Farmer-led Integrated Upland Watershed Management Trainers' Resource Book

Module 8

Upland Farm Resources' Management Processes/ Experiences

Upland Farm Resources' Management Processes/ Experiences

(1) Hence, against this background, the objectives of this module are:

- To describe how some community-based as well as on-farm sustainable watershed management processes and techniques are being implemented successfully in Asian Upland Watershed
- To assess what impacts are being created by these techniques/processes on both the local people and environment
- To draw lessons for their replication

Some Effective Watershed Management Processes and Techniques for Upland Community and Farm Management

(2) What are these successful processes/ techniques

This training module deals with some examples of successful processes and techniques for management of community and farmlands in upland watersheds.

How is this module arranged?

The module consists of case studies of upland community and on farm resource management demonstrating the processes and techniques and programmes for upland farm rehabilitation.

The module is as follows:

8.1 An indigenous case study of Sri Lanka to demonstrate sustainable farmer-managed IWM programmes.
8.2 A case study based on traditions of the farmers from India to demonstrate how a village developed itself sustainably from a stage of complete degradation.
8.3 SALT techniques for on-farm rehabilitation.
8.4 PFT for on-farm rehabilitation in temperate, dry, rain-fed climates in China.

MODULE 8.1
INDIGENOUS VILLAGE TANK (IVT) SYSTEMS IN SRI LANKA

(3) Objective

- The objective of this section of the module is to describe the manner in which old customs, traditions, and relationships promote highly participatory watershed management.

(4) What is IVT?

(5) Is IVT the oldest and the most effective system?

- These are practised in native to dry zones of Sri Lanka, southern India as well as parts of Vietnam and China.
- Their origin could be traced back to about 2,500 years in Sri Lanka.
- These are among the most successful cases of farmer-led watershed management:
  - with limited natural resources,
  - a high degree of unpredictable rainfall, and
  - harsh rainfed climatic conditions.

(6) How does it work?

- It is called a village tanks' (small reservoir) system.
- The system is composed of a series of small reservoirs of water.
- These are physically connected to each other within a drainage basin in a cascade.
- A three-fold farming system operates as follows:
  - the paddy fields below the tank,
  - the village settlement or homesteads, near the tank, and
  - ancient slash-and-burn cultivation, called *Chena,* in the upper watershed.
- The paddy fields are provided with supplementary irrigation from the tank.
- Homesteads and *Chena* (shifting agriculture) are rainfed.

(7) What is the importance of the system?

- It allows the practice of sustainable farming systems in the whole watershed.
- It protects and sustains them against extreme weather conditions.
- The maintenance of the system and distribution of water were turned into a culture/rituals and a duty to god or the king.

(8) What has contributed to sustainable agricultural development?

- The mechanism of clear identification of:
  - village leadership,
  - collective decision-making, and
  - strong linkages between
    - * traditions,
    - * customs,
    - * rituals, and
    - * farming practices.
- Maintenance and equitable distribution of benefits as a duty to god.
- Appropriate land allocation below the tank so that all receive equitable benefits from harvested water.

(9) Which were the factors that kept the system going by making them a part of rituals and culture of the people?

