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Sustainable gardening

A garden is something different to each gardener. A garden has the potential to change the character of an area it can also be a place to express one's creativity. Above all, it gives us a space to interact with the environment, witness nature's cycles and celebrate the harvest of fruits and vegetables.

What is a Sustainable Garden?

A sustainable garden works in complete harmony with nature and depends on eco friendly alternatives to reduce the immediate negative impact on the environment. Sustainable gardening uses natural biological methods to create healthy soil and ecosystems and produce healthy, insect-resistant plants. It is about growing food, flowers, grass and trees based on an understanding of nature. The process of gardening here lays emphasis on a thoughtful balance between resources used and results gained.

Types of sustainable gardening

Organic gardening: focuses on creating a healthy garden, with the foundation being to "feed the soil, not the plant." Gardeners view the garden as a mini eco-system to be maintained by returning plant wastes to the soil via composting and using physical and biological methods to control pests.

Fukuoka's method: leaves almost everything to nature: no tilling, no fertilizer, no pesticides, no weeding, and no pruning. this approach is intended to be "free of human intervention," and allows nature to take its own course.

Biointensive: raised, cultivated beds are used to grow a lot of food in a small area-two to ten times more than what conventional mechanized agriculture can grow. To grow food this way takes one-third to one-thirtieth the water need and one one-hundredth the human and mechanical energy needed for more common methods. Special compost preparations and sprays are used to enhance biological life of the soil. The shelf life and flavor of vegetables is better, and animals have a preference for biodynamically grown grain when given a choice. Biodynamic methods can also be used to regenerate soil in arid areas.

Permaculture-short for "permanent agriculture"-is a way of designing and maintaining farms and gardens (or whole communities) that have the diversity, stability, and resilience of natural ecosystems. This involves an integrated approach in which, as in nature, plants, animals, land, people and houses all serve to support a multi-use ecosystem that provides food, energy, shelter, and other material and non-material needs in a sustainable way.

Where to begin?

One of the first questions encountered while going in for sustainable garden in ones backyard is where to start? A beginning can be done by selecting a site for your garden. The following are the parameters to be kept in mind for selecting a site:

a 100 lb. bag of 10-20-10 converted to weight equates to 10 lbs. nitrogen, 20 lbs. phosphate, and 10 lbs. Potash.

MESSAGE

Karnataka's salubrious climate has made gardening a home activity. Challenges are posed in the urban scenario due to limitations of space, time, resources and knowledge of both traditional and scientific approaches to sustainable gardening.

I am happy to note this attempt to comprehensively address the issue and believe that the information herein would be valuable both to the academic and the amateur gardeners.

Sd/
Additional Chief Secretary &
Development Commissioner.
Government of Karnataka

- Amount of sunlight received: the site should receive almost 6-8 hours of sunlight in a day in case of food crops and plants like roses and lilies. However if you are planning to plant small herbs, shrubs and ferns can do well with lesser amount of sunlight.
- Check the slope of the site: if the site is at the bottom of a hill, water logging may take place in the monsoon months and damage the crop. The site should have adequate drainage.

Planning your garden

The traditional method of vegetable garden design was to plant long, orderly rows. Most home gardeners now opt for planting in beds rather than rows. This method allows you to concentrate your compost on the area where the plants are growing rather than wasting it on the paths between the rows. Walking between the rows also ruins the soil structure, so beds are really a better way to go. The beds do need to be small enough so that you can easily reach in to weed and harvest all the plants without stepping on the bed itself. Also, if you raise your beds about 8 to 12 inches, you will have improved drainage. Another popular style is potager, which mixes flowers together with herbs and vegetables in an ornamental fashion so that the garden is both functional and ascetically pleasing. Many vegetables also thrive in containers, so you don't even need a garden in order to get those garden-fresh vegetables. Also, think about location when planting. You can economize space by planting vegetables next to each other that mature at different times. This way, you have already harvested one when it's neighbor is becoming mature, so both have plenty of space and sun when they need it most.

