WATERSHED DEVELOPMENT WORKS

Watershed work phase is the core component of the project. Creating permanent structures as required the slope, geology and topography starting from ridge to valley to conserve rain water at point of its incidence with ground. Tapping the water resources at right place at right time will increase the effectiveness of this project. The objective being reclamation of natural resources and creating sustainability to assets created under this project. A multi-tier ridge to valley sequence approach was approached towards implementation of watershed development projects. A net budget of 56 percent is allotted for this work.

NATURAL RESOURCES MANAGEMENT

The physical treatments are to be carried on during the watershed development work phase. While implementing the project, it is necessary that the treatments are carried out starting form ridge and progressing towards the valley. This approach is followed with the following objectives:

a) Protect the upper reaches to avoid erosion and reduce runoff
b) Avoid siltation of structures in the middle and lower catchments.
c) Ensure the cost effectiveness of structures in the valley and
d) Improve overall efficacy of the measures.

This phase is the heart of the programme in which the DPR will be implemented. Some of the important activities included in this phase are:

a. Ridge Area Treatment : All activities required to restore the health of the catchment area by reducing the volume and velocity of surface runoff, including regeneration of vegetative cover in forest and common land, afforestation, staggered trenching, contour and graded bunding, bench terracing etc.
b. Drainage line treatment with a combination of vegetative and engineering structures, such as earthen checks, brushwood checks, gully plugs, loose boulder checks, gabion structures, under dykes etc.
c. Development of water harvesting structures such as low-cost farm ponds, nalla bunds, check-dams, percolation tanks and ground water recharge through wells, bore wells and other measures.

d. Nursery raising for fodder, fuel, timber and horticultural species. As far as possible local species may be given priority.
e. Land development including in-situ soil and moisture conservation and drainage management measures like field bunds, contour and graded bunds fortified with plantation, bench terracing in hilly terrain etc.
f. Crop demonstrations for popularizing new crops/varieties, water saving technologies such as drip irrigation or innovative management practices. As far as possible varieties based on the local germplasm may be promoted.
g. Pasture development, sericulture, bee keeping, back yard poultry, small ruminant, other livestock and micro-enterprises.
h. Veterinary services for livestock and other livestock improvement measures.
i. Fisheries development in village ponds/tanks, farm ponds etc.
j. Promotion and propagation of non-conventional energy saving devices, energy conservation measures, bio fuel plantation etc.

Soil and Water Conservation Works

Mainly the watershed development works are divided into three stages such as ridge area treatments, Slope treatment, Plains or flat level (Area treatment) and Drainage line treatments. Different treatments are planned for each micro watershed to see the geographical and socio economic condition of that specific area. The details are briefly described below:

A. Ridge Area Treatment Plans:

It is very important to treat the ridge as this is where the major water resources originate. This involves mainly hilly region in IWMP-1 watershed. For the ridge area treatment of IWMP-1 watersheds, following structure are been proposed after interaction between the watershed committee, Neighbour Hood Groups, GramaPanchayats, Block Panchayat and other field staff of line departments and WDT engineer.

a) Graded Bunding
b) Gully Plug
c) Contour Trenches
d) Staggered Trenches
e) Earthen Bund

a. Graded Bunding:

"Graded bunds or graded terraces or channel terraces are the bunds or terraces laid along a pre-determined longitudinal grade very near the contour but not exactly along contour".

The graded bunds, commonly used are comparable to the narrow base terraces. They are used for the safe, disposal of excess runoff high rainfall areas and regions where the [clay] soil is relatively impervious. Farming operations are not done on bunds or bund channels.

Function:

1. These terraces act primarily as drainage channel to regulate and conduct runoff at non erosive velocity.
2. To make the runoff water to trickle rather than to rush out.

b. Gully Plug:

The portion where the stream begins, the structure is constructed with arranging loose boulder perpendicular to the flow of water is called gully plug.

Benefits:

1. Prevents soil erosion of land and reduces the flow of water and further prevents the formation of new streams.
2. Very useful in moisture conservation and reduces the scroucing and desiltation of the streams.

c. Contour trenching:

It is a simple, and a low-cost method of checking the velocity ofrunoff in the ridge area of any watershed. A contour trench is a trench dug along acontour line. A contour line is a line, which joins together points of the sameelevation. Digging a trench along such a line increases the chances of containingrunoff for a longer period of time within the trench. It is also true that if trencheswere not to follow a contour, such digging could actually increase the possibility ofsoil erosion because there would be a rise in the velocity of runoff following anincrease in the slope of the land.

