Sub-Theme-II

Appropriate Technology for Sustainable Living

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"We are stuck with technology when what we really want is just stuff that works." **– Douglas Adams**

Introduction

Technology has been the driving force of civilization as we know. Earlier, technologies used to be small in scale, responsive to local skills and needs. These evolved slowly over a long period of time and catered to the local needs. Today, the technologies have grown in scale with high production rates, consuming large quantities of energy and resources, requiring large capital and highly-skilled manpower. The high production rate, consuming large quantities of natural resources has been damaging the ecosystem by indiscriminate extraction and the resulting environmental degradation. It is clear that present mode of production is unsustainable and damaging to the society. For example, ill effects of pesticides and fertilizers used in agriculture, have now become the concern of all. Hence, there is need to consider alternative ways of meeting our needs without damaging our ecosystems.

Appropriate technologies (AT) refer to technologies that are adaptable to local needs, acceptable to users and made using locally available materials with the aim to improve the lives and livelihoods of people in resource-constrained environments. Appropriate technology is used to address wide range of issues. The concept of appropriate technology is multi-faceted; in some contexts, appropriate technology can be described as the simplest level of technology that can achieve the intended purpose, whereas in others, it can refer to engineering that takes adequate consideration of social and environmental ramifications and connected to sustainable living.

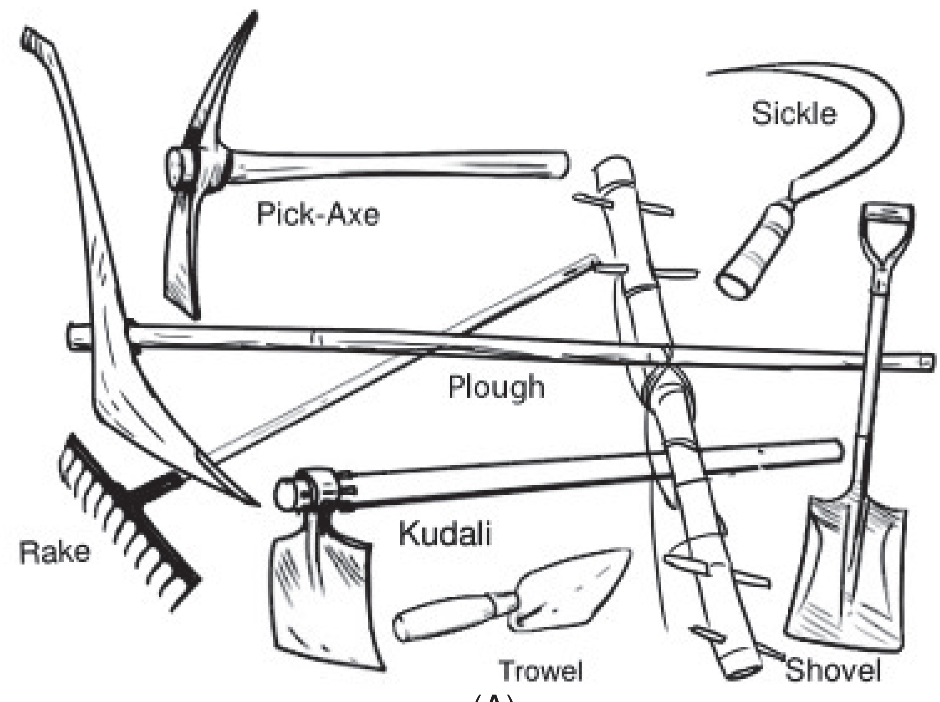
Box 2.1

Characteristics of Appropriate technologies (AT)

- Require only small amount of capital
- Use of locally available materials
- Relatively labour intensive but more productive than many traditional technologies
- Small enough in scale to be affordable to individual families or small group of families
- Can be understood, controlled and maintained by villagers whenever possible, without a high level of special training
- Can be produced in villages or small workshops
- Suppose that people can and will work together to bring improvements to the Communities
- Offer opportunities for local people to become involved in the modification and Innovation process
- Are flexible, can be adapted to different places and changing circumstances
- Can be used in productive ways without doing harm to the environment

As it is not possible to go back to older methods of production; there is a need to revisit the technological alternatives available and such technologies are referred to as AT (Box-2. I**).** AT is just the technological change(s)/ modification(s) or even innovation to meet the specific need and purposes of the community. It is also a search for suitable technologies that havebeneficial effects on income distribution, human development, environmental quality and the distribution of political power- as well as productivity – in the context of particular communities and geographical regions

In fact, these technologies are developed keeping in mind the people who use it, the context and place of its use. These also enable the community regarding its operation and maintenance. It is adaptable to varying requirements. We can see the existence of many such tools and devices that have been evolved with the need of mankind. It could be a plough, hand pump, stove, handloom, water wheel, wind mill, biogas plant, etc. Many artisanal skills in textile, carpentry, metal work, pottery, stone work, weaving etc. already exist across rural India. Use of ATs is inevitable for sustainable living and livelihoods. It works on the principle of decentralization of production systems, using renewable energy (solar, wind, or water) to the maximum extent possible. These energy sources are available almost everywhere and need only the right technology to harness those. Locally available energy resources, unlike conventional energy sources like coal and oil, have lesser impact on the environment. Moreover, they do not need to be transported over long distances.



