# Model Watershed Management Plan for Shivapur Village

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**Abstract-**Water is one of the limited vital natural resources, which is indispensible for existence of all living matter hence it is known as ELIXIR of life, plant, animal and man. Potable water which was once thought to be an infinite, is in fact a fast depleting scarce commodity and at the present rate of consumption by mankind it would not last longer and become as dearer as fossil fuels today. Hence it becomes necessary to harness the water resources available on Earth through the application of science and technology. As a part of our last year students, we selected different areas for watershed development, surveyed them, analyzed the data and finalized the proposals. We could develop social contacts with the local people along with carrying out socio-economic survey of the area in the best possible way. It was decided that the proposals must be easily acceptable and adoptable by the local people, so that they would not have to depend upon the Government's financial assistance. These proposals include:

1. Simple technical constructions such as farm ponds, check dams, bunds on streams and around the farms, contour trenches on sloping lands, terracing etc.
2. Agronomical measures such as strip cropping, crop rotation, economical irrigation practices etc.
3. Clearing the wells and water bodies from silt, improving the village ponds etc.
4. Recharging groundwater artificially by rain water harvesting etc.

We are sure that the farmers will afford these schemes and will be encouraged as these conservation measures, if implemented, will result in their better prospects in future.

**KEYWORDS:** Soil and Water conservation, Contour trenches, watershed development, Village pond, Social mapping

## 1. INTRODUCTION

THE National Water Policy (NWP) 1987 stated that water resource planning should be done with reference to a hydrological unit such as a basin or sub-basin. The idea of basin planning has found wide acceptance and frequently it is expanded to sustainable basin planning. But this was never operationalised. The National Commission for integrated water resource development 1999 recommended river basin organizations of the representative kinds, with a very large principal body of a general assembly or river parliament kind and a smaller executive committee. However these ideas have not made much headway. In the NWP 2002 adopted on 1st April 2002, river basin organizations are mentioned, but their scope and powers have been left to the basin states. Therefore a truly integrated, holistic planning for a basin or a sub-basin would involve interdisciplinary planning for the basin or sub-basin. This includes harmonizing diverse water uses on the demand side and integrating all development from local rainwater harvesting and micro shed water development to mega projects on the supply side along with fully internalizing environmental, ecological, human and social concerns and fully associating the people concerned at all stages. Watershed development is one of such integrated holistic plans.

Watershed is rain water shed off area of a stream. Rain falls on the lands, flows overland and subsurface into streams and drains off away. Our earth contains 97% of total water in ocean as sea water, 1.5% as glaciers, 0.86% water at 800 m. below ground surface and only 0.64% of water is available for human activities. Out of 0.64% of water, which is available for human activities, 90% of water is used for irrigation, 8% for domestic use, 2% for industrial use. In India 30% of total land is urban land. On an average, our country receives about 120 cm. of precipitation per year, mostly rainfall. Proper planning therefore is necessary so as to obtain as many benefits as possible with minimum expenditure.

## 2. WATERSHED CONCEPT

Watershed is an area draining into a stream. It is a small catchment from which all precipitation flows into a single stream. It forms natural way to dispose off the runoff as efficiently as possible. It is a pear shaped area bounded by high topographical divides carved out by rainfall, the flows of which form the streams. It is a converging mechanism which increases minor streamlets and rivulets into progressively larger, major, deeper and lower end streams, tributaries and rivers. It is a synonym of catchments or basin of a river, coined for an area restricted to 500 sq.km.

## 3. IMPORTANCE OF WATERSHED MANAGEMENT

Water is the national wealth and should be treated as such. The problem of drinking water scarcity is growing day by day. One of the main reasons for this is the lack of planning and management of water resources. In agriculture dependant country like India, water plays key role in development of economic growth. The traditional method of drawing water with the help of bullocks did not upset the balance. But with the installation of electric

pumps, the rate of withdrawal increased tremendously and the water balance disturbed. In spite of few efforts of the water works department, that include a shift from traditional water conservation and distribution methods to new water storing techniques, it has failed in achieving its goals. In contrast to this, are the age old water management systems that are community based and dependant entirely on the tradition, wisdom, technical skills, foresight and experience. They are sustainable and eco-friendly.