Objectives:

- Slowing down the velocity of runoff
- Checking soil erosion, and
- Improving local soil moisture profile

Contour trenches are constructed in the ridge area of a watershed. Rainwater,which falls in this area, flows unchecked carrying with it eroded soil into the flatterportion of the watershed referred to as the "valley". This eroded soil gets depositedas silt in the reservoirs and ponds, thereby reducing their life. Thus, any waterharvesting work undertaken in the valley will become meaningless unlessappropriate measures such as contour trenching are undertaken to control runoffand soil erosion on the ridge. Contour trenches serve to collect the rainwater thatfalls in the ridge area. This way the soil moisture profile in the area adjacent to thetrench gets improved. Along with the water, the eroded fertile topsoil also getsdeposited in the trench. It is, therefore, necessary to combine trench constructionwith plantation.

d. Staggered trenches

In medium rainfall areas with highly dissected topography, Staggered ContourTrenches are adopted. The length of the trenches is kept short around 2-3 m and the spacingbetween the rows may vary from 3-5 m. The chances of breaches of SCT are less as comparedto Continuous Contour Trenches. Over time, experience of watershed

programs has shown that it is better to staggerthe digging of contour trenches. This is because it has been found that invariably errors havebeen made in contouring over long distances. If the contour trench is not level and by mistakesloped, then water starts to flow from the high point to the low point, cutting a path and in-creasing soil erosion. Therefore, instead of making trenches continuously, they should bemade in a staggered, discontinuous manner.

Objectives:

- Slowing down the velocity of runoff

- Checking soil erosion, and
- Improving local soil moisture profile

e. Contour earthen bunds

Contour bunding is a simple and low-cost method of checking the velocity of runoff in the ridge area of any watershed. A contour bund is a bund constructed along a contour line. A contour line is a line, which joins together points of the same elevation. Making a bund along such a line increases the chances of containing runoff for a longer period of time within the bund.

Objectives:

- Slowing down the velocity of runoff
- Checking soil erosion
- Improving local soil moisture profile

Contour bunds are constructed on the ridge area of a watershed. Rainwater, which falls in this area, flows unchecked carrying with it eroded soil into the flatter portion of the watershed - the "valley". This silt gets deposited into the reservoirs and ponds, thereby reducing their life. Thus, any water harvesting work undertaken in the valley, will become meaningless unless appropriate measures such as contour trenching and bunding are undertaken to control runoff and soil erosion on "the ridge. Like contour trenches, blinds also collect the rainwater that falls in the ridge area. This way the soil moisture profile in the area adjacent to the blind is improved. Along with the water, eroded fertile topsoil also gets deposited in the blind. It is, therefore, important to combine contour blinding with appropriate vegetative measures.

B. Land Development

The second tier treatment is the slope treatment. This is generally done on agricultural land or waste land. This generally includes water conservation or surface water storage structures. This being highly labour intensive, will involve more of manual labour; so, funds from Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) can be taken. Following structures are been proposed in these areas

Following structures are been proposed in these areas

a. Land Leveling
b. Plantation
c. Earthen Bund

Land leveling: Bench terracing means construction of nearly level steps like fields along contoursusually by half cutting and half filling procedure. It is an earthen embankment or a ridge andchannel, constructed across the slope at a suitable location to intercept surface runoff water. It may be constructed with an acceptable grade to an outlet or with a level channel and ridge.By adopting bench terracing, both degree and length of slope are reduced which help in soilmoisture conservation for enhanced crop production. Bench terracing is recommended forslopes from 10 to 30%.

Planation: Several agronomical measures are adopted, supplementing the mechanical measures in the treated lands. The processes of soil erosion (detachability and transportability) will continue resulting fluctuating crop fields. These measures include: -

a. Contour Farming - planting on contours.
b. Mulching using various techniques that will increase the water retention capacity of the soil, for instance mixing straw and breaking clods. Mulching is particularly helpful in vegetable cultivation, where assured soil moisture is a necessity.
c. Use of dense growing crops/ cover crops for instance cowpea, pulses, paddy. These will reduce splash erosion.
d. Mixed cropping. increasing the capacity to retain water
e. Intercropping or strip cropping, alternating either blocks or strips with different crops.
f. Use of organic manure or green manuring with legumes, such as cowpea, dhaincha, pulses.This improves water-holding capacity.

