

• While erecting a new taxon, the pollen morphology with allied taxa should essentially be compared.

• Protologue should be supported with brief pollen morphology and/or palynogram (diagrammatic representation of the pollen)/pollen micrograph.

• Type specimens preferentially should bear a palynogram or pollen photographs, or at least a pencil sketch of the pollen.

• Loan/exchange of palynograms and scanning electron micrographs of pollen between different herbaria must be espoused for dissemination of information.

• Basic training must be imparted to taxonomists on pollen procedures and study of morphology.

• All taxonomic laboratories must be equipped with the minimum infrastructure for pollen analysis.

• Collaboration between taxonomists and palynologists should be encouraged.

Eventually, all taxonomists must strive for modernization at the first instance, by

integrating pollen morphological criteria in their curriculum. They must realize the inter-relationship between the two subjects with the intention of supporting taxonomic data with palynological information. In the present sophisticated epoch of information technology, where taxonomists have undertaken the task of developing digitized 'virtual' herbaria, the implementation of SEM-based micro-morphological studies is not thorny. The venture would add a 'feather in the cap' of Linnean taxonomy and facilitate in solving intricate taxonomic problems, mainly at infra-specific levels. Our endeavour must be oriented to converge the two parallel disciplines, amalgamate and ameliorate them and develop a more reliable, authentic, standardized and intelligible taxonomy.

1. Krishnankutty, N. and Chandrasekaran, S., *Curr. Sci.*, 2008, **94**, 565–567.

2. Bauer, F., Illustrations of Orchid plants. With notes and prefatory remarks by J. Lindley, London, 1830–1838.

3. Brown, R., *Trans. Linn. Soc.*, 1833, **16**, 685–745.

4. Mohl, H., *Ann. Sci. Nat.*, 1835, **3**, 148–180; 220–236; 304–346.

5. Fischer, H., *Z. Wiss. Mikrosk.*, 1912, **29**.

6. Wodehouse, R. P., *Pollen Grains. Their Structure, Identification and Significance in Science and Medicine*, McGraw-Hill, New York, 1935.

7. Erdtman, G., *Pollen Morphology and Plant Taxonomy/Angiosperms*, Waltham, Mass., Stockholm, 1952.

8. Nair, P. K. K., *The Pollen Grains of Western Himalayan Plants*, Asia Publ. House, Bombay, 1965.

9. Nair, P. K. K., *Palynol. Bull.*, 1968, **4**, 1–12.

10. Garg, A., *Curr. Sci.*, 2007, **93**, 593–594.

11. Templeton, A. R., *Annu. Rev. Ecol. Syst.*, 1981, **12**, 23–48.

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Watershed development: how to make 'invisible' impacts 'visible'?

J. S. Samra and K. D. Sharma

The innovative and imaginative economic reforms, policies, programmes and investment portfolio have been internalized through various mechanisms of convergence. In this way the development process is evolving and dynamic in chasing efficiency, equity, social justice, reducing poverty, realizing sustainable livelihood and environmental services.

About 60% net sown area in India is rain-fed, supporting 87% pulses and coarse cereals, 77% oil seeds, 66% cotton as cash crop and 50% cereals. The entire 67.7 mha forests, grasslands, 80% mangoes and apples, all dry land and temperate fruits, 67% livestock and 40% human beings are distributed in the unirrigated agro-ecologies. During 1985–95, rain-fed regions witnessed higher agricultural growth rate of 4.01% compared to 2.90% in the irrigated areas. However, during the post-1995 liberalization, the growth in rain-fed agriculture¹ decelerated to almost zero, as against that of the irrigated region to 2.07%.

The Indian Planning Commission's Working Group on Natural Resources

Management² has noted that, in spite of spending about Rs 192,510 million (US\$ 4500 million) for watershed development in the rain-fed region of India, the results are 'invisible', and the treated areas have reverted to their 'original status'. Clearly, the development processes require a thorough examination.