(A)

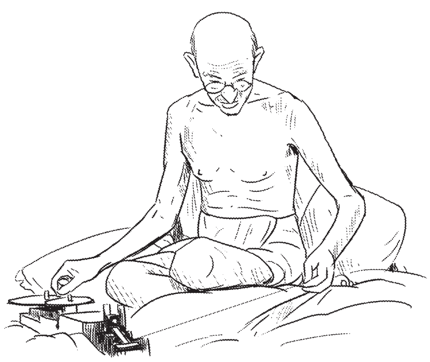
Fig. 2.1. *Pictures showing tools and implements used since (A) ancient times and (B) the recent technology developed for lighting a rural poor man's house*

(B)

Similarly, at local ecosystem level, food, energy, water, and waste disposal are also handled locally by ecological systems. These are systems that conserve resources by recycling organic nutrients back into the soil and re-using manufactured goods in innovative ways. Thus, appropriate technology makes it possible to satisfy our basic human needs while minimising our impact on the environment.

"***Technology should empower, not enslave.***" **–Mahatma Gandhi.**

Mahatma Gandhi set out to reform our civilization by re-interpreting the central principles in the light of the needs of the present age. He would claim to be extending, deepening, discovering "true meaning". This he did through following three strategies-



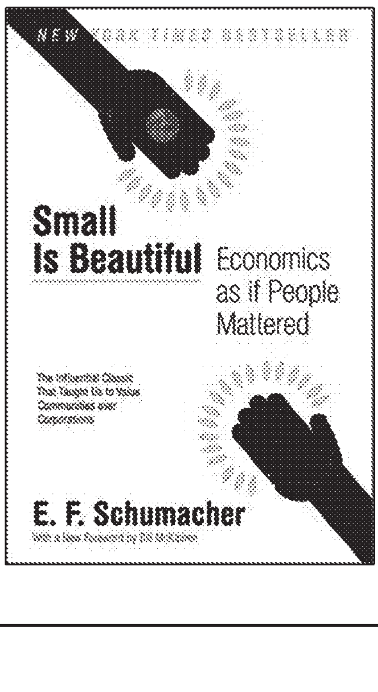
1.Using tradition as resource that we are free to pick and choose

2.Treating tradition to critical evaluation and revision like a scientific theory

3.Drawing upon insights of other traditions

Small is Beautiful

A study of economics as if people mattered as Gandhi said, the poor of the world cannot be helped by mass production, only by production by masses. This mobilises the priceless resources which are possessed by human beings, their clever brains and the skillful hands, and supports them with first class tools. The technology of mass production is inherently violent, ecologically damaging, self-defeating in terms of non-renewable sources, and studying for the human person. The technology of production by the masses making use of the best modern knowledge and experience, is conductive to decentralization, compatible with the laws of ecology, gentle in its use of scares resources, and designed to serve the human person instead of making them servant of the machine. I have named it intermediate technology to signify that it is vastly superior to the primitive technology of bygone ages but at the same time much simpler, cheaper, and freer than the super-technology of the rich. One can also call it self-help technology, or democratic or people's technology to which everybody can gain admittance and which is not reserved to those already rich and powerful.



It is admitted on all hands that the poor of the world cannot be helped by mass production, but only by production by the masses. This mobilises the resources which are possessed by human beings. It is also admitted that the technology of mass production is inherently violent, ecologically damaging, self-defeating in terms of non-renewable sources. Hence, people need such small and effective technologies which evolve out of the available resources by the community and for the community. So, these technologies, as termed Appropriate Technology, are usually small. And as E. F. Schumacher, the renowned economist correctly mentioned 'Small is Beautiful.' However, it needs to be clear enough that the AT is NOT restricted to only design and development of tools, but new methods and technique also.

