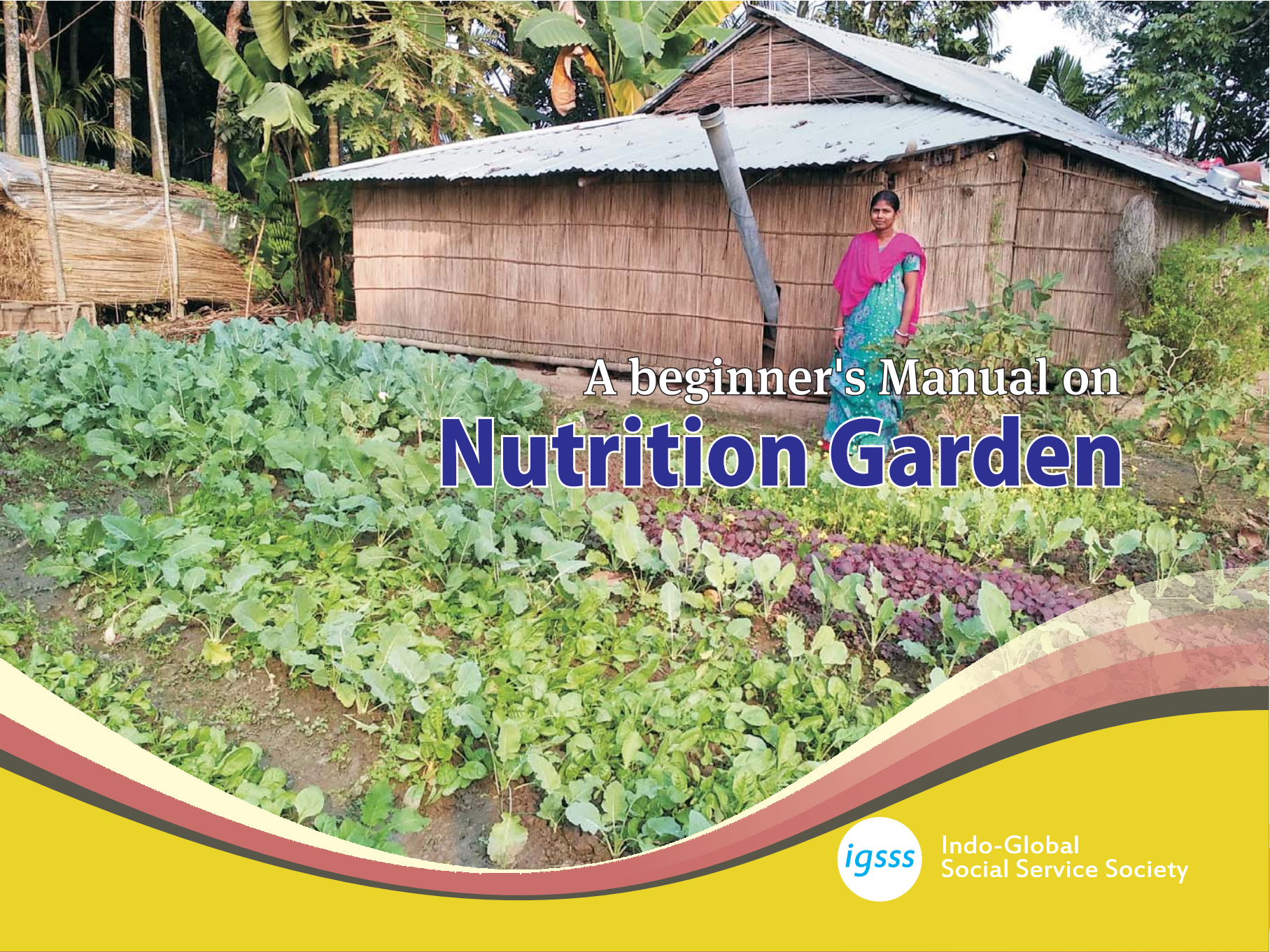




A beginner's Manual on **Nutrition Garden**



Indo-Global
Social Service Society

A BEGINNER'S MANUAL ON NUTRITION GARDEN

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1st published: March 2019

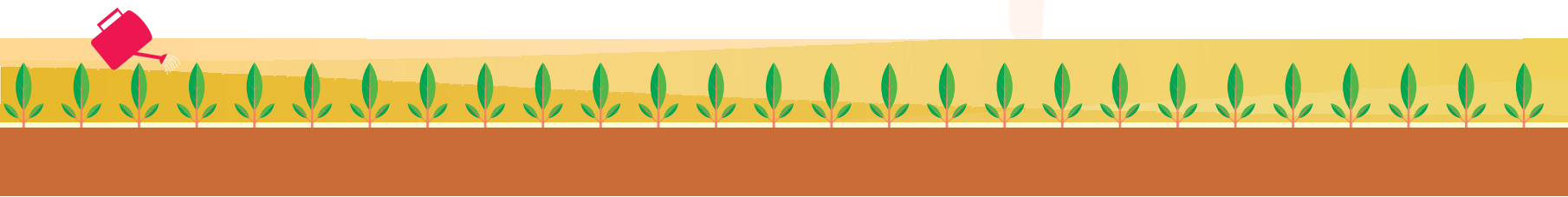
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Published by : Indo-Global Social Service Society, New Delhi

