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WASTELAND MANAGEMENT—ROLE OF GEOSYNTHETICS — A CASE STUDY

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ABSTRACT

A variety of Geosynthetics, both natural and synthetic are being widely used for the protection of soil, from erosion caused by rain water or flowing water. Prevention of soil erosion is vital part of wasteland development. The binding factors such as roots of vegetation, together with Geosynthetics will be an ideal combination to retain soil grains and thereby promotes fertility of land. In this paper various wasteland management techniques envisaged with the application of geosynthetics for an area of 300 acres of dry land near Karisari village, Kamarajar District, Madurai is dealt in detail. In the first phase of investigation a Hydrogeomorphological map of the area was prepared and wasted flows during rains were estimated. Making use of the data from investigation, various wasteland development techniques were formulated. The major techniques explored were construction of minor irrigation structures, artificial recharge by contour hedging, development of greenery with the application of coir geofabric, farm forestry, social forestry etc. With the implementation of the techniques we hope to achieve the following: 1. Conservation of soil through reduction of erosion. 2. Increasing the soil moisture conditions. 3. Generation of power. 4. Recharge of ground water. 5. Flood control 6. Creation of new command areas. 7. Providing water for greening.

INTRODUCTION:

Water is indispensable for life and more so for man. The need for water is felt more for better living with modern services. The per capita consumption has increased form a few litres in the stone age to as much as 600 litres in developing countries today. The demand for water for irrigational and industrial complexes also increased correspondingly to meet the requirements of the growing populations.

The involved problems are becoming more and more complex with the vagaries of precipitation and recurrence of droughts. In drought affected areas, tanks and reservoirs are repeatedly left unfilled, thereby causing acute scarcity for water and leaving millions of hectares of irrigated tracts without sowing. Unfortunately this basic concept is ignored hitherto in India as evident from the example of unused river flows. Inspite of the shortages, huge quantities to the tune of 1677 billions of cubic meters of river waters are left into the seas annually. Planned approach to develop the river waters not only fills the gap between demand and supply but also solves many complementary problems on national scale.(3)

Watershed is an area draining the rain water into a stream. It is a small catchment from which all precipitation flows into a single stream. It forms naturally to dispose the runoff of rainfall as efficiently as possible A watershed provides a limited surface area within which physical process pertinent to the morphology and hydrology could be appreciated. The climatic variables, the water and sediment discharge, water storage and evapotranspiration of a watershed help in determining denudational rates, moisture and energy balances. These determinations help the management of land, water, greenery and energy. The comprehensive development of a watershed so as to make productive use of all its natural resources and also protect them is termed as watershed management. The major objectives of watershed management are conservation of soil and water, improving the ability of land to hold water, rain water harvesting and recharging and growing greenery.

The area selected for this project was around 300 acres of wasteland located in the Kamarajar District of Tamil Nadu and is shown in Fig.1.

WATERSHED CHARACTERISTICS:

Characteristics of the microwatershed considered under this study is shown in Table 1.

Table 1: Watershed Characteristics:

Sl. No.	Parameter	Description
1.	Size	1.2 Km^2
2.	Shape	Elongated
3.	Physiography	Latitude 9°58' N, Latitude 78°30'E Altitude within 100 m from MSL.
4.	Slope	Mild slope towards middle from both sides
5.	Climate	Average annual rainfall-250 mm to 325 mm, Temperature - 17°C to 41°C.
6.	Land Use	See Fig.2
7.	Vegetation	Normal bushy and thorny vegetation corresponding to dry equatorial climate.
8.	Geology and soils	Top layer up to 1m depth black cotton soil with high lime content, below that loamy black cotton soil.
9.	Hydrology	See Fig.3, Water quality parameters for the ground water sample from the watershed are shown in table.2.

