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WATERSHED MANAGEMENT-STATUS, DESIGNING, PROBLEMS AND PROSPECTS

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INTRODUCTION

Land and water management is the key to sustainable agriculture. In dry lands, water is the single most limiting factor of crop production. In rain-fed areas, rainfall is the only source of water, and its efficient utilization is important for successful crop production (Panigrahi et al., 2009). Besides, droughts resulting from uncertain rainfall conditions, the consequent water scarcity are common in dry lands. Proper rainwater management, conservation and development of water resources is therefore essential for meeting demands such as water for domestic use, drinking water for cattle, industrial water needs etc. besides water for irrigation (Bosch and Hewlett, 1982). Along with water, conservation of soil, nutrients and organic carbon on watershed basis becomes a necessary in water scarce areas (Panigrahi et al., 2017).

Watershed is generally defined as the geographic area draining to a common outlet in a drainage line. The watershed area is always defined with reference to an outlet point in a drainage line. The area of the watershed increases as we move downstream along a drainage line and it decreases as we move upstream. A very large watershed is called macro watershed and a very small one is called micro watershed. Micro watershed generally has a single order stream as its drainage line whereas a macro watershed has multiple drainage lines of higher order.

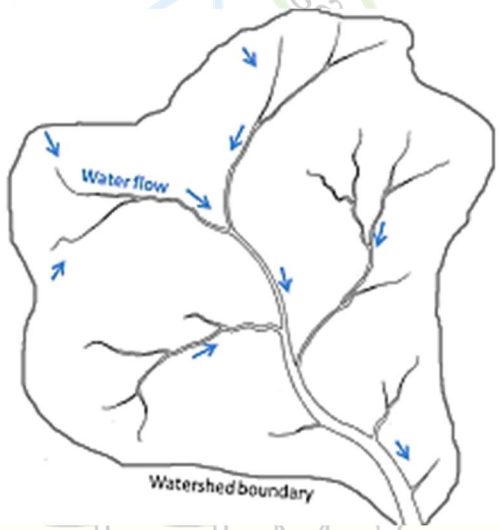

Fig. 1. Sketch of a watershed with its boundary

Since watershed is a hydrological entity, water resources planning and its utilization are best attempted by taking watershed as a unit of planning. Rain water management often involves interventions for runoff control and retention such as bunds and vegetative barriers and also water harvesting structures (eg. farm ponds, check dams) and ground water recharge structures (eg. nala bunds and percolation tanks). All these interventions are designed according to the estimated runoff which in turn depends upon the watershed area above it (Schwab et al., 1993). The quantity and quality of the

basic natural resources such as climate, soil and water decides the bio-mass production in a watershed and hence the human and cattle population can be sustained (Panigrahi et al., 2019). Therefore, while planning resource use, this aspect of watershed is taken into consideration. A higher population will exert more pressure on the resources of the watershed which can result in over exploitation and consequent degradation of resources (Richards and Singh, 2001).

STATUS OF WATERSHED DEVELOPMENT PROGRAMMES IN INDIA

India has about 16 percent of the world's population but only 4 percent of its freshwater resources. In India, the estimated rate of groundwater extraction in the 1990s exceeded the replenishment rate by 104 billion m3yr-1 compared with 30 billion m3yr-1 in China and 10 billion m3yr-1 in northern Africa (Gallart, and Llorens, 2003). Currently, more than 10 percent of central groundwater board blocks are overexploited. It has been calculated that blocks where exploitation is beyond the critical level have been increasing at a rate of 5.5 percent each year (MoRD, 2001). Since 1995, the Government of India has moved towards creating common guidelines as a framework for watershed development. However, concerns remain that legislative measures to protect and manage India's water resources are hindered by the lack of an integrated framework for watershed management, a lack of effective departmental coordination, and a focus on supply- rather than demand-side mechanisms (Sharma, 2001). Another major problem is that disparities between the scientific and the public perceptions of the role of forests are embedded within water and watershed policy.

WATERSHED DESIGN / DEVELOPMENT AND MANAGEMENT

In a broader sense, watershed management implies rural development with watershed as unit of planning (Lal, 2000). Apart from development of agriculture, it may encompass areas of infrastructure development such as transport and communication, and even health, energy and education for the overall well being of watershed community (Panigrahi and Srivastava, 2011). However, agricultural development and certain issues and challenges of watershed management should be emphasized.