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The purpose of this manual is to encourage people to make optimum use of their surplus homestead space for augmenting their efforts for health and/or livelihood security. The guidance & recommendations provided herein are mostly generalized in nature, and are based on both primary as well as secondary information. Readers may please note that the success of these recommendations may vary partly due to the local conditions (including the level individual sincerity, effort, & care) that are beyond the control of the publisher, and IGSSS is not accountable for any issues arising therefrom.

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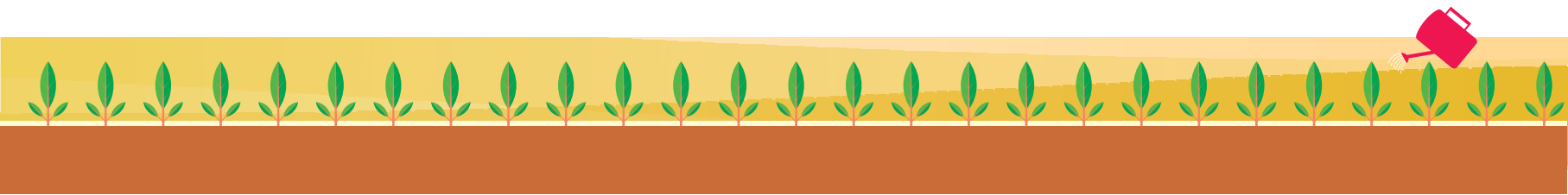


Preface

Kitchen garden has been one of the common-most promotional activities of non-government organizations in their endeavour to safeguard the life & 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 & ensuring in terms of the food- & 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 applications. Although not exhaustive in itself we are hopeful that it has covered all major aspects of nutrition gardening and hence shall be quite useful for the stakeholders. We look forward to the translation & 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.

Krushna Chandra Sahu
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FOOD VERSUS NUTRITION

- ◆ FOOD is for hunger, NUTRITION is for health. FOOD is a necessity, NUTRITION is essential. FOOD is the body, NUTRITION is the soul.
- ◆ NUTRITION is the nourishment or energy obtained from the food consumed. Satisfying the hunger or taste doesn't necessarily mean meeting the nutritional requirements of the body.
- ◆ A 'healthy food' is not only safe for the body but also nutritionally effective. A 'junk food' on the other hand has poor nutritional value despite its palatability and capacity to satisfy hunger.
- ◆ 'Malnutrition' implies to an overall and marked nutritional deficiency in the body. However, excess of nutrition can also cause health issues such as obesity.
- ◆ Therefore 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 Indian balanced diet is rice/chapati with dal & curry because rice/chapati dominates in carbohydrates, dal in proteins, and vegetables (curry) in micronutrients such as vitamins & minerals. Supplements such as milk, curd, and/or meat/fish/egg further enrich this traditional diet in many ways.





Nutrients for the body

Macronutrients	Micronutrients
<i>Needed in larger quantities</i>	<i>Needed in smaller quantities</i>
Carbohydrates (These are commonly identified as sugar, and are a source of instant energy. Source: rice, wheat, yam, potato, etc.)	Minerals like iron, sodium, calcium, and potassium, etc.. These are inorganic chemicals that help our body maintain the bone & tooth health, nerve & muscle function, and immune system, etc. Source: nuts, beans & lentil, dark green leafy vegetables, milk(calcium),etc.
Fat & Essential Fatty Acids (These provide energy, support cell growth, protect organs, and help keep the body warm. Source: Vegetable oil, ghee, butter, etc.)	
Dietary fibre (Protects us from gastrointestinal problems, and even against type-2 diabetes . Source: whole grains, fruits, vegetables.)	Vitamins like Vitamin-A, Vitamin-B, and Vitamin-C 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.
Protein (It helps the body build & repair tissues, and also to make some important body chemicals like hormones and enzymes. This is the building block of the body. Source: Beans & legumes (pulses), fish, meat, egg, milk, cheese, etc..)	

Note: Most foods contain not one but various nutrients, some in higher quantities and some lesser. About 90% of rice is carbohydrate, but it contains small amounts of fat & fibre too. Water is also categorized as a nutrient.



UNDERSTANDING NUTRITION GARDEN

Home gardens may have different purposes, and accordingly their components and/or landscaping/design may vary. Most home gardens prioritize ornamental plants (flowering/non-flowering) whereas a kitchen garden is a home garden that essentially prioritizes vegetables for regular domestic consumption.