Watershed management arrests the soil erosion, reclaims vast tracts of eroded lands, improves soil moisture, harvests rainwater, reduces floods, recharges groundwater and revives greenery. In due course it restores rainfall, revives healthy climate, regenerates soil, rejuvenates green foliage and revives environment. Further it renders the rural population self sustaining in food, fat, fiber, firewood, fodder, fruit, health and hygiene. As a result dependence of poor reduces, their farm produce increases and per capita income improves resulting in overall economic growth of the rural poor.

Rural development through watershed management must become a powerful instrument of national regeneration and for this the village people have to work together with the firm conviction "Our village is one family." Whatever affects one family or the whole village is shared by all inhabitants and hence all must put their shoulder to the wheel of security the welfare of the whole community. The government officials also then offer many development schemes and the village gets the sweet fruits of the progress. Watershed management is meant for growing biomass, the pipeline for prosperity of the people for bridging the gap between poverty line and per capita income. In achieving this objective, the people's part is awareness, participation and response.

## 4. SOCIO-ECONOMIC SURVEY – PEOPLES' PARTICIPATION

In watershed management, people's awareness, participation and response is of utmost importance in improving the economy of farmers. First identify the priority needs of the people. People's cooperation in the development is very important and it is available for projects that fulfill their immediate needs. Everyone naturally thinks first about what he is going to gain from the project. As individual projects start yielding direct benefits to the people, they start participating enthusiastically. The discussions with voluntary social service organizations or with the Government officials also give valuable information about various techniques or schemes available for further growth and increase the scope of the project.

Social mapping is also the best technique for better community participation. This technique is very much useful in getting correct and maximum information about a particular area in the village. All people in that area are invited at the community centre of the village – most preferably, the temple, at their convenient time i.e. in the evening. A free informal discussion is required in this meeting. An informal map of the area is drawn by the project leader either on the paper or even on the soil below, where they have a meeting. The plan is to be drawn by the local people only from the information available with them in the meeting. While drawing the plan the discussion must go on regarding the problems existing in the area if any, also. Due to such informal discussion, the people in the meeting feel very free and give the information promptly. Such an informal meeting develops the social relationship between the people and the project leaders. They co-operate the leaders fully. In this technique, the old age people of that village are the key persons; as they are the most experienced. They know the existing problems properly. Similarly in the same meeting, the project leader can get the maximum information regarding the measures taken by the ancient people on the problems in the villages in the ancient days. This information, the leaders can get from these old persons only.

We, along with our students selected Shivapur village in Kudal Taluka (Konkan Region) for its watershed development. Though the village is situated in Konkan region, which has heavy rains in rainy season, after the month of February, water does not become available for the purpose of agriculture. For this area, we prepared a questionnaire and got it filled by the villagers and thus the data was collected for preliminary study

So to satisfy above mentioned needs the watershed management is essential for Shivapur village.

## 5. WATERSHED MANAGEMENT PLAN FOR SHIVAPUR VILLAGE

In Konkan region, the climatic conditions are very good. Rainfall intensity is very high as compared to other regions of Maharashtra. But rainwater is not successfully utilized throughout the year due to the existing soil conditions in the region. The upper layer of soil crust is of laterite type, which is very pervious in nature. Due to mountainous region the rain falling in this area is quickly runs off towards the sea and no water retains in the soil. So water does not become available after month of February.

We carried out the socio-economic survey by using following questionnaire:

1. Name:
2. Address:
3. Occupation:
4. Monthly income:
5. Other family members, their occupation and education:
6. Migration of any family member, if yes, why?
7. Village population:
8. Own farm? If yes, how much?
9. Own wells? Own bore wells?
10. No. of bore wells in village:
11. Own animals? How many?
12. Drinking water sources?

13. Crop grown in the farm:
14. Major problem in the village:
15. Farm water resources:
16. Any such scheme started earlier or not?

A door to door visit of our students for getting filled this questionnaire made easy for us to have the proper information. We got the following information:

1. Occupation: farming
2. Monthly income (average): Rs.880/-
3. Total population: 1140
4. Total animals: 276
5. Total agricultural land:270 Acres
6. Public wells: 6 and private wells: 2
7. No. of primary schools: 2
8. No. of teachers: 5
9. No. of students: Boys: 70, Girls: 81
10. No. of secondary schools: 1, No. of teachers: 2
11. Government Dispensary: 1
12. Bridges: 5
13. No. of ropeways: 11
14. Development works: Road(Zillha parishad and Gram Panchayat)
15. Trees: Supari, Coconut, Bamboo, Karvand, Wildwood, Kajoo, Natural Forest Mango, Vet type of Bamboo, Rubber
16. Watershed Area: 924.212Hactres
17. No. of Villages: 1
18. No. of Hamlets: 8

Due to this questionnaire, an excellent relationship was developed between villagers and us.

