Participatory Approaches to Sustainable Rural Water Resources Development and Management : Indian Perspective

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Summary :

India is facing the increasing water stress due to population growth, increase in water demand, vulnerability from climate change and deterioration in water quality from domestic as well as industrial and agricultural pollution load. India occupies about 2.45% of the world area and has a share of 5% of global fresh water resource and with this share of vital natural resources about 16.87% of the world population is to be catered. Currently the population of India is little over 1 billion and it is expected that it will reach a figure of about 1.5 billion by the year 2050. The water availability per capita per year at present is 1730.6 CM (m^3) and has almost reached to the water stressed (<1700 CM) condition.

Despite the tremendous economic development and growth of industries and service sector, the livelihood of about 68% of Indian population depend on agriculture directly or indirectly. More than 70% of its population lives in rural areas although there is an increasing trend of urbanization in the last two decades. The irrigation water accounts for about 90% of the total water resources utilization. India stands at a cross roads in institutional options for natural resources management at local and village levels. The emphasis on future options like watershed development through participatory approaches coupled with sustainability issues is now widely recognized as a potential approach for vitalizing the rural economy.

Climate variability in India in terms of rainfall and temperature, has noticeable spatial and temporal variations. Even after achieving full irrigation potential from surface and sub-surface water resources, a major portion of cultivated area shall remain rainfed. Furthermore, the conditions may deteriorate in terms of severity of droughts and intensity of flash floods under the climate change scenario. In this article different measures followed for soil moisture conservation

through rainwater harvesting on watershed basis in problematic Laterite, coastal saline and hill zones of West Bengal a state of India are discussed.

Although in recent years, both Government and Non-Government Organizations have stepped up their efforts in water conservation by rainwater harvesting on watershed basis through participatory approach, the Government of India's Commitment to Participatory Irrigation Management (PIM) with the help of Water Users Associations (WUAs) needs to be strengthened through adoption of its framework from state level down to village level. An attempt is made in this article to highlight some key factors in structural framework as well as in the operation domain of PIM involving WUA in the Indian perspective.

Introduction :

Watershed is a natural hydrologic entity governed by the terrain topography from where runoff is drained at a point. Watershed development refers to conservation, regeneration and judicious utilization of natural resources. It aims to bring about an optimum balance between the demand and use of natural resources so that they remain sustainable over time. Every human being on earth is a stakeholder in watershed development. And so, for that matter, is every animal, domesticated and wild – only, they do not have a constituency. We should realize that our well being is inseparable from the well being of the ecosystem (Aswathanarayana, 2001).

The competing demands in agriculture, industry and domestic sectors are fast depleting the water resources of India. Even after achieving full irrigation potential from surface and sub-surface water resources, a major portion of cultivated area shall remain rainfed. In the process of watershed development, 'peoples participation' has been identified as a vital element for success and sustainability of the programme. Environmental regeneration is possible only when the concerned people realize a need for it and are empowered to have control over the process of resource utilization, management and conservation. There can be no sustainable natural resource management unless it involves the participation of all inhabitants of the concerned watershed in an active manner.

In this context a look at Government of India's Vision for Integrated Water Resources Development and Management (Ministry of Water Resources, 2003) appears appropriate. Government of India's commitment to PIM and the encouragement of water management being undertaken with the help of WUAs are apparent from a perusal of its National Water Policy.

Thus the Water Vision should aim at empowering communities and various stakeholders and beneficiaries, producing more food and using water more productively, and managing water to conserve the quantity and quality through rainwater harvesting to ensure the existence of healthy catchments, encouraging more innovation in water resources management, and better governance.

Importance of Participatory Approaches to Sustainable Watershed Development in Rainfed Areas :

Water Availability in India is Driven by the Monsoon with a high degree of spatial and temporal variability and the extent varies from 100 mm of mean annual rainfall at westernmost regions to 11,000 mm in some places in northeast part of the country with summer monsoon (June – September) accounts for 75% of the annual rainfall for the major portion of the country. Extreme temperature variation exists in the range of 50° C in western desert in summer to sub-zero in northern most area in winter (Table I).