Farm Bunds: Bunding, also called a bund wall, is the area within a structure designed to prevent inundation or breaches of various types. Field bunding is one of the important structures which check the runoff of water from the Farm level. Often Farm area left without proper bunding, water freely flows out of the Farm and scope for percolation is almost negligible. Hence Farm bunding plays an important role in conservation of moisture at Farm level. As the multi-tier approach ridge to valley, drainage line treatment and land development farm bund fall in the third agenda.

C. Plains or Flat Level Treatment:

These are at field level of farmers where farmers are operating at a very high labour intensive way. These generally field bunding, crop pattern alteration. The prime aim is to conserve the rain in the field. In this area stone bunding is not feasible due to unavailability of stone in the local area. So in the plain or flat level treatment the two things are proposed as under.

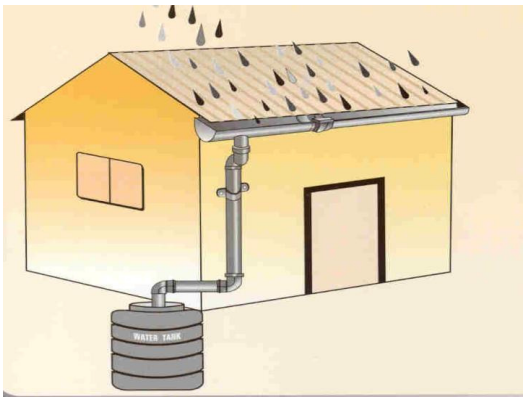
1. Farm Bund
2. Centripetal terracing
3. Rain water harvesting pits
4. Afforestation/ Plantation

D. Water conservation Structures and activity: The activities are generally taken in the bottom area/ valley region of the watershed area. The structures will help in the storage of the water which increases the soil moisture and water table of the area. Land can be irrigated through these structures. The proposed structures are as follows:

1. Rain (Roof)Water Harvesting
2. Farm ponds/Irrigation wells
3. Check Dam
4. Well Recharge

Rainwater harvesting from rooftop catchments

Rooftop Rain Water Harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the household needs through storage in tanks. The main objective of rooftop rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dryland, hilly, urban and coastal areas. Rainwater harvesting usually involves collecting water from cleaner surfaces, such as roofs. There are several reasons for harvesting rainwater today including: low-cost irrigation, domestic water supply, water



and soil conservation, aquifer recharge, and flood control. It is also desirable to use rain because of the high quality and softness of the water and the relative absence of contaminates such as disinfection byproducts (chlorinated hydrocarbons), endocrine disrupting compounds (antibiotics and hormones), heavy metals, agricultural chemicals and chlorine resistant microbes that are increasingly appearing in our ground and tap water. Rainwater collection systems are cost effective and easy to maintain by the average homeowner and are easier to install and use than wells or surface ponds.

Well recharge

The broad aim of the programme is to improve the water quantity and quality levels of homestead open dug wells and small homestead ponds. This will contribute to enhanced health and welfare of the community through improved access to drinking water. The reduction of public spending on Tanker Water Distribution to the water stressed regions which is common during summer is also envisaged as a broader goal of the programme.

The specific objectives of the programme are

(i) recharge ground water

(ii) improved drinking water availability across the year

(iii) significantly reduce the impact of drought and consequent public spending on supply of drinking water in tankers to the water stressed regions

(iv) Improved agricultural production and productivity.

The programme would also envisage strengthening of the decentralization programme and the PRIs, in discharging their basic mandate in water sector through community efforts that are cost effective and sustainable.

Biogas plants

The term 'biogas' is commonly used to refer to a gas which has been produced by the biological breakdown of organic matter in the absence of oxygen. The gases methane, hydrogen and carbon monoxide can be combusted or oxidized with oxygen and the resultant energy release allows biogas to be used as a fuel. Biogas is a commonly used bio fuel around the world and is generated through the process of anaerobic

digestion or the fermentation of biodegradable materials such as biomass, manure, sewage, municipal waste, rubbish dumps, septic tanks, green waste and energy crops. This type of biogas comprises primarily methane and carbon dioxide.

Biogas has a wide variety of uses and can be used as a relatively low-cost fuel for

the generation of energy and heating purposes, such as cooking. For example, basically any facilities which need power are able to use biogas to run engines, or to generate either mechanical or electrical power. Biogas can be compressed, similar to natural gas, and is able to be used to power motor vehicles. Biogas is a renewable fuel, so it qualifies for renewable energy subsidies in some parts of the world. It is possible to concentrate the methane within biogas to the same quality standards as fossil fuel derived natural gas to produce biomethane. If concentrated and compressed this biogas can then be used in vehicle transportation.