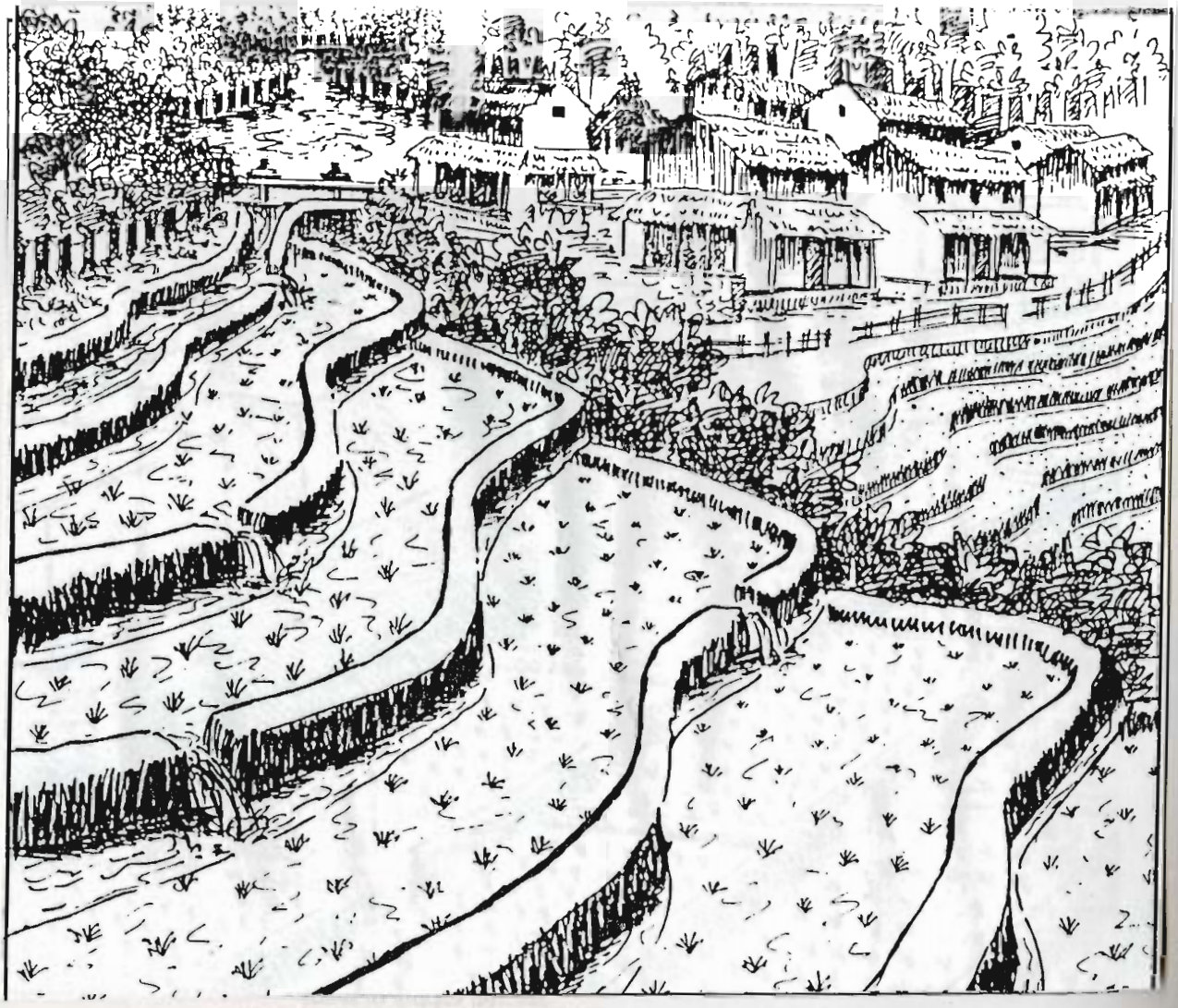
- The *Attam* system (reciprocal exchange of labour)
  - The *Betma* cultivation (sharing of land in part of the paddy tract with assured supplies of water in a season of drought for equitable benefits)
  - The *Rajakariya* system (responsible for maintenance of the tank- bund and canal fence on a sharing basis and as a duty to the king)
  - Exchange of seed materials for an assured supply of seeds

(10) Implications

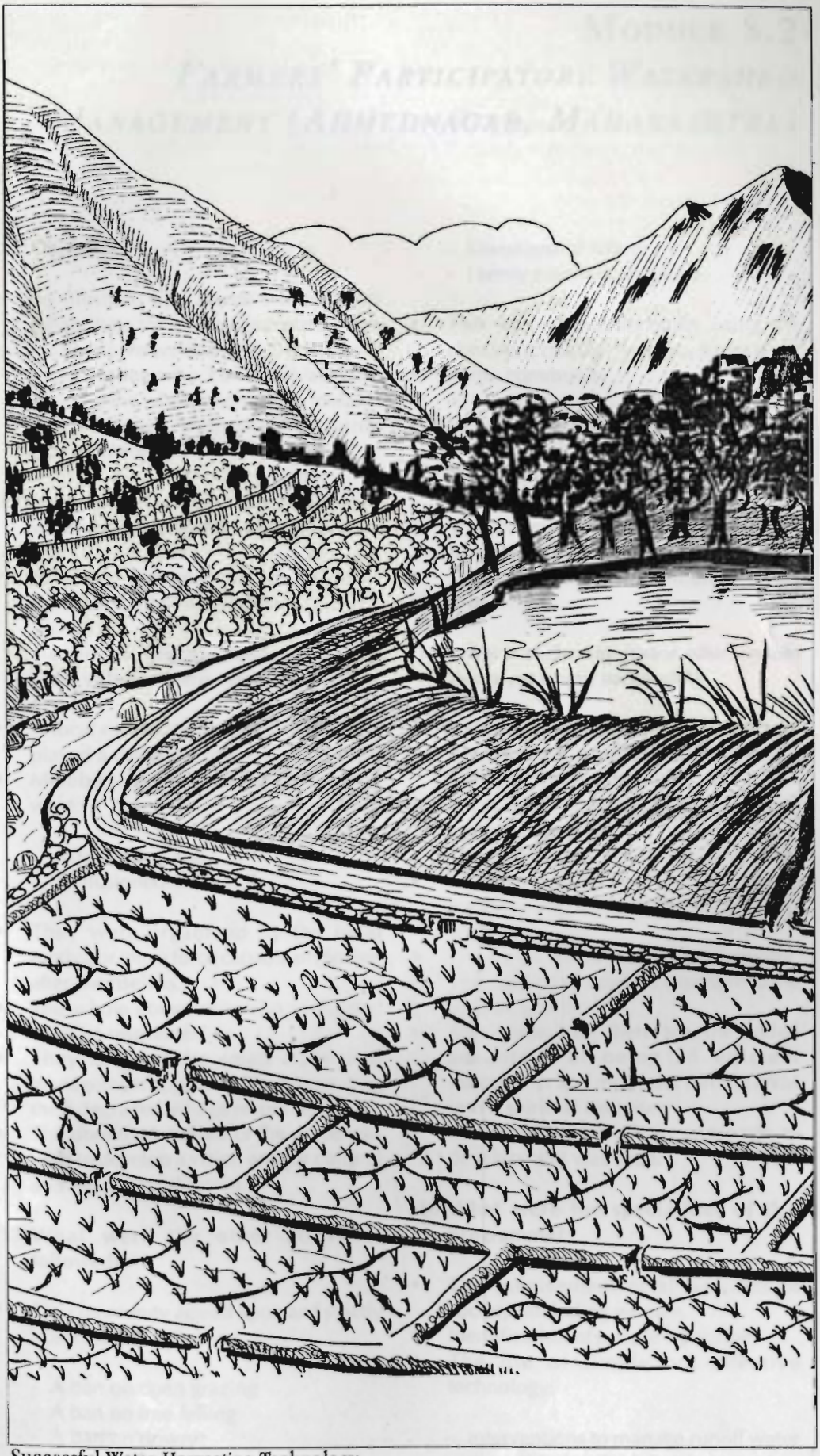
- The Indigenous Village Tank system is an age-old water-harvesting technique.
- This system is especially suitable to all dry zones like those in Sri Lanka.
- The system has proved to be one of the major contributing factors

