

Fallacies in Indian Watershed Management Programme

A.K. Gosain

Department of Civil Engineering
Indian Institute of Technology, Delhi, INDIA
E-mail: gosain@civil.iitd.ac.in

ABSTRACT: The spatial and temporal variability experienced in the weather conditions of a local area as well as the landmass on which they act makes the overall system highly dynamic and therefore complex to understand in terms of its water resources. Watershed management philosophy offers a great deal in handling these complexities and has been accepted globally. However, it is a pity that invariably this philosophy has not been implemented effectively.

In India, integrated watershed management has been adopted as a part of the National Water Policy (NWP, 2002) for conservation of natural resources. Recently, enhanced emphasis is being placed on ensuring that the local level users participate in the planning and management of the natural resources at the watershed level through the "Haryali" Guidelines of the Ministry of Rural Development, (MoRL, 2004). Although the intent is in place the mechanism to achieve the goal is inadequate and faulty. The present paper discusses the fallacies inherent in the watershed management programme and goes on to suggest the remedies for designing and implementing the watershed management philosophy in a scientific manner. Furthermore, the paper also addresses the issue of handling the externalities in the watershed management programme that are invariably ignored.

The paper demonstrates the use of new technologies in the form of a GIS based modeling framework for local level planning. Use of case studies has been made to bring home some pertinent fallacies and also to demonstrate the applicability of new technologies to address some of the problems in watershed management programme.

Keywords: Watershed Management Programme, GIS, Integrated Watershed Management, Externalities.

INTRODUCTION

There is no doubt that India as a country has done well in the sector of water resources in the last fifty years, which has played a very vital role in the progress of the country. Water resources development is a continuous process which has to be resorted to because of ever increasing demands. The size of these projects may vary from major irrigation projects catering to millions of hectares of land to very small structures fulfilling the requirements of a small community at the village level. The interventions of the kind of major projects are proposed using a detailed planning and evaluation process whereas the interventions of later kind are very large in number and are usually devoid of any detailed analyses and evaluation. There have been many instances where implemented projects have been found to be responsible for creating problems for the society. Most of these problems arise from lack of understanding of the implications of these interventions on the water resources.

The inherent spatial and temporal variability in the weather conditions of a local area as well as the landmass on which it acts renders the overall system highly dynamic. Therefore even in the virgin state it is

difficult to understand the response of the landmass to the weather inputs. The situation becomes much worse when the extent of interventions keeps on increasing as the case is in India at present.

One of the reasons for such unabated interventions is that India shares about 16% of the global population but it has only 4% of the world's total water resource (GoI Planning Commission, 2001). The estimated rate of groundwater extraction in the 1990s, exceeding the replenishment rate has been calculated at 104 billion m^3yr^{-1} compared to 30 billion m^3yr^{-1} in China and 10 billion m^3yr^{-1} in northern Africa. Currently over 10% of blocks (administrative units below district) classified by the CGWB (Central Ground Water Board) have been identified as being over-exploited and blocks where exploitation is beyond the critical level have been increasing at a rate of 5.5% each year.

Watershed management has been advocated to alleviate the impacts of the overexploitation of the land and water resources. There is no doubt that the integrated watershed management philosophy offers a great deal in managing the land and water resources in a sustainable manner (Calder, 1998 and Gosain and Rao, 2004). However, it is a pity that invariably this

philosophy remains on paper and has not been implemented in practice.

LAND AND WATER ISSUES IN INDIA

Land and water are linked very closely. Whilst there is no national legislation for land policy, land is also regarded as a state subject. Formally, guidelines for planning and management of land resources should be discussed between the State Land Use Boards (SLUB), the National Land Use and Conservation Board (NLCB) and the National Wasteland and Development Board (NWDP). However, it is recognised that there is a pressing need to revitalize these organisations to serve their original purpose of promoting integrated land use planning (GOI Planning Commission, 2001). Land policy is also indirectly and subtly conveyed through other policies such as the National Water Policy 2002, Environment Policy and the Watershed Programmes. There are currently no national policies in place which broach water demand management through any of the institutions.