The expected outcomes of a technology are compared to a list of characteristics generally associated with "appropriateness." These characteristics are defined in terms of the expected socio-economic impacts on the poor in rural and/or urban areas, and the environmental impacts. Technology specifications lists are also subjective and often considers short-term and long-term impacts

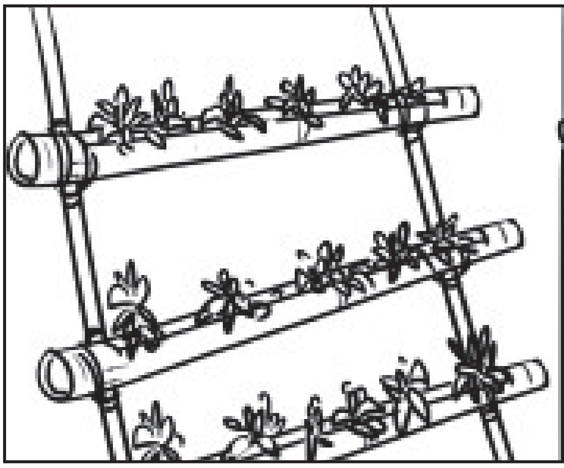


Fig.-2.2. Hydroponics

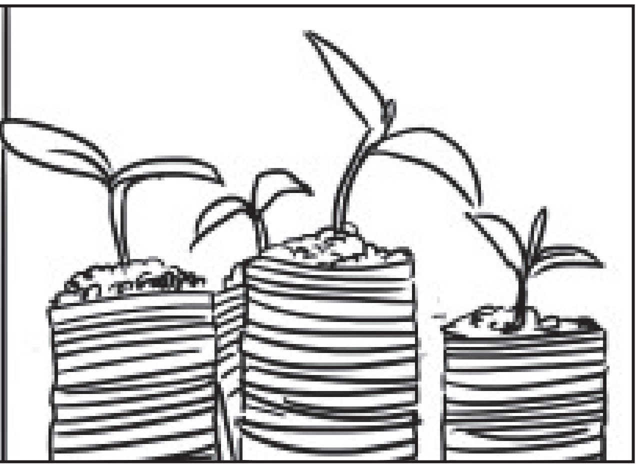
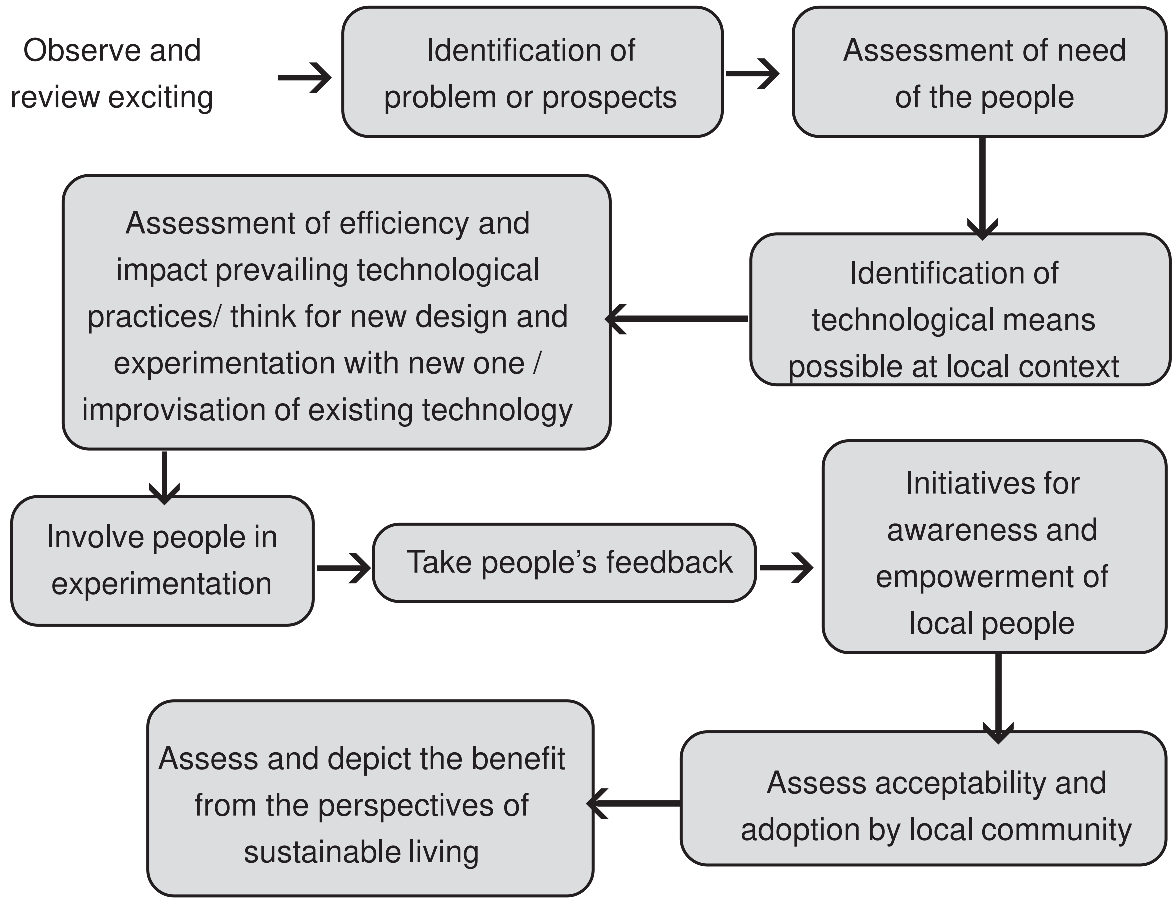