  - to sustaining people over the ages.
  - Livelihoods depend on it.

- The IVT is the source for supplementary irrigation, especially in extreme weather conditions, which assures sustainability of the system.
- This is a successful example of people's participation in IWM for the common good.
- Every member of the community benefited from the system.
- There is distinct division of labour, decided by rituals, in which everyone plays his/her role effectively.
- The system evolved a culture of sustainable IWM by turning operations, the mountains, and duty into rituals, thus assuring long-term sustainability.
- The system is based on equitable land allocation as well as equitable benefit sharing.



Age-old Water Conservation and Utilisation Practices in Sri Lanka



Successful Water Harvesting Technology

MODULE 8.2

FARMERS' PARTICIPATORY WATERSHED MANAGEMENT (AHMEDNAGAR, MAHARASHTRA)

(11) Objective

- To illustrate how farmers themselves rehabilitate their degraded watersheds for their own welfare with the help of a local leader who can motivate and organise the whole community towards farmers' own watershed resource management

(12) How was farmers' participatory watershed management launched?

- In 1975, the general condition of Relegan Siddhi village was:
  - extremely degraded and
  - the villagers were very poor.
- A local motivator (Annasaheb Hazare) played a catalystic role.
- Members of the farming community were:
  - disintegrated and
  - disillusioned.
- They were organized by the local motivator into a force capable of looking after themselves.
- The whole community was motivated to share responsibility.
- They adopted the small watershed management approach for regenerating their degraded village resources.
- The dominant culture of the place was used to develop a vision and for cultural and moral revitilisation.

(13) What were the other activities followed?

- The community agreed upon and strictly observed the following.
  - A ban on open grazing
  - A ban on tree felling
  - A ban on dowry
  - A ban on consumption of liquor
  - Donations of labour
  - Family planning activities
- This was accomplished by using the dominant cultural/religious framework of the community.

(14) What was the effect of the programme?

- The overall crop productivity was raised substantially.
- The community achieved complete self-sufficiency in food grains.
- Today, the whole community looks prosperous.

(15) What was the key factor which made this programme successful?

- Cultural and moral revitilisation and development of a vision of a sustainable self-sufficient community
- Local leadership and the spirituality to motivate farmers
- The leader knew the village very well
- The leader knew the local culture and traditions and used them for sustainable IWM
- The leader was one of the community
- The leader had received exposure to the outside world
- The leader had, therefore, the added advantage of being an efficient executioner and motivator turning IWM into a spiritual exercise
- In short, the Gandhian approach to development was used.

(16) What were the specialities of this programme?

- The involvement of all sections of society, including women
- Identification of people's priorities
- The use of simple but effective technology:
  - interventions to manage runoff water
  - through watershed development by:

  * cheap methods,
  * local materials, and
  * local labour

- It was a holistic and sustained development programme including:
  - water management,
  - community-managed erosion prevention, and
  - widespread afforestation.

- These activities have been in practise for the last 20 years.

(17) What was the forum for decision-making?

