rains, the nursery bed should be roofed by plastic sheet; whereas, it can also be removed if it is not raining. There should not be roof for long time in sky bed.
- ☑ Application of compost and sowing methods are like in raised bed.

Sunken nursery bed (for dry and hot season)

- ☑ These types of seed beds are prepared during winter or dry season for holding moisture in soil. In contrast to the rainy season, rainfall is scarce and preparation of seedlings will require water during the months of February to May. During such season, nursery beds should be prepared to contain the moisture in the soil as much as possible.

- ☑ To prepare such nursery, the land should be dig out below the ground surface and keep the small raised boundary.
- ☑ The water would be preserved in effective way in comparison to raised bed; which helps to grow up healthy seedlings.
- ☑ Application of compost and sowing methods are like in raised bed.

After Care

All other practices right from sowing/planting to harvesting are given in following chapters.

Chapter-7

Seed Treatment and Planting Techniques

There is a saying "As you sow, as you reap." So sowing is very important for success of any crop. It is safe to use certified or foundation seeds of notified varieties for a successful crop. Fresh seeds with required germination percentage (above 65%) and purity have to be purchased from authentic sources.

Seed sorting and treatment of seeds and seedling

- ☑ Clean the seeds properly, separate diseased, insect infected and broken seeds
- ☑ Seeds or seedling needs to be treated before sowing/transplantation
- ☑ Seeds / seedlings(roots) can be dipped in the cow urine solution (cow urine: water 1:10 dilution) for 5-10 minutes
- ☑ Seeds /sapling (roots) also can be treated in sour curd water (1:10) for a period of 5-10 minutes
- ☑ Seeds can also be treated with chemicals like Thiram 1.5 gram + Carbendazim 1 gm per kg of seed
- ☑ Seeds can be treated with bio-fertilisers like Rhizobium culture, Azotobacter , Azosprillum and PSB
- ☑ Dry the treated seeds for a while in the shade and then go for sowing
- ☑ Soak the seeds overnight before sowing
- ☑ Ensure instant transplantation of treated seedlings
- ☑ Ensure seed sowing/seedling transplantation in the afternoon
- ☑ Apply water as required
- ☑ Use crop residue as soil coverage/mulch to check weed growth, reduce soil moisture and adding organic matter

Sowing/Planting Distance

The sowing/planting distance depends on the growth of the plants, duration of the crop and yielding capacity. The following spacing will be adopted in nutrition gardens.

Crop	Sowing method	Distance (cm)	Distance (cm)	Days for harvest
Beet	Direct	30	20	70-80
Broccoli	Indirect	60	40	80-110
Carrot	Direct	25	10	80-110
Cauliflower	Indirect	60	45	80-110
Cabbage	Indirect	60	40	90-120
Knolkhol	Indirect	45	20	80-100
Potato	Direct	60	20	80-110
Brinjal	Indirect	60	45	90-120
Tomato	Indirect	60	30	90-120
Garden pea	Direct	30	10	75-90
French bean	Direct	45	20	75-90
Capsicum	Direct	60	30	90-100
Pumpkin	Direct	180	180	100-120
Pointed gourd	Direct	100	50	90-120
Okra	Direct	50	30	90-120
Radish	Direct	30	10	60-100
Onion	Indirect	15	10	110-165
Garlic	Direct	15	7.5	120-140

Sowing/Planting

There are two ways of sowing seeds, depending on the size of the seed. The best planting method is always indicated on the seed packet.Sowing directly is best for larger seeds that are easy to handle. Sowing indirectly into seedbeds is best for very small seeds that are difficult to handle. The seeds are germinated in a propagator and moved outdoors later.

Direct Seeding

- ☑ Sow seeds (soaked and organically treated) on line as per seeds size and shape, just half an inch of depth
- ☑ Cover the seeds with fertile soils/FYM
- ☑ Ensure seedling transplantation of certain plants (chilli, cabbage, tomato etc.) between 15 to 21 days of aged
- ☑ Direct sown crops like okra, cluster beans and cowpea can be sown on one side of the ridges at a spacing of 30 cm
- ☑ Small onion, mint and coriander can be planted/sown along the bunds of plot
- ☑ Seeds of transplanted crops like tomato, brinjal and chilli can be sown in nursery beds or pots one month in advance by drawing lines
- ☑ After sowing and covering with top soil and then dusting with 250 grams neem cake so as to save the seeds from ants
- ☑ About 30 days after sowing for tomato and 40-45 days for brinjal and chilli and big onion the seedlings are removed from nursery and transplanted along one side of the ridges at spacing of 30-45 cm for tomato, brinjal and chilli and 10 cm on both the sides of the ridges for big onion
- ☑ The seedlings can be watered once in two days in the earlier stages and then once in 4 days later
- ☑ The perennial plants should be located on one side of the garden, usually on the rear end of the garden so that they may not shade other crops, compete for nutrition with the other vegetable crops
- ☑ Adjacent to the foot path all around the garden and the central foot path may be utilized for growing different short duration green vegetables like coriander, spinach, colocasia etc

Transplanting

- ☑ The seedlings are ready to be planted out when they have four leaves or the stalk is as thick as a pencil. Transplanting means moving the seedling and surrounding soil to the grow box or container. Here are some tips for transplanting seedlings:
- ☑ Choose the sturdiest, healthiest plants
- ☑ Plant out in the afternoon or on a cloudy day to ensure that the seedlings are not damaged by strong sunlight.
- ☑ The day before planting out, water the grow boxes and plant pots thoroughly, to create the best possible environment for the seedlings.
- ☑ Remove the seedlings and a little soil, using a trowel or small spoon. Use a stake or spade to make 10 cm drills in the grow box or pot, making sure you leave the right amount of space between each plant.
- ☑ The plant roots should point downwards and be separated. In one quick movement, cover with soil and press down lightly to remove any pockets of air. Make sure that you bury plants as deeply as before.
- ☑ When you have finished transplanting the seedlings, water gently, making sure that the roots remain covered. You can punch holes in a water bottle or jar lid to produce a fine spray.

Chapter-8

Nutrient Management

Nutrient requirement of vegetables and fruits

Plants require primary nutrients Nitrogen (N), Phosphorous (P) and Potash (K) in large quantities which are supplied through organic manures like decomposed cattle manure, vermi-compost, oil cakes, bone meal and wood ash. Chemical fertilizers like Urea and Ammonium Sulphate for N, Super Phosphate for P and Muriate or Sulphate of Potash for Kin major quantities and secondary nutrients. Secondary nutrients like Sulphate (S) Calcium (Ca) and Magnesium (Mg) are required in medium quantities. S is available in sulphate fertilizers like Ammonium and Potassium Sulphate. Super Phosphate contains both S & Ca. Other micro-nutrients like Iron (Fe), Manganese (Mn), Boron (Bo), Copper (Cu), Zinc (Zn) and Molybdenum (Mo) and Chlorine (Cl) are required in small quantities. In case of deficiency these are supplied as micro nutrient fertilizers either separately or in combined form. These can be supplied either as soil application or as foliar spray. All these nutrients are available in organic manures in a balanced way. Conversion of cattle manure and farm waste into vermi-compost and applying is preferred in nutrition garden. Bio-fertilisers like Rhizobium culture, Phospho-culture, Azotobacter, Azospirillum are now available to supplement the nutrient need of crops.

Organic manure

Matter produced from the decomposition of dead bodies of any organism or the excreta of any organism becomes an organic manure. Organic manure enriches the macro-nutrients in the soil like NPK (Nitrogen, Phosphorus, and Potassium). It also improves the soil texture and structure increasing the water-holding capacity.

Importance and efficacy of organic manure:

- ☑ It provides nutrition (macro & micro) to the plants in a simpler form making it easier for the intake by plants.
- ☑ It increases the population of beneficial organism in the soil.
- ☑ It increases the water holding capacity, as well as air holding capacity in the soil.

- ☑ It also helps maintain the soil at a proper pH, saving it from being acidic or basic.
- ☑ It helps control the temperature of the soil.
- ☑ It also helps prevent soil erosion.
- ☑ Moreover, it helps prevent plant diseases to some extent.

Compost

Compost is a form of organic matter and can be made from a range of organic materials usually considered to be waste.

- ☑ Ingredients: Straw, cut grass, organic waste from the kitchen, weeds, plants, leaves, animal manure (except from dogs and cats), wood ash, animal and fish bones, feathers, cotton cloth, bits of leather or paper, soil.
- ☑ Do not use cooked food, large pieces of wood, plastic, metal, glass, crockery, wire, nylon, synthetic fabrics, coal ash, seeding grass or very tough weeds.
- ☑ Composting is a natural process that involves the decomposition of organic matter. Millions of microorganisms drive the compost process by breaking organic matter down to its original nutrient form.
- ☑ Highly beneficial to soil and plant growth.