Fig.2.3. An eco-friendly technology for raising seedlings

A. **Concept of Appropriate Technology in Sustainability Framework**

Appropriate Technology based development focuses on development within an ecosystem limit with emphasis on regenerative development to strengthen the process of self-reliance of the community with appropriate Science and Technology Literacy and Eco-literacy. In the process it stresses on developing knowledge and skill of community on scientific understanding of daily work and life and equally ecological understanding of their context, so that appropriately they can design their daily walk of life with more hand print and reduced foot print. In order to make it more efficient, it leverages through appropriate technology design which is developed locally, as per their requirement. Here, technology is designed with principle of minimalism, energy efficiency, more option of renewability, regenerative cycle, more user friendly so that everyone is empowered through the process of its application. Entire inquiry-based learning in the context of AT followed a framework as mentioned below.

B. **Frame work**



C. **Focus**

No technology by itself can be considered as Appropriate Technology as it is always with reference to the context. An 'appropriate technology 'in one place may be inappropriate at another place. Hence, the understanding the local context is to be used and evolved accordingly.

Some of the areas where appropriate technologies are widely used are:

I. Water
II. Renewable Energy
III. Transportation
IV. Agriculture
V. Habitat
VI. Livelihoods
VII. Disaster Management
VIII. Food preservation
IX. Education.

Box- 2.2. Footprints and handprints

The **Environmental footprint** measures human demand on nature and its impacts. This serves as composite measure of the negative impact of human endeavour on the environment.

This is made up of several specific footprints like **carbon footprint** (CO_2 emission due to fossil fuel), **water footprint** (per capita consumption of water, direct and indirect), **ecological footprint** (Quantity of nature it takes to support people) etc. Hand prints are about the positive actions we take now to reduce the footprint.

Human ingenuity is required 'now' to increase the handprint and reduce the footprint and assume human scale.

'We can think of the difference between handprints and footprints in these simple terms: Footprints are the negative consequences of all that it takes to sustain a person or an organisation for a year— the total planetary "cost" of your presence.

Handprints represent the benefits of your presence: they're the positive changes that you bring into the world during this same year. If footprints are what we unavoidably take, handprints are what we intentionally give'.

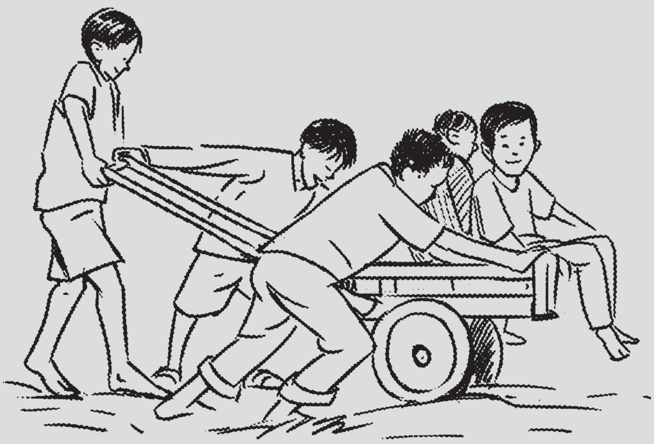
The image of our limb prints resemble that of a Jurassic creature with huge footprints and small hand prints, with voracious hunger.

Appropriate technologies are a way of enhancing our hand prints.

Traditional Knowledge Systems and practices are rich source of examples for Appropriate Technologies.