Analyzing the soil in your garden

This is essential to know the nutrient requirement for the plants. The bulk of soil is made up of a mixture of organic matter, rock and mineral particles. However, it's the air, water and nutrients in the ground that the growing plant really relies on. These are taken up by the roots and then used by the plant to form flowers and leaves. The relative proportions of all these, along with pH, determine the soil type. In order to know the type of soil, one can conduct a simple experiment. Fill a small bottle of 500 ml capacity with 1/3 of soil from your garden. Then, pour water t o make up for the remaining two thirds. Shake this mixture well and let the solution settle for nearly 15-20 minutes. Then observe the layers which have formed inside the bottle. The mixture will settle as distinct layer organic, clay, silt and sand.

The height of each layer indicates the predominance of a particular type of soil. For example, if the clay layer is more than the others, the soil is clayey.

Addressing the water demand in a garden

Water is a precious commodity and needs to be used judiciously. Often, use of more water is equated with enhanced productivity which is not true. Use of excess water results in washing away of vital nutrients and can harm productivity. The below mentioned steps can be followed to address water demand in a sustainable manner.

- Know the water demand of different plants and group them together
- Use alternative methods of irrigation like drip irrigation etc.
- Reduce the area of thirsty lawn
- Water plant roots, not the leaves.
- Avoid watering in the heat of the day or in windy weather
- Improve the soil's capacity to take up and retain water
- Use mulch to keep soil moist
- Don't over water - check the soil moisture before you water

Understanding the plant nutrient requirement

Essentially, three elements viz., Nitrogen, phosphorus and potassium are most important for plant growth. Plants often do not grow in soils deficient in either one of these. Even if they grow, plants exhibit signs of stress and display stunted growth. Lets examine the role of each one of these elements with respect to plant growth.

Nitrogen: It is important for the production of green tissue. It gives the plant a healthy deep green colour. It promotes stem and leaf growth and increases the protein content of edible plants. It is essential therefore for plants for enhancing the development of leaves.

Signs of deficiency: the plants become stunted and yellow in colour. Eventually the leaves at the bottom of the plant begin to dry up and wither. This process continues up the plant until (in extreme cases) the whole plant dies.

Phosphate: is essential for the development of a strong healthy root system. Young plants have a rapid intake of phosphorous, so it is important that seed beds and seed composts have a plentiful supply. Root crops such as Carrot, Potato will all decrease in yield if there is insufficient Phosphate available. It is also vital for the movement and storage of food reserves within the plant, and the main nutrient concerned with the proper development of seed production.

Signs of deficiency: deficiency of Phosphate may be indicated in plants when the foliage becomes a blue/grey shade of green. This gradually turns to a bronzy shade of green as the deficiency worsens. Growth slows down and the plant gives a poor yield of fruit and seeds.

Potassium: brighter colours and improved keeping qualities are the result of sufficient supplies of potash. It also toughens up plants making them more resistant to disease, and can help to counterbalance any excess of Nitrogen. Potash plays an important part in the formation of sugars and starches which can be stored by the plant in swollen roots.

Signs of deficiency: a deficiency of Potash shows first as yellowing of the leaf margins, these may later go brown and scorched looking. Sometimes the deficiency may show up as leaf spotting and often starts at the base of the plant. In severe cases the whole plant can collapse and die.

There are various ways in which nutrient availability can be enhanced. One of the easiest methods is to go in for compost. Compost can also help you in management of wastes at the household level.

Preparing the compost

An essential part of sustainable gardening is meeting the nutrient requirement of plants in an eco friendly manner. This can be done by going in for composting.

Compost is the cheapest way of enriching garden soil and is an effective way of reducing the amount of rubbish you discard each week. Up to 40 per cent of our weekly rubbish is peelings and food scraps that could be put to better use in the garden. Kitchen scraps (excluding meat, fish, eggs and fats) and garden waste (prunings, grass clippings and leaves) can be converted through natural processes into a healthy food supply for vegetable, fruit and flower gardens. The methods include composting, worm farming (vermiculture) and fermentation.