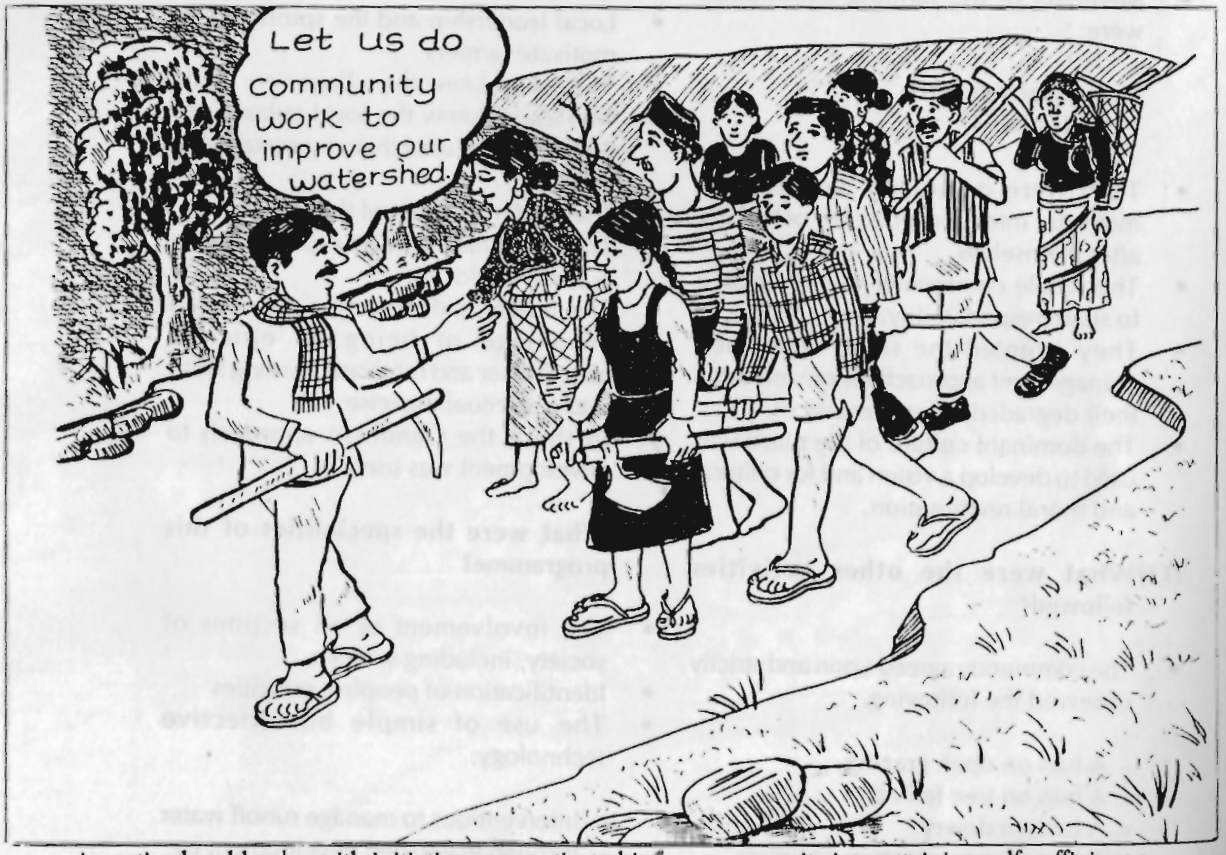
- The primacy of the village assembly (*Gram Sabha*)
  - All major decisions were taken by the *Gram Sabha*
    * institutionalised democratic system of functioning.

(18) Implications

- Watershed management activities were undertaken with:
  - full and active participation of local farmers and
  - yielded exemplary results.

- The programme has been successful in:
  - overall resource conservation and
  - in building up land-based resources
    * the management and use of the benefit by the farmers themselves.

- The farmers now have been able to raise their crop productivity by 25–30 per cent.
- This has resulted in better standards of living.
- There is marked improvement in socioeconomic and environmental conditions.
- However, the programme was fully dependent on a very dedicated spiritual leader, hence its replicability is not yet proven.



An active local leader with initiative can motivate his/her community into attaining self-sufficiency

MODULE 8.3
SLOPING AGRICULTURAL LAND TECHNOLOGY (SALT)

(19) Objectives of the Module

Before the objectives of this section of the module are delineated, giving a brief picture of SALT will put the subject into perspective.

Background

(20) What are the proponents of SALT saying?

Proponents of SALT technologies argue that:

- 'Modern agricultural technologies' rely heavily on:
  - improved varieties,
  - commercial fertilizers, and
  - chemicals.
- These technologies are scientifically proven.
- But they have largely remained out of the reach of the majority of farmers in the mountains and rainfed areas of Asia.

(21) What has SALT's 20 years of experience to offer?

- SALT was devised and tested by Mindanao Baptist Rural Life Centre (MBRLC) in the Southern Philippines.
- It was found useful for hilly farmlands.
- Nitrogen-fixing agroforestry is a viable option:
  - for raising land-based production and
  - sustaining it in an environmentally friendly ecosystem.

(22) Hence, the objectives of module 8.3 are:

- To present a brief description of SALT models as on-farm successful agroforestry methods
- To explain the conditions required for the operation of SALT
- To draw lessons from experiences that would be helpful for launching similar programmes in similar domains

SALT Approaches

(23) What is SALT ?

- SALT is basically a package of technology models using a contour, double hedgerow agroforestry concept of:
  - diversified crop production for
  - sloping farmlands.
- The SALT approach includes techniques of:
  - growing field crops,
  - permanent crops;
  - forages; and
  - forest species in alleys in between the double hedgerows of nitrogen-fixing species.
- Crops are grown in contour farming practices with a focus on:
  - minimising soil erosion,
  - improving and sustaining soil fertility,
  - enabling farmers to produce enough food, and
  - a decent income for household members.

(24) Is nitrogen a limiting factor in agricultural production?

- There is abundant N in nature (80% of the air we breathe consists of gaseous nitrogen).
- It, being in a gaseous form, is not available for most crops.
- However, there are a number of nitrogen-fixing plants.
- These trees can fix substantially high levels of nitrogen into the soil, provided they are given:
  - appropriate conditions and
  - right organisms (such as *Rhizobium* and *Frankia*).