Rainfed agriculture is critical to agricultural performance in India. Nearly half of all food grains are grown under rainfed conditions and hundreds of million of poor rural people depend on rainfed agriculture as the primary source of their livelihoods. Of an estimated 143 million ha net cultivated land in India, about 97 million ha (68%) is rainfed/ dry land producing 44% of the country's food requirements while supporting 40% of human and 60% of livestock populations(Sharma, 2006). Even if the country's full irrigation potential of 139.5 million ha is realized, agricultural production in 75 million ha will continue to be solely dependent on rainfall. About 15 million ha of dry land lies in the arid region which receives less than 500 mm rainfall; another 15 million ha is in 500to 750 mm rainfall zone, 42 million ha is in 750 to 1150 mm rainfall zone, with the remaining 25 million ha receiving more than 1150 mm rainfall per annum. Droughts occur once in 3 to 5 years either due to a deficit in seasonal rainfall during the main cropping season or from inadequate soil moisture availability during prolonged dry spells between successive rainfall events. For more than a century there exists a clear association between El nino events and weak monsoons. Over the period of 1871-1988, 11 of 21 drought years were El nino years. Low yields and crop failures often lead to food and fodder scarcity resulting in a near famine situation that further accelerates the process of land degradation. Physiographically the rainfed region encompasses 218 Districts including the desert terrain of Rajasthan in the northwest, the plateau region of central India, the alluvial plains of the Ganga-Yamuna river basin, the central highlands of Gujarat, Maharasthtra and Madhya Pradesh, the rain

shadow region of Deccan in Maharashtra, the Deccan plateau in Andhra Pradesh and the Tamil Nadu highlands (Singh et al., 2000). It is in the rainfed belt where cultivation of coarse cereals (91%), pulses (91%), oilseeds (80%) and cotton (65%) predominates. In these rainfed areas, farmers' dependence on livestock besides arable farming, as an alternative source of income, is very high. Preliminary estimates indicate that nearly two out of three heads of cattle of the total Indian cattle population of 219 million heads thrive in rainfed regions (FAO, 2000). These data emphasize the crucial role played by rainfed agriculture in the Indian economy and India's food security as the rainfed agriculture would continue to occupy a prominent place in Indian agriculture for an indefinite period. In the soil and water conservation point of view, the most vulnerable areas in West Bengal are gravely and lateritic tracts of western districts (Purulia, Bankura, Birbhum, Western part of Burdwan and West Midnapur), the hilly areas of Darjeeling district and coastal saline zone mainly comprising of 24-Parganas (South) and 24-Parganas (North) districts. Soil moisture conservation through different *insitu* rainwater harvesting practices on watershed basis is the only alternative for improving cropping intensity and the socio-economic upliftment of farmers in these regions (Ravi Babu, 2006).

Participatory integrated watershed development refers to conservation and regeneration of natural resources like soil, water and plants through **vegetative** including afforestaiton, horticulture and pasture development etc. and **engineering measures** like contour bunding (Figure I), trenching (Figure II), terracing (Figure III), nala bunds, gully plugs (Figure IV) and check dams etc. through local people active participation.

Soil Moisture Conservation through Rainwater Harvesting on Watershed Basis with Peoples Participation : State of West Bengal – A Case Study

West Bengal is endowed with remarkable variations in physiographic resources. In the soil and water conservation point of view, the most vulnerable areas are gravely and lateritic tracts of western districts (Purulia, Bankura, Birbhum, Western part of Burdwan and West Midnapur), the hilly areas of Darjeeling district and coastal saline zone mainly comprising of 24-Parganas (South) and 24-Parganas (North) districts. Soil moisture conservation through different *insitu* rainwater harvesting practices on watershed basis are discussed as below:

Western laterite zone:

Based on the topography and soil characteristics, the land form in this region can be classified into four groups namely steep sloping (more than 10 %) uplands/barren hillocks (*Dungri*), upland

(*Tanr*), midland (*Baid*) and lowland (*Kanali/Bohal*). The uplands are mostly in an advanced state of degradation, lacking humus and major plant nutrients. They are untreated lands and support low intensity cropping with low productivity, if not actually remaining fallow and barren. The midlands are mostly terraced Paddy fields with thin soil cover and poor moisture retention capacities. Seventy percent of total agricultural land in this region falls under upland and midland, depending mostly on rainfall for any crop to be grown. Annual Paddy is grown in the low lands, which are relatively fertile and productive. Despite the fact that the amount of rainfall is high enough to sustain the crop growth, but uneven distribution of rainfall during the crop season causes moisture stress conditions during critical stages of crop growth and lead to frequent crop failure in the region.