Composting combines nitrogen-rich green waste (kitchen peelings, cut flowers, vacuum cleaner dust and weeds) with a significantly larger volume of carbon-rich brown waste (leaves, straw, wet shredded paper and small twigs), water and

air. It uses natural processes of decay led by insects, worms, fungi and bacteria. The volume reduces as wastes heat up and cool down and over a few months, the middle of the heap converts to crumbly brown-grey humus that will enhance soil condition and fertility. Compost's minerals and nutrients remain available in the soil and improve the soil's structure and water-holding qualities. Twigs and material from outside edges of compost heap many need to re-composted as the edges do not heat up to high enough temperatures. Turning the heap during the 'cooking' process reduces this problem.

Natural fertiliser

Nourishing the soil with a compost tea or a manure tea, a natural fertilizer and revitalizer that is relatively simple to make. All it takes is a spade full of animal manure, a bag or pillowcase, a 5-litre bucket and some compost. Simply mix the ingredients in the bag and let it stay in the bucket of water for a few days. The result is a completely natural fertilizer that allows a garden to maintain a healthy balance between good and bad microbes.

Composting works significantly faster in the summer than in winter, but can still be used year-round. If there is space in your garden, have at least two compost bins side-by-side, and use them in turn. Compost can also be made in a variety of containers.
Try an open-base, one metre-wide interlocking wooden box; straw bales (the straw is used for compost material the following year); wire netting and black plastic insulated with cardboard or carpet; or large recycled plastic bins. Your compost bin should be in an accessible, sheltered part of the garden and have a sloping lid and rainproof covering rain cools the compost and the transformation process is inhibited.

The compost prepared can be applied now. Your garden is now ready for sowing.

Gardening on rooftops

In cities, not everyone can have the luxury of staying on ground floor. A majority of the population in urban areas stays in apartments and flats having little space for a garden. In such a scenario, one has three options:

a) Grow plants in flower pots
b) Use the rooftop for garden
c) Explore soil-less gardening options

Preparing media for rooftop gardening and pots:
A lightweight potting mix is needed for ideal for these types of gardens. Soil straight from the garden cannot be used because it may contain too much clay. Clay soil consists of extremely small (microscopic) particles. In a container, the bad qualities of clay get highlighted it holds too much moisture when wet, resulting in too little air for the roots, and it pulls away from the sides of the pot when dry. Ideal soil mixture should have 30% or more gravel or coarse matter or average.
Try prepare the media for plants, use one part compost with one part garden loam, and one part clean coarse sand, adding a slow-release fertilizer. Lime may also be needed to bring the pH to around 6.5. With this mix, your plants will have enough nutrients for 8 to 10 weeks. If plants are grown longer than this, add a water-soluble fertilizer at the recommended rate. Repeat every two to three weeks. An occasional dose of fish emulsion or compost will add trace elements to the soil. Do not add more than the recommended rate of any fertilizer since this may cause fertilizer burn and kill the plants. Container plants do not have the buffer of large volumes of soil and humus to protect them from over fertilizing or over liming.

Lets look at requirements for each one of these options in detail.
Plants in flower pots: is a common method of growing plants in urban areas. There are some things to be kept in mind before going in for a garden of potted plants. Almost any type of container can be used for growing vegetable plants. For example, try using baskets, drums, cans, tubs or wooden boxes. The size of the container will vary according to the crop selection and space available. Depending on the need, pots with capacity of 15 liters and above can be used.
Tips for potted plants:

- Make sure your pot has adequate drainage. Holes should be 1/2 inch across. Line the base of the pot with newspaper to prevent soil loss. Make sure the container is big enough to allow root growth. Check the plant tag to get an idea of the plant's mature size before planting. If in doubt, get a larger pot.
- Good soil is essential for all pot grown plants. Fill the pot with quality potting soil up to an inch from the rim - any more soil will wash out when you water. Expect some settling of soil over time.