- The nitrogen thus fixed becomes available for agricultural crops.

(25) When does an agricultural system become viable?

- It must maintain a balance between:
  - inputs and
  - output ratios.
- Outputs include:
  - nutrient losses,
  - soil erosion,
  - leaching, and
  - losses occurred in crop harvests
  - animal feed,
  - fuelwood harvest, and
  - burning.
- The better the harvest, the more the inputs needed to replace the plant nutrients removed by crops.

(26) Can this critical balance be maintained between outputs and inputs?

- MBRLC's research outcome suggests that this can be maintained.
- By growing suitable species of nitrogen-fixing plants in double hedgerows along contours.
- Nitrogen-fixing agroforestry systems can provide:
  - up to 40 to 60 tons of fresh organic matter and
  - as high as 200kg of nitrogen per hectare.

(27) Examples of Nitrogen-fixing Agroforestry Techniques for On-Farm Development

- Four types of successful farming system methods are summarised in this sub-module.
- These methods are centred around nitrogen-fixing trees.

(28) SALT-1: Sloping Agricultural Land Technology-I

(29) How is it carried out on a hectare of land?

- This model consists of growing :
  - food crops (45%) in crop rotation,
  - permanent crops (30%), and
  - fast-growing nitrogen fixing trees/ shrubs (NFT/S) (25%).
- Food crops and permanent crops are planted 3 - 5m wide.
- The NFTs/Ss are thickly planted in:
  - three to five metre-wide contoured alleyways, depending on the slope of the land
  - in double hedgerows.
  - The steeper the slope, the narrower the alley ways.

(30) What is the pruning schedule for nitrogen-fixing trees?

- When the trees have attained the height of 1.5 to 2.0m.
- They are pruned to a height of 50 to 100cm
- The materials thus pruned are spread and incorporated in:
  - alleys between the hedgerows and
  - to serve as organic fertilizer mixed with crop residues.

(31) SALT-2: Simple Agro-Livestock Technology-II

(32) What are its specific features?

- The system consists of (as an example on a ½ ha of land):
  - an animal component of 14 goats
  - plus the SALT-1 system.
- The land area covered is half a hectare in this example of which:
  - half of the land is devoted to a standard SALT-I system for food production for the family and
  - the other half is put under forage crops for the goats.
- Goat manure is applied to the field along with NFT pruning and crop residues.

(33) SALT-3: Sustainable Agro-Forest Land Technology

(34) How is the system carried out?

- The basic features of the system are:

- reforestation,
- farmer-focussed, and
- small-scale.

- The land area covered is 2 ha in this example.
- The lower 1 ha is placed under the SALT-1 system for food.
- The remaining upper 1 ha is put under forest tree plantation.
- The tree species included in the method can have a maturity period from one to 20 years after planting.

(35) SALT-4: Small Agro-Fruit Livelihood Technology-IV

(36) How is this system established?

- This is an agroforestry model placed under fruit production.
- The method is described here for half a hectare of land.
- The whole area of ½ ha is planted with SALT-I type of hedgerows.
- The lower one-fourth of alleyways are placed under food production.
- The alleyways of the upper three-fourths are brought under fruit production.
- Fruit alleys are used for food crops until fruit trees attain maturity.

(37) What is the impact of the programme?

(38) Does it control soil erosion?

- Raindrop splashes and runoff are primarily responsible for causing soil erosion.
- Good ground cover and some barriers to runoff are to counter-balance their effects.
- SALT data on nitrogen-fixing plants grown with arable crops clearly show that under optimum management

  - soil erosion can be adequately checked
  - in most hill farming situations.

- Under a non-SALT system it is recorded that:

  - soil losses are 58 times higher than found under SALT,
  - runoff is 13 times higher than found under SALT, and
  - sediment collection is 116 times higher than found under SALT.

- This shows the effectiveness of the SALT programme in controlling soil erosion. In the Philippines, it has been used to build green terraces within five to six years after the hedgerows are planted.

(39) Which are the suitable nitrogen-fixing trees (NFT) for SALT

- It is a widely accepted fact that:

  - neither are all legumes nitrogen-fixing,
  - nor are all non-legumes non-nitrogen fixing.

- It takes a complex technical process to determine the nitrogen-fixing ability of a plant.
- The rule of thumb is, therefore, that good NFTs are plants:

  - with many nodules,
  - with adequate moisture, and
  - which are a pinkish colour when crushed.

- The recommended species for N-fixing hedgerows include:

  - *Calliandra tetragona,*
  - *Calliandra calothyrsus,*
  - *Leucaena diversifolia,*
  - *Gliricidia sepium,*
  - *Erythrina poepiggiana,*
  - *Flemingia macrophylla,*
  - *Desmodium rensonii,*
  - *Indigofera anil,*
  - *Alnus nepalensis* (for the HKH region), and
  - *Leucaena lecaufela.*

(40) What is the effect of NFT's biomass on crop yield?

- When the nitrogen-fixing hedgerows were planted at 2 to 6m spacing with maize crops,
- the 2m spacing produced the highest maize yield (5.41 t/ha) and
- the 6m spacing gave the lowest maize yield (3.81 t/ha).
- The closer the spacing,

  - the higher the amount of biomass production and

- the greater the amount of biomass available per hill.

