Participatory Watershed Management for Sustainable Rural Sector in India

Pooja Pravin Jirge
College of Architecture Kolhapur, India

Abstract— Sustainable environment is the only answer to safeguard our future from depleting away natural resources. Soil erosion & land degradation coupled with declining per capita availability of land & freshwater are posing serious threat to environment. Hence careful and concentrated efforts are needed for efficient and effective management of natural resources for increased productivity of the soils. Watershed management encompasses the concept on optimum utilization of soil and water for agricultural production as well as applying together the technical know-how the people and the environment in to a homogeneous situation. To overcome these problems related to water Central Government has started a program of watershed management viz. Integrated Watershed Management program (IWMP).The watershed program aims at full employment on the people who are struggling to earn their livelihood also they are not expected to pay attention to the conservation strategy unless their daily needs of food, fiber and fuel are met. This article also emphasizes on participatory watershed management.

Key words: Integrated Watershed Management, Participatory Watershed Management, Soil & Water Conservation

I. INTRODUCTION

Water is an essential element in a human life cycle. Watershed is a geo-hydrological unit or piece of land that drain at a common point. The watershed is an important source of drinking water. It is a region delineated with a well-defined topographic boundary and water outlet. It is a geographic region within which hydrological conditions are such that water becomes concentrated within a particular location for eg. River or a reservoir by which the watershed is drained.

The watershed management approach includes both the natural and the social systems with special emphasis on linkages between upland and lowland areas and their respective human and physical endowment. The management of watershed includes all measurements that can be taken to protect manage and conserve water & related land resource.

Integrated watershed management is the process of formulating and implementing a course of action involving natural agricultural and human resources of a watershed. It involves-

- Utilizing the land based on its capacity
- Protecting fertile top layer soil
- Minimizing setting up of tank reservoir and lower fertile land
- Protecting vegetative cover through the year
- In situ conservation of rainwater
- Safe diversion of gullies and construction of check dams for increasing ground water recharge
- Water harvesting for supplemental irrigation.

The Ministry of Environment & Forest (MoEF), Ministry of Rural Department (MORD), NABARD, Ministry of Agriculture, etc. have implemented various policies for Watershed management in India. After studying these GOVERNMENT WSD PROGRAMS AND GUIDELINES IN INDIA from 1973 up till now it was found that the policies were modified according to the change in environment. Initially the main objective was to conserve water and soil in drought prone areas but gradually it was found essential to include economic development, regenerate the degradation of forest, rainfed farming, sustainable natural resource management, etc. in the watershed management programs. The major concept implemented was participatory approach to build capacity of fringe communities with the help of watershed management.

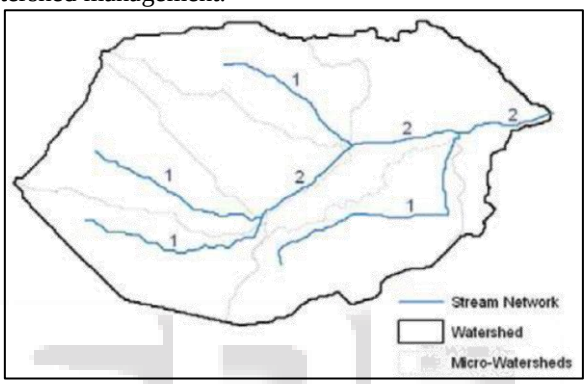

Fig. 1:

Stream network, micro-watersheds and watershed large watershed has divided into six micro-watershed based on stream order. Numbers on the stream network shows the stream order of respective stream.

II. WATERSHED MANAGEMENT APPROACHES

A. *Integrated Approach*

This approach suggest the integration of technologies within the natural boundaries of a drainage area for optimum development of land, water, and plant resources to meet the basic needs of people and animals in a sustainable manner. This approach aims to improve the standard of living of common people by increasing his earning capacity by offering all facilities required for optimum production. In order to achieve its objective, integrated watershed management suggests to adopt land and water conservation practices, water harvesting in ponds and recharging of groundwater for increasing water resources.