Watershed development in India has been managed by three central ministries: the Ministry of Agriculture (MoA), the Ministry of Rural Development (MoRD) and the Ministry of Environment and Forests (MoEF) (Panchayati Raj and Natural Resources Management, 2000). The Planning Commission of India, which is in charge of the development of Five-Year Plans for the effective and balanced utilisation of the country's resources, co-ordinates long-term policy development in this area. The Commission is separated into Divisions which establish sector-wise Working Groups to make recommendations on policy matters for the formulation of the Five-Year Plan. Watershed development is in the Agriculture Division. There is also a Water Resources Division and an Environment and Forestry Division.

Indian planning now has an emphasis on decentralised local planning. After the 1993 reform there are now District Panchayats, Block Panchayats and Village Panchayats below the State level. The most significant development is that the Panchayats have been assigned a wide range of functions with respect to the preparation of plans and implementation of schemes for economic development and social justice. Some of these functions include agriculture, land improvement and soil conservation, minor irrigation and water management, social forestry and farm forestry. The role of the Panchayats in watershed development has been enhanced with the recommendations of the Hariyalli Guidelines of the

watershed development (Guidelines for Hariyalli, 2003) and they have been recognized as the primary implementing agency of watershed planning and action. In principle there are committees such as the Watershed Committee, which are supposed to have technical members responsible for providing technical help in their domains. However, in actual practice such expertise is very rarely available in the rural areas, with the result that interventions are being made without any sound planning.

The Department of Science and Technology (DST) of the Ministry of Science and Technology and the Ministry of Information Technology provide science and technology inputs to the different ministries involved in land and water management. In particular, the Natural Resource Data Management Systems (NRDMS) programme of the DST is working to develop methodologies and technological tools to enable local bodies to prepare and implement plans. The outputs of this R&D programme should contribute to the capacity building of the national watershed management programmes and make a contribution in formulating national policy for watershed management (DST, 2002). However, this is a slow process and requires capacity building at the local and the next higher levels.

WATERSHED DEVELOPMENT PROGRAMMES

The MoA, MoRD and the MoEF, along with their respective line departments in the Indian states, are the three main government ministries in charge of watershed and development. Each programme focuses on different aspects and activities within the ministries' watershed development criteria.

The MoA has worked in watershed development since the 1960s and deals with issues including erosion prone agricultural lands, optimizing production in rain-fed areas and reclaiming degraded lands. The Department of Agriculture and Cooperation (DAC) and the Department of Agricultural Research and Education (DARE) of MoA are involved in all aspects of watershed development. They are supported by two autonomous bodies; the Indian Council for Agricultural Research (ICAR), and the National Institute for Agricultural Extension and Management (MANAGE). The MoA is currently implementing several schemes/programmes including the National Watershed Development Project for Rainfed Areas (NWDPPRA), Soil and Water Conservation in the Catchments of River Valley Projects (RVP) and Flood Prone Rivers (FRP), Reclamation of Alkali Soils,

Watershed Development Project in Shifting Cultivation Areas (WDPSCA) and Externally Aided Projects (EAPs).

The MoA puts 156 mha (about 49 per cent of the total geographical area) as the cultivated acreage. This is bifurcated into 53 mha irrigated, 90 mha rainfed and 14 mha of fallow area. The forest area is estimated to be 68 mha (22 per cent). A recent estimate further puts the degraded land at 174 mha (53 per cent) of the 329 mha of the geographical area. The majority of this area (107 mha) is degraded on account of water erosion, whereas the contribution of other factors to land degradation include: wind erosion 17.79 mha, degraded forests 19.49 mha, water logging 8.52 mha, shifting cultivation 4.91 mha, and salt affected areas 3.97 mha (Sharma, 2002).

The MoRD has been implementing watershed projects only since the late 1980s. It deals with non-forest wastelands and poverty alleviation programmes with important components of soil and water conservation. The key department in MoRD is the Department of Land Resources (in particular the Wastelands Development Division). However, there are two other departments, the Department of Drinking Water Supply and Department of Rural Development also involved in watershed development activities.