Preparation of Compost

Compost can be prepared in a pit method or heap method for nutrition garden. But vermi-composting and NADEP compost methods are ideal for nutrition garden.

Vermi-compost:

Vermi-compost is the bye-product of the earthworm's excreta when worms consume cattle dung, leaf mould and other organic wastes for their food. It is a complete, balanced and natural feed for all types of plants, and can safely be used for vegetables, flowers, fruit trees, foliage and field crops. It contains more nutrients than compost or farm yard manure.

There are different methods of making vermi-compost. In the 'pit' method, a pit has to be made by digging out the soil from a portion of the field, and in the 'heap' method a structure has to be made by using cement & bricks. Alternatively, portable vermi-bags are also available. Dimensions of the pit or the cemented structure: - Length 6 ft or more, breadth 3-4 ft. and height 2-2.5 ft. The structure is to be made in such an order that the excess water can ridge out from that. In the 'pit'

method, layers of polythene have to be kept so that the micro-organisms and the liquid of that vermin-compost cannot leak out directly to the soil. It needs a cool & dark place so as to prevent drying.

Preparing a vermi-bed

The lowermost layer should be of one inch thick of gravels on the polythene. Next should come a layer of 1.5 inches of sand on the layer of gravels. Then comes the layer of 1.5 inches of coconut coir on the layer of sand. After that fill the pit with decomposable matter and cow dung, and wait for about three weeks until the decomposable matter gets partially decomposed naturally. Basically two varieties of earth worms are used to make vermin-compost, *Eisenia fetida* and *Eudrilus eugeniae*. These can be purchased from people already doing vermi-composting on commercial basis. There are some government departments which also provide support for this initiative. The vermi-bed should be sprayed with water regularly, so that the moisture in the bed can be maintained facilitating the compositing process.

Application

Since vermi-compost is very rich in nutrients than ordinary compost, hence three table-spoonfuls for a mature plant may be enough. Dig lightly into the soil around the plant, and apply this as a top dressing. Then cover it with soil followed by deep watering. Mixing two table-spoonful of this compost with four cups of water and leaving the mixture for about 24 hours produces a liquid manure known as 'worm tea' or 'compost tea' which is very useful in applying as a spray. It is in a way similar to amrit pani. The liquid that comes down from the ready-to-use vermi-bed is known as 'vermi-wash' It is also very rich in nutrients. It can be collected at an interval of 10 days. Mix 10 litres of water in 1 litre of vermi-wash, and spray it as a pesticide too.

Precautions

Bitter leaves like neem and kalmegh, onion and garlic peels are prohibited to be used in this compost. Non-decomposable materials are prohibited to be used as ingredients. Chemical pesticides and insecticides are also prohibited. Keep it safe from mouse, hen, and other earth-worm-eaters. Shade is also important factor in vermi-compost. The compost needs to be stored in a breathable container. Composting can be done

either in pits, concrete tanks, well rings, wooden beds, earthen floor or raised beds. A shed is needed to protect the earthworms from sun and light. They have to be also protected from natural enemies like poultry, ducks and other birds. The optimum temperature for vermi-compost production is 25-30^{0}C. For a 10 sqm bed the materials required are:

- ☑ Dry organic matter 200-300 kg
- ☑ Decomposed FYM 300-400 kg
- ☑ Earthworms 10000
- ☑ Water for ready supply
- ☑ Old gunny bags to cover the beds
- ☑ Temporary shed.

Nadep Compost

Tank construction:

Build a rectangular tank of 3m x 2m x 1 m made of brick walls and floor with mud plaster. Leave holes in the tank walls for aeration (about 4 holes along each side wall and two holes in each end wall). Plaster the inner walls and the bottom of the tank with mud and cow dung mixture.

Raw materials:

- ☑ Waste organic matter: about 1500 kg (remove glass, polythene, stone, metals etc.)
- ☑ Cattle dung: 90-100 kg
- ☑ Dry sieved soil: 1750 kg
- ☑ Urine soaked soil is more effective
- ☑ Water: Enough to keep the pit moist

Method of filling:

First Layer : 15cm compact layer of plant waste material

Second Layer : Cow dung slurry (4 kg dung mixed with 10 bucket of water) and drench thoroughly

Third layer : Add 2cm of sieved fine soil (60 kg). Keep adding layers in this way until the materials are heaped 15 cm above the lip of the tank. Add another 7cm layer of fine soil on the top heap and seal the tank with cow dung plaster.

- ☑ Build a temporary shed of thatch and bamboo to shield compost tank from direct sunlight and rain.
- ☑ After 3-4 months digestion is complete and compost is ready having dark colour and pleasant smell.
- ☑ Sieve through a thick mesh and use the compost. In order to improve the quality of compost, at 75-80 days make some holes by bamboo. 500g PSB, 500g azotobacter and 500g rhizobium is added to 23 litre of water and poured through the holes and the holes are closed. This will increase the quality of compost.

Liquid manure

Most organic manures are either in solid or semi-solid form (such as cow dung); but the liquid manure, which is basically a mixture formed by different micro-organisms, is an exception. It is a low cost and time efficient manure.

Fresh cow dung and urine is mixed in the unit at 1:1 ratio. Then 10 parts of water is thoroughly mixed and allowed for fermentation process. This will take 12 hours, and then add 1 kg of jaggery for every 100 litre fermented solution. Again, it is allowed for fermentation and sedimentation process. The clear and enriched liquid organic manure is ready for field application in another 12 hours.

Amrit Pani

Amrit pani is an Instant soil fertility enhancer. It can also be used for seed treatment. It is a mixture of 10 kg cow dung, 500 gram honey and 200 gram desi cow ghee. The mixture is diluted in 200 litre of water and used over one acre by sprinkling or with irrigation water.

Ingredients: Water-200 litres, cow dung-10kg, honey or jaggery-500grams, desi cow ghee/ mustard oil -250 grams/ml

Preparation:

Cow ghee is thoroughly mixed with cow dung and honey or jaggery. It is diluted with 200 litres of water and stored in a container/drum, It should be stirred twice a day for a week.

Usage:

- ☑ For seed treatment use 20 parts Amrit pani solution and 80 parts water. Seed or seedling treatment with Amrit pani can be done for better germination and management of soil borne diseases.
- ☑ To increase Soil fertility 200 litres of Amrit pani should be used per acre along irrigation water

Panchagavya

Ingredients:

Cow dung 7 kg, cow ghee-1 kg, cow urine-10 litres, water-10 litres, cow milk-3 litres, cow curd-2 litres, jaggery-3 kg and ripe banana-12 numbers.

Preparation:

Mix cow dung and ghee and keep it for three days. Add water and cow urine to this after 3 days and keep it for 15 days with regular mixing during morning and evening. After 15 days mix cow milk, cow curd, jaggery and banana and close the mouth of the drum. Stir twice daily and Panchagavya will be ready after 30 days.

Use:

3% solution can be sprayed. The solution of Panchagavya can be mixed with irrigation water at 50 litre per ha either through drip irrigation or flow irrigation. Soak the seeds or dip seedlings for 20 minutes in 3% solution before planting or seeding. The seeds can be dipped in 3% solution before drying and storing.

Jeevamruth

Ingredients:

Cow dung-10 kg, cow urine-10 litres, jaggery-2 kg, pulse grain powder-2 kg, live forest soil-1 kg and water-200 litres.

Preparation:

Mix all properly and keep for fermentation for 6-8 days in a drum. Stir the solution regularly twice daily.

Use:

Apply when ground is ready for planting.500 litres is required for one ha. It can also be used in irrigation water.

Beejamruth

Ingredients:

Cow dung 5 kg, lime 100 gram, cow urine 5 litre, sajiv soil 50 kg and water 20 litres.

Preparation:

Take 5 kg cow dung in cotton cloth and dip in water. Take one litre of water and add 50 gm lime in it. Squeeze the solid portion of cow dung.Add 5 litre of cow urine, 1 litre lime water 50 gm sajiv soil and 20 litres of water. Keep the mixture for 12-16 hours. Filter it and use in seed treatment.

Sanjeevani

Sanjeevani is a mixture of cow dung, cow urine and water in 1:1:2 ratios and kept for fermentation for 7-9 days with regular stirring.