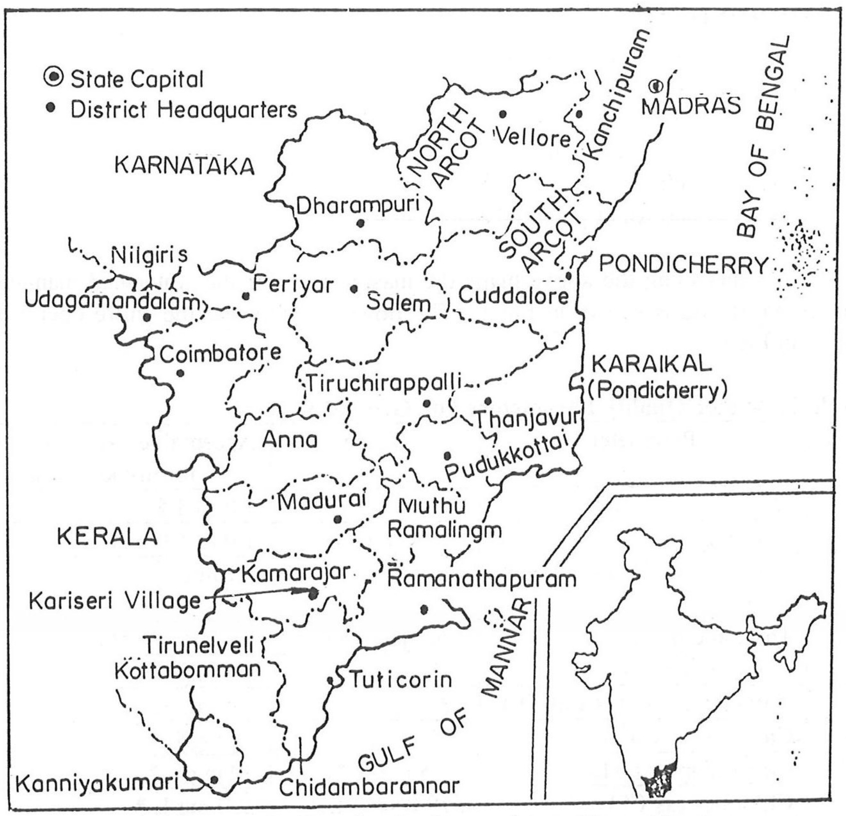

Figure 1: Project Area Location Map

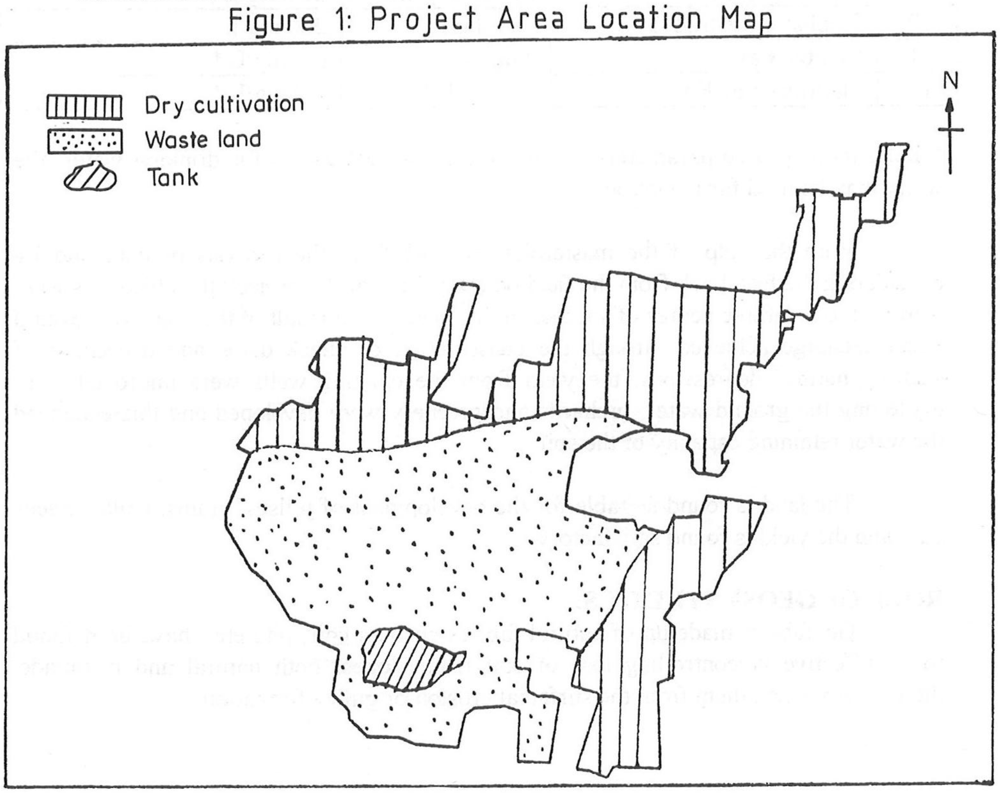

Figure 2: Land Use Map

METHODOLOGY:

As a part of the Primary investigations, surveys were conducted and the following maps were prepared.