Nutrition Garden is an improved form of kitchen garden where select vegetable crops are grown more or less systematically so as to meet the nutritional requirements of the family. Thus, whereas a normal kitchen garden may have randomly selected crops chiefly based on external factors of preferences such as palatability & feasibility, a nutrition garden takes into consideration more internal preferences & needs (nutrition).

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 & anemia particularly among women & children in particular.

The recommended intake of vegetables

*The Expert Committee of the Indian Council of Medical Research, taking into consideration the nutrient requirements, has recommended that every individual should consume at least 300 grams of vegetables (green leafy vegetables : 50 g; other vegetables : 200 g; roots & tubers : 50 g) in a day. In addition, fresh fruits (100 g), should be consumed regularly. Since requirements of iron and folic acid are higher for pregnant women they should consume 100 g of leafy vegetables daily. High calorie vegetables and fruits to be restricted for over weight/obese subjects. (National Institute of Nutrition 2011, **Dietary Guidelines for Indians**, <http://ninindia.org/DietaryGuidelinesforNINwebsite.pdf>.*

Benefits

- ◆ It is a source of fresh and nutritious vegetables for the family throughout the year.
- ◆ Helps ensure a quality control in the production so as to maintain the food & 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.
- ◆ It reduces the expenditure in buying vegetables.
- ◆ 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.

DESIGNING A 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, but have poor chances of survival/growth
- ◆ Crops needed to be grown but have high feasibility
- ◆ Human resources available to take care
- ◆ Perceived risks (such as theft, animal grazing, etc.).

For instance, crops like tubers & ground nut, etc. may give good production in a small space. If there are risks of theft or animal grazing, then adequate fencing may be required.

Design option-1: 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 below. For the hanging type, crops comfortable in that position are to be selected such as bitter gourd. 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.



Design option-2: Horizontal gardens

Raised Bed

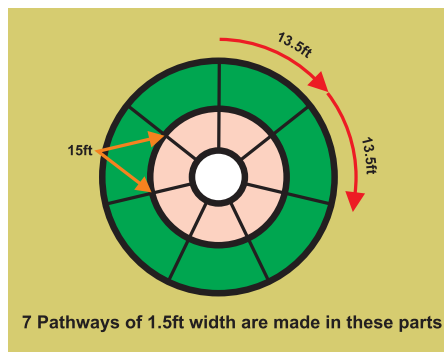
Raised beds are preferred to avoid soil compaction, where the area often gets waterlogged during the wet season. The preferable size is 5-6 ft X 2-3 ft with a height of 1-1.5 feet. The beds combine crops/vegetables with different root depths and light requirements. Spread of rice husk/ hull, and vermin-compost 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.

Circle garden

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.

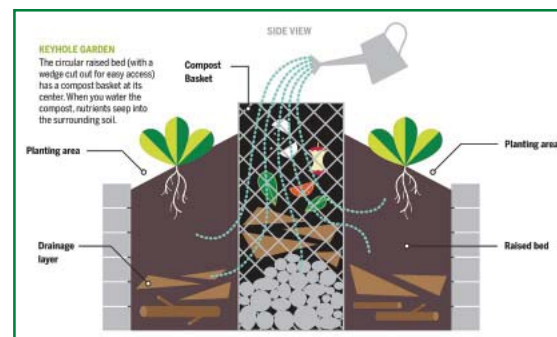
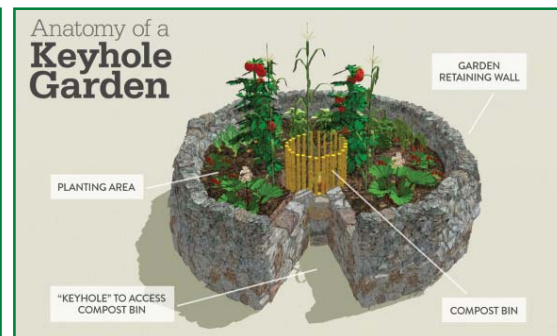


An ideal size for Circle Bed is 750 sq.ft. to 800 sq.ft. A circle of radius 15 ft is then drawn with a stump at the centre. The layout is marked with lime or ash. The 15 ft long radius can be divided into segments at 1 ft, 1.5 ft, 2 ft, 3.5 ft and 5.5 ft (one can decide this according to preferences) and circles are to be drawn with each radius-segment. This way each pathway 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 & feasibility. The target is to have atleast 14 beds(2 patches per pathway) in place.

Key-hole garden:

This special design helps maintain the moisture & nutrients in arid conditions because even a bucket of water can help the plants survive for 5-6 days. This is possible because the design promotes a process known as reverse osmosis and capillary action.