Cow dung

Cow urine

Water

Beeja Sanjeevani

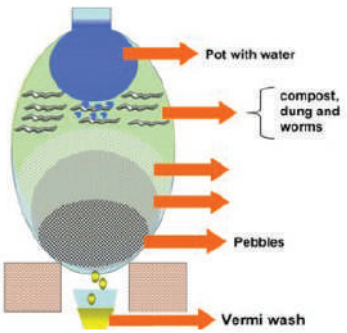
- ✓ This is 20% aqueous solution of sanjeevani
- ✓ Planting material dippped, dried and planted
- ✓ 2-3 liters solution is required for 1kg seeds
- ✓ Enriches the seeds to provide nutrients and growth promoting hormones during initial growth

Beeja Sanjeevani

- ✓ This is 5% and 10% solution of sanjeevani
- ✓ 5% is sprayed at initial stages up to 30 DAS
- ✓ It can also be mixed in irrigation water
- ✓ 40 litres of 5% solution is required for 1 acre

- ✓ **Mix these ingredientsin the ratio of 1:12 in an earthen pot**
- ✓ **Keep it for fermentation for 7 - 9 days**
- ✓ **Stir twice a day**

Vermi-wash



- ✓ Big earthen pot/plastic drum with a tap fitted to the bottom placed in the shade.
- ✓ Laid out concrete or red sand 5 cm in the bottom
- ✓ 30-40 cm thick layer of soft kitchen waste or 10 days old dung filled in the pot
- ✓ Introduce 500-1000 earthworms in the pot
- ✓ An earthen pot with the minutes hole in the bottom hanged over the pot after 15 days of inoculation.
- ✓ After 2-5 days extract collected in the earthen pot from the tap is called vermiwash

Spray system

- ✓ Vermi-wash is diluted in water 5 times and sprayed on the foliage of crops

Flow system

- ✓ Vermi-wash is diluted in water 5 times and sprayed on the foliage of crops

Seed/Seeding treatment

- ✓ Vermi-wash is diluted in water 5 times and sprayed on the foliage of crops

Chemical Fertilisers

Gardeners should have their soil tested about every 2 years. This is especially important for beginners who are unfamiliar with growing plants. A soil test clearly indicates the levels of nutrients in the soil and recommends the amounts of each nutrient to add.

- ☑ Do not use too much fertilizer. This can kill plants.
- ☑ Use recommended dose of fertilizer
- ☑ Fertiliser can be broad casted during land preparation (basal) or as top-dressing

- ☑ It can be used in band placement or in ring method. The fertilizer is applied in a strip to the side of the row before planting. With this method you must be careful to prevent the roots from coming in contact with the fertilizer band, which can kill plants.
- ☑ In limited cases foliar application can be taken up

Integrated Nutrient Management

The prolonged and over usage of inorganic fertilizers has adverse effect on human and soil health, besides creating serious concerns of environmental pollution. Hence the use of integrated nutrient management becomes indispensable for maximizing vegetable/fruit production, productivity, sustaining soil health and quality.

- ☑ Minimum tillage to conserve soil organic matter and biotic life including earthworms.
- ☑ Convert all available biomass on the farm into compost.
- ☑ Add at least 2-3 tonnes of compost par ha annually(10 t is ideal)
- ☑ Incorporate leguminous plant materials into the soil.
- ☑ Make up soil deficiencies by applying minerals such as rock phosphate, gypsum and pyrites.
- ☑ Apply pot manure or liquid manure
- ☑ Adopt suitable crop rotation, mixed and inter-cropping.
- ☑ Include legumes in crop rotation.
- ☑ Use appropriate bio-fertilizers
- ☑ Add small quantity of chemical fertilizers on the basis of soil test report.
- ☑ Use micro-nutrients like Boron, Molybdenum, Zinc, Iron etc. when deficiency is noticed.

Organic farming

The basic principles to be followed in organic farming are:

- ☑ Cultivate crops in the ideal cropping season
- ☑ Avoid off-season cultivation of vegetables in traditional growing areas since it may result in heavy incidence of pests and diseases.
- ☑ Cultivate varieties already acclimatized in the locality. Priority should be given to medium yielding varieties tolerant to pests and diseases rather than high yielding varieties.

- ☑ Select pest and diseases resistant varieties in areas and seasons when severe incidence of pests or diseases is expected.
- ☑ Follow scientific crop rotation practices regularly in vegetable cultivation.
- ☑ Raise a leguminous crop and plough back to soil at its pre flowering stage before cultivating a heavy feeding vegetable crop in particular site.
- ☑ Practice shifting type of cultivation and keep land fallow at least one season in a year.
- ☑ Plough back all the crop residues to the soil whenever a crop is over.
- ☑ Practice composting regularly for converting biodegradable wastes to organic manures. Fungi like *Pleurotus sp.*, and earthworms (*Eudrillus eugineae*) can be effectively utilized for making compost at a faster rate and for making it nutrient rich.
- ☑ Locally available organic materials like farmyard manure, poultry manure, goat manure, green leaves, organic cakes, fish meal, bone meal, etc. may be given priority for use in the organic farming. Apply farmyard manure or compost as basal dose and organic concentrates like organic cakes, poultry manure, vermin-compost etc. as top dressing.
- ☑ Use weeds as mulches or cover it with soil for converting to organic matter. In organic farming, native strains of bio-fertilizers like Rhizobium, Azotobacter, blue green algae, azolla, phosphate solubilizing bacteria and fungi, mycorrhizal fungi, etc. may be utilized for fixing nitrogen and increasing availability of phosphorus to plants. The enzymes and hormones produced by microorganisms also impart favourable effects on growth and productivity of crops.
- ☑ Burning pits before sowing or practice solarisation to control soil borne pests and diseases.
- ☑ Remove alternate hosts of pests and diseases and follow eco-friendly pests and disease control measures like cutting and removal of pests and diseases plants or plant parts, trap cropping, use of colour, sticky and other traps for attracting and killing insects.
- ☑ Promote biological control of pests and diseases by promoting parasites and predators.
- ☑ Homemade insecticides like neem oil – garlic mixture, neem kernel suspension, tobacco decoction, etc. have wide use for control of pests and diseases in organic farming of vegetables. Plants like Andrographis sp., Clerodendron, Eucalyptus etc. also have values in pest control.
- ☑ Microorganisms like viruses, fungi, bacteria etc. are currently utilized in pest control under organic farming.

Chapter-9

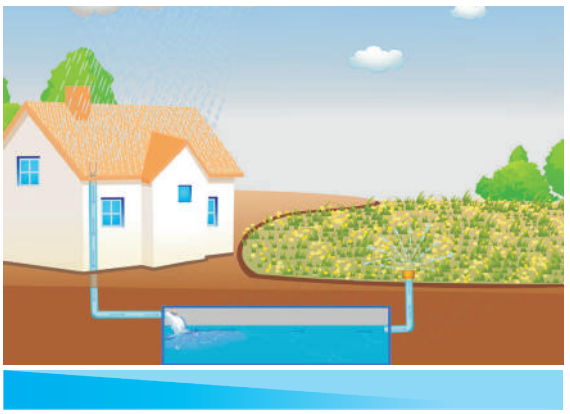
Water Management

Importance of water

Water helps a plant by transporting important nutrients through the root and stem. Nutrients are drawn from the soil and used by the plant. Without enough water in the cells, the plants droop, so water helps a plant to stand. Water carries the dissolved sugar and other nutrients through the plant. So water is an essential input for nutrition garden. The crops get water from rainfall or irrigation.

Water Harvesting

Where irrigation is limited, rainwater harvesting is the option. Water-harvesting structures stop the flow and instead cause the water to sink into the soil where it can be used by plants. Where sloped areas need to be used for cultivation, contour ridges or terraces need to be made. You can use a simple tool called an A-frame to measure contours (imaginary lines which run at right angles to the direction of a slope). After marking contours with the A-frame, ridges and trenches can be built to catch, divert and sink run-off water. Identify areas for water-harvesting Identify areas at the school where water run-off may be causing problems (such as all sloped areas, areas of bare soil, paths, roads, roofs, taps, sinks and showers).



Capturing runoff from rainfall either to divert water directly to crop root zones or to store it for future use is an ancient technology .At household level, methods for capturing water range from shaping the land around the household to direct water onto fields or into underground storage tanks, to harvesting water from rooftops and storing it either in above-ground or underground tanks

Water management in nutrition gardens

Most of the vegetables are medium duty crops while some vegetables like legumes and cucurbits are light duty crops. Crops like colocasia are heavy duty crops. Therefore irrigation needs of vegetables and fruits differ as per type, soil characteristics and weather. The following tips will be useful for water management of vegetables and fruits in nutrition garden.

Add organic matter

Adding compost to the soil will help reduce the plants' need for water. Studies have found that increasing the amount of organic matter by only 5% will quadruple the water holding capacity of the soil. Compost can be worked into the soil for incorporation. The residues of the previous crop can be incorporated into soil for increasing organic matter content of soil. Green manuring with cowpea and beans will not only add organic matter to the soil but the legumes in the mix will fix nitrogen and increase the fertility, a win-win way to go.