To improve the soil moisture regime of these lands and to address the mid season moisture stress condition of crops grown in up and midlands, *insitu* rain water harvesting techniques namely Staggered Contour Trenches (SCTs)/Continuous Contour Trenches (CCTs), Contour bunding (Figure I), 30:40 and 5 % models (Figure V) etc., have been introduced in the region on micro-watershed basis. These measures demonstrated their ability in conserving the rainwater received during the monsoon season. They helped in maintaining better soil moisture regime conditions, stabilizing yield of crops and providing conducive environment for bringing the severely eroded soils under the cover of vegetation and grasses. These insitu rainwater-harvesting measures are now widely acclaimed as successful soil and water conservation measure in the region.

Coastal saline zone:

The coastal area of West Bengal is earmarked by near surface shallow aquifers with saline/brackish water, which is therefore unfit for irrigation purposes. On the other hand, the ground water suitable for irrigation is found at greater depths (300 - 400 m) and its exploitation is expensive and hence not feasible. In most of the coastal area of West Bengal, no perennial canal with water suitable for irrigation is present. During monsoon, excess water is present, causing water logging and submergence of crops where as no crop is cultivated during rabi and summer seasons due to lack of good quality irrigation water. The only alternative left is excavation of farm ponds in individual farmers fields (considering the rest of the field as catchment/watershed of pond) for storing excess rain water during monsoon period and reusing it for giving life saving protective irrigation to the crops during the post-monsoon period besides practicing pisciculture. The farm ponds are excavated in 1/4 to 1/3 of the total land holding size of each farmer. The

ponds are generally located at the lowest point of the field and the runoff water is collected due to gravitational flow. The side slope of the ponds varies 1:1 to 2:1. The usual depth of the farm ponds is maintained at 3 m. The excavated soil is used for construction of peripheral bunds and raising the level of remaining land.

Hill zone:

Agriculture is the main occupation of the people of Darjeeling district. The major food crop grown in the hills is rainfed Maize, where as Paddy is grown in foothills and plains. In addition to Tea, Cardamom and Orange are the major plantation crops grown in the region. The major source of water supply in Darjeeling hills region is springs or small rivulets locally known as *Jhoras* with only limited discharge available during post monsoon period. The irrigation facilities exist only in 8 - 10% of the cultivated land predominantly from perennial jhoras and river lift irrigation in the foothills. The cropping intensity in Darjeeling district is as low as 110%. To improve the present level of cropping intensity and productivity in Darjeeling hill watersheds, construction of bench terraces by breaking the steep slopes and structures for collection of rain water for giving life saving protective irrigation to crops during critical stages of crop growth were introduced. As inherent topographic features and steep slopes do not allow the farmers of Darjeeling hills for construction of large water harvesting structures, therefore, Small Water Harvesting Tanks (Figure VI) with hand pack retaining walls are increasingly becoming popular in this region. These tanks are filled with water either from the nearby springs using siphon pipes or diverting the excess runoff from their catchment area. The stored water is utilized for giving life saving irrigation to Maize, Cardamom plantation and Vegetables, which are grown extensively in the region. Under cutting and landslides are common in Darjeeling hills. Hence, for providing stability to the structure, hand packed and rough dressed retaining walls with locally available stones/boulders are usually made and stone boulder soling of pond base is carried out. Moreover, stones are hand packed from the foundation level. Other soil moisture conservation treatments for hill watersheds include repairs to the bench terraces, dressing and stone pitching of risers of bench terraces for stability of sloppy lands and stream training works.

The Role of Water Users Association in Participatory Irrigation Management :

A practical definition of Participatory Irrigation Management (PIM) in the Indian context is that PIM involves a Water Users Association (WUA) taking over management (including operation and maintenance) of at least one level of canals above the outlet (i.e. the minor canal) and also

being associated with State Irrigation and Command Area Development (CAD) Progrmmes, Agriculture and Water Resources Departments, efforts at improved and integrated water and agriculture management. Simultaneously, PIM involves a redefinition and refocusing (and not a mere reduction or downsizing) of government's role in irrigation so as to lead to a genuine partnership or joint management between the government and WUAs. Thus, PIM involves an approach based upon integrated and joint management of irrigation with the community (in the form of the WUA) and government agencies working together for equitable, rational, timely, and convenient allocation of water and increase in efficiencies both in canal management and on-field water application. Hooja (2006) opines that the PIM approach should allow flexibility from region to region, irrigation system to irrigation system and even WUA to WUA. It can be applied to major, medium and minor irrigation and even to larger tank or lift irrigation systems,

PIM legislation should specify that regardless of whether the source is lift irrigation (from rivers or from community tube wells), or a tank system or a conventional irrigation system based upon storage and water distribution, wherever water is to be distributed between 30 or more farmers, the PIM and WUA approach should be mandatory.