Two organisations support the MoRD: the National Institute of Rural Development (NIRD) and the Council for Advancement of People's Action and Rural Technology (CAPART). The former provides advice on policy matters about watersheds, through the Centre for Natural Resources Management (CRES), whilst CAPART deals with the voluntary sector. CAPART also had a division which sanctioned watershed projects to NGOs and voluntary organisations but there has been slight change in the policy recently. Programmes implemented by MoRD include the Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP), Integrated Wastelands Development Programme (IWDP), ongoing watershed projects under the Employment Assurance Scheme (EAS), Technology, Development, Extension and Training (TDET), Investment Promotional Scheme (IPS), Support to NGOs, the small Wastelands Development Task Force Scheme in MP and some Externally Aided Projects (EAPs).

The MoEF is the major ministry dealing with forest and wasteland issues. Since 1989, the ministry implemented the Integrated Afforestation and Eco-development Projects Scheme (IAEPS) with the intention of promoting afforestation and the development of degraded forests within a watershed approach.

Until 1995, watershed development projects were officially co-ordinated by multi-sectoral programmes (with differing objectives) launched by the GoI. After review in 1999 by the MoRD and the MoA a common set of operational guidelines, objectives, strategies and expenditure norms were established for watershed development programmes in 2001. These are implemented through programmes such as DPAP, DDP and IWDP (overseen by the Department of Land Resources). The guidelines encourage the active involvement of non-governmental organisations, semi-governmental institutions and private enterprises, universities and training institutions. Whilst these programmes have laudable objectives, there remains the concern that the emphasis of many watershed development programmes is still firmly based on the belief that water resources remain unexploited and are still available for development through both groundwater abstraction and through the use of water harvesting techniques (Gosain *et al.*, 2007).

The MoRD had revised these guidelines through an initiative called "Hariyalli" (MoRD, 2004), which literally means greenery, and had the following objectives for projects taken under the scheme:

- Harvesting every drop of rainwater for purposes of irrigation, plantations including horticulture and floriculture, pasture development, fisheries, etc. to create sustainable sources of income for the village community as well as for drinking water supplies
- Ensuring overall development of rural areas through the Gram Panchayats and creating regular sources of income for the Panchayats from rainwater harvesting and management
- Employment generation, poverty alleviation, community empowerment and development of human and other economic resources of the rural areas
- Mitigating the adverse effects of extreme climatic conditions such as drought and desertification on crops, human and livestock population for the overall improvement of rural areas
- Restoring ecological balance by harnessing, conserving and developing natural resources i.e. land, water, vegetative cover especially plantations
- Encouraging village community towards sustained community action for the operation and maintenance of assets created and further development of the potential of the natural resources in the watershed
- Promoting use of simple, easy and affordable technological solutions and institutional arrangements that make use of, and build upon, local technical knowledge and available materials.

All the objectives except the first one, where the intention is to harvest every drop of water, are very legitimate and can be pursued effectively provided an elaborate mechanism to implement such objectives is put in position. However, if one goes through the complete set of recommendations it may be realized that all the recommendations are mainly geared towards ensuring proper utilization of funds having fixed a rate of development *a priori* (Rs. 6,000 per hectare which I have learnt that has recently been enhanced). It may be debated that it was supposed to be a figure which can be taken as the maximum cap, but there will be hardly any project where less than this figure is disbursed. This is one single reason that most of the watershed projects have landed up with interventions that can consume maximum funds irrespective of the facts whether they are justified or not.

As far as the first objective is concerned, the intent to harvest every drop which falls over the area might be dangerous from an ecological and environmental angle. It has the capability of bringing about biophysical changes to the extent that the total character of the existing hydrological regime is changed. If implemented, there might not be any surface flow available any more to the downstream areas. It must be understood that every area has a prevalent water balance and any intervention caused is bound to change its water balance, the extent of which is dictated by many factors including the local biophysical characteristics and weather conditions. It is unfortunate that the emphasis in watershed development programmes is still firmly based on the belief that water is essentially an infinite resource and can be managed through the continual development of ground-water abstraction together with the implementation of water harvesting techniques (KAWAD, 2001).

The present implementation of the watershed management programmes in India including the 'Hariyalli' programme had many shortcomings. Some of the major ones include:

- Invariably ignoring the hydrological boundaries of the watersheds
- Ignoring the connectivity of the watersheds and treating each watershed as a stand alone unit, where activities within the watershed are considered independent of their impacts downstream
- Ignoring the hydrological characteristics of the watershed while deciding on the possible interventions
- Non-availability of the quantitative evaluation procedures, and
- Ignoring the environmental sustainability aspects.