Mulching

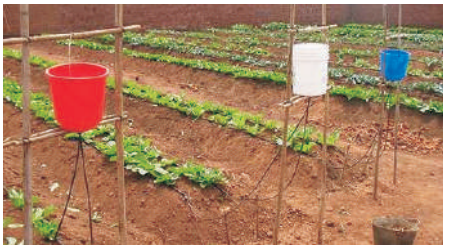
Mulching helps to reduce evaporation and cool the soil (or warm the soil depending on the type of mulch used). Mulching can reduce the plants' water needs as much as 50%. Straw is a good mulch and as it breaks down it will add organic matter to the soil. Mulch is any material used to cover the soil to help it retain moisture. Mulch helps to protect the soil from erosion and can improve soil fertility and its capacity to store water, prevent the soil from drying out and reduce the number of weeds. Dry grass, dry leaves or compost all make good mulch material. Use a thick layer, about 1-3 inches is a good rule of thumb. Newspapers (only newsprint) can be put down around plants to help to cut down on weeds and reduce evaporation. Use about 2-4 layers and secure with ground staples or just put some straw cover to keep in place. Polythene mulches can also be used.

When applying mulch:

- ☑ Avoid materials which have seeds or roots (to prevent weeds growing from the mulch);
- ☑ If using dry grass or dried leaves as mulch, sprinkle a layer of wood ash and a thin layer of well-rotted manure on the soil before applying the mulch. This will avoid the nitrogen starvation of crops by soil bacteria which are breaking down the mulch.

Use drip irrigation

Drip irrigation applies water to soil/roots and reduces evaporation. Use the correct emitters to deliver the right amount of water to the vegetable bed. Put the drip irrigation under the mulch to cut down on evaporation.



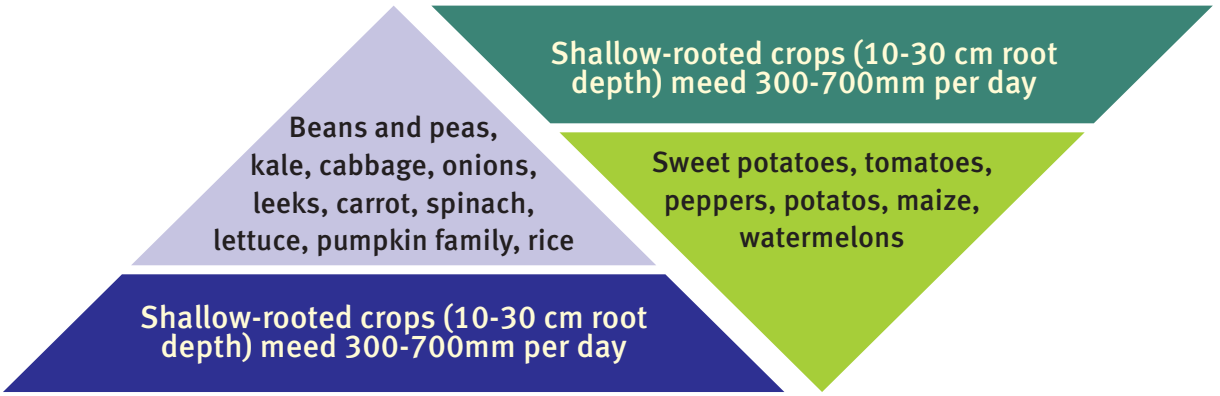
In general, drip irrigation saves a substantial amount of water and labour, increases yields, and often also improves the quality of the produce. Bucket kits are a complete unit with a bucket, drum or tank placed about 1-1.5 m above the ground, a valve to control the flow (simple on-off in basic units), a screen to filter the water, plastic water distribution lines, dripper lines, and emitters (or micro-tubes or drippers). They operate by gravity. They are usually designed for areas ranging from 25 to 500 m2; some are modular, enabling expansion over time. Because they are made with lower-cost materials, they are cheaper than conventional commercial drip irrigation systems; but they are also less robust as a result. Solar pump with drip system has been popular.

Adjust the irrigation to meet the critical needs

Water needs will vary depending on the stage of development of crops. Moisture levels are critical when plants are young and have not developed a mature root system, right after transplanting and during flowering and fruiting. Watering should be given at these critical stages.

Change the type of crops

Consider not growing crops that are heavy water users like corn or potato and cauliflower/cabbage etc. If you can't do without in the garden, make sure to mulch heavily. Try to grow deep rooted crops.



Change planting pattern

Plant in blocks as opposed to rows. Leaves shade the soil and you get less evaporation.

Adjust watering time

Clay soil holds water well but absorbs it slowly for which use low flow emitters, longer duration and water less frequently. Sandy soil is the exact opposite of clay soil and loam is something in the middle. So the frequency of irrigation will be as per soil and depth will vary. Irrigation in cool hours reduces surface evaporation.

Control weeds

Weeds compete with plants for water and nutrients. So remove weeds from the field to reduce water demand.

Pitcher Irrigation

Use of buried unglazed clay plots, often called 'pitcher irrigation', is another very ancient irrigation technology appropriate for home gardens, especially in dry areas .The pot is buried near the root zone of trees (or other crops), filled with water, and covered to prevent evaporation. The water seeps slowly through the porous sides

of the pot, and minute hairs on roots pull the water out. Pitcher irrigation encourages deep rooting and reduces evaporation: it not only saves water but saves labour too; and it has fewer technical problems than drip irrigation. A variation described by is 'bottle-feeding' of tree seedlings. In this technique, a bottle is filled with water and sealed .A small hole is punched into the top and the bottle is inserted top-first into the root zone at an angle. It needs to be refilled every few days. During the dry season it is important to make the most of what little water is available. You can use methods such as clay pot watering or bottle watering (illustrated below) to give water to plants

Water conservation tips

- ☑ Add organic matter to the soil to help it retain water.
- ☑ Use the clay pot or bottle-watering methods to conserve moisture (see illustration).
- ☑ Cover all soil, including paths, with mulch.
- ☑ Plant groundcover plants on bare soil (e.g. beneath fruit trees).
- ☑ Plant small crops beneath large crops in beds.
- ☑ Gently fork the soil in beds to improve infiltration and root penetration.

Tips for watering fruit crops

Some fruit trees need more water when they are still becoming established. Once trees are mature, they may be watered less. Tree tomatoes, papayas and bananas need more water than most other fruit trees, while citrus (orange and lemon), avocado, mango, mulberry and guava trees need less water.

- ☑ Fruit trees should be given extra water when flowers begin to form, as this will help with fruit production.
- ☑ Avoid over-watering.
- ☑ Give vegetables water during dry periods or when plants show signs of water stress. On average vegetable beds need watering twice per week.
- ☑ Apply two buckets (20 litres) of water per each square metre of bed.
- ☑ The soil should be watered gently as the force of pouring water can compact the soil and reduce penetration.
- ☑ If you do not have a watering can with a rose, make a watering rose using a plastic cup or bottle with holes punched through the base (as shown in the illustration).

Chapter-10

Pest Management

What is a pest?

Pests are harmful organisms that cause damage to crops. They may be insects, diseases or weeds. The problems are usually caused by poor management practices such as growing crops at the wrong time of year or giving plants too much or too little water or fertiliser.

- ☑ The use of pesticides can also worsen pest problems by killing beneficial animals which would otherwise eat pests.
- ☑ Pests also quickly become resistant to pesticides, prompting farmers to use stronger chemicals which in turn lead to increased pest resistance.

Pest control methods

The most effective means of controlling pests and diseases in the long term is to use a combination of the management methods described below.

- ☑ Chemical methods should only be used as a last resort.
- ☑ Home-made sprays can be effective against a wide range of pests and diseases and provide a safer and cheaper alternative to bought sprays.
- ☑ If you do buy sprays, make sure you know exactly which pest you are targeting and how to use the spray correctly.

Pest Management

Good crop management is the best way to prevent pest and disease outbreaks from occurring in the first place.

- ☑ Give crops enough nutrients and water to enable them to use their own defences against pests. Avoid over-watering and using chemical fertilisers. These can make plants grow too fast, thereby making them weak and susceptible to pest and disease attacks.
- ☑ Practice crop rotation and inter-cropping.

- ☑ Ensure that crops are planted at the correct time of year to match their requirements; Try to find out which creature is causing the problem.
- ☑ Make strong trellises to lift climbing or trailing plants (such as cucumbers, pumpkins, tomatoes, beans and peas) off the wet ground.
- ☑ Plant members of the pumpkin family on mounds to improve drainage and prevent disease.
- ☑ Destroy infected plant material by burning or placing it in the centre of a hot compost heap. Pick up all fallen fruit from fruit trees, tomatoes, pumpkins or squash and feed it to livestock to kill fruit fly larvae.
- ☑ Keep weeds under control so they do not compete with vegetables.