- Light-colored containers to lessen heat absorption and discourage uneven root growth.
- If you choose clay pots, remember that clay is porous and water is lost from the sides of the container. Plants in clay pots should be monitored closely for loss of moisture.
- Since potting mixes drain water rapidly, fertilizer will be washed out of the container as you water.
- In an exposed location, container plants loose moisture quickly. Some plants will need to be watered daily, especially during hot, dry weather.

Rooftop gardens: theoretically, any roof surface can be used for gardening. A main problem however is how to keep the soil from washing away while you're waiting for the roots to branch enough to bind the soil. Another important parameter to be considered is whether the roof can hold the extra weight added on by the soil and plants. A structural engineer will be able to guide you on this.

The bottom most layer in the rooftop garden should be a waterproof one to protect the building from leaks. The next layer should be made up of light weight gravel. This layer called the drainage layer keeps the growing media aerated and takes care of excess water. A filter straw matt can be used to drain the water away while retaining soil particles. The final layer will be the one containing the growing media and plants. It must be remembered that these layers must be able to mimic the conditions found in nature and create an environment which can support plant growth.

Soil-less gardening: Soil-less gardening is also called hydroponics, chemiculture. Here instead of soil, nutrient water medium will be used. One needs water, sunlight and nutrient medium for gardening. As plants needs nutrients, sunlight and air for their food preparation nutrient water solution acts as a source of nutrient supply. Almost all kind of plants can be grown in soil less medium. Some of the advantages of soil less gardening include no soil pests and diseases, optimal nutrient intake which results in healthier plants, faster growth rates.

Sowing

An important thing to remember before going in for sowing is the timing. Not all crops grow well at all times. If you plant all your vegetables at the same time, everything will come to maturity at the same time. The solution is to continually plant small amounts of short-season vegetables throughout the growing season. That way, you can enjoy your vegetables all summer long and not be inundated by them all at once. Sowing should be done when the soil is fully ready and there are no visible signs of any weeds in the site.

There are some plants that, when planted close together, will benefit each other. Likewise, there are certain combinations of plants that will inhibit the growth of one or both types of plants. Here are a few combinations to avoid:

- Potatoes inhibit growth of tomatoes and squash
- Beans inhibit growth of onions

This isn't to say that you can't grow these plants together in the same garden, they should not be sown next to each other.

Pest management

A common problem encountered in all farms and gardens are the pests. These organisms come in wide range of sizes and shapes and need to be handled carefully in order to eliminate them without causing any adverse impacts on the crops.

Pesticides can be prepared from commonly available plants. Garlic, Neem oil, extracts from chrysanthemum etc make excellent natural remedies for most pests. One can also check if natural pesticides are available in the market for use in the garden. Crop rotation can also be used on a three or four year cycle, Planting the same set of crops repeatedly may lead to diseases like 'rusts' that are hard to eradicate.

When planning vegetable crop rotations (in sequences of 4 or 5 growing seasons) inter-plant leaf crops (salads, herbs and green veg) with main crops. Companion plants used within the rotation can provide variety in smaller gardens. A preferable crop rotation sequence is:

- Legumes = peas, beans or a green manure that's dug in before it sets seed (they fix nitrogen from soil and atmosphere)
- Brassicas = cabbage family such as Brussel sprouts, broccoli, cabbage, cauliflower heavy feeding fruit-type crops = tomato, eggplant, capsicum, pumpkin, sweet-corn (with beans as companions);
- Onion family including garlic, beetroot;
- Root crops = potato, carrots

Physical barriers can stop pests in their tracks. Examples include grease-bands around tree trunks to catch crawling insects, mist netting over carrots to prevent carrot root fly, nets over berry bushes and grapevines to keep off moths and birds, buried containers with stale beer to catch snails. You can protect young plants by encircling them with a food can with both ends removed. Push the bottom end of the can into the soil.