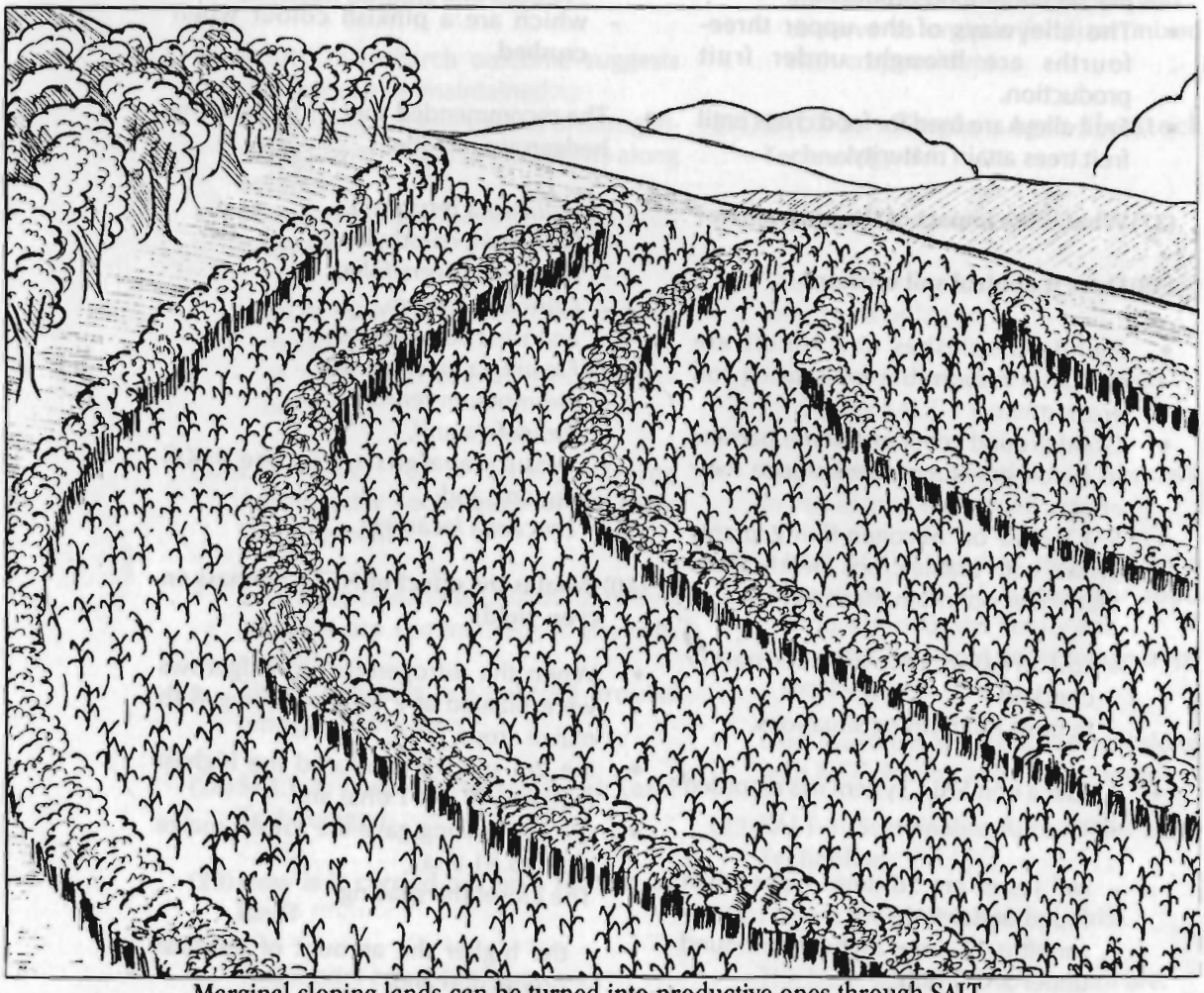
- This results in higher productivity as well as maximum soil conservation.

(41) Does the SALT-1 system demonstrate phosphorus deficiency?

- Basically, maize is a heavy feeder on phosphorus.
- An intensive system of maize growing in SALT systems has led to phosphorus deficiency, especially after two to three maize crop seasons.
- This suggests that under such systems
  - applying commercial phosphatic fertilizer might be required.

(42) Do SALT methods provide increased incomes?

- Maize yield:
  - in nearby non-SALT areas = 0.5 to 1.0 t/ha.
  - in SALT areas = 2 t/ha.
  - if the advantage from the SALT-2 system is added, i.e., the use of animal manure,
    - * the maize yield could be as much as 4.0/ha.



Marginal sloping lands can be turned into productive ones through SALT

MODULE 8.4
PLASTIC FILM TECHNOLOGY (PFT) FOR TEMPARATE ZONES

(43) Objectives

- To describe how PFT has been used successfully to raise on-farm agricultural production and productivity in China
- To illustrate the impact PFT is creating on the well-being of the local people
- To draw lessons for future implications

Background

(44) What are the constraints that hamper food production and productivity in temperate zones.