The organization structure of WUAs and functions would differ for small river lifts (RLIs) or tube well lifts, from those for tank systems or larger irrigation and Command Area Development Schemes. For regular irrigation or command area schemes each canal minor should have a WUA with two members each being provided for, in the Management Committee from head, middle and tail areas respectively of the minor. As long as Water rights continue to be linked to land ownership, each landholder drawing water from the canal minor (or from the RLIs or Community tube wells) would be a member of the WUA.

Various State governments in India have gone in either for a 'big bang' approach of uniform and simultaneous introduction of PIM throughout the State based upon, and preceded by legislation (the leading example being Andhra Pradesh), or have gone in for some sort of a 'bottom-up' slow and steady approach (starting with pilot projects) of motivating and facilitating the creation of WUAs wherever the farmers agree to voluntarily come together and to form them so that they gradually take over some functions on their local irrigation systems.

Conclusion :

The rainfed areas which constitute about 70 per cent of cropped land in the country suffer from series of problems such as low and erratic rainfall, high degradation of land resources, huge

volume of runoff, depletion of soil fertility due to continuous soil erosion, depleting ground water levels due to over exploitation, low crop productivity and production, low income, lack of employment opportunities and low standard of living. Over a period of time, participatory integrated watershed approach for systematic development of rainfed areas has been evolved to address these critical problems. Water Resources Development and management with peoples participation needs to be strengthened through empowerment of Water Users Association.

Recommendations :

- Involving all stakeholders in integrated water resources development and management.
- Empowering and institutionalizing Water Users Association.
- Movement towards full cost pricing of all water services.
- Increased pubic funding for research and innovation.
- Increased cooperation internationally (and, may we add, even intra-nationally) in river basins.
- Capacity building programme for all level of stake holder, policy makers, Government functionaries and researchers for various aspects of PIM involving WUA for sustainable rural water resources development and management

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Table – I INDIA – LAND AND WATER RESOURCES AT A GLANCE

General

♦	Geographical Area	:	329 Mha
♦	Location	:	Latitude 8º-4´ & 37º-6´ North Longitude 68º-7´ & 97º-25´ East
♦	Forest Cover	:	21.11 %
♦	Population (As on 01.03.2005)	:	1097.1 Million
♦	Average Annual Rainfall	:	1170 mm
♦	Major River Basins (Catchment Area more than 20,000 sq.km)	:	12 nos. having catchment Area. 253 Mha
♦	Medium River Basins (Catchment Area less than 20,000 sq.km)	:	46 Nos. having catchment Area. 25 Mha

Water Resources

♦	Natural Run-off	:	1869.35 BCM
♦	Estimated Utilisable Surface Water Resources	:	690 BCM
♦	Total Replenishable Groundwater Resources	:	432 BCM
♦	Total Annual Utilisable Water Resources	:	1122 BCM
♦	Available Groundwater Resources of Irrigation	:	361 BCM

Land Resources

♦	Total Cultivable Land (200-02) (P)	:	184 Mha
♦	Ultimate Irrigation Potential	:	140 Mha
♦	Cumulative Irrigation Potential created upto – 2004-05.	:	105.30 Mha
♦	Gross Sown Area (2001-02) (P)	:	190.3 Mha
♦	Net Sown Area (2001-02) (P)	:	141.3 Mha
♦	Gross Irrigated Area (2001-02) (P)	:	76.4 Mha
♦	Net Irrigated Area (2001-02) (P)	:	55.9 Mha
♦	Food Grain Production during 1950-51	:	50.8 m.t.
♦	Food Grain Production during 2003-04	:	213.5 m.t.

Source : INCID NEWS, Volume 5, Issue No. 4, 2005.

	
Contour Bunding	Contour Trenches
	
Bench Terraces in Hills	Series of Gully Plugs
	
5% Technique	Water Harvesting Tank on Hill Slopes