## 6. PROBLEMS IN THE AREA

According to socio-economic survey, following problems were observed:

- All people are dependant only on farming.
- The land available for each family is very less (i.e. from 1 – 3 acres).
- To satisfy annual food requirements they need to take a crop thrice a year. But due to non-availability of water from February to May and also uncertainty in arrival of monsoon they are unable to take crop thrice a year and at present they take it only twice a year. This has led to low per capita income of people and hence poverty in the village.
- There is significant slope with intense rains resulting in high degree of erosion.
- It is politically neglected area.
- The men and boys above the age 14 years migrate to metropolitan cities for job opportunities and improving their standard of living.

So to satisfy above mentioned needs, the watershed management is essential for Shivapur Village.

## 7. CLIMATE

Tropical humid climate with good monsoon rainfall in June, pleasant winters with 270 c to 300 c. temp., tolerable summers with bright sunshine for 150 days and favorable humidity with 50% humidity. Good rainfall yet scarcity of water due to lack of bunds and boundary cultivation, negligence of rainwater harvesting and total lack of watershed approach for better crop product.

TABLE 1
MONTHLY RAINFALL DATA

| Month | Rainfall (mm) | No. of days |
|---|---|---|
| January | Nil | -- |
| February | Nil | -- |
| March | Nil | -- |
| April | Nil | -- |
| May | 10 | 8 |
| June | 4000 | 28 |
| July | 4000 | 30 |
| August | 4000 | 30 |
| September | 500 | 22 |
| October | 250 | 22 |
| November | 100 | 9 |
| December | Nil | -- |

## 8. WATER BUDGETING

Rain water on watershed = Area x Rainfall
= 924.212 x 104 x 4
= 37.68 x 106 m3
= 37.68 Mcum.
Evapo transpiration 30% = 11.304 Mcum
Ground water recharge = Area x Infiltration x sp.yield
= 34.65 Mcum.
Surface storage = Tank area x Depth
Wasted water as runoff = 0.07 cum

Maximum water should be retained for checking erosive velocities and improving the moisture conditions. Land survey and subsurface investigations were carried out to know the drainage pattern. Theodolite survey was carried out along the stream. RLs of the stream were taken at 10m. intervals and at each central point Reduced levels were taken at 5m., 10m. and 15m. in perpendicular direction from the longitudinal alignment of the stream.

## 9. SOLUTIONS:

Following structures were proposed for watershed management:

TABLE 2
CHECK DAM ALONG THE STREAMS:

| Check Dam No. | Reduced Level (m) | Height (m) | Cost | Capacity |
|---|---|---|---|---|
| 1 | 93.760 | 5 | Total for all the check dams = Rs. 8,68,381.63 | Total capacity of check dams = |
| 2 | 89.130 | 4 | | |
| 3 | 83.250 | 4.5 | | |
| 4 | 79.680 | 3 | | |

| | | | | |
|---|---|---|---|---|
| 5 | 75.640 | 3.5 | | 8,767.5 Cum. |

### 9.1 Konkan Water Ponds and Farm Pond

Konkan region receives rainfall upto 4000 mm. but in a few months after completion of rainy season problem of water starts. Because of the geographical characteristics of this region water cannot percolate deep into the ground. Konkan Farm pond is one small pit in which 400 gauges Silpholine plastic paper is spread in pit and water is stored which can be used in required period. The sizes of pond change according to the requirement of water. Up to 4 cum. Capacity ponds are prepared. As per the land availability the length, breadth and depth of the tank changes.

The land possessed by each farmer is very less for agriculture, it is therefore difficult to provide a small pond in each farm plot so we suggest large farm pond of size 50m. X 30m. X3m. on upstream side of village. We can construct the diversion dam and check dam along the stream. Due to check dams the water level of stream rises and that water is diverted or collected in farm pond with pipeline by providing valve inlet of pipe. This water in the pond is pure in nature, which can be used for drinking purpose and cultivation of land. We can provide the PCC of 0.75mm.thick at the base of pond and stone pitching on sides.