Encouraging beneficial animals

Many insects (including ladybirds, praying mantises, assassin bugs and wasps), spiders, birds, frogs, lizards and other animals eat pests.

- ☑ To attract these beneficial animals, plant flowers around the garden and make piles of rocks in the garden.
- ☑ Chickens and other poultry can help when clearing land to be used for crops, since they can remove pests (including grasshoppers, cutworms, caterpillars and other bugs) and weeds as well as improving the quality of the soil with their manure.
- ☑ Strong-smelling plants (e.g. marigolds, herbs, onions and garlic contain chemicals that repel a variety of pests. These plants should be intercropped with vegetables or grown as hedges around gardens.

Hand-picking pests

Large pests including grasshoppers, bugs, slugs and snails and caterpillars can be picked off by hand from plants. Swarms can be removed by brushing plants with a soft broom. Any insects that are caught can be fed to chickens. If pests are too small to pick, squash them on the side of the plant. The smell repels other insects.

Slug traps

Slugs and snails can be caught in shallow containers filled with old beer. Put one or two traps in each bed, especially during the rainy season. Feed the drowned snails and slugs to chickens.

How to make a fruit fly trap:

To make a fruit fly trap, cut the top half from an old plastic water bottle and make a small hole in the lid. Turn the funnel-shaped top section upside down and place it inside the lower part of the bottle. Fill the lower part about ¼ full of water and rotting fruit such as guava, mango or pumpkin; Hang the fly trap in affected fruit trees or place them in beds where pumpkins, cucumbers or squash are growing. The flies will be attracted by the smell from the trap and will fly in through the small hole in the lid, becoming trapped.

Food residue can also be used to trap insects

Place old cabbage leaves, half an orange skin or half a pumpkin or squash shell on plant beds in the afternoon. Early the next morning, collect the slugs, snails, caterpillars and cutworms that have hidden under the traps.

Other Traps

Use of pheromone traps is recommended for tomato fruit borer, army worms, fruit flies, legume pod borers, eggplant and okra fruit and shoot borers, diamondback moth, and other pests for monitoring and/or mass-trapping. Yellow sticky traps could be used to monitor and trap whiteflies, leafhoppers, winged aphids, adult leaf miners, and other species. Blue sticky traps are recommended for managing thrips.

Cultural practices

Clean cultivation is essential since weeds could act as the alternate hosts for the insect pests and the virus diseases transmitted by insects. Healthy seedling production practices should be followed to ward-off the early season sucking pests and the viruses that they transmit. Plants from the same family should not be planted next to each other, since they may share the common pests and diseases.

Use resistant/tolerant varieties

Various resistant and tolerant varieties against key pests have been released from research stations. In pest endemic areas such varieties need to be introduced. Some of the varieties are listed below.

Crop	Variety	Pest Resistance	Source
Tomato	Hissar Anmol	Leaf curl virus	HAU, Hisar
Brinjal	BB-7, BB-44	Bacterial wilt	OUAT
	Pant Ruturaj	Bacterial wilt	GBPAUT, Pantnagar
	Pusa Bhairav	Phomopsis wilt	IARI, ND
Cabbage	Pusa Mukta	Black rot	IARI, Katrain
Cauliflower	Pusa Subhra	Black rot	IARI, Katrain
Pea	FC-1	Powdery Mildew	IIHR, Bangluru
Cowpea	Pusa Komal	Bacterial blight	IARI, ND
French bean	Pant Anupam	Mosaic	GBPAUT, Pantnagar
Okra	Arka Anamika, Abha	YMV Mosaic	IIHR, Bangluru
	Parvani Kranti	YMV	MAU, Parbahani
Capsicum	Arka Gaurav	Leaf curl virus	IARI, ND
Chilli	Pusa Jwala	Leaf curl virus	IARI, ND
Cucumber	Poinsete	Powdery mildew	NSC
Musk melon	Arka Rajhans	Powdery mildew	IIHR, Bangluru
Water melon	Arka Manik	Powdery mildew	IIHR, Bangluru

Barriers

Smear the stems or trunks of plants with a ring of cooking oil or petroleum jelly to prevent insects from crawling up to suck the tender plant leaves or fruits. Protect young plants from caterpillars, mice and grasshoppers by using old plastic containers or tin cans with the base cut out. Press the container a few centimetres into the soil to prevent damage by cutworms. Make barriers around plants to prevent crawling insects from attacking them.

Only use chemical pesticides as a last resort. You can make some home-made pest and disease remedies which are safer and cheaper than those bought from shops. Mix a handful of sawdust with a sticky substance such as molasses, syrup or tree resin and sugar to make a paste. Spread the paste on plant beds at specific points. The sweet smell attracts cutworms, which then get stuck in the mixture.

Crop leaves may be dusted with clay, lime, flour, chalk, rock dust or wood ash to kill thrips, aphids, mites and whitefly. Lime dust kills loopers, slugs and small beetles and should be spread around the base of plants to repel most crawling pests. Chilli or garlic powder can be used to treat ants, crawling insects and some soil pests. Powders in general can be used to prevent pest attacks on stored grain and can be made from dried, crushed basil leaves, chilli and garlic to treat fungal infections.

Use herbal products

Neem kernel extract:

50 g of neem kernel is required for use in 1 litre of water. The kernel is pounded gently so that oil does not come out. The outer coat is removed before pounding and used as manure. The kernel should be 3-8 month old as azdirachtin remains in good quantity during this period. The pounded kernel powder is gathered in a muslin pouch and soaked overnight in water. The pouch is squeezed and the extract the filtered. The filtrate is mixed with sandovit, soap pill, nirma or soap cake. One ml of emulsifier is added to 1 litre of water.

Neem leaf extract:

For 5 litre of water, 1 kg green leaves are required. The leaves are soaked overnight in water. The next day the leaves are ground and the extract is filtered. The extract is beneficial against the leaf-eating caterpillars.

Neem cake extract:

100 gram of neem cake is put in a muslin cloth pouch and soaked in 1 litre of water overnight. It is filtered and emulsifier is added @ 1 ml in 1 litre and sprayed on crops.

Neem oil spray:

30 ml of neem oil is added to 1 litre of water and stirred well. Add emulsifier @ 1 ml per litre of water and spray immediately

Panchagavya

Ingredients:

Cow dung 7 kg, cow ghee one kg, cow urine 10 litres, water 10 litres, cow milk 3 litres, cow curd 2 litres, jaggery 3 kg and ripe banana 12 numbers.

Preparation:

Mix cow dung and ghee and keep it for three days. Add water and cow urine to this after 3 days and keep it for 15 days with regular mixing during morning and evening. After 15 days mix cow milk, cow curd, jaggery and banana and close the mouth of the drum. Stir twice daily and Panchagavya will be ready after 30 days.

Use:

3% solution can be sprayed. The solution of Panchagavya can be mixed with irrigation water at 50 litre per ha either through drip irrigation or flow irrigation. Soak the seeds or dip seedlings for 20 minutes inn 3% solution before planting or seeding. The seeds can be dipped in 3% solution before drying and storing.

Jeevamruth

Ingredients:

Cow dung 10 kg, cow urine 10 litres, jaggery 2 kg, pulse grain powder 2 kg, live forest soil 1 kg and water 200 litres.

Preparation:

Mix all properly and keep for fermentation for 6-8 days in a drum. Stir the solution regularly twice daily.

Use:

Apply when ground is ready for planting. 500 litres is required for one ha. It can also be used in irrigation water.

Beejamruth

Ingredients:

Cow dung-5 kg, Lime-100 gram, Cow urine-5 litre, Sajiv soil-50 kg and Water-20 litres.

Preparation:

Take 5 kg cow dung in cotton cloth and dip in water. Take 1 litre of water and add 50 gm lime in it. Squeeze the solid portion of cow dung. Add 5 litre of cow urine, 1 litre lime water 50 gm sajiv soil and 20 litres of water. Keep the mixture for 12-16 hours. Filter it and use in seed treatment.

Sanjeevani

Sanjeevani is a mixture of cow dung, cow urine and water in 1:1:2 ratio and kept for fermentation for 7-9 days with regular stirring.

Amrit Pani

It is a mixture of 10 kg cow dung, 500 gram honey and 200 gram desi ghee. The mixture is diluted in 200 litre of water and used over one acre by sprinkling or with irrigation water.