- Land use map (Fig.2)
- Hydrological map (Fig.3)
- Ground water potential map (Fig.4)

By analysing the above maps the master plan for the watershed management was prepared and is shown in Fig.5. The flowchart showing the entire operations is shown in Fig.6.

Table 2: Water Quality Parameters For Ground Water

Sl.No	Parameter	Value	Acceptable values prescribed for drinking water
1.	pH	8.2	7.0 to 8.5
2.	Turbidity	3.0 N.T.U	1.0 to 5.0 N.T.U.
3.	Colour (On platinum cobalt scale)	Colourless	5 Units
4.	Taste and odour	Unobjectionable	Unobjectionable
5.	Total Solids	1795 mg/L *	500 mg/L *
6.	Total Hardness (as $CaCO_3$)	280 mg/L *	200 mg/L *
7.	Calcium (as Ca^{2+})	100 mg/L *	75 mg/L *
8.	Magnesium (as Mg^{2+})	37.5 mg/L *	30 mg/L *
9.	Chlorides (as Cl^-)	379.85 mg/L *	200 mg/L *
10.	Sulphates (as SO_4^{2-})	495 mg/L *	200 mg/L *
11.	Iron (as Fe)	Traces	0.1 mg/L *
12.	Fluorides (as F^-)	2.6 mg/L *	1.0 mg/L *

* Even though these parameters exceeds the prescribed limits for drinking water, the water may be used for irrigation.

With the help of the masterplan evolved from the analysis of data and by considering the feed back from the field on each stage of the project, the objectives were achieved to a definite degree of success in this case. As a result of the improved ground water recharge achieved through the construction of check dams and deepening of existing natural depressions, the yield from the existing wells were improved. By exploiting the ground water, orchards and greenery were developed and this enhanced the water retaining capacity of the soil.

The land is found suitable for the development of pulses, grams, chilli, greens etc. and the yield is found satisfactory.

ROLE OF GEOSYNTHETICS:

Geofabrics made up of natural fabrics such as coir, jute etc. have been found to be effective in controlling loss of soil from slopes, both natural and manmade, thereby protecting them from the surfacial erosion or gulley formation.