The major objectives of a watershed programme are:

1. Increased crop production
2. Protection of environment
3. Drought mitigation and improved water availability/Flood control
4. Achieving social equity
5. Soil and Water Management
6. Alternate Land Use Systems
7. Livestock Management
8. Pisciculture
9. Apiculture
10. Other agri-based enterprises
11. Livelihood based farm and off farm activities

Various activities taken up in a watershed programme include:

1. **Soil and Water Management:** Soil conservation works such as bunding and terracing, vegetative barriers etc in arable lands and contour trenching in non-arable area, loose rock and pucca check dams in water courses for soil conservation and grade stabilization and water harvesting and ground water recharge structures (nala bunds and percolation tanks) are taken up under this component. A number of specialised practices developed by research institutions such as conservation furrow, ridge and

furrow, broad bed and furrow etc. have been found to be helpful in in-situ moisture conservation. Mulching is also recommended for soil moisture conservation. Of late, mulch-cum-manuring with organic mulches are being promoted with the twin objectives of moisture conservation and organic matter build-up.

2. Improved Crop Production: Improved crop management, practices include improved/high yielding varieties, integrated nutrient management, weed management, integrated pest and disease management and use of improved agricultural implements and machinery. Alternate

3. Land Use Systems: In watershed management, it is often desirable to go for alternate land use systems for better resource utilization as well as for improving the income of farmers. Various options are afforestation, agro-forestry, agri-horticulture, horti-pastoral, sivi-pastoral systems and bio-fuel plantations. Of late, medicinal and aromatic plants are being recommended for increased returns.

4. Post-harvest Technologies: Post-harvest technologies assume great importance for reducing post-harvest losses, value addition of agricultural products and marketing.

5. Live Stock Management: Diversified farming systems are often the best way to insure against variation of weather and market. Animal husbandry (Dairy, Poultry, Sheep and Goats, Piggery, emu farming etc,.) provides the best alternative source of income to the farmers, which is more stable.

6. Others: Some of the other programmes that can be taken up under watershed programmes are Sericulture (silk worm rearing), Pisci-culture (fish rearing), Apiculture (bee keeping) etc.

7. Action Plan Preparation: Action plans are prepared based upon the need assessment made through Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) surveys.

Detailed programme planning is done under the various components of watershed development such as soil and water management, improved crop management, alternate land use system etc. It may be necessary to carry out further detailed surveys in order to arrive at the exact locations and dimensions of interventions and to estimate cost and benefit/cost ratios of watershed development.

Integrated Watershed Management (IWM) aims at holistic development of an area through optimal resource utilization by adopting watershed as a unit. Conservation of natural resources such as soil water and vegetation is of paramount importance in watershed programme for maintaining productivity and achieving sustainability.

Following is a list of thrust areas needing attention of those involved in watershed research and development:

1. Low cost technologies for soil and water conservation
2. Monitoring of ground water status and ground water recharge mechanisms.
3. Crops and cropping systems which promote resource conservation and fetch higher returns such as medicinal and aromatic plants, floriculture, horticulture.
4. Farming systems development and increasing role of animal husbandry to provide stable income and returns to farmers.
5. Post harvest technologies for preventing losses, processing and value addition.
6. Institutional mechanisms for market intelligence and marketing.

7. Water and air quality assessment and amelioration measures for pollution control.
8. Institutional mechanisms for meeting situations arising out of uncertain rainfall conditions.