Chemical methods

Pesticides provide immediate control. But many pests build up resistance to pesticides, thus becoming able to withstand stronger and stronger chemicals. Most beneficial animals are also easily killed by sprays. This can lead to the presence of "super-pests" that have no natural predators. In this situation the farmer then becomes dependent on expensive chemicals which can be harmful to human health and the environment. So pesticides can only be used when all other methods fail and pest build-up exceeds economic threshold level (ETL). Always consult local agriculture/horticulture staff to identify the pest and use appropriate pesticides.

Precautions in use of pesticides

- ☑ Do not use pesticides if you are: ill, pregnant, breast-feeding or under
- ☑ Never buy chemicals in unmarked containers
- ☑ Make sure the chemical is appropriate for the pest you want to kill

- ☑ Always read and follow the directions and safety instructions on the container
- ☑ Wear protective clothing when applying the pesticide
- ☑ Avoid contact with your skin
- ☑ Do not eat, drink or smoke when applying pesticides
- ☑ Do not eat vegetables that have been recently treated with pesticides
- ☑ Do not spray pesticides when it is windy
- ☑ Store pesticides away from food and keep them out of the reach of children
- ☑ After handling any poison, including home-made ones, wash your hands carefully with clean water and soap
- ☑ Bury pesticide containers and never use them for storing food items or water

Integrated Pest Management (IPM)

Limiting the damage that pests cause can be very important to farmers, particularly if the pest substantially reduces the harvestable yield. Integrated Pest Management (IPM) is an approach which combines all useful methods for controlling a certain pest (or group of pests); optimally these methods will work synergistically. Integrating different IPM methods effectively requires skill and knowledge. The more we know about a pest's biology and ecology, the better we can manage the pest and minimize damage from it. In IPM different methods will be used to keep the pest under control and the materials used to manage pests and diseases will be less expensive, locally available and will be user friendly. The IPM practices to be followed have been outlined below.

- ☑ Invert the soil after harvesting a crop to expose pests.
- ☑ Clean bunds and channels of grasses.
- ☑ Grow pest-tolerant varieties.
- ☑ Sow the crop at right time.
- ☑ Sow healthy seeds and increase the seed rate so that uprooting insect/disease-infested plants later does not affect optimum plant population.
- ☑ Use mechanical and physical methods.
- ☑ Release insect parasites and predators.
- ☑ Use bio-pesticides

.

Chapter-11

Intercultural operations, weeding, mulching and use of trellis

Inter-cropping

Inter-cropping is the planting of different types of plants in the same bed or row. Intercropping within rows in the same bed helps to intensify food production; yields may be lower for some crops, but more nutrients are produced per square metre. Inter-cropping has many other advantages. It reduces labour and saves space because the crops are close together; reducing the time spent on watering and compost application. Moisture is conserved because low-growing plants grown between taller plants cover the soil, reducing evaporation. This also reduces the space in which weeds can grow. Pest problems are reduced because pests and diseases prefer plants of the same family and are less interested in mixtures of many different crops. The nutrient needs of different crops are presented in Table below.

Heavy feeder	Cabbage, tomato, pepper, chillies, maize, pumpkin, cucurbits, potato, brinjal
Light feeders	Onion, garlic, carrot, beans and peas

Inter-cropping tips

- ☑ Plant heavy feeders (such as kale, maize and potatoes) with light feeders (legumes and root crops).
- ☑ Plant leaf crops next to root crops, fruit crops or legumes;
- ☑ Plant the seeds or seedlings according to the recommended spacing;
- ☑ Organise plants according to their different shapes. Tall, thin plants such as carrots, leeks, onion and garlic can be grown next to wide, low-growing plants such as cabbage, bush beans or spinach;
- ☑ Remember that different crops take up beds for different lengths of time. Kale or spinach may stay in beds for months or even years, as they can continue to grow while the leaves are being harvested. Others, such as beans and tomatoes, may only occupy beds for a couple of months.

Weeding

Weeds are unwanted plants which appear in beds or fields. They must be kept under control so that they do not compete with crops. Many weeds are useful, as they can be fed to livestock or made into compost, liquid fertiliser or home-made pesticides. Here are some tips for weed control:

- ☑ Pull up all unwanted weeds before they seed;
- ☑ Put weeds at the bottom of pits or heaps to kill them;
- ☑ Use thick mulch between vegetable plants to smother weeds;
- ☑ Intercrop tall plants such as maize and cassava with low-growing plants such as pumpkins, beans or sweet potatoes to reduce the spread of weeds.

Mulching

Mulch is any material used to cover the soil to help it retain moisture. Mulch helps to protect the soil from erosion and can improve soil fertility and its capacity to store water, prevent the soil from drying out and reduce the number of weeds. Dry grass, dry leaves or compost all make good mulch material.

Benefit of mulching

- ☑ It maintains the soil moisture
- ☑ It holds soil during irrigation and rains
- ☑ It helps preventing weeds.
- ☑ Mulching materials later on can be used as manure.
- ☑ It maintains soil temperature

Trellis

Planting vegetables vertically using a trellis offers advantages to gardeners beyond saving space. Managing pests and harvesting are easier because vegetable plants are more accessible. Fewer vegetables are wasted because ripe fruit are not hidden behind lush foliage, and trellised vegetables can be used to hide less attractive garden spots.

Varieties of common garden vegetables are well-suited to trellis planting. You can grow many long-vined varieties successfully in small spaces if you train them to grow on trellises. For cucurbits trellis is very important to increase the yield and facilitate harvesting. To get more yields, supporting the vine in vertical way is preferred. Wooden stake or tree branches can be put near the plant as trellis. Improved trellis in form of GI wire nets are now available which can be fixed to bamboo poles.

Training and pruning

- ☑ Pruning and training the vine over the trellis is very important to get maximum yield from the plant.
- ☑ Allow the plant to grow without any lateral branches and tendrils up to about 12 nodes of stem. Then, the main stem should be pruned.
- ☑ By this pruning, laterals growing from the nodes can arise. We should not allow any laterals branches from plant below the trellis, and should put them upward on the trellis.
- ☑ Lightly tie the stem with the trellis using a string, and prune those tendrils which go above the trellis.

Chapter-12

Harvesting & Post-Harvest Management

Producing nutritional food crops is the first step only, for it has to be followed by efficient management for balanced availability of nutrition in the diet as well as protecting measures to prevent nutrition loss during cooking.

DOs	DON'Ts
1. Pressure/steam cooking 2. Washing of vegetables properly before peeling & cutting	1. Wash the cut vegetables 2. Soak the cut vegetables for a longer time.

Harvesting of vegetables and fruits

Vegetables harvested at the peak of their maturity and used promptly are always superior in nutrition, flavour, taste, and appearance. Produce should be harvested only when it is mature. Under-ripe produce contains fewer nutrients while over-ripe produce may contain disease-causing organisms. The stage of maturity of a crop is indicated by the appearance of the produce. Fruit crops often change colour when they are ripe; cereals and legumes must be completely dry, while root and tuber crops should be harvested once they have reached the desired size.

Following tips are to be followed.

- ☑ Harvesting and handling of crops must be done with good hygiene in mind. The people, tools and containers used in harvesting crops must be very clean and dry
- ☑ Care should be taken not to damage any of the produce during harvesting
- ☑ Harvest root vegetables while they are still tender-delay can make them pithy, tough, and unfit for consumption
- ☑ Harvest all fruit and pod vegetables when they attain their proper size, while they are still tender.
- ☑ Melons, tomatoes, and ash gourd can be allowed to ripen on the vine
- ☑ Clip leafy vegetables frequently at their most succulent and tender stage
- ☑ Pumpkin, chill, colocasia, and onion bulbs can be harvested as immature or mature produce

- ☑ Harvested produce should be cleaned and sorted through in order to remove any blemished, damaged, over-ripe or under-ripe produce; harvesting different types of produce
- ☑ Root and tuber crops should be harvested when they reach the desired size. Sweet potatoes, Irish potatoes and yams do not store well but can be kept in pits for a few weeks (or, they can be dried and made into chips which can be milled for flour)
- ☑ Fruits and vegetables should be eaten soon after harvesting as they quickly lose nutrients and begin to decay. You can dry fruit and vegetables to preserve them

Preserving nutrients

Many people destroy valuable nutrients when they cook their food. The following points will help you choose and prepare nutritious meals.