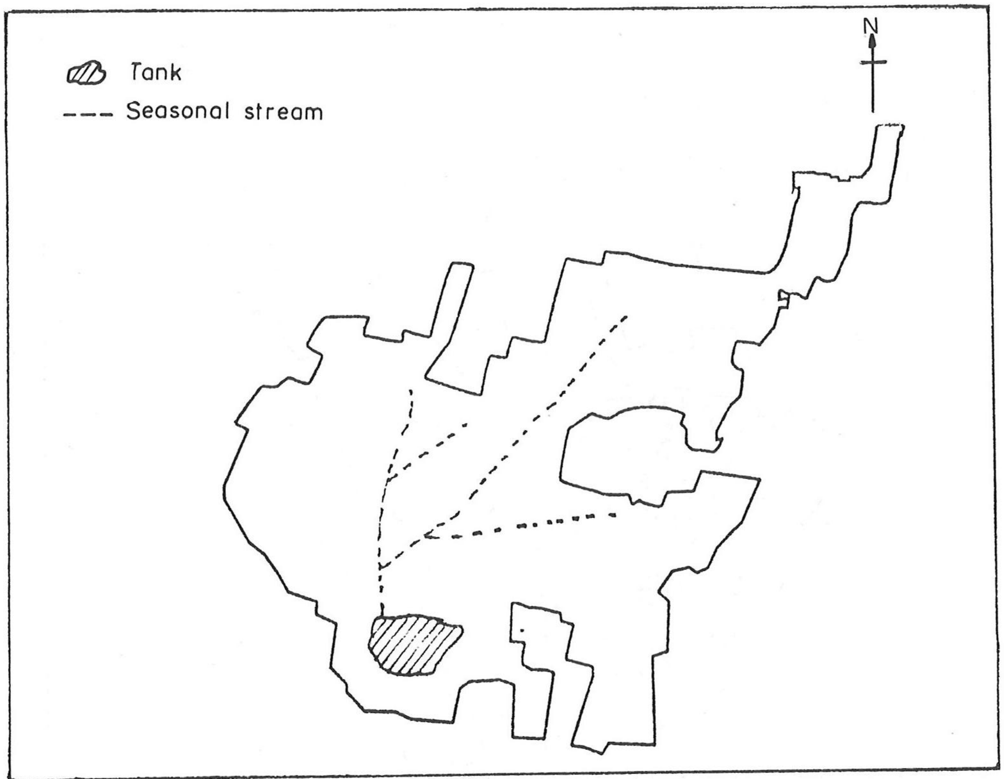

Figure 3: Hydrological Map

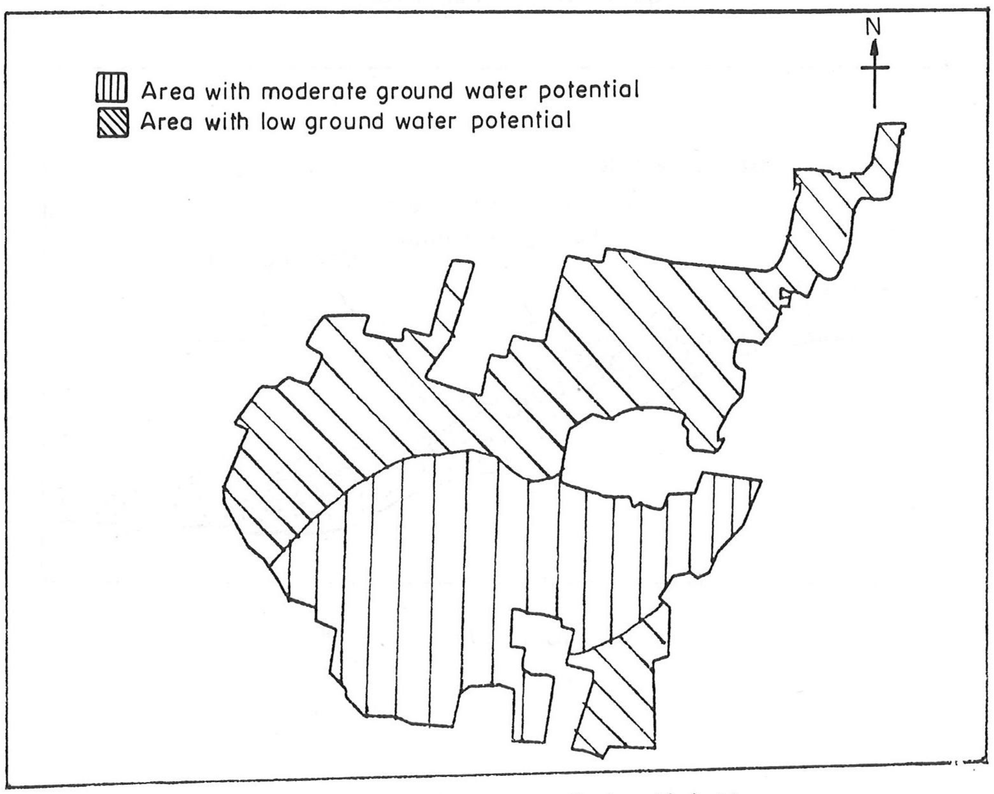

Figure 4: Ground Water Potential Map

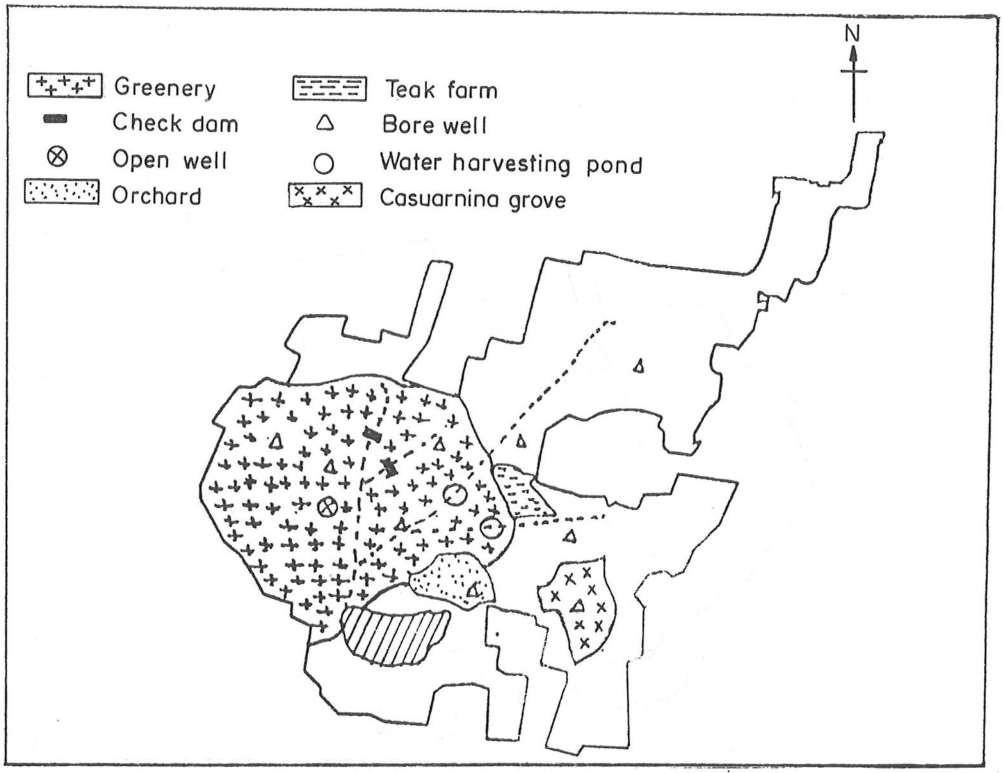

Figure 5: Master Plan

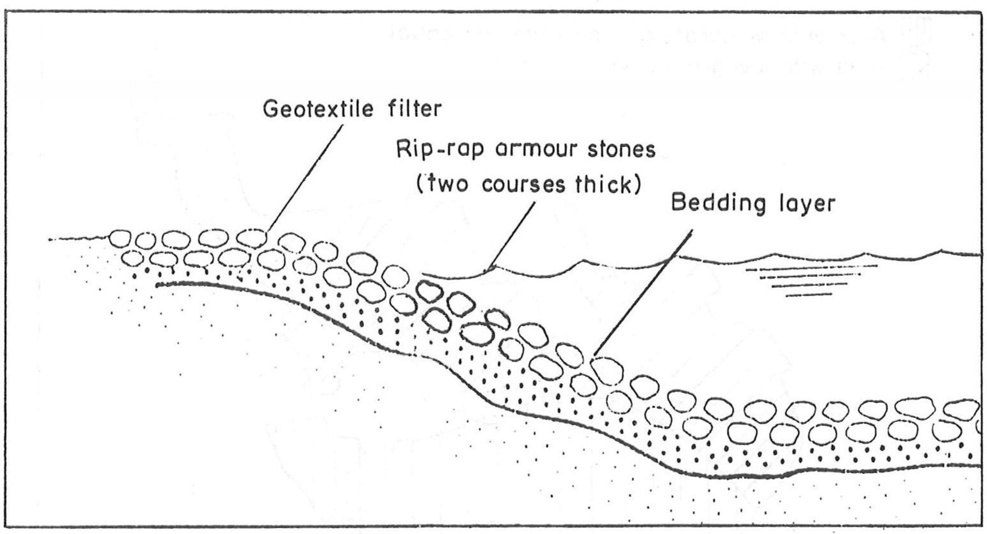

Figure 7

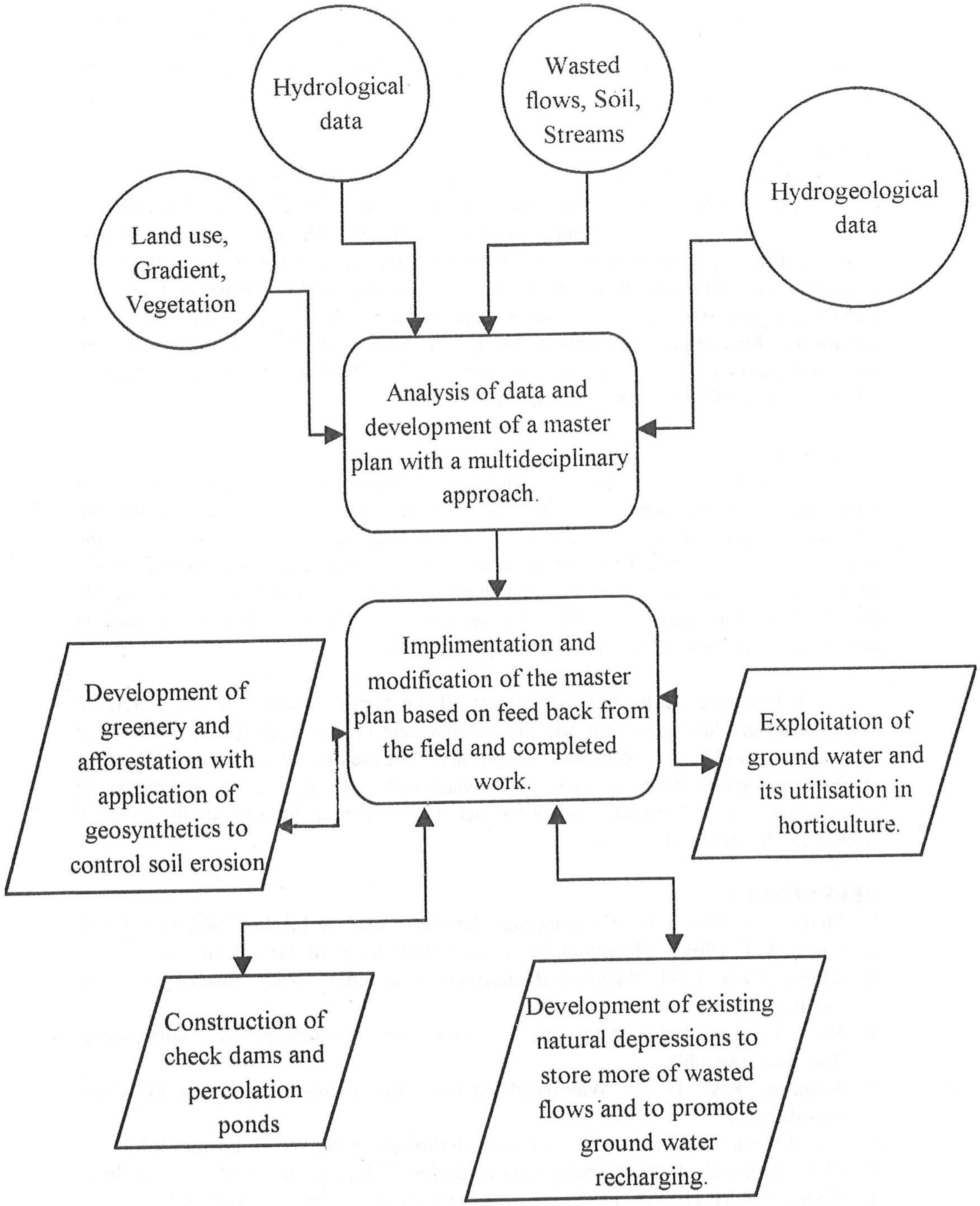

Figure 6: Methodology

Presence of coir or jute nettings was found to significantly help the growth and preservation of the vegetation cover which more initially denuded slopes. Under conditions of material cost presently prevailing in India, coir and jute nettings are significantly economical compared to nets made form synthetic materials.

Erosion Control:

Erosion control is based on the principle of filtration. The geotextile filter is placed between natural soil and the protective coverings. Geotextile filter simplifies the construction by reducing the number of protective layers. The Fig.7 shows the use of geotextile filter replacing a multigranular filter in a bank protection scheme. In rip-rep protection, the rough side of the composite geotextile is placed in contact with the soil. Usually the geotextile filter is laid on a prepared soil surface, without the use of any intermediate blanket layer and covered by rip-rap. Usually the bonded rip-rap is 0.4 m. thick and consist of 150 mm to 250 mm stones. If the load is more, it is increased to 0.6 m thickness of 150 mm to 450 mm size stones.

CONCLUSION:

By adopting the scientific principles of watershed management it has been established that, the concept of wasteland development is quite possible through integrated watershed management with the application of geosynthetics for the microwatershed considered under this study. The prevention of wasteflows from the land through storage in depressions and small reservoirs has contributed considerably to the cause of increased ground water recharge and which in turn has resulted in increased yields form wells to help growing of greenery.

It has been established that almost all the factors involved in the watershed management are interdependent and the improvement of one leads to improvement of the remaining and hence the overall development, but the hitch lies in the identification of the vital parameters for the given watershed. In this case application of geosynthetics for soil erosion control has acted as a shot in the arm for the cause of waste land development.

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