A saucer filled with beer is just as effective as commercial poison baits for controlling snails. They are attracted by the smell, drink and then drown in it. A sheet of newspaper will also attract snails and slugs, which can then be disposed of by dropping them into a bucket of heavily salted water. Snails avoid sand, lime, or ashes. Use it to border your garden.

Table 1: Approximate Plant Food Contents

Material	% N	% P	% K	Comments
Cow manure	0.4	0.1	0.4	Very variable plant food content. Slow acting. Don't mix with lime.
Horse manure	0.6	0.1	0.5	
Pig manure	0.4	0.1	0.5	
Poultry manure	1	0.4	0.6	
Sheep manure	0.8	0.1	0.7	
Farmyard manure	1	0.5	1	
Feathers	8	0	0	Very variable.
Wood ashes	0	0.5	10	Alkaline in effect. Weather briefly before use.
Weathered soot	4	0	0	Do not use this fresh, or mix it with lime.
Fishmeal	9	12	4	Variable.
Castor meal	5	2	1	Seed waste.

A protective circle of sawdust around new seedlings will stop snails from feeding on them. Sawdust sticks to the snail's foot and stops it from moving any further toward your plants.

Weed Control Tips

- Eliminate weeds early in the growing season, before they develop a spreading root system or set seeds.
- Cultivate on a sunny, warm day so weeds that have been pulled or tilled will dry out and die.
- Apply an adequate layer of mulch to prevent seedling weed emergence.
- Remove weed clippings from the property if there is a chance that seeds have been set.
- Clipping weeds slows their growth and prevents weed plants from going to seed. Use a lawn mower, clippers, or string trimmer to prevent weeds from going to seed. Mowing will not eliminate perennial weeds.
- The easiest way to control weeds is by preventing them from getting started in the garden. Do not allow weeds to enter with garden seeds, in manure, by sharing perennial plants that have weeds seeds or vegetative parts with the roots, using contaminated compost, or allowing weeds in or bordering the garden from going to seed.

Frequently asked questions

What are the advantages in having a garden in ones backyard?

Gardening is a creative endeavor it can help one express his or her creativity. It also provides one with an opportunity of working with the environment and understanding it.

How do I identify the type of soil in my backyard?

The minerals present in soil impart a colour to it. Red, yellow or brown colours are usually related to the different degrees of oxidation, hydration and diffusion of iron oxides in the soil. dark colours of a soil are associated with one or a combination of several factors, including impeded drainage conditions, content and state of decomposition of organic matter, the presence of titaniferous magnetite etc.

Table 2: Good companions for garden

Food plant	Good companions	Avoid
Apple tree	A herbal lay (if mature trees), garlic, horseradish	Potatoes, grass around young trees
Beetroot	Onion, cabbage	Runners, beans
Beans -broad	Potato, carrot, cabbage, spinach,	Onion, garlic
Beans - French	Potato, cabbage, sweet corn, strawberries, cucumber, brinjal.	Onion, garlic
Beans - runner (climbing)	Sweet corn	Onion, beetroot, sunflower
Cabbage (& relatives, such as broccoli, cauliflower)	Potatoes, mint	Tomato, garlic, strawberry
Cauliflower	Beans	
Carrot	Peas, onion, lettuce, tomato,radish	
Cucumber	French beans, cabbage, lettuce	main crop potato
Brinjal	Beans	
Garlic	Lettuce	Peas, beans, cabbage, strawberry
Gooseberry	Tomato	
Lettuce	Carrot, strawberry, onion, radish, marigold,beetroot	
Onion	Beetroot, tomato, lettuce, strawberry, chives	Peas, beans
Peach	Garlic	
Peas	Carrot, radish, turnip, cucumber, beans, sweet-corn	onion, garlic
Potato	Beans, sweet-corn, cabbage, horseradish	Tomato, squash/pumpkin, cucumber, sunflower
Pumpkin and squash	Sweet corn, runner bean	Potatoes
Radish	Lettuce, peas, cucumber, carrot	
Raspberry cane	Garlic	Potato
Spinach	Strawberry, broadbean	Cabbage
Strawberry	Spinach, French bean, lettuce,	Cabbage family, tomato, garlic
Sweet-corn	Potato, broad bean, runner bean, pea,pumpkin, squash, cucumber, melon	
Tomato	Basil, parsley, chives, garlic, onion, asparagus, borage, carrot, celery, beans,sweet-corn	Potato, strawberry
Turnip	Peas, raddish	