Legislation promoting central and state adaptation of the programmes and the involvement of outside parties and autonomous agencies had led to a myriad of watershed development programmes and research initiatives at the state and district level. Looseness in departmental co-ordination was again reflected at the national level by the Working Group of the Planning Commission. The Group had recommended a 25 year Perspective Plan on sustainable rainfed agriculture through Watershed Development to treat/reclaim/cover 63.40 mha of land by the end of XIII Plan (Table 1) at a cost of Rs. 758,000 million (Sharma, 2002). The Perspective Plan presupposes that each of these ministries has a definite niche area based upon their role in past watershed programmes. The recommendation of a mechanism to avoid the overlap in the activities of the three major ministries MoRD, MoA and MoEF through compartmentalising functions has further increased the divisions within watershed management.

Table 1: The 25 year Perspective Plan for Sustainable Rainfed Agriculture through Watershed Development

Plan Period	Area Proposed for Treatment (million ha)	Per ha Cost (Rs.)	Total Cost of Treatment (million Rs.)
IX Plan (1997-2002)	10.00	5,000	50,000
X Plan (2002-2007)	12.00	7,500	90,000
XI Plan (2007-2012)	15.00	11,000	165,000
XII Plan (2012-2017)	15.00	15,000	225,000
XIII Plan (2017-2022)	11.40	20,000	228,000
Total	63.40		758,000

Source: Sharma (2002).

The difficulties in disseminating knowledge, experience, scientifically validated information and methodologies are made worse by the lack of any common framework between states and departments. This is accentuated further by the lack of any common set of agreed management strategies based upon validated scientific knowledge.

The MoEF is expected to take control of forested areas, whereas the MoRD is meant to keep control of the schemes such as DPAP, DDP, IWDP previously started by the ministry. Similarly, it is a Government of India recommendation that the MoA should concentrate on watersheds containing 'panchayats'

(village councils) through schemes like NWDPPRA. This approach of compartmentalizing the functioning of the different ministry players is the exact opposite to the integrated approach that the country claims to follow.

Recently, Government of India has come out with common guidelines for watershed development that shall be used for every watershed development project irrespective of the implementing department or the ministry (GoI, 2008). Some of the key features of this new unified approach are as follows:

- States have been delegated powers to sanction and oversee the implementation of watershed projects within their areas of jurisdiction and within the parameters set out in the guidelines.
- There would be dedicated implementing agencies with multi-disciplinary professional teams at the national, state and district level for managing the watershed programmes.
- The project duration has been enhanced in the range of 4 years to 7 years depending upon nature of activities spread over 3 distinct phases viz., preparatory phase, works phase and consolidation phase.
- Productivity enhancement and livelihoods shall be given priority along with conservation measures. Resource development and usage will be planned to promote farming and allied activities to promote local livelihoods while ensuring resource conservation and regeneration.
- The new approach envisages a broader vision of geo-hydrological units normally of average size of 1,000 to 5,000 hectares comprising of clusters of micro-watersheds. If resources and area exist additional watersheds in contiguous areas in clusters may be taken up.
- Special efforts need to be made to utilize the information technology and remote sensing inputs in planning, monitoring and evaluation of the programme.
- There would be a multi-tier ridge to valley sequenced approach, which should be adopted towards the implementation of the Watershed Development Projects.

Although through these guidelines some of the aspects those were altogether neglected may get some attention but the major concerns are still grossly neglected.

WHERE IS THE "INTEGRATION"?

Integrated watershed management does not merely imply the amalgamation of different activities to be

undertaken within a hydrological unit. It also requires the collation of relevant information so as to evaluate the cause and effect of all the proposed actions. The watershed is the smallest unit where the evaluation of man-induced impacts upon natural resources becomes possible with respect to the water balance approach. Therefore although the 'panchayat' remains the preferred implementation unit, the watershed should be the evaluation unit used in assessing impacts. The evaluation process does not need to be complicated, a simple audit can also suffice the requirement. Hopefully, the evaluation component of the recent common guidelines include evaluation of water resource implications and not merely fulfilling of financial targets.