PROBLEMS AND PROSPECTS IN WATERSHED MANAGEMENT

India's guidelines for watershed development programmes have been revised three times since their introduction in 1986. They aim to make investments in watershed management have a long-lasting impact on crop production and rural livelihoods in rain-fed cropping areas. They are reviewed periodically, but only to accommodate cost escalations and revise targets. The current guidelines were introduced in November 2000, renamed as the National Watershed Development Programme for Rain-fed Areas (NWDPRA) of the Ministry of Agriculture. In addition to setting a framework for watershed development in the country, the guidelines proclaim a blanket investment per unit area for diverse land–water interventions and make special provisions for promoting income generation for landless people. Watershed management needs to take a multipurpose approach to improving land and increasing water availability for crop growing, livestock and human use through soil and moisture conservation measures. An effective watershed project should aim to drought-proof areas by capturing every falling raindrop. This is technically possible. An assessment by the Centre for Science and Environment estimates that if half of India's average annual rainfall of 1170 mm were captured over 1.12 ha of land in each of the country's 587 226 villages, then the 6.57 million litres of rainwater thus collected would meet the annual cooking and drinking needs for an average village of 1200 people. Doing this would help both to sustain surface water supplies and to recharge aquifers. However, it has been reported that despite the extensive programmes carried out to provide drinking-water to rural areas, number of villages still had a drinking-water problem. Even the watershed development programmes set up to complement the drinking-water programmes in villages did not improve the situation. As a result, much of the 420 hectare metres of average annual available precipitation flowed uninterrupted to the sea without fulfilling its ecological functions of enhancing surface water supplies and recharging groundwater to any appreciable extent.

The experiences of watershed development projects have been quite varied. The few successful projects are outnumbered by the many unsuccessful ones. There are situations where some successful watershed projects have not even provided for the minimum amounts of drinking-water and fodder. Many watershed projects, designed to conserve rainwater to improve irrigation, have tended to ignore communities' primary need of access to drinking-water. On similar lines, some projects have neglected to develop pastureland and propagate soil-moisture conservation practices. A few community groups have taken the initiative themselves with some external assistance. For example, the villages of Sukhomajri in Haryana and the Chakriya Vikas Pranali scheme in Jharkhand have improved their socio-economic conditions in a relatively short time by linking improved in situ moisture conservation with economic activities that build up social capital. These examples show that watershed development is a viable model for the economic development of poverty-stricken rural areas.

The two main problems of watershed development programmes have been the lack of any consistent criteria for selecting villages and the process of implementation. This raises several management-related questions. The poor performance of many development projects has not reduced the

number of new projects. One of the most intractable problems in development has been the lack of project sustainability. Many projects have failed to build in strategies to maintain their assets once project support ends. Feedback from several projects indicates that many farmers only benefit from watershed projects by getting short-term paid labouring work. Because communities see few long-term benefits emanating from these projects, they have little interest in operating and maintaining project assets. This issue is being confronted by some donors in their projects. Many watershed projects have failed in their primary objective of arresting land degradation. One study indicates that the rate of land degradation in rainfed areas in the 1990s is likely to have been more than twice the rate in the 1980s, largely because of increased soil erosion. At the other extreme, many projects have failed because of a pattern of uniform treatments across diverse agro-ecological conditions, leading to a less than desired impact. The continued lack of drinking- and irrigation water in several Indian states shows that drought-proofing interventions have failed to stop land degradation in rural areas and have failed to improve rainfed agriculture and the availability of drinking-water.

EMERGING ISSUES

Imparting livelihood security, poverty reduction, employment generation, social equity and gender mainstreaming in rural areas are key-concerns in any development programme. Climate change and its mitigation and adaptation strategies are receiving worldwide attention and hence interventions promoting such efforts need to be incorporated in watershed management programmes. We need to promote interventions of Clean Development Mechanisms, Organic Farming, Conservation Agriculture, Non-pesticidal methods of pest control etc. for arresting degradation of resources and to make our environment a safe place to live on. There is need for increased use of modern technologies such as Geographic Information Systems and Remote Sensing for enhancing our efficiency of planning, implementation and monitoring of watershed development programmes

CONCLUSION

The continuing drought problems in India suggest that the country's drought-proofing efforts through the watershed approach to be strengthen. There is a need to be fresh thinking about the watershed approach to drought proofing. All the watershed projects should have the basic design and implementation strategies. The frequent reviews of the progress with required targets lines to be fixed for better delivery of the outputs and outcomes. The participation of the people and community ownership should be encouraged. Targets to benefit the landless and those who do not own benefits from the proposed program should also be fixed. There is a need to initiate negotiations among different beneficiaries and stakeholders. Overall, the watershed development and its sustainable management are of crucial importance in India. The progress of globalization should also be followed by conservation of local natural resources through watershed program which may productive for the rural people.

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