- ☑ Eat food fibre. Dietary fibre, or roughage, aids in digestion. It is available in whole grains, fresh fruits, and vegetables. Whole wheat bread, bran cereals, crunchy raw carrots, and other root crops are especially valuable sources of fibre
- ☑ Eat unpolished rice. And remember, the water left after cooking your rice is very nutritious.
- ☑ Eat plenty of salad. Salad improves your appetite and aids digestion
- ☑ Eat fresh seasonal fruits and vegetables. Fruits and vegetables are very nutritious, and very tasty. Eat them in season and preserve them to have all year round

Follow these tips to reduce nutrient loss during cooking and processing:

- ☑ Eat the leaves of root vegetables, such as turnips, radish, beets, and knolkhol. Their leaves contain more nutrients than the root. Cook them with potatoes or a leafy vegetable.
- ☑ Cook vegetables in a pressure cooker. This saves time and retains more of the vitamins B and C.
- ☑ Salads, fruits, and vegetables should be washed first and then cut to prevent washing away water soluble vitamins B and C and minerals.
- ☑ Cook, preserve, or process cut fruits and vegetables immediately after cutting. Long soaking of cut fruits and vegetables washes away valuable nutrients.
- ☑ Select fresh and sound fruits and vegetables for cooking.
- ☑ Avoid deep-frying.
- ☑ Cook leafy vegetables on a low flame. Carrots and pumpkin can be cooked on a high flame.

Chapter-13

Preservation of Fruits and Vegetables

Preservation of vegetables and fruits

The surplus vegetables and fruits are either to be sold or preserved for lean season use.

- ☑ Select raw vegetables, such as cauliflower, ginger, lotus stem, carrot, radish, and raw mango slices.
- ☑ Peel, cut, and wash the raw material.
- ☑ Place the prepared material in glass jars.
- ☑ Prepare a chemical solution in pre-boiled tap water using 3 per cent salt, 0.8 per cent glacial acetic acid, and 0.2 per cent potassium meta-bisulphite.
- ☑ Pour the chemical solution into the glass jars containing the fruit and vegetables.
- ☑ Fill to the brim. (There should be 1 1/2 as much solution as fruit and vegetable mix.)
- ☑ Close the jars tightly and store them in a cool and dry place.
- ☑ Wash the vegetables and fruit thoroughly before cooking. For pickles, pakora, and chutney, the preserved mix can be used immediately after straining.

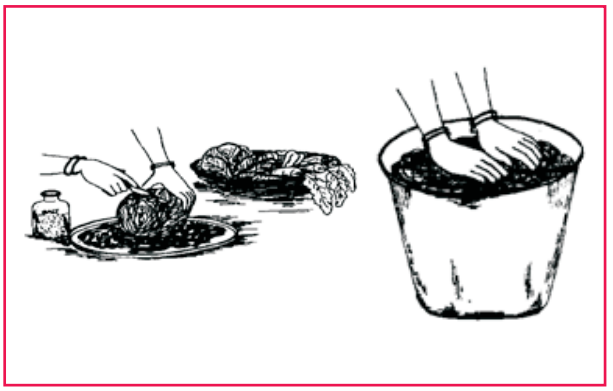
Preservation

Consider preserving your fruits and vegetables so you can enjoy them in the off season. They can be bottled, pickled, turned into chutneys, preserved as pulp or juice, fermented, or dried in the sun. There are various preservation techniques using sugar, salt, spices, chemical preservatives, or organic acids. Consult your local government nutritionist or look for someone in your community who can teach you food preservation techniques.

Fermentation

Fermentation is a great way to preserve several types of vegetables together at one time. One of the vegetables in the mix should be cabbage. Cabbage contains substances which help in fermentation. When cabbage is not available, radish or cucumber will serve the purpose.

Procedure



Select any type of vegetable except potato, sweet potato, or other vegetables which are rich in carbohydrates. Wash the vegetables thoroughly in clean water, and wipe them dry with a clean, rough cloth.

Shred the vegetables, preferably with a stainless steel knife or shredder. Cabbage (or radish or cucumber) should comprise at least half the total weight of the vegetable mix. Add 22 g (4-5 tsp) of common salt per kg of shredded vegetables and mix it thoroughly. Allow it to stand for an hour or two. Put the mixture in a glass or plastic container, such as a bucket. The size of the container depends on your requirement. If you are using a wood or earthen container, coat the inside with wax. Press down on the shredded vegetable mix until the brine solution is squeezed to the surface.

Press down on the shredded vegetable

Take a plastic sheet (200 gauge) twice the size of the mouth of the container and cover the mix.Press down on the plastic sheet to expel all the air.

Pour water on the plastic sheet so that the sheet will be forced down on top of the vegetable mix.

Fasten the hanging edges of the plastic sheet with a thick thread around the neck of the container to make it airtight. Keep the container in a cool place. Vegetables can be preserved by fermentation for about three months. But, once the container is opened, the vegetables in it should be used the same day. If this is not possible, preserve the leftover vegetables by bottling, refrigeration, or the use of preservatives.

Soft drink

To make a refreshing soft drink, add sugar and spices to the fermented juice, heat, and serve.

Preparation

Fermented vegetables are sour. So, wash the mixture thoroughly with water. This will remove the acid and salt. Cook the mixture to your taste.

Instead of washing off the fermented juice, you might like to collect it and serve it as a nutritious drink. Fermented vegetable juice is rich in vitamins B and C. It is a good appetizer served before meals, and can be used as a stock for curries.

Low cost Storage: Zero-energy cool chamber

Spoilage of fresh fruits and vegetables is a serious problem. Cool storage can prolong the life of fresh produce, but refrigeration equipment is expensive to buy, expensive to run, and expensive to maintain. There is, however, a practical, low-cost alternative for on-farm fruit and vegetable storage which employs the cooling power of evaporation. Zero energy cool chambers stay 10-15° C cooler than the outside temperature and maintain about 90 percent relative humidity. And they are easy to build out of locally available materials, such as brick, sand, bamboo, straw, and gunny bags.

Construction

- ☑ Select a raised site close to a source of water. Make a floor with bricks. Erect a double wall 70 cm high, leaving a cavity 7.5 cm wide between the two walls.
- ☑ Drench the chamber with water. Soak fine river-bed sand with water.
- ☑ Fill the cavity between the double walls with this wet sand.
- ☑ Make a cover frame of bamboo, sirki, straw, or dry grass.

- ☑ Make a cover frame of bamboo.
- ☑ Build a thatched-roof shed over the chamber to shield the chamber from direct sun and rain.Build a thatched-roof shed over the chamber to shield the chamber from direct sun and rain.

Operation

- ☑ Keep the sand, bricks, and top cover of the chamber wet
- ☑ Water twice daily, in the morning and evening
- ☑ A drip system can be built with plastic pipes, micro-tubes connected to an overhead water source
- ☑ Store your fruits and vegetables in perforated plastic crates. Do not use bamboo, wood, or fibreboard boxes because these will be damaged by moisture
- ☑ Water twice daily or ensure watering with drip system
- ☑ Cover these crates with a thin polyethylene sheet
- ☑ Rebuild the chamber with new bricks after 3 years. (The bricks' pores become blocked over time and this reduces the chamber's effectiveness)

Bamboo iceless refrigerator

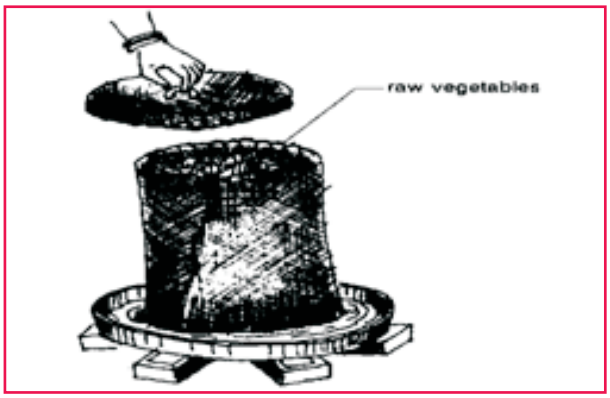
In rural areas, storage of vegetables, milk, and other perishable food items is a problem, especially in the hot summer months. The bamboo iceless refrigerator is a low-cost device for storing food. It can be made easily by rural women out of commonly available materials.