As the impacts resulting from actions taken at the 'panchayat/watershed' level will be experienced at a higher level within the drainage basin, the assessment of these impacts will require the availability of a framework which enables the mapping of such units and their entities and the interconnections from the Panchayat level to the higher catchment level. In the hierarchy, river basin is at the highest level of drainage system to catchment at the intermediate level and the watershed at the lowest level. In view of the unabated interventions of various kind such framework will need regular updation to reflect fully the most recent baseline that should be used for planning and management of the natural resources by the relevant departments. This framework, once available, could be used by all the line departments and updated by the relevant departments which have designated areas of jurisdiction over the data entry. The format should be made consistent with local to state and national level structures as well as the corresponding watershed, catchment and basin level structures. Such a framework shall also be used to enumerate the freshwater ecosystem services each system is serving. Only with such an infrastructure made available we can say that we have moved towards the first step of integration.

MAJOR PROBLEMS OF WATERSHED DEVELOPMENT PROGRAMMES

In recent years, watershed development programmes promoting soil water conservation measures, forestry and irrigation have been termed successful in many semi-arid areas of India. Agricultural production has increased and the livelihoods of large numbers of people have been enhanced. However, this success may be short lived and inadequate (Gosain *et al.*, 2007) as has also been reported in the evaluation reports of the MoRD and MoA.

Within watershed development programmes the implementation of soil and water conservation measures, forestry and surface- and groundwater-based irrigation schemes have generally all been promoted to local communities and NGOs as “good things”. In the right circumstances, these interventions can indeed be hugely beneficial. The problems arise when these “good things” are implemented, in excess or in combination, such that the total evaporative loss from a catchment becomes close to the amount of rainfall input and the catchment approaches what is termed a “closed” or no-runoff condition.

The demand for ever-increasing water supply due to change in land use and bringing more areas under irrigation is also widening the gap between the rich and poor. As the demand for water rises, shallow wells are rapidly being replaced by deep boreholes that require machinery and funds to drill. Consequently, the poor are often thrust into a debt cycle where they have to borrow increasing amounts of money to extract reducing quantities of water. Stress caused by the inability to repay debts is a contributing factor to the presently very high rates of suicide amongst small farmers.

Furthermore, watershed development projects have often focused on (expensive) supply side measures directed at increasing storage, infiltration and recharge whilst doing little to manage demand. Current Government policies have actively encouraged the creation of these boreholes, often indirectly advantaging the wealthy whilst forcing others into increased poverty. Unfortunately, reduced water availability hits the most vulnerable and hence poorest communities and farmers first, often by robbing them of even the water they require to maintain livelihoods and their basic water needs. In many cases less vulnerable people have the resources to continue exploiting the diminishing water supplies, further contributing to inequitable distribution and use of resources.

A perverse and inequitable consequence of the excessive promotion of soil and water conservation measures within watershed projects is that the ownership of water may be effectively transferred from communal to private owners. Most of the soil and water conservation measures, including checkdams and other physical structures tend to reduce surface flows of water which might otherwise have flowed in to traditional village tanks for communal use. On the other hand, private landowners generally benefit from the structures and interventions on their land which increase recharge and the availability of the effectively “private” groundwater that they can access.

A “sanctioned discourse” is developing within government and donor circles which are leading to watershed activities being promoted as benign technologies that are at the very least “poverty neutral”. There is evidence to indicate that the “sanctioned discourse” is pursued even when circumstances change radically, as happens when a region moves from water surplus into water deficit. In water deficit conditions there is overwhelming evidence to show that many present water-related policies and practices are doing little to benefit the poor—and little to achieve the basic objectives of the programme.

The basic flaw in the watershed management programme is the fixation of the money on per unit area basis being made available to the PIAs (Project Implementation Agencies). So far these have been governmental and non-governmental organizations but under the new guidelines, Gram Panchayats have been recognized as the new implementing agencies. It may be said that this figure is only used as the upper cap but the truth is that very rarely any lesser amount has been asked for by the PIAs.

This amount on the per unit area basis which started with Rs. 4,000 per hectare and got revised to Rs. 6,000 per hectare and then to Rs. 7500 per hectare, can only be comfortably spent if construction of some structural interventions are part of the watershed development plan. Consequently with every watershed taken up the number of such structures that block the water keep on increasing in a drainage system.