The evolution of watershed development in India

The earlier pre-independence incarnation of the present-day watershed development consisted of preventing soil erosion in the catchments of River Valley Projects (RVPs) and various schemes on dry

land agriculture, soil and moisture conservation. The objectives were empirical, thematic, commodity centric and lacked comprehensiveness of generating income, employment, equity, livelihood, and integrated as well as sustainable use of natural resources, including the soil capital. The community participatory process of developing all inclusive resources within a natural geo-hydrological unit of a watershed is being experimented since 1974 by different research and development endeavours. After 1982, NGOs, governmental organizations and donor-driven resources also jumped on the bandwagon of refining the watershed development projects. Centrality of the role of gender, poverty, landless, asset-less

labour, indigenous technical knowledge, artisan, craft, local skills, resources and tribal people was recognized. Post 1989, the Union Ministry of Agriculture (MOA), Ministry of Rural Development (MORD), and Ministry of Environment and Forests (MOEF) invested in integrated natural resources management in watersheds with the aim of enhancing productivity, income, employment and environmental externalities. These ministries devised their own norms and guidelines with a common philosophy of participation of the community. The Hanumantha Rao Committee³ nailed down the principles of transparency by operating joint accounts, contributions for meaningful peoples' participation, role of Gramsabha (eligible voters), women, landless or asset-less, NGOs, self-help groups, users' groups and other innovative alternative institutions. It was a significant step to re-christen the role of the Government as a service provider and accommodative to Panchayati Raj Institutions. The Haryali Guidelines issued by the MORD⁴ made Panchayats the Project Implementing Agencies.

Watershed development programmes

The MOA, MORD and MOEF along with their respective departments in the States, are the three main government ministries in charge of watershed development programmes in the country⁵. Each programme focuses on different aspects and activities within the ministry's development criteria.

The MOA has worked in watershed development since the 1960s and mainly deals with issues, including erosion-prone agricultural lands, optimizing production in rain-fed areas and reclaiming degraded lands. The Department of Agriculture and Cooperation and the Department of Agricultural Research and Education of the MOA are involved in all aspects of watershed development. They are supported by two autonomous bodies; the Indian Council of Agricultural Research, and the National Institute for Agricultural Extension and Management. The MOA is currently implementing several schemes/programmes, including the National Watershed Development Project for Rain-fed Areas, Soil and Water Conservation in the Catchments of RVPs and Flood Prone Rivers, Watershed Deve-

lopment Project in Shifting Cultivation Areas, Reclamation of Alkali Soil, Watershed Development Fund and Externally Aided Projects (EAPs).

The MORD has been implementing watershed development projects only since the late 1980s. It deals with non-forest wastelands and poverty alleviation programmes having components of soil and water conservation. The key department in MORD is the Department of Land Resources. Two organizations support the MORD: the National Institute of Rural Development and the Council for Advancement of People's Action and Rural Technology. The former provides advice on policy matters about watersheds, while the latter deals with the voluntary sector. Watershed programmes implemented by MORD include the Drought Prone Areas Programme, Desert Development Programme, Integrated Wastelands Development Programme, and EAPs.

Since 1989, the MOEF has been implementing the National Afforestation and Eco-development Project, with the intention of promoting afforestation and development of degraded forests within an integrated watershed approach.

Up to the X Plan (2002–07), nearly 51 mha has been developed on watershed basis. The MORD accounted for 63% of the 'treated' area, spending nearly 50% of the total funds and the MOA 'developed' the remaining 37% of the area, but used slightly more than 50% of the total funds². The MOEF and Planning Commission had only limited involvement.

The conundrum and the way out

In order to assess the performance of various ongoing projects/programmes of watershed development, a series of evaluation studies have been conducted. These studies support the fact that in several watersheds the implementation of the programme has been effective for natural resource conservation by increasing the productivity of the land, increasing additional area under agriculture, employment generation and social upliftment of beneficiaries living in the rural areas. But these have not spread to wider areas in the State or national level. Often, the treated areas have reverted to the original status and the impact of the development on productivity, equity and sustainability is generally 'invisible' at a

larger scale. This could be primarily due to lack of focus on livelihood component under the watershed development programmes. Sustaining people and their interest in conserving the natural resources for their livelihood, and not merely in land and water conservation, is a necessary prerequisite for the management of natural resources in rain-fed areas⁶.

The scientific concept of watershed-based development could not be adopted in a majority of cases due to scattering of 500 ha micro-watershed units over the entire district. It has now been recognized that though a unit of 500 ha may be adequate for development of land resources, it is inadequate for the development of water resources as well as management of common lands/forest department lands.

Most watershed development programmes have often stressed on the (expensive) supply-side measures directed at increasing water storage, infiltration and groundwater recharge. Gale⁷ concluded that there are no 'quick fixes' to emerging over-exploitation threats and certainly not without action to constrain water demand.

Participatory approach has been promoted for the past 10–15 years, but more than 30% government-funded watershed development programmes/activities continue to be under 'top-down' approach even at this stage². This has resulted not only in continued over-exploitation of natural resources, but also in non-inclusive growth and inequality. No programme, whatever be its technical excellence, will succeed unless the people are (a) convinced of its necessity, (b) participate in it willingly, and (c) assume responsibilities, including partial sharing of its cost in cash or kind.