PROMOTION OF NON-CONVENTIONAL ENERGY SAVING DEVICES

Solar LED Street Lighting

A solar lamp is a portable light fixture composed of a LED lamp, photovoltaic solar panel, and a rechargeable battery. Solar lamps recharge during the day. At dusk, they turn on (usually automatically, although some of them include a switch for on, off and

automatic) and remain illuminated overnight, depending on how much sunlight they receive during the day. Discharging time is generally 8 to 10 hours. Solar lights are easily installed and maintained, and provide a cheaper alternative to wired lamps.

LED Street lighting is a fresh new alternative to traditional street lamps such as LPS, HPS, or MH street lights. LED lighting provides a multitude of advantages over conventional incandescent light: LED street lights are environmentally friendly, energy

efficient, and cost-effective. This smart, "green" option for outdoor lighting has emerged on the green scene due to the recent technological advancements of LED illumination.

Solar lanterns

The solar lantern is a cheap alternative to a Solar Home System (SHS) providing 4-5 hours of high quality lighting service. It provides higher quality light than the use of candles or kerosene lamps. The Solar Lantern, powered from innovative solar technology, is the ultimate cost saving solution designed specially to give bettered bright light for long hours. It is a perfect fit for indoor and outdoor lighting conditions. Solar Lantern is a revolutionary new device that harnesses power from the sun. It is simple and robust in its design. It is a permanent replacement for paraffin and kerosene lamps there by creating a smoke free environment for all.

Solar water heating (SWH)

Solar water heating (SWH) or solar hot water (SHW) systems comprise several innovations and many mature renewable energy technologies that have been well established for many years. In a "close-coupled" SWH system the storage tank is horizontally mounted immediately above the solar collectors on the roof. No pumping is required as the hot water naturally rises into the tank through thermo siphon flow. In a "pump-circulated" system the storage tank is ground or floor-mounted and is below the level of the collectors; a circulating pump moves water or heat transfer fluid between the tank and the collectors.

SWH systems are designed to deliver hot water for most of the year. However, in winter there sometimes may not be sufficient solar heat gain to deliver sufficient hot water. In this case a gas or electric booster may be used to heat the water.

The heat from the sun is used to heat the water by a special method (FPC) so that hot water is available 24 hours, even in rainy days. In this system there is no electronic conversion, only heat exchange. Since this instrument is fixed on top of the building where sun light can strike the panel, additional

space inside the house is not required. There is no electric hazard and no electricity bill to be paid. Pay only the initial installation charge and enjoy the natural hot water 24 hours. Suitable for houses, hospitals, hotels and factories. MNRE (Ministry of Natural Renewable Energy) subsidies are also available for renewable energy products.

MINI DRINKING WATER SUPPLY SCHEMES

In spite of heavy annual rainfall, and numerous rivers and ponds, the State of Kerala is paradoxically situated among the country's lowest per capita ground water availing state. Water plays an important role in the welfare of societies through its widespread linkages. Water needs are complexly linked with the daily life and its scarcity can be an obstacle to economic growth. The important aspects in this regard are (i) the availability of water for production and income generation; (ii) water for domestic needs, which have a significant role in maintaining human health; and (iii) sustainable environmental management. Among the water users in different sectors, consumption by households has very specific influence on human well-being. Even though the household consumption constitutes only eight per cent of the total water usage, the value of water for household purposes is reckoned much higher than the value of it for industrial use and farming.

Hence, providing potable water to all sections of the society becomes one of the major concerns of the governments. The problem of financing the water service may be one of the contributing factors for institutional change. In this context, privatization or market based profit dominated approach to water supply service has emerged as a policy suggestion to tackle the problem. However, privatization of an essential service of water is not politically and socially viable. Further market strategies and privatization tend to raise inequalities. Another approach, aiming both economic and environmental sustainability includes decentralized development with co-operation of NGOs and local communities. Community management of drinking water has recently emerged as an alternative.

Declining water table has a consequence on the family managed drinking water supply. In this background, conservation of the exiting water resources and its efficient management becomes the priority issue at policy level.

Providing rural drinking water supply is one of important functions of the Panchayat system. Wherever the water supply is lower than the norms laid down by Government, augmentation of water supply is to be taken up. Drinking water has to be provided within 1/2 km of the habitation.

It is proposed to start sixnumbers ofmini rural drinking water supply schemes in the following locations, of which two has been taken under the EPA.

CROP DEMONSTRATIONS

The agricultural system is characterized by low productivity, shift towards less labour intensive crops and increasing marginalization of agricultural income in the household economies. These deplorable conditions form the backdrop to the local initiative for agricultural rejuvenation.