How important is soil pH for plants?

Soil pH is an important factor and it directly influences the uptake of various nutrients by plants. Most soil nutrients are readily available when soil pH is at 6.5. When pH rises above this value, nutrient elements such as phosphorus, iron, manganese, copper, and zinc will become less available. When soil pH drops below 6.5, manganese can reach a toxicity level for some sensitive plants.

Which organisms are good for my garden?

The following creatures can help you in maintaining a healthy garden:
Ladybugs - these creatures can feed on aphids Lizards -lizards will search basements, garages and bushes for tiny pests Spiders - The average spider eats about 100 insects a year. Toads - One toad can eat between 10,000 and 20,000 slugs, flies, cutworms or grasshoppers per year. Bats - besides being a valuable pollinator, bats consume large quantities of insects. A single little brown bat can catch 600 mosquitoes in one hour. Bees - As pollinating agents

Beetles -beetles' favorite insect meals are cutworms, grubs and root maggots. Some even love slugs and snails. To invite them into your garden, place a log or board at one end of your garden. Birds - the small birds consume more than half their total weight in food everyday and a big part of their diet is insects.

What are the benefits of crop rotation?

Crop rotation prevents build up of disease vectors in the soil and preserves micro-nutrients. Planting the same type of crops leads to the depletion of similar set of nutrients. Rotating is not very difficult, but does take a little advance planning as well as a basic knowledge of the vegetable families. Vegetables are broken down into basic family groups. Individual group members should not be planted together as they use the soil in similar ways and share similar pests.

What are the common soil composition improvers that can be used in my garden?

The following materials can be used:

Bark and woodchips are useful if quite fine grades are used. They are however, slow to decompose and take effect. Nitrogen deficiency may occur when first used.

Leaf mould: The value of this depends on the sort of leaves that have been used to make it. Soft, fleshy leaves are not very good at improving the soil composition. Tough, fibrous leaves are best.

Straw : This is very good for composition improvement, but it makes the soil short of nitrogen for a while when first added. If you plan to use straw, let it rot down first. However, Straw can also contain harmful weed and possibly hormone weedkiller residues (as for manure).

Lawn mowings : These are very cheap!. They must, however be composted down first. Mowings are difficult to compost on their own, so should be mixed with other materials in the compost heap. If you have no other material to mix, add some soil in layers with the mowings.

How important is aeration for plants?

Aeration is necessary for many reasons,primarily to ensure full and proper decomposition of organic matter to humus and plant foods, to allow roots and other soil organisms to breathe, and to assist drainage. Aeration can be improved by most of the techniques used to improve drainage.

What can I do to improve the water retention capability of soil?

This problem is mostly encountered in sandy soils. The answer is generally to add as much of the right sort of organic matter as you can get your hands on, so that you increase the number of little organic sponges in the soil that can absorb water in times of plenty and give it up to root hairs in times of dryness.

How do I know if the soil in my garden is having drainage problem(s)?

Dig a hole 6" wide and 1' deep, using a shovel or spade. Fill the hole with water. When the water has drained completely, fill the hole again, and keep track of the time necessary for the water to drain completely from the hole. If the water drains completely within 3 hours or less, drainage is too rapid, probably as a result of sandy soil. If water is still standing in the hole after 8 hours, drainage is too slow, probably as a result of too much clay in the soil.
If the water drains within 4 to 6 hours, the drainage is fine.