As shown in the figure, there are two concentric circle beds of 3 metre and 0.5 metre dia. The area between the outer circle and the inner circle is dug upto a depth of 4 inches and then filled with a thick mulch(decaying leaves primarily) layer of 18 to 24 inches, followed by making a heap from a mixture of soil and compost. The central hole is used for water and bio-waste supplement. Ridges and furrows are made in the circle like spokes to plant tubers / root plants, carrot, radish, beat etc.. An outer fence consisting of natural insect repellants like coriander (*dhania*) and marigold etc. is to be raised whereas the remaining beds are used for cultivation of leafy vegetables. The outer layer also consists of creepers which can be raised with the help of props to form a higher canopy. Alternative spokes are used for plantation of tomato, and brinjal, etc.





Efficient management of every available space can increase the crop area and diversity

Three such key-hole gardens can ensure year-long supply for vegetables to an average household.

The unit cost of key-hole garden is approximately Rs.1800 based on the following considerations:

- ◆ Bricks (200 Nos.) - 800
- ◆ Labour cost 2@Rs.200/person/day - 400
- ◆ Seeds (for year) - 350
- ◆ Poly-net and wires for creepers - 250

Since the above estimates are likely to have regional variations hence the maximum anticipated cost is Rs.2200 (approx.).

MANAGING PRODUCTIVITY

The productivity in a nutrition garden is obviously dependent on selection of species, soil fertility, availability of necessary soil moisture, and pest management, etc.. Since the products(vegetables) are expected to be organic, hence all management practices also need to be compatible with that. Hence, organic manures and organic insecticides play a key role here.

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.

Different types of organic manure:

- | | | |
|--------------------|--|-------------------|
| ◆ Vermin compost | ◆ Compost | ◆ Green manure |
| ◆ Legume crops | ◆ Mulching | ◆ Cow dung manure |
| ◆ Farm yard manure | ◆ Azolla and water hyacinth composting | ◆ Liquid manure |



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 the different micro-organisms, is an exception. It is a low cost and time efficient manure.

What is Amrit Pani or Amrit Jal?

The name(meaning 'nectar water') suggests that this liquid manure is highly nourishing for the plants. It improves both soil- and plant health more successfully or quickly. Furthermore, it can serve as a pesticide too.

Ingredients for the simplest form of Amrit pani:

Cow dung: - 1 kg, cow urine: - 1 litre, jaggery:- 50 gm(alternatively six overripe bananas), and water : - 10 litres. Some also prefer to add besan(1 kg) to it. If to be developed primarily as a pesticide, neem leaf powder(1 kg) is to be added to it. Costlier forms use cow ghee and honey as ingredients too. The source-cow should be preferably indigenous which feeds on natural fodder.

The above indicates the ratio only, and one can choose the right quantity based on the requirement.

Preparation:

In a plastic or strong earthen container of adequate size(about 15 litres) mix all the above ingredients thoroughly. Stir this mixture slowly with a wooden stick twice or thrice a day(clock-wise & anti-clockwise), cover it with a cotton cloth or anything that allows air to pass, and keep for 4 days so as to complete the fermentation process(that promotes the growth of beneficial microbes). After 4 days the preparation should be filtered for immediate use.

Application process:

1 litre of this preparation(filtered liquid) is mixed with 9 litres of fresh water, and then this mixture can be used for spraying over the crops twice a week. It nourishes the soil and the plants, and helps repel pests. It also promotes plant growth. Seed treatment(soaking seeds in this liquid for 24 hours before sowing) and root treatment(putting the root portion of saplings in this liquid for 30 minutes before planting) promotes better germination and stronger growth of plants respectively.

Precautions: This mixture can be used only for 7 days, and also it should be kept in a shady place. The mouth of the container should be closed so as to prevent unwanted contamination.

Vermi-compost

The degraded organic matter formed by the earth worms is known as vermin compost. It is highly enriched with nutrients and also improves the soil texture & structure. Moreover, it promotes plant growth.

Various organic waste materials can be used for vermin-composting, like crop residues, kitchen waste(solid), farming waste, green or dry leaves, weeds, vegetable waste, and animal excreta, etc..

There are different methods of making vermin-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 vermin-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 kept so that the micro-organisms and the liquid of that vermin-compost cannot leak ou directly to the soil.

Preparing a vermin-bed:

The lowermost layer should be of one inch 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 vermin-composting on commercial basis. There are some government departments which also provide support for this initiative.



The vermin-bed should be sprayed with water regularly, so that the moisture in the bed can be maintained facilitating the composting process.

Application:

Since vermin-compost is very rich in nutrients than ordinary compost, hence three table-spoonfuls per 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-spoonfuls 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 vermin-compost. The compost needs to be stored in a breathable container in a cool & dark place so as to prevent drying.