At present the agricultural activities in the area are mainly aimed to meet the local needs and only small amount of vegetables are sent to outside market for sale. The farmers rely on old techniques and patterns for agricultural production. The area has wider scope for the use of modern techniques and improved tillage practices. As banana and vegetables are the key horticulture produce in the area, it is proposed to bring more area under these crops. To popularize these crops, crop demonstrations were taken under the Entry Point Activities. It is proposed to give 5 banana seedlings to all households and to introduce organic vegetable cultivation in 50 cents per Neighbourhood Group. As crop diversification is also essential for economic sustainability, it is proposed to introduce water melon, jasmine and floriculture. The plants of money fetching horticulture plants like mango, rambutan, mangosteen, guava, etc. will also be supplied to the households to improve the economic condition of the farmers.

The activities aimed at irrigation will enhance the productivity and will irrigate more area which paves way to bring more area under agriculture/horticulture production.The villagers expressed much enthusiasm towards expanding their horticulture activities.Moreover the watershed area holds good potential for horticulture activities. Hence it is important to promote and expand horticulture activities in the area.

Avenue plantation

Afforestation is the process of establishing a forest on land that is not a forest, or has not been a forest for a long time by planting trees or their seeds. Trees could be planted along the roads, which could check the erosion in the depression of the roadside.

Advantages:

- It helps meet the world's increasing demands for timber and forest products
- Soil erosion is avoided as trees prevent rapid run off after heavy rainfall.
- Jobs are provided.
- Trees provide oxygen
- The beauty of the landscape is preserved
- Trees absorb carbon dioxide and help cut down the danger of global warming
- Trees help prevent heavy storms

Alarmed over the massive degradation of its lush green cover, it is proposed to launch an ambitious social forestry project aimed at instilling a love for nature in the student community, and other inhabitants. The programme will have three elements - 'Our Trees' for school students, 'Puzhayoram' for those who live in the reaches of major drains in the area including the banks of Vamanapuram River and 'Vazhiyoram' (roadside tree shades) for other inhabitants of the area. Under the 'Our Tree' programme, students from Classes 5 will plant fruit trees in their school premises and take good care of it and manage them for five years. Necessary arrangements will be sought to provide grace marks according to how well they take care of the plants. Under 'Puzhayoram' seedlings of bamboo, reeds and other suitable plants will be planted along the sides of the major drains ensuring the side wall protection. Under 'Vazhiyoram', other inhabitants will plant trees along the sides of major roads. The persons who plant

trees alongside the road sides will be responsible for taking care of them too. The Project Implementation Agency will be working in tandem with the Public Works Department to implement the project. The Social Forestry division of Kerala Forest Department will provide saplings of around 25 varieties of trees including teak, jackfruit, anjili, bamboo, reeds and gooseberry that would be planted as part of the programme.

It is proposed to bring all the educational institutions in the project area under thisscheme.

Budget

The distribution of budget under the natural resources management activities for different micro watersheds as per IWMP guidelines is given below:

No.	Name of micro watershed	Amount in Rs.
1	Aruvipuram (4V10a)	1,42,46,400
2	Cheruvalam (4V11a)	11,08,800
3	Kanchinada (4V11b)	61,06,800
4	Ayanikuzhi (4V25a)	34,94,400
5	Moozhi (4V26a)	1,59,76,800
6	Nellanad (4V29b)	2,19,99,600
	Total	**6,29,32,800**

Major interventions suggested

The major interventions suggested under the watershed development works are the following:

1	Stream bank protection – engineering structures (1.50 M height)
2	Stream bank protection – engineering structures (1.00 M height)
3	Stone pitched contour bunding
4	Earthen bunds
5	Centripetal terracing with husk trenching and mulching
6	Strip terracing for rubber
7	Staggered trenches
8	Moisture collection pits
9	Rain (roof) water harvesting

10	Gully plugs
11	Foot bridges
12	Water harvesting structures (ponds)
13	Water harvesting structures (wells)
14	Supply of Terafil Water Filter
15	Well recharging
16	Improvement of public wells
17	Improvement of existing wells
18	Renovationof drains
19	Renovation of ponds
20	Mini drinking water scheme
21	Renovation and repair of existing irrigation schemes
22	Solar electrification of Block Panchayat and Grama Panchayat
23	Solar street lighting for colonies
24	Solar junction lights
25	Bus shelters
26	Biogas plant
27	Stream bank stabilisation using Geo textiles
28	Conservation of sacred grooves
29	Live hedges
30	Fodder cultivation