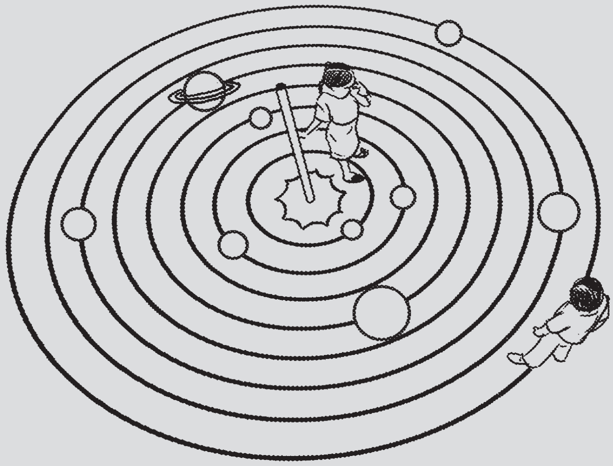
BOX-2.3

Traditional Technical Knowledge (TTK) is related with design and uses tools and implements in day-to-day life, including design and construction of traditional housing, boat, musical instruments, etc. TTK always works along with Traditional Ecological Knowledge Systems (TEKS) and Traditional Values and Ethics (TVE)Some important areas of TKS which children need to be exposed to and encouraged to explore are – traditional agricultural planning, crop calendar, traditional cultivar, agro-biodiversity, seed preservation, crop storage, post-harvest processing, forestry practices, sacred flora and fauna, ethno-medicinal practices, non-cultivated edible sources, water conservation, traditional housing, handloom practices including traditional design and its association with nature and environment, social institutions, cultural activities linking to cropping cycle etc. Such exposure may help the learner to gather many information about local practices linking environmental stewardship, social responsibility and community-based sharing, cultural practices, its sources and meaning etc. At the same time, it will help to accrue idea and skill on climate change adaptation, disaster risk reduction and designing a sustainable life style.4



BOX-2.4

BaLA – Building as a learning aidIt is about reimagining school as space for children. BaLA is about developing the school's entire physical environment as a learning aid – the inside, the outside, the semi-open spaces – everywhere.At the core, it is about maximising the educational 'value' of a built space. It is based on 'how children learn'. Building as a Learning Aid (BaLA) aims to use the built elements like the floor, walls, pillars, staircases, windows, doors, ceilings, fans, trees, flowers, or even rainwater falling on the building as learning resource. This is Appropriate Technology at work.



Learning, Playing, Acquiring life skills Adaptation

BOX-2.5

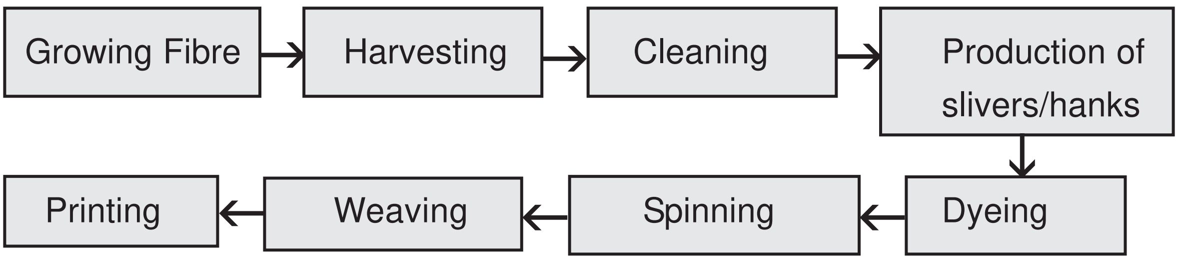
Teaching Science by Creating Toys from Trash – Aravind GuptaFor almost 30 years now, Arvind Gupta has been taking his love for science and learning to the children of India. He's the dream teacher we all yearned for. Gupta has travelled to over 3000 schools, demonstrating captivating science experiments to wide-eyed children. What sparks their imagination further is that Gupta uses only everyday garbage as the building blocks of these experiments. "All teaching aids we use are hand-made. It is important for children to see that you don't need fancy materials. Science can also help you look critically at materials that are often considered trash, there is a lot of learning in that itself"

Examples from community

(i) Vibrant fabrics of India

India was a pioneer and world leader in textile making. Inventions of machines for large scale production of textiles saw India lose its prominent place besides loss of livelihoods in the sector. Today, there is renewed interest in these traditional practices because they are inherently sustainable, capable of creating local employment and livelihood options and are safe for the environment.

Production of fabric from growing fibre to making cloth involves several processes. These vary from place to place to cater to local availability of fibre, community aspirations and constraints, existing materials and skills etc. Hence, there is a scope for understanding and appreciating the practices in local context and if possible improve upon it.