Area for part 'A' measured from toposheet by using planimeter A = 504.51 Ha.

Rain water on the watershed = Area X Rainfall
= 504.51 X 104 X 4.0
= 20.18 million cubic meter

Area for part 'B' measured from toposheet by using planimeter A = 419.698 Ha.

Rain water on the watershed = Area X Rainfall
= 419.698 X 104 X 4.0
= 16.79 million cubic meter

TABLE 1
RAINFALL DATA

| Farm Pond | Dimension (Trapezoid) | Quantity of water stored | Cost Rs. |
|---|---|---|---|
| A | 50 X 50 X 3 | 4102.75 Mcum | 6,89,134.06 |
| B | 50 X 50 X 3 | 4102.75 Mcum | |

Total storage of water = 8205.5 Mcum.

### 9.2 Subsurface Investigation

As a part of survey, the students did subsurface investigations by Electric Resistivity Method. The sites for these investigations were chosen as per the farmers' needs. Some farmers needed to know the water table depths in their farms. Our students found the depths there by Electric Resistivity Method free of cost and thus established a good rapport with those farmers.

The electric resistivity of a rock formation limits the amount of current passing through the formation when an electric potential is applied. It may be defined as the resistance in ohms between opposite faces of a unit cube of the material. If a material of resistance R has a cross sectional area A and length L, then its resistivity can be expressed as

$P = RA/L$

Units of resistivity are ohm-m.

Resistivity of rock formations vary over a wide range, depending on the material, density, porosity, pore size and shape, water content and quality and temperature. There are no limits for resistivity of various rocks, igneous and metamorphic rocks yield values in the range 100 to 104 ohm-m. In relatively porous formations, the resistivity is controlled more by water content and quality within the formation than by the rock resistivity. For aquifers composed of unconsolidated materials, the resistivity decreases with the degree of saturation and the salinity of the ground water. Clay minerals conduct electric current through their matrix, therefore, clayey formations tend to display lower resistivities than do permeable alluvial aquifers.

Subsurface investigations of ground water using electric resistivity method indicated that the water table is at a depth of 5m. - 8m. in the end of December month. By implementing watershed measures we can increase this water table to a large extent.

Water spring development structures near water spring on the upstream. The structures were very simple in construction and the proposal was submitted to the Government for financing through one of the NGO's AVNI (Anna-Vastra-Niwara) in Kolhapur. A demonstration was given to the local people for the simple proposed structures such as rainwater harvesting bunds, terracing, Continuous Contour Trenching, Bunding and Planting. We are sure that the farmers for getting maximum benefits can take these measures.

## 10. WATERSHED BUDGETING

Evaluating the requirements of people and animals, appreciating the present land use pattern together with the production and planning the future land use based on shortfall in watershed budgeting:

Watershed Area: 5000 Ha.

No. of people living in the watershed: 1140

No. of families: 163

Present cultivating land: 270 Ha.

Current family income: Rs. 880/- per month i.e. Rs. 10,560/- per year.

Total income (From two crops): Rs. 17, 21,280/-

Hence, total income from one crop: Rs. 860640/-

Due to Watershed Management:

Existing cultivated land: 270 Acres

Current total income (From three crops): Rs.25, 81,920/-

Additional land cultivated due to watershed management: 20 Acres

Income from 20 Acres land: Rs. 1, 91,253/-

Gross income: Rs.27, 73,173/-

Per family income per year due to watershed management: Rs.17, 01, 3.33/-

Per family income per month: Rs.1417.77/-

Total percentage increase in income due to watershed management: 62%

## 11. BENEFIT COST RATIO

- Cost for construction of check dams, farm ponds, contour trenching, bunding etc. = Rs. 18, 675,15/-
- Benefit derived in the form of increased income: Rs. 27, 73,173/-
- Benefit cost ratio: 1.49

Hence model watershed plan is beneficial for total development of village Shivapur.

## 12. CONCLUSION:

Watershed management can bring about transformation of village Shivapur with increased per capita income and certain other measures like developing agro based industries, bamboo based industries, tourism centre (Village is surrounded by mountains covered with forest with natural picturesque beauty), naturopathy etc. by utilizing the available natural resources in best possible manner. Model watershed plan for village Shivapur will render the people self sustaining and will be a major step to stop the migration of men especially boys above the age of fourteen. This will also help to solve the present problem of overcrowding of the cities.

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