Application of fertilizers and pesticides:

As already mentioned, the home nutrition garden has to be essentially organic preferably; so chemical fertilizers, pesticides, and synthetic growth promoters are not advised for use. Instead, preparations like amrit pani and compost tea that act both as a manure and organic pesticide are recommended. Other safe organic pesticides such as the Chilli-Garlic solution can also be considered where necessary.

Integrated Pest Management:

A complementary protection measure against pests can be any of the following two options:

- ◆ Yellow Marigold flowers can be planted around the nutrition garden because their colour helps divert some of the garden pests.
- ◆ Yellow Sticky Traps can be used which attract the insects and then get them stuck on the traps restricting their movement.

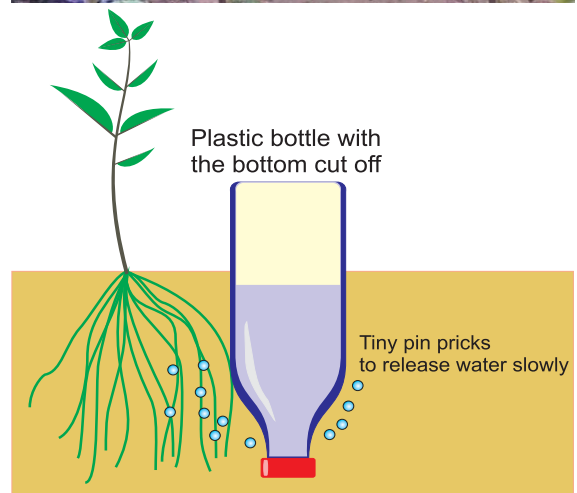


WATER CONSERVATION

We know from the beginning that the kitchen garden or the nutrition garden efficiently uses the waste water from the kitchen. Mulching helps in reducing irrigation requirement in the dry areas, as in case of key-hole garden. Organic manure improves the water-holding capacity of the soil, and rain water harvesting can be an additional help if the garden has even a small-size open tank(cemented structure).

A simple & affordable version of drip irrigation conceived for home gardens is the bottle drip irrigation. It makes efficient application of the already used plastic bottles. This method is convenient for use for plants that have strong stems to hold the bottle pressure, or otherwise there is some supporting mechanism such as props used for creepers. Four to five small holes are made in the bottle cap, water is filled in, the cap is tightened, and then the bottle is kept hanging upside down in a correct position that allows the water dropping at the root area.

For plants that are shrubby or otherwise do not have a supporting system for hanging bottles, the method is to be different. Holes are made in the cap, and the bottom part of the bottle is cut off. The bottle is then buried upside down around the plant by digging a hole (the depth should be such that about one-third of the bottle goes inside). Water is poured through the cut-off portion which can also receive rain water, so the hanging ones can also be made accordingly. An advantage of this bottle irrigation is that liquid manure can be mixed with the water instead of solid manure.



CROP SELECTION

Selection of vegetable crops for home garden depends on the size of the area available and the choice of family members. It will be desirable to produce all kinds of vegetables that the family members like, if the available area is large enough and provided that they can be grown satisfactorily in the region. If land is limited, it is advisable to grow crops that produce large yields per unit area and time. For instance, tomato, brinjal, chilli, cucurbits (ridge gourd, bottle gourd, bitter gourd, and cucumber), beans, leafy vegetables, radish, carrot, beet root, cabbage, cauliflower, onion and garlic are the main crops for an average-size garden. If land is sufficiently available, then crops such as banana, papaya, guava, and lemon can be grown in a home garden.

Selection criteria

The vegetable and/or fruit crops selected for the nutrition garden are usually based on the following preferences:

- ◆ Quick-yield crops(such as leafy vegetables)
- ◆ Long-time fruiting/production(such as lemon)
- ◆ Low-caring crops(such as drumstick)
- ◆ Crops compatible with the dietary habit(such as potato & brinjal)

Some other considerations in crop-planning can be as under:

- ◆ Long-term and multi-useable vegetables
- ◆ Selection of crops from which good seeds could be extracted
- ◆ Substantial yield in short duration(s)
- ◆ Protection of soil, water, seed and crops.



However, it is important to note that the selection criteria given below are applicable to cropping on a considerable scale only and not for two/three plants.

Selection according to the environmental condition/soil

- ◆ Use of shady places:- Turmeric, garlic, different types of colocasia, chilli, sweet potato, leafy vegetables.
- ◆ Use of partial shady places:- Water spinach, Panjabi spinach, Elephant foot yam, ginger, turmeric, colocasia.
- ◆ Use of high trees as support:- Yam, flat beans, winter melon, black pepper.
- ◆ Use of trellis:- Pumpkin, bottle gourd, Malabar spinach, flat beans, cowpea, bitter gourd, ridge gourd, little gourd, pointed gourd, snake gourd, cucumber, etc..
- ◆ Use of unutilized marshy land:- Colocasia(shola & loti varieties), thalkudi(gotu kola), brahmi, and talmakhana(kulekhara), etc..