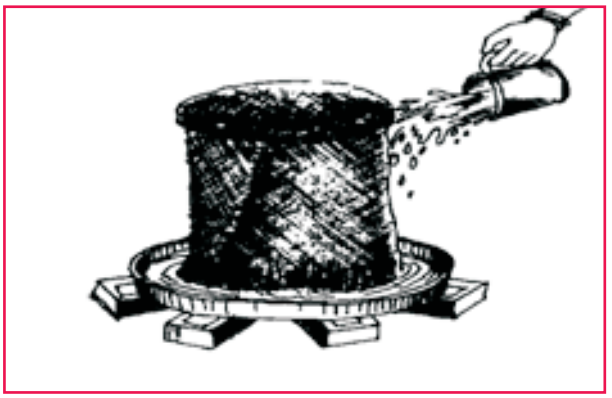
Materials needed:-

- ☑ A cylindrical basket made of bamboo or slender sticks of. wood with an open weave
- ☑ A loose-fitting lid
- ☑ Jute cloth
- ☑ Metal or clay tray (circular or square)
- ☑ Stones or bricks. Basket
- ☑ Loose-fitting lid

Construction

- ☑ Cover the basket loosely with the jute cloth. Sew the jute cloth around the rim of the basket. The lower end of the cloth must hang loosely around the bottom, exceeding the length of the basket
- ☑ Arrange four or five bricks or stones in a circle. Place the metal or clay tray on top
- ☑ Place three to five stones (or bricks broken in half) in a circle inside the tray.
- ☑ Place the jute-covered basket on top of the stones in the tray. basket loose-fitting lid
- ☑ Fill the tray with water. Make sure that the loose ends of the jute cloth dip into the water





Using the iceless refrigerator

- ☑ Place your perishable food in the basket
- ☑ Cover the basket with the loose-fitting woven lid. Cover the lid with a loose fitting, wet jute cloth
- ☑ Cover the basket with the loose-fitting woven lid. Cover the lid with a loose fitting, wet jute cloth.The water will evaporate from the cloth, keeping the contents of the basket cool and fresh
- ☑ Dampen the jute material-top and sides periodically with clean water. The water will evaporate from the cloth, keeping the contents of the basket cool and fresh.

Chapter-14

Seed Production Technology

With advancement of technologies, especially development of improved varieties and hybrids, seed production has become a specialized job requiring great expertise. Vegetables for seed production are grown in idea soil, climate and disease-free conditions. Each crop / variety is grown in specified isolation distance meeting all the field and crop standards. Timely inspection and rouging are also done to maintain seed purity. Handling of seed crop curing, threshing, cleaning, package and storage are specialized jobs requiring thorough knowledge. Since pests and diseases affect seed field more than that of vegetable field, timely crop protection measures are to be taken, especially for control of seed borne diseases.

Seed Preservation and Storage

5 tips for preserving and storing organic seeds from nutrition garden;

Step-1

Clean seeds promptly after removing them from plants - It is essential that as soon as you take seeds from plants that's the first thing you do is thoroughly clean them. That means removing all soil, dirt, and dust residue. This can be done with a recyclable facial tissue or soft hand towel. Depending upon the species, you may also need to remove additional matter such as natural coatings, shells, husks, and cobs.

Step-2

Dry seeds before storing- Once clean, your seeds will need to be dried. Separate seeds by type accordingly, and spread them out evenly on a dry paper towel or clean dye-free parchment. Resist the urge to use newspaper - the ink can seep through onto the moist seeds. If the sun is shining feel free to let them dry quickly in their naturally lit environment.

Step-3

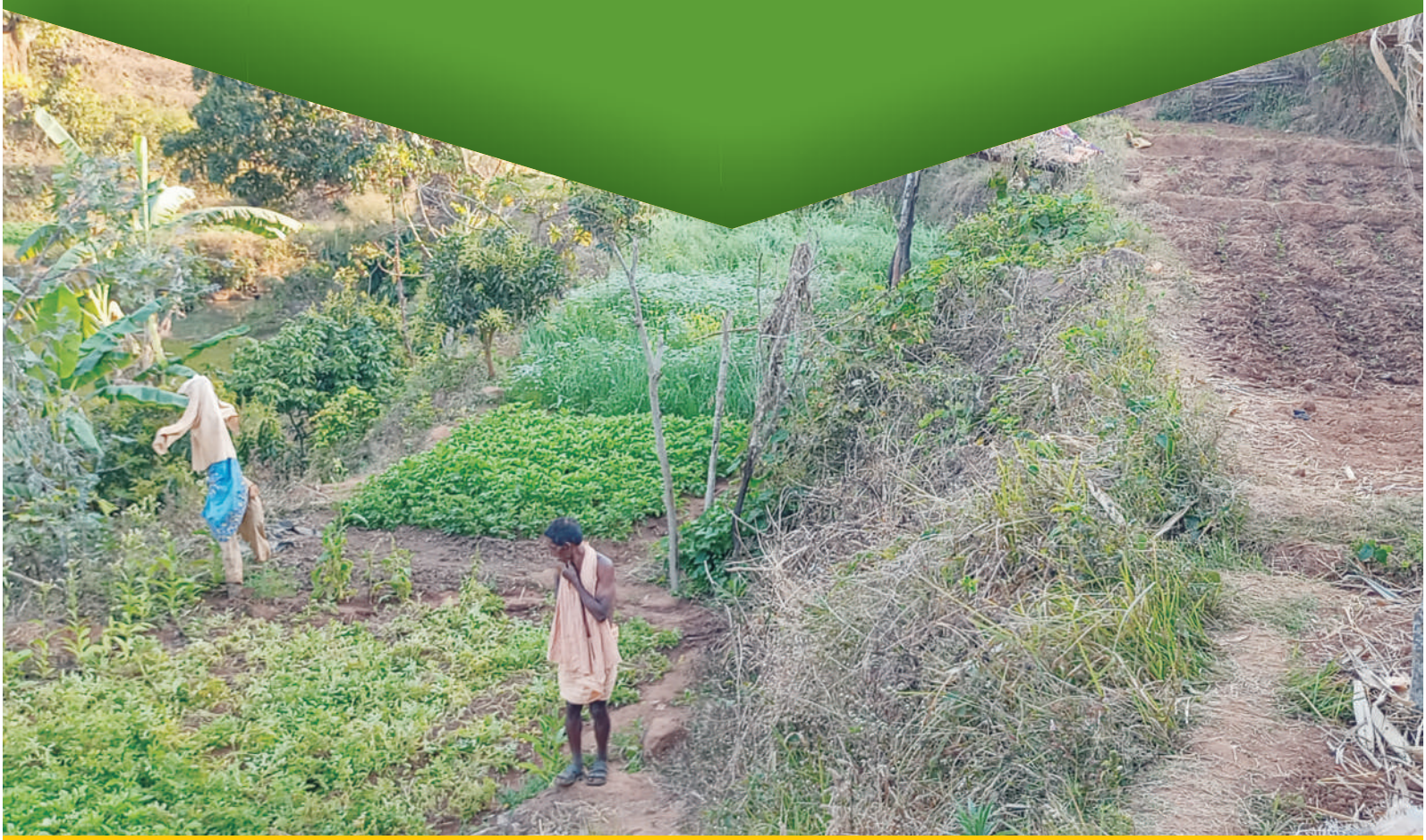
Freezing seed for long term storage - Inspect your seeds to ensure that they have completely dried. When that is confirmed you are ready to place them into a container for safe storage. If storing seeds for the long term (approximately up to 2 years) you will need to freeze them. When freezing, place the same-kind seeds into a ziplock bag and seal them tightly. Because you need to reduce the rate of aerobic respiration you must exclude all oxygen from the container. If you're forward thinking about seed preservation on a larger scale you may consider investing in a vacuum sealer to completely extract all oxygen from the atmosphere surrounding your seeds. Label each bag by type of seed and the date that is was packed away. Once sealed and labelled place them at the back of the freezer away from opening doors so that the temperature remains constant

Step-4

Open area storing for shorter term- Organic gardens in regions with more static climates may require the storing of seeds for the short term alone. Whatever the reason, if you are looking at shorter term seed preservation, you may be considering open area storage. You will still need to sustain the seeds in an airtight container to keep the oxygen at bay. Temperatures should remain cool and constant as well. At the same time, you will need to prevent moisture from entering the container. This can be accomplished with an old household trick involving powdered milk. Place two heaping tablespoons of powdered milk onto layers of tissue (three or four will be fine, depending upon the ply count), wrap the tissue firmly around the powder (you don't want any of the powder to touch the seeds), and place it within each jar/container where your seeds are being preserved. Once again, label each container by type and date

Step-5

Carefully transmission from storage to planning – When the time comes for you to remove your seeds from storage be sure to keep them sealed until the container/ziplock has returned to room temperature. Remember, seeds should not leave storage until you are truly ready to return them to the soil, so plan your planting schedule accordingly. The above seed preservation tips will serve your personal or community nutrition gardening needs. However, when it comes to seed preservation on a larger scale much more care is involved, delving into agricultural sciences and tailoring preservation methods by plant species.



Indo-Global
Social Service Society
Celebrating the Spirit of Humanity

28, Institutional Area, Lodi Road, New Delhi–110003
Telephone: 91 11 45705000
E–mail: info@igsss.net, Website: www.igsss.org
Facebook: www.facebook.com/igsss, Twitter: @_igsss