In the absence of properly designed 'exit strategy', post-project sustainability continues to be a challenge. Post-project sustainability could be achieved by ensuring (a) adequate delivery mechanism at the national, state and district levels, (b) capacity building at the community level, (c) sustainability of Community Building Organizations, (d) attention towards allocation of users' right over Common Property Resources, (e) payment of genuine contribution by actual users, (f) concurrent monitoring and evaluation through independent organizations, (g) timely fund flow, and (h) modality for carrying out repair and maintenance of created assets.

Development of livelihoods from farm-production systems as well as from off-farm activities continues to receive less attention under the watershed programmes. Formal linkage was also not facilitated regarding the livelihood component, as it was not even considered as a formal agenda under the programme. Forestry component has hardly been integrated with watershed development programmes due to inadequate administrative support at the district and state levels. Livestock management as well as fisheries components did not receive attention in the watershed development programmes, thus excluding a large part of the landless and asset-less people depending on these resources for their livelihood.

The issue of equity poses one of the most difficult challenges in the implementation of watershed development programmes. Most of the issues thus emanated from the lack of balance in² (a) private-social benefits, (b) short-term and long-term gains, and (c) scientific (i.e. ridge-to-valley and integrated) approach vs crop productivity-centric approach to resources management.

Until 1995, watershed development projects were coordinated by multi-sectoral programmes with differing objectives launched by the Government of India. Legislation promoting Centre and State adaptation of the programmes, and the involvement of outside parties and autonomous agencies has led to a myriad of watershed development programmes and research initiatives at the state and district levels⁸. Poor implementation of the watershed development programmes at field level as well as lack of convergence between inter-related schemes of different development departments could

partly be ascribed to the differences in guidelines of different ministries. Laxity in departmental coordination is again reflected at the national level by the Working Group of the Planning Commission². The Planning Commission² has prepared a 25-year perspective plan to develop 88.5 mha through watershed development approach in the country up to the XIII Five Year Plan. The recommendation of a mechanism to avoid overlap in the activities of the three major ministries of MORD, MOA and MOEF through compartmentalizing functions, which opposes the integrated approach, has further increased the divisions within the watershed development programmes.

Through a consultative process among the MOA, MORD, MOEF, Ministry of Water Resources, Ministry of Panchayati Raj, Planning Commission and National Bank for Agriculture and Rural Development, the National Rainfed Area Authority⁹ has developed 'Common Guidelines for Watershed Development Projects' for evolving a unified perspective by all the stakeholders. These guidelines have become operational since April 2008, for implementation of new watershed development projects in the country. The key features of these guidelines are: (a) decentralizing the powers to the state governments for sanctioning and implementing the watershed development projects, (b) involving dedicated institutions of multi-disciplinary professionals at the national, state and district levels, (c) flexible project duration of 4–7 years in three distinct phases to expand the scope of work, (d) focusing livelihoods through integrated farming systems, (e) clustering small watersheds in the range 1000–5000 ha to optimize the transaction cost, (f) scientific planning

and capacity building for innovative new paradigms, and (g) implementing multi-tier ridge-to-valley approach for inter-departmental coordination and networking. Hopefully, these guidelines would converge, harmonize and rationalize the development process and investment portfolios of various ministries and departments implementing the watershed development projects in the country.

1. NCF, Report, National Commission on Farmers, Ministry of Agriculture, New Delhi, 2006.
2. Planning Commission, Report of the Working Group on Natural Resources Management: Eleventh Five Year Plan (2007–2012), Planning Commission, Government of India, New Delhi, 2007.
3. Hanumantha Rao Committee, Report of the Technical Committee on Drought Prone Areas Programme and Desert Development Programme, Ministry of Rural Development, New Delhi, 1994.
4. MORD, Report, Ministry of Rural Development, New Delhi, 2000.
5. Panchayati Raj and Natural Resources Management, Report, 2000; http://www.Panchayats.org/dnrm_reports.html
6. Kerr, J. M. and Chung, K., Report, International Food Policy Research Institute, Washington DC, 2001.
7. Gale, I., Report, United Nations Educational, Scientific and Cultural Organisation, Paris, 2005.
8. Sharma, R., Report, Ministry of Rural Development, New Delhi, 2002.
9. NRAA, Report, National Rain-fed Area Authority, Ministry of Agriculture, New Delhi, 2008.

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