B. *Consortium Approach*

Consortium approach emphasizes on collective action and community participation including of primary stakeholders, government and non-government organizations, and other institutions. Watershed management requires multidisciplinary skills and competencies. Easy access and timely advice to farmers are important drivers for the observed impressive impacts in the watershed. These lead to enhance awareness of the farmers and their ability to consult with the right people when problems arise. It requires

multidisciplinary proficiency in field of engineering, agronomy, forestry, horticulture, animal husbandry, entomology, social science, economics and marketing. It is not always possible to get all the required support and skills-set in one organization. Thus, consortium approach brings together the expertise of different areas to expand the effectiveness of the various watershed initiatives and interventions.

III. VARIOUS ASPECTS OF WATERSHED MANAGEMENT

A. Entry Point Activity (EPA)

Entry Point Activity is the first formal project intervention which include various activities for villagers for mobilization of community participation. This is carried out during the selection and finalization of the watershed. It is highly recommended to use knowledge based entry point activity to build the rapport with the community. Direct cash-based EPA must be avoided as such activities give a wrong signal to the community at the beginning for various interventions.

B. Land & Water Conservation Practices

Soil and water conservation practices are the primary step of watershed management program. Conservation practices can be divided into two main categories: 1) in-situ and 2) ex-situ management. Land and water conservation practices, those made within agricultural fields like construction of contour bunds, graded bunds, field bunds, terraces building, broad bed and furrow practice and other soil-moisture conservation practices, are known as in-situ management. These practices protect land degradation, improve soil health, and increase soil-moisture availability and groundwater recharge. Moreover, construction of check dam, farm pond, gully control structures, pits excavation across the stream channel is known as ex-situ management. Ex-situ watershed management practices reduce peak discharge in order to reclaim gully formation and harvest substantial amount of runoff, which increases groundwater recharge and irrigation potential in watersheds.

C. Capacity Building

Watershed development requires multiple interventions that jointly enhance the resource base and livelihoods of the rural people. This requires capacity building of all the stakeholders from farmer to policy makers. Capacity building is a process to strengthen the abilities of people to make effective and efficient use of resources in order to achieve their own goals on a sustained basis. Capacity building program focuses on construction of low cost soil and water conservation methods, production and use of bio-fertilizers and bio-pesticides, income generating activities, livestock based activities, waste land development, market linkage for primary stakeholders. Therefore, organizing various training at different scales are important for watershed development.

IV. COMPONENTS OF WATERSHED MANAGEMENT

A. Catchment Area of River

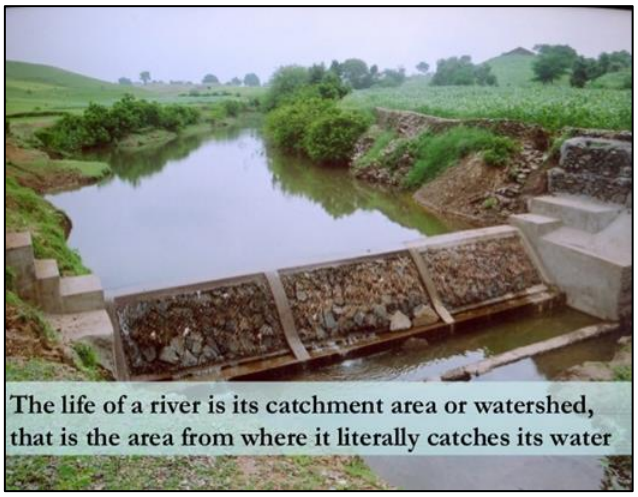

Fig. 2:

B. Continuous Contour Trenches with Plantation

Fig. 3:

C. Contour Bunds on Gentle Slope

Fig. 4:

D. Gully Plugs or Boulder Checks

Fig. 5:

E. Gabian Structures

Fig. 6:

Fig. 7:

Fig. 8:

Fig. 9:

F. Percolation Tank

Fig. 10:

G. Farm Ponds

Fig. 11:

Fig. 12:

Fig. 13:

H. Land Leveling & Bunding

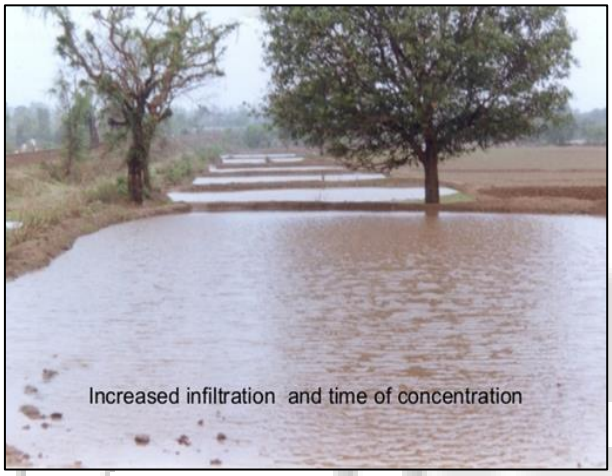

Fig. 14:

Fig. 15:

I. Masonry Check Dams

Fig. 16:

J. Bunding Bench Trenching

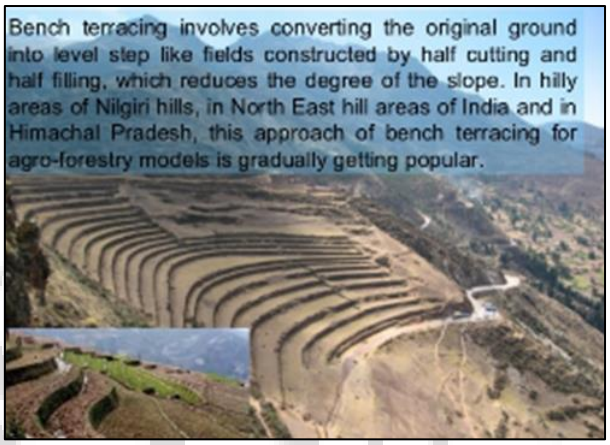

Fig. 17:

V. CASE STUDIES

A. Hiware Bazar Watershed Development Program

Hivre Bazar is a village in Maharashtra's drought prone Ahmednagar district. It was environment degraded, but less than a decade it turned itself into one of the most prosperous villages of the country. In this village water harvesting and watershed management works are done after studying and analyzing water budget of the village. This budgeting was done under the technical guidance given by the District Groundwater Department (G.S.D.A.) Groundwater budgeting program was started in 2004 by people's participation in this village. By this innovative program total availability of water was calculated by measuring rainfall received by the village and regular monitoring of water level of six observation wells were established in the watershed of the village. Collecting of rainfall and water level data was done by the villagers. A budget of available water of the village was presented before gramsabha after monsoon season. After keeping drinking water and day today requirement of human beings and animals, Seventy percent of remaining water was used for irrigation purpose. Management of this water was done by modifying area of cultivation and type of crop to be cultivated and such resolution was passed in gramasabha.

B. Water Conservation Structures of the Village

Sr. No	Type	No	Capacity	Percolated water	Store water
1	Percolation tank	2	100	10	140
2	Cement bandhara	4	2	0.4	5.6
3	Gabbian bandhara	0	0.5	0	0
4	Farm pond	3	7	1.05	14.7
5	Earthen Dam	52	0.5	1.3	18.2
6	CCT	210	Ha	37.8	0
7	Underground bandhar	0	0.5	0	0
8	Looze boulder	3035	0.001	1.52	21.5
9	Kolhapur type bandhara	6	2	0.6	8.4
Total				52.67	Cr. Ltrs

Table 1:

C. Water Auditing & Watershed Management

Since the village experienced drought in the past years and its position in drought prone area, about thirty percent of available water (excluding drinking and domestic water) is preserved for future use by allowing it to recharge to the groundwater. So that declining groundwater level of the village is restored.