Vegetables in different pH ranges of soil

'pH' is a term in chemistry used to measure the acidity or alkalinity of soil. A pH value of 7 is neutral, i.e. neither acidic nor alkaline(like distilled water). Values less than 7 indicate increasing acidity whereas greater than 7 indicate increasing alkalinity(basic soil).

Most crops prefer a neutral soil and can tolerate small deviations therein, but high acidity or alkalinity may be very detrimental for crop survival & growth. Following is a brief list of vegetables according to their pH tolerance:

pH range	Crops
5.5 to 7.0	Brinjal, chilli, etc.
5.5 to 7.5	Tomato, gourds, pumpkin, cucumber etc.
6.0 to 7.0	Spinach, pole bean, etc.
6.0 to 7.5	Bush beans, beet-roots, radish, green peas, etc.
6.0 to 8.0	Lady finger, roselle, sweet potato, etc.



Compost or vermi-compost acts as a buffer, i.e. helps crops grow in more acidic or alkaline soil.

Selection based on water requirement:

Crops can be selected on the basis of their water demand considering the water availability as under:

VERY LOW	LOW	MODERATE	HIGH
Water melon Pumpkin, Ash gourd	Cluster bean French bean, Cow-pea, Pea Ridge gourd, Bottle gourd	Tomato Chilli, Onion Potato, Carrot, Cucumber	Leafy vegetables Cabbage, Cauliflower Broccoli



Selection based on rooting depth:

This implies to the fact that if the soil is not of the quality to support the rooting depth of a crop, then it is not advisable to grow the same crop there unless it is planted in a pot or other such container.

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, Garlic, 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

Selection based on growing season:

Seasonality is an important factor in crop selection, as under:

Season	Vegetables
Kharif (June- Oct)	Cucurbits, Brinjal, Chilli, Okra, Tomato, Ginger, Cow Pea, 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,



Selection based on light requirement:

This refers to availability of direct sun light because some crops need more sun light while some others prefer partial shading. Full sun means atleast 6 hours of direct sunlight. Growing plants under partial shade needs careful watering & pest management. Some of the medium light demanders like beet & cauliflower can also thrive under partial shade whereas some low light demanders can also bear more exposure to sun. The general principle is that sunlight is required more for fruits & roots than for leaves, stems, & buds.



Categorization based on light requirement	Vegetables
Low light demanders	Leafy vegetables
Medium light demanders (require atleast half a day of sunlight)	Potato, Radish, Turnip, Carrot, Palak, Beet root, Onion, Cabbage, Cauliflower
Photo-intensive(require full sun)	Tomato, Brinjal, Okra, Chilli, Capsicum, French bean, Cucumber, Cow Pea

SUSTAINABILITY

Sustainability refers to both short-term and long-term continuation of the achievement or benefit. For instance, in home garden context, banana is a self-regenerating crop whereas drumstick survives for many years. Crop rotation is one of the strategies for sustainable production.

Most vegetables are short-lived, i.e. annual & seasonal; so their seed collection is an important step towards a sustainable nutrition gardening. For this purpose the following considerations are to be made:

- ◆ Collection from healthy and disease-free plants only
- ◆ Collect seeds from the middle of the crop or fruits
- ◆ Select the best seeds(shape/size) and reject damaged or rotten ones

Dry, cool(normal temp.), and clean seeds are to be packed in small paper packets(name of the variety mentioned on each packet), and then these packets can be put in a tightly sealed & dry glass jar. Sometimes the whole, well-dried mature fruit is stored directly without extracting the seeds.

Multi-storey cropping

Multi-storey cropping is a part of the strategy for sustainability. It includes both annuals and perennials. Perennial plants are usually taller and yield for a longer period, even if seasonal. These are



usually fruit crops though jackfruit can be used as a vegetable too. Their distribution should be preferably more towards the edges of the garden. Certain annual crops like ginger can be grown under their shade too. Medium-height plants like lemon & papaya, etc. can have sporadic distribution in the garden whereas banana is usually grown at a corner.

The perennial combo:

Perennial plants are an essential part of the sustainable gardening. A combination of four crops, viz. drumstick, banana (green and/or ripe), papaya, and lemon is commonly recommended because these plants ensure mutually complementary nutrition for us. Drumstick plant gives both pods and leafy vegetables, papaya gives both vegetable & ripen fruit, banana sustains its production by itself, and lemon is produced more than consumed (except for pickles). Drumstick is a good source of calcium, iron, and essential vitamins; and the leaves help control diabetes. Papaya is a good source of dietary fibre and various vitamins; and aids in digestion. Green banana is high in resistant starch (that acts like dietary fibre), contains probiotic bacteria, and helps absorb nutrients better. Ripe banana is rich in carbohydrates, and both types contain several minerals & vitamins such as potassium and vitamin B-6. Lemon is rich in vitamin-C.