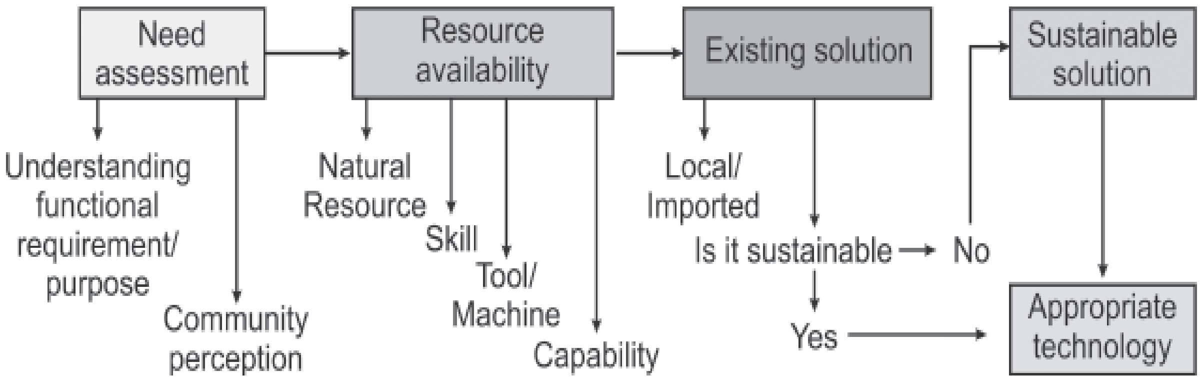


(ii) Traditional fishing practices

Fish farms provide a major part of food for large number of people. A large population in India is engaged in harvesting fish. Though traditional practices exist, commercial fishing has emerged in a big way dominating the fishery sector. Large scale mechanized fishing is found to be unsustainable and damaging to the environment. Traditional practices of fishing demonstrate a

good understanding of behaviour of fishes, their reproduction cycle, seasonality, use of local materials and skills to catch them and sustainability of resource. Each part of the country shows diversity in practices to suit the local context. Hence, it is increasingly relevant today to revisit, study, understand and appreciate traditional practices in fishing and explore scope for improvement of different nets, tarps, methods, sacred pools, sustainable harvesting etc.

Thematic examples are given to improve the focus. Appropriate technologies also work on synergies. They tend to address several issues simultaneously. Suggested steps for identifying and approaching AT solutions.

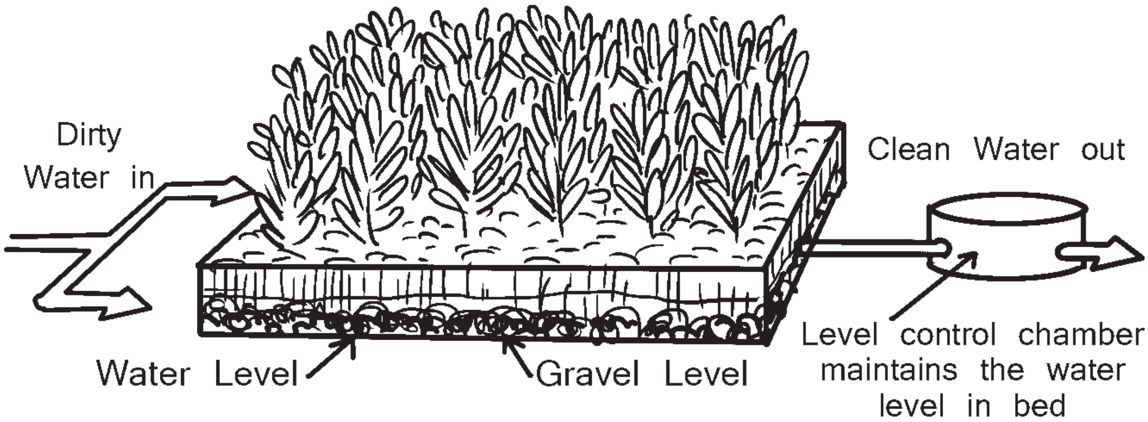


Model Projects

Project -1: Waste water treatment using reed bed

Background

Water is basis of life and fresh water is becoming scarce day-by-day because of different reasons. Some uses like drinking, cooking and washing require good quality water while other uses like gardening, flushing of toilet can be possible with poor quality water. Hence there is need to conserve, recycle and reuse water to reduce fresh water requirement in the house. Fresh water used in the house can be treated and reused for secondary purposes at the household level.



Objective

To assess the efficiency of biological treatment system in treating household grey water for reuse

Methodology

(A) Materials required

Drum / tub, pebbles, pH strips, test tubes & chemicals, cow dung slurry, plants

(B) Experimentation

The experiment is to be conducted step-by-step as described below-

- Take a used drum /tub (approximate capacity of 200 litres) and make suitable inlets and outlets (figure needs to be included)
- Fill the drum / tub with pebbles up to 75 % of its capacity
- Collect the grey water from the household in a suitable container
- Assess the quality of water by studying pH, colour, odour, ammonia, sulphide etc. (whichever is feasible)
- Known quantity of water needs to be passed on to the drum and allow it to retain for a week time
- After four days, outlet water may be assessed for the same parameters which has been measured earlier at different time intervals (2, 4, 6 , 12, 24 hours etc.)
- Repeat this for three times for standardising the same
- Next step is along with the same set up and requires to add cow dung slurry or any micro-organisms into the pebbles and repeat the same experiment