Water audit based on rainfall up to the month September for the year 2004 indicated that 8.65 crore litter of water deficient in the village as per proposed area of cultivation. Available water was managed for drinking, domestic and irrigation purpose according to the proposed water budget. In 2005 total 271 mm of rain fall was received by the village. During this year also 4.39 crore litters of water was deficit as per the proposed water budget. This deficiency was overcome by increasing drip irrigation from 57 hec. to 87 hec., decreasing area of higher water required crops and change in cropping pattern. During the year 2006 village received 549 mm of rainfall. As per last year's planning of cropping pattern, about 147.5 crore litters of water was surplus in the village. This surplus quantity of water was used for irrigation by increasing 150 hec. Of jawar, 60 ha. of wheat & 50 ha. of gram in rabbi and vegetable in hot weather.

From water audit it was cleared that if village receives above 400 mm of rainfall, it can manage ground water scarcity in summer season. Since the village receives an average rainfall of 350 to 400 mm rainfall, it experienced a shortage of water in the range of 5 to 8 crore liters. To overcome this shortage gramsabha of the village decided to ban drilling of bore wells for irrigation.

– Total available water

1) Available water = Area. in Ha x Rainfall in m 307.70 cr.ltr
2) Water stored in the soil 5% 15.39 cr.ltr
3) Water percolated in soil10% 30.77 cr.ltr
4) Soil moisture 30% 92.31 cr.ltr
5) Additional water percolated due to water conservation 52.67 cr.ltr
6) Total available water 191.13 cr.ltr
7) Required water
8) Population x required water 50 lpcd x 365 days 2.08 cr.ltr
9) Cattle x required water 30 lpcd x 365 days 1.31 cr.ltr
10) Water required for cultivation 229.55 cr.ltr
11) Water required for other purpose (2% of rainfall) 3.822691 cr.ltr
12) Total Required water 236.76 cr.ltr
13) Total available water - Required water = -45.63 cr.ltr
14) Total reserved water = -45.63 cr.ltr

D. Rain Water Harvesting

Two farm ponds and rain water harvesting structure on school building was constructed in village. This structure was constructed by school children's to generate awareness and motivation for rainwater harvesting among school children's. Benefits acquired by implementing this project ground water storage is increased in the watershed of village. By constructing sewage water management system around hand pumps of village helped to feed water to plantation & animals. The innovative resolutions like ban on drilling of irrigational bore wells, implementation of watershed development works by 'shramadan'(voluntary labour) by the villagers, following the panchasutries of ideal village motivated the society in water harvesting and watershed management. The water available from R.W.H. is 7 lakh liters which is directly recharge to groundwater through drinking water bore well. The villagers manage the groundwater properly to reduce the B.P.L. Just by giving water to farmer to increase per capita income of village from 800 to 24000 Rupees.

VI. RALEGAN SIDDHI WATERSHED DEVELOPMENT PROGRAM

A. Impact of Watershed Program

The Ralegan Siddhi watershed, located in Ahmednagar district towards North-East side of Pune city was selected for study. The topography of the village is very undulating having a range of small hills around the village and it is an acute drought prone areas of the district. The temperature varies from 12 to 44 and rainfall is scanty i.e., 450 mm to 650 mm. The soil is shallow with low fertility status of black cotton soils which limits the potential of agricultural production. The geographical area of the village measures 971.56 ha out of which 691 ha area is under cultivation and 130 ha area is under forests. The cultivated area is 345 ha in kharif and 655 ha in rabi season. The total geographical area of the village was sub-divided into four sub-watersheds based on contour map. The strategy adopted constituted of conserve soil by arresting run-off water leading to higher infiltration and thus help in a watershed approach with a ridge to valley perspective and an emphasis on soil conservation and biomass generation was adopted. Only 417 cultivators living

in Ralegan Siddhi participated actively and made two systems i.e., environment system and production system for improvement in the village. Environment system covers afforestation, soil conservation (afforestation cum pasture development, contour bunding, land leveling etc.) and water conservation (nala bunding, percolation tank, K.T.Bandhara and Gabrion structures). Production system covers improved agricultural practices, horticultural development and drip irrigation. The expenditure incurred was almost Rs.75 lakhs to complete works in this watershed. People contributed voluntary labor for village development. They preferred a motto of - "One for all" and "All for one" so as to develop their village. The impact of watershed management is tremendous and presented in the Table below:

Sr. no.	Indicators	Before watershed	Present status	Increase
1	Agriculture			
1	Double cropped area (ha)	630	956	52%
2	Cropping intensity (%)	98	164	66%
3	Oilseed area (ha)	20	134	6 times
4	Pulse area (ha)	27	96	3.7 times
5	Intercropping area (ha)	-	65	Full area
6	Use of improved seed (ha)	50	860	17 times
7	Seed treatment (ha)	40	410	10 times
8	Use of chemical fertilizers (t)	8	83	10 times
9	Area covered with Plant protection measures (ha)	45	301	6.7 times
2	Irrigation area (ha)			
1	Well irrigation	56	448	8 times
2	Canal irrigation	-	18	18 times
3	No. of wells	34	103	3 times
4	No. of community wells	-	5	All
3	Biogas plants (No.)	-	39	All
4	Two bowl seed drill (No.)	-	48	All
5	Sprayers (Nos.)	-	10	All
6	Threshers (Nos.)	-	5	All
7	Electric pumps	15	103	7 times
8	Magazine subscribing farmers (No.)	10	247	25 times
9	Value of average per capita yield of all crops (Rs.)	446	6466	15 times

Table 2:

B. Impact of the Integrated Watershed Development Program

Such an increased and sustained land productivity resulted in rural poverty alleviation and thus, village stakeholders benefited and improved the socio-economic status of people. Milk producers formed an Association and a milk collection center in this village was established. Milk production enhanced to 3,000 liters per day and was marketed to the near-by town. This lead to the assured daily income to the cultivators from dairy farming.

VII. Conclusion

By comprehensive development of Watershed by constructing bandharas, percolation tank, farm ponds, CCT etc. and also by adopting the unconventional measure like bore blast technique the additional water is stored in groundwater. Along with the measures taken by Social Forestry Department, if we will adopt the biological as well as technical measures for rainwater harvesting, it will certainly add to the ground water storage. The work will be executed with the help of local people with the financial help of Government; hence it will be economically viable. As these techniques are eco-friendly, the development due to this in future will be sustainable. To cater this problem of water storage in rural areas, the technique of water shed management is best suited. By implementing this method the ground water table is increased thus providing sufficient water to the farmers during summer season.

The main aim is to implement watershed development program is to recharge ground water and conserve soil along with enhancement in the economic background of the villagers. The villager's participation aims one step forward in the direction of development of the village. It is essential to promote Watershed management concept wherever feasible in Rural Sector similarly to rainwater harvesting in Urban Sector.

References

[1] Research Paper "A Case Study of Watershed Management for Madgyal Village" by Pandurang D. Jankar & Dr.Mrs.Sushma S. Kulkarni
[2] Research Gate paper on "Watershed Management Concepts & Principles" by Suhas P. Wani & Kaushal K.Garg.
[3] Case Studies – Personal Interaction in Hiware Bazar & Ralegan Siddhi.
[4] World research institute
[5] Indian Water Portal
[6] Watershed impact evaluation using remote sensing. Gopal Kumar1,*, D. R. Sena2, R. S. Kurothe1, V. C. Pande1, B. K. Rao1,A. K. Vishwakarma1, G. L. Bagdi1 and P. K. Mishra.1)Central Soil and Water Conservation Research and Training Institute, Research Centre, Vasad 388 306, India. 2) Central Soil and Water Conservation

Research and Training Institute, 218, Kaulagarh Road, Dehradun 248 195, India.
[7] WATERSHED ACADEMY WEB Principles of Watershed Management. http://www.epa.gov/watertrain
[8] International Water Management Institute
[9] Participatory Watershed Management For Sustainable Rural Livelihoods In India
[10] Research Paper 2006-2 By Budumuru Yoganand And Tesfa G. Gebremedhin. Integrated watershed management: evolution, development and emerging trends Guangyu Wang Shari Mang Haisheng Cai1, Shirong Liu3, Zhiqiang Zhang, Liguo Wang John L. Innes.