Crop rotation:

This is often practiced in gardens to allow soils to recover. Different crops have different levels of nutrient demand. Those that demand heavily are known as heavy feeders, like leafy vegetables (e.g., spinach) and fruit vegetables such as pumpkin, cucumber, and tomatoes etc, as well as grains like corn.

- ◆ Most roots and tubers, such as beets, carrots, yams and taros, and herbs & spices such as ginger, turmeric, chilli, garlic, and bunching onion, etc. are considered medium feeders as they remove less nitrogen.
- ◆ Most beans and peas are considered low feeders and can be grown on poor soils. They even add nitrogen to the soil.
- ◆ High feeders should be followed by medium feeders, and preceded by low feeders.



Another factor that needs to be considered is: 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).

To avoid pests, we can try also 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 intercrop 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. Such strategies are in fact a part of integrated farming.



Integrated farming not only promotes food & nutritional security, but also augments the financial security. In this picture, the pond can be a source of fish whereas its ridges can be used to grow plantain, colocasia, and other vegetables.



Source list of downloaded images

1. Raised bed images:

Image-2: <https://opimedia.azureedge.net/-/media/images/men/editorial/articles/magazine-articles/2011/04-01/companion-planting-with-vegetables-and-flowers/men-am11-gkh003.jpg>

2. Key-hole garden images:

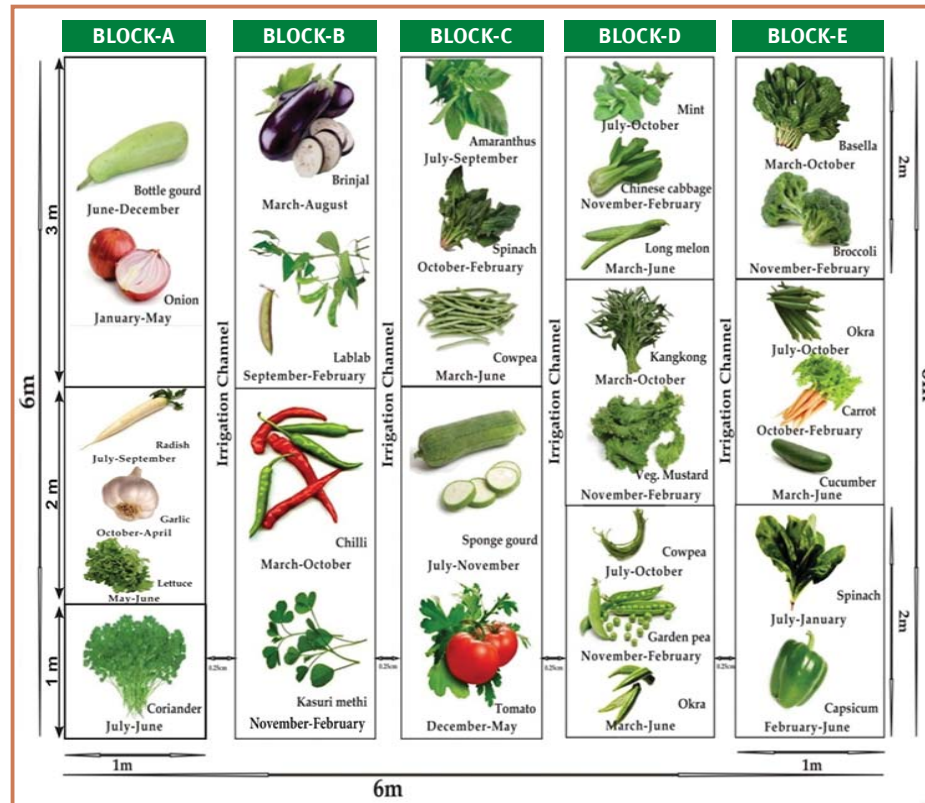
Image-2: https://ucanr.edu/blogs/napanewspaper//blogfiles/49207_original.jpg

Image-3: https://ucanr.edu/blogs/napanewspaper//blogfiles/49203_original.jpg



ANNEXURE - 1

LAYOUT & PLANNING OF A NUTRITIONAL GARDEN (6 x 6 SQUARE METRE)



(Source: Jindal, S. and Dhaliwal, M.S., 2017. *Development of Vegetable Nutrition Garden Model for Diet Diversification and Improved Nutrition Security of Urban & Peri-Urban Households*. Accessed through www.researchgate.net. Image exclusively accessible at https://www.researchgate.net/figure/Layout-and-planning-of-6-x-6-square-meter-vegetable-nutrition-garden_fig2_320129099)