- Suitable aquatic / terrestrial plants viz., Canna, Salvinia, Grass or any locally available plants etc., can be grown over the same set up and repeat the experiment
- Observe the change in parameters of water quality by analysis, collect the data and draw the inferences

Outcome

- Understand the efficiency of different biological treatment systems
- Understand the scientific principles involved in water quality monitoring, analytical skills, interpretation of observed data and ultimately understanding the mechanisms of natural wetland

Project - 2: Preservation of food products by drying

Background

Food availability in nature is seasonal. In order to make it available off season, it needs to be preserved. One of the simplest methods used is drying. Fish, meat, vegetables, fruits herbs etc. have been dried and used since antiquity. Present project tries to understand the dynamics of drying process under varying conditions

Objective

To understand the dynamics of preservation of food by drying

Methodology

(A) Materials required

Food products, tray, thermometer, weighing scale

(B) Experimentation

This is to be conducted step-by-step as described below-

- Select the material to be dried from the locality (e.g. ginger/ fish etc.).
- Prepare a tray (metal, bamboo, wood) of a convenient size (square or round).
- Keep the material to be dried in the tray and keep it in a shade outside the house.
- Measure the temperature at the tray and weight of the tray and product every one hour and measure the ambient temperature also.
- Repeat the experiment by keeping the tray in Sun and record the values.
- Upgrade the tray with a glass /plastic cover (with adequate ventilation) and repeat the experiment.
- Draw graphs of time Vs temperature and time Vs moisture.
- Observe – explain the change in the rate of drying in different systems.
- Suggest the methods to improve the performance.

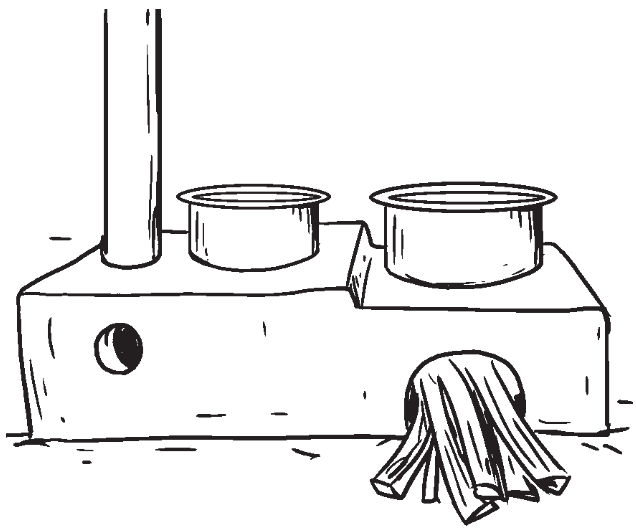
Expected Outcome

An understanding of the dynamics of the process of drying and the influence of various parameters involved.

Project - 3: Performance Assessment of Biomass based Cooking Stoves

Background

Biomass is traditionally used fuel for cooking in most part of rural India. Biomass in form of twigs of tree branch, tree leaves, waste biomass, bio-residue like rice straw, cotton stalks etc., are used in traditional cook stove in the rural areas. Biomass cooking stove is heated by burning wood, charcoal, animal dung



or crop residue. These types of stoves are the most common way of cooking and heating food in developing countries. Varieties of cooking stoves in terms of its design, purpose and available resources in that particular area are in use. Biomass burnt in these stoves to generate heat energy, which is used for boiling of water and cooking of food items. In this study, students will assess the various cooking stoves in terms of design available in the neighbourhood.

Objectives

1. To assess the design variations in the various types of biomass based cook stoves.
2. To assess the performance of various types of biomass based cook stoves.

Methodology

(A) Materials required

Different types of fuel and stoves, thermometer, weighing scale

(B) Experimentation

The experiment is to be conducted step-by-step as mentioned below-

- Identify the different types of cooking stoves that are in use in the neighbourhood and marked with A, B, C
- Identify the design variations of all these stoves and identify the significant variations in the design.
- Consider at least three different types of fuels and pot for boiling of water for all different cook stoves.
- Boil one litre of water. Note the initial water temperature and time taken to raise the water temperature to 100 0C. Also note the amount of biomass consumed during this period of time.
- Repeat the experiment at least three times for each case.

Expected Outcome

1. Understanding the performance of each type of stoves for different type of biomass fuels.
2. Understanding the scientific rationality and the difference in performance among the different type of stoves and fuels.