- Efforts to meet the food needs of fast-growing populations in cold temperate zones have met with multiple complex constraints which are:

  - technological,
  - socio-eco-environmental,
  - related to support services,
  - problems of policy issues,
  - adverse climatic problems,
  - soil-related problems,
  - lack of irrigation, and
  - low soil temperature problems.

(45) What have farmers done traditionally in cold temperate zones to overcome these problems?

- Farmers through experience have:

  - developed and used traditional mulching techniques to overcome these adverse conditions.

- Applied straw/fallen leaves to protect farm crop roots from cold.
- Put stones near plants to increase soil temperature and to reduce water loss through evaporation.
- These methods are useful but have many limitations resulting in less effectiveness.

(46) How is plastic film technology a breakthrough in temperate agriculture?

- Plastic film was introduced into temperate agriculture during the 1950s in Japan.
- This brought about great changes in temperate hill agriculture.
- It transformed traditional hill/mountain agriculture into a modern system.

(47) What does plastic film do?

- The soil is covered with plastic film to:

  - increase temperature,
  - retain moisture,
  - promote seed germination and emergence, and
  - accelerate the growth and development of

    * roots and
    * the whole plant.

- This has enabled farmers to achieve high yields and good crop qualities.

Global Usse of PFT

(48) Is Japan the leading country in developing PFT?

- Japan produces various kinds of

  - covering materials,
  - including polythene films.

- Japan has been using this technology since the 1950s.

(49) Where is it used?

- In green houses
- In plastic canopy cultivation
- On open land

(50) Which are the crops for which PFT can be used?

- Many field crops
- Horticultural crops
- Industrial crops

(51) Which other countries are using PFT?

- The USA, France, Germany, Italy, Spain, and China.
- These countries have also made significant achievements in:

  - studying,
  - applying, and
  - developing covering materials.

(52) Does PFT have other preventive functions?

- It prevents damage from

  - insects and diseases.

- It improves the quality of products.
- It increase maturity and yields.
- It is effective particularly in:
  - counter-balancing adverse conditions and
  - environmental situations prevailing in:

    * wet areas,
    * cold areas, and
    * arid areas.

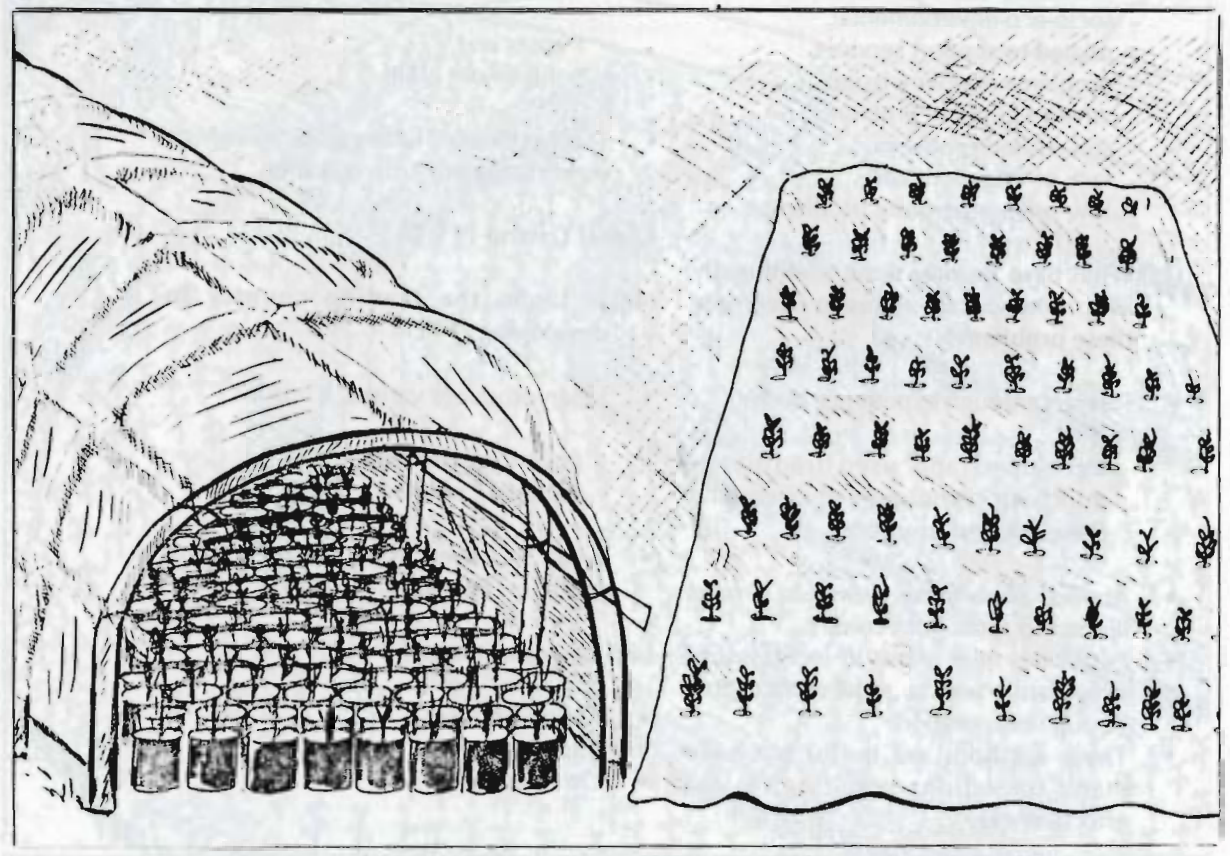
- It prevents the loss of plant nutrients.