ANNEXURE - 2

NUTRITIONAL VALUES OF VEGETABLES

Name of the vegetable	Energy (Kcals)	Moisture (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)
Ash gourd	10	96	0	0	0	2	1	30	20	1
Beans, scarlet	158	58	7	1	2	30	2	50	160	3
Bitter gourd	25	92	2	0	1	4	1	20	70	1
Bitter gourd, small	60	83	2	1	1	11	2	23	38	2
Bottle gourd	12	96	0	0	0	2	1	20	10	0
Brijal	24	93	1	9	9	4	1	18	47	0
Broad beans	48	85	4	0	1	7	2	50	64	1
Cauliflower	30	91	3	0	1	4	1	140	30	1
Cho-cho marrow	27	92	1	0	0	6	1	140	30	1
Cluster beans	16	81	3	0	1	11	3	130	57	1
Colocasia stem	18	94	0	0	1	4	1	60	20	0
Cowpea pods	48	85	3	0	1	8	2	72	59	2
Cucumber	13	96	0	0	0	2	0	10	25	1
Double beans	85	74	8	0	1	12	4	40	140	3
Drumstick	26	87	3	0	2	4	5	30	110	0
Drumstick flowers	50	86	4	1	1	7	2	210	68	1
Field beans, tender	48	86	4	1	1	7	2	210	68	1
Figs, red	53	80	1	1	2	11	6	187	39	0
French beans	26	92	2	0	1	5	2	50	28	1
Ghosala	18	93	1	0	1	3	2	36	19	1
Giant Chillies	24	93	1	0	1	4	1	10	30	0
Jackfruit, tender	51	84	3	0	1	9	3	30	40	2
Jackfruit seeds	133	65	7	0	1	26	2	50	97	2
Kankoda	52	84	3	1	1	8	3	33	42	5
Karonda fresh	42	91	1	3	0	3	2	21	28	0

Name of the vegetable	Energy (Kcals)	Moisture (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)	Protein (g)
Karonda dry	364	18	2	10	3	67	0	160	60	39
Kheksa	29	90	1	0	1	6	2	27	38	0
Kovai	18	93	1	0	1	3	2	40	30	0
Knol-Khol	21	93	1	0	1	4	2	20	35	2
Ladies finger	31	90	2	0	1	6	1	66	56	0
Lakuch, raw	73	90	2	1	1	14	3	67	25	0
Leeks	77	79	2	0	1	17	1	50	70	2
Lotus stem, dry	234	10	4	1	9	51	25	405	128	61
Mango, green	44	88	1	0	0	10	1	10	19	0
Onion stalks	41	88	1	0	1	9	2	50	50	7
Papaya, green	27	92	1	0	1	6	1	28	40	1
Parwar	20	92	2	0	1	2	3	30	40	2
Pink beans	44	87	3	0	1	7	2	54	70	2
Plantain flower	34	90	2	1	1	5	1	32	42	2
Plantain green	64	83	1	0	1	14	1	10	29	6
Plantain stem	42	88	1	0	1	10	1	10	10	1
Pumpkin fruit	25	93	1	0	1	5	1	10	30	0
Pumpkin flower	39	89	2	1	1	6	1	120	60	0
Ridgge gourd	17	95	1	0	0	3	0	18	26	2
Snake gourd	18	94	1	0	1	3	1	26	20	22
Sundakai, dry	269	12	8	2	5	55	18	390	180	2
Sword beans	44	87	3	0	1	8	2	60	40	2
Tinda, tender	21	93	1	0	1	3	1	25	24	1
Tomato, green	23	93	2	0	1	4	1	20	36	2
Vegetable marrow	17	94	1	0	0	3	1	10	30	1
Water chestnut fresh	115	70	5	0	1	23	1	20	150	2
Water chestnut dry	330	14	13	1	3	69	0	70	440	2

Source: Gopalan C. Rama Sastri B.V and Balasubramanian, S.C, 2004, Nutritive Value of Indian Foods, National Institute of Nutrition, ICMR, Hyderabad
(Accessed at http://agritech.tnau.ac.in/nutrition/pdf/nutritive%20value_vegetables.pdf)

CONSERVATION OF NUTRITIONAL VALUE OF VEGETABLES

- ◆ 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.
- ◆ The balanced diet is ensured through inclusion of a variety of different food items, like rice, dal, and curry in a single intake so that the nutritional deficiency of one is fulfilled by the other.
- ◆ Patients may need to follow a specific diet chart prescribed by the nutritionist or dietician. Like, diabetic patients have to limit/avoid rice, ripe banana, and bit root.
- ◆ The balanced diet may vary according to the age, so what is good for the infants may not suit the older persons.
- ◆ Girls/women in general and pregnant & lactating mothers in particular need special care in ensuring nutritional diets required for them given the health issues specific to them like iron deficiency.
- ◆ During the lean period when vegetables are not much available, the focus should be on millets which are also very nutritious & healthier. Millet flour can be added to rice flour, wheat flour, or gram flour to prepare various nutritious dishes.

Do's

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.

Don'ts





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