Project -4: Potential of charcoal for sustainable agriculture

Background

Charcoal can be used as a soil amendment for improving its properties. It improves water retention capacity, soil fertility, increases the microbial population and ultimately improving the plant growth and productivity. Application in soil also leads to carbon sequestration, as carbon captured by the plants from the atmosphere are buried in the soil for a long time

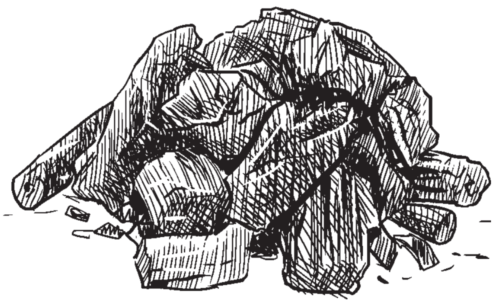
Objective

To assess the impact of charcoals on water retention properties and plant growth

Methodology

(A) Materials required

Charcoal, pots, plant seeds



(B) Experiment

This is to be conducted step-by-step as described below-

- Take 5 pots and fill it with same type and quantity of sand or soil
- Add 0 (control), 5, 10, 15 & 20 g of uniformly powdered charcoal in each pot and mix it uniformly
- Irrigate the pot with the same quantity of water slowly and measure the quantity in outlet and quantify the same.
- In addition soil moisture at periodical intervals (4, 8, 12, 24 hours) may be estimated by difference in weight (gravimetric method)
- Sow the seeds of any vegetable in the pot (three to five plants as replicates)
- Study the growth pattern over the period of time viz., germination per cent, plant height, number of leaves, number of branches, leaf area and yield (if time period permits)
- Collect the data, analyze the same and draw the inferences

Outcome

Understand the impact of charcoal on water retention properties and plant growth

Project -5: Comparative study of thermal performance of traditional and modern houses

Background

Traditional houses were inherently responsive to the local climate. They were built with simple materials but sophisticated thinking to make them comfortable and liveable with changing seasons. Modern construction by contrast is not responsive to climate and requires lot of external energy to keep cool. The purpose of the project is to compare the thermal performance (during summer and winter months) and evaluate their suitability.

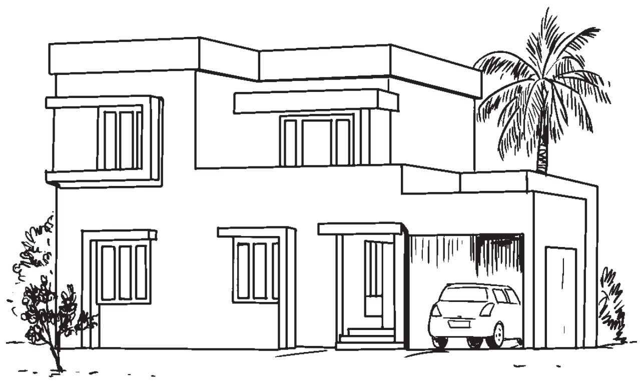
Objective

Evaluate the thermal performance of traditional and modern houses

Methodology

(A) Material required:

A laboratoryThermometer



(B) Experimentation

Step-1: Select a single storied traditional house and modern house for the study with the same area

Step-2: Measure the temperature outside and in various parts of thermometer at suitable intervals (of half an hour or 1 hour)

Step-3: Draw graphs of Temperature vs.Time

Step-4: Compare the two systems for thermal comfort

Step-5: Inference: Relate the result to the materials of construction and design of the house and scientific reason behind it

Expected Outcome

Understand the thermal performance of traditional and modern houses and the scientific reasons behind the differences

Additional Project ideas

1. Design optimization of solar cooking system
2. Use of traditional methods of storing food grains
3. Use of simple ropeways for transportation of materials
4. Use of natural additives in making handmade paper resistant to insect attack
5. Foot operated pumps for water lifting / energy efficient water lifting devices
6. Accessories for rainwater harvesting systems to prevent initial dirty water entering the storage
7. Technology for Aquaponics / hydroponics for fodder –livestock
8. Use of micro / wick irrigation method
9. Community-based warning system for natural disaster
10. Community-base warning systems to avoid human-animal conflict
11. Low wattage solar pumping system for domestic water lifting
12. Comparative study of different types of fishing traps/gear used in traditional systems
13. Study on floating decks for growing food crops on water bodies
14. Performance study of e-rickshaw
15. Water lifting/ power generation from hill streams
16. Managing drinking water during flood
17. Evaluation of impact of a new technology replacing the old practices/ technology in day-to-day life
18. Studying an existing cottage industry in our locality, evaluating needs and constraints and suggesting solution
19. Traditional water harvesting in arid region and their relevance
20. Harvesting water from atmosphere