(53) How long have Chinese farmers used PFT?

- It has been modernised with Japanese technology since 1978.
- Ever since, China has carried out innovative activities with PFT.
- They have been using it mainly for vegetable cultivation.
- Thick PF (0.1mm) used by them earlier had proved to be less effective.

(54) Why is it proving more effective for substantially raising the yields of many crops?

- It helps extend crop farming to colder environments with short growth periods.



By the use of plastic films, seedlings can be raised in adverse climatic conditions

- For this reason, Chinese farmers call this 'a white revolution'.

(55) How was the need felt for developing a suitable PFT technology?

Because of the:

- need for controlling moisture and temperature,
- need for extending farming into colder environments, and
- need for weed control.
- In their research agenda on PFT, the following items were included

  - industrial crops,
  - cereal crops,
  - vegetable crops,
  - fruit crops, and
  - plastic films and plastic film machines

- PF technologies were developed based on farmers' needs.

(56) How much is the area under PFT in China?

- In 1991, four million ha were already covered with PFT.
- This makes China the leading user of PFT in the world.
- There are more than 80 species of crop plants being successfully cultivated with PFT.

Reach on PFT

(57) What is the PFT research agenda?

The research agenda is to carry out the following.

- Investigational activities focussed on:

  - function of metabolism in roots,
  - enzyme activities,
  - photosynthesis,
  - absorption of nutrients, and
  - physiological and biochemical aspects.

- These studies also include investigations of:

  - light,
  - heat,
  - water,
  - air,
  - fertilizers,
  - seed germination, and
  - vegetative and reproductive growth.

(58) What has been found out by PFT research?

- PFT has a relatively stable effect on the environment.
- PF can increase the effective accumulated temperature of each growing season by 200 to 300°C.
- It increases the maturity period by about seven to 10 days.
- It increases yields by 30 to 50 per cent.

(59) Is PFT economically beneficial?

- It is a relatively low-cost technology.
- It provides higher economic gains.
- Polythene film costs range from US$ 48 to 108/ha.
- The input and output ratio ranges:

  - from 1:1.73 (for cowpeas) and
  - to 1:12.96 (for water melons).

(60) What happens to used PF?

(61) How important is it to retrieve used PF?

- The used PF cannot dissolve into the soil.
- It causes tilling and field management problems.
- It interferes with normal plant growth and development if not retrieved.
- If animals eat it, they will suffer from intestinal diseases.
- Hence, to clear the agricultural environment, it is necessary to retrieve the used PF.

(62) Implications

(63) Why should Plastic Film Technology be used?

- It controls soil erosion.
- It increases land temperature.
- It improves soil fertility due to microbial activities.
- It improves soil moisture content.
- It improves the soil's physical properties.
- It restrains the salt effect on young seedlings.
- Effects of diseases and insects are minimised.

- It minimises weed infestation.
- It increases the maturity of various crops by five to 20 days.
- The harvesting period can be shifted:
  - either by 40 to 60 days,
  - or can be delayed by 40-60 days.

(64) Major constraints to PFT use?

- Retrieval of the PF is essential otherwise it will create a serious environmental hazard as it is degrades the environment.

(65) Conclusions

Village Tank Systems

- The Indigenous Village Tank (IVT) system is an age-old water harvesting technique being operated in the dry zone of Sri Lanka and other Asian countries.
- One of the major contributing factors to sustaining farming systems is the well-being of the people.
- The IVT is the source for supplementary irrigation, especially in extreme weather conditions.
- This indigenous system is the best example of farmers' sustainable WM.

A Local Leader Initiated Farmer-Led WM Programme in India

- It is interesting to note that watershed management activities
  - undertaken with the full and active participation of local farmers
  - yielded exemplary results in overall resource conservation, and encourage management and use for the benefit of the farmers themselves.
- The farmers now have been able to:
  - raise their crop productivity by 25-30 per cent.
  - which, in turn, has provided them with better standards of living and improved socioeconomic and environmental conditions.
- IWM based on the traditions and culture of the native people can uplift most degraded resources and social bases.

SALT

- Any development programme designed to improve the quality of life of farmers with a focus on sustainability will succeed if it adequately addresses the farmers' problems, resource constraints, needs, aspirations, and the circumstances under which they are operating.
- SALT is one such approach, which appears attractive, particularly to hill farmers.
- And a system, to remain productive, would largely depend on sustained conservation and use of resources, thereby striking a balance between output and input factors. The SALT approach has convincingly addressed this issue.

PFT

- It is widely believed that Plastic Film Technology (PFT) is increasingly proving to be an important breakthrough in transforming traditional agriculture into modern agriculture in temperate zones.
- With the help of PFT, farmers have been able to manipulate environmental conditions in their favour.
- With its use, farmers now have been able to adjust the planting and harvesting times of many agricultural crops to suit their own convenience and market opportunities.

This final module gave examples of the recent processes/technological experiences available to farmers for upland watershed management.

Further Reading

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