The proponents of watershed management programmes (DLR, 2006) may feel that the budget made available for the programme is not sufficient, but in the event of the absence of a mechanism to find out the extent to which the watershed interventions in a drainage system should be allowed, it may be a blessing in disguise. The Parthasarthy Committee (DLR, 2006) made a case of increasing the per hectare expenditure limit to Rs. 12,000 despite the fact that the general findings have been that in its present form, the programme has not been successful especially for the poorest of the poor. It has been seen that some of the river systems of south India, such as the Krishna basin, have reached closure and one of the reasons is the over-implementation of the watershed programme.

Every two to three years, so-called improvements are being made in the guidelines by giving them a catchy new title, whilst ignoring all the other requirements such as providing transparency, enhancing accountability, bringing in scientific basis, making evaluation and tracking improvements to the livelihoods of the poor. Most of these aspects do not create

any interest in the promoters of these programmes and invariably they claim that we are already doing all this. In the new common guidelines (GoI, 2008), some of these aspects have been covered but many are still missing.

CROSS-CONNECTION OF WATERSHED DEVELOPMENT WITH OTHER PROGRAMMES

The major players that influence the policy which in turn influences the water ecosystems can be grouped into two categories with respect to the scale at which they operate. The main players from this angle are the ministries and organisations involved in planning, implementation and management of the big water-related projects. Most of these projects, be they a major irrigation project or a hydropower project, have been in the realm of the government or at the most public sector domain. It is only recently that the private sector started participating, once the government policies were changed to woo private participation. Let us take the case of hydropower projects in India. There are many big projects which are coming up with private investment. However, there is no clear policy on environmental flows. If, tomorrow, consideration of environmental flows is imposed on a project which had not considered them during the design phase, then the whole profitability of the project might change and it might be difficult for a private investor to absorb.

Furthermore, there are many policies that may influence the ecosystem services but are never addressed. The case of interlinking of rivers is another case where despite being a mega project—the size of which has never been implemented—has not been looked at from its impact on ecosystem services. There are numerous other cases where decisions have been taken independently by the respective ministry or organisation, without looking at the possible implications. Some of the examples are:

- The intent of the MoEF to cover 33 per cent of the country with forest cover
- The recent intent of the government to cover 40 million hectares of wasteland with *Jatropha* plants to produce bio-diesel
- To let the Special Economic Zones (SEZ) to come up on agricultural lands
- To let farmers extract any amount of groundwater free of cost with free electricity or subsidised diesel.

The other kind of players are those who work at the local scale for programmes that are again run by the central and state government departments but by

involving agencies that are either NGOs of Gram Panchayats. At this scale, there are more inherent problems than the earlier situation where one is concentrating on a single project. In this case, the programme is invariably widespread. However the policies are made with a view to have minimum variability, in order to get uniformity of implementation. Unfortunately, such a uniformity of implementation is detrimental for water resource related projects. Some of the past and present programmes that have faced difficulties are:

- The National Drinking Water Mission which has seen a very large number of hand pumps becoming defunct after installation
- Watershed management programme which has created problems for downstream people in many cases
- The rejuvenation of old tanks programme that has limited success due to over-doing the watershed development activities.

THE WAY FORWARD

The priorities of the country in the context of improving the use and sustainability of the freshwater ecosystems may be categorized under various related issues of improvement in policy, governance, and infrastructure. What has been observed in the past is that we have very good policies in position but when it comes to implementing the same policies, either the process is incomplete and faulty or the administrative and technical infrastructure is inadequate and/ or insufficient. Research is needed to address the loopholes identified in these issues so that it can supplement the intended purpose whether it is policy, governance or infrastructure.

Support for Policy Improvement

The policy, being an intent put together by domain experts and policy makers, is invariably a very good document that addresses all the concerns of a very wide cross-section of stakeholders. The same situation occurs with the National Water and Environment policies in India. These are very good documents in their own right. However, there are few issues that are either not adequately addressed or are altogether missing. Some of these issues are briefly discussed below and might need research outputs for further support in bringing home the point.

- The National Water Policy (NWP) does talk of a river basin approach to manage the water resources effectively. It somehow does not explicitly

emphasize that the same drainage area based approach should also be continued for the sub-areas of the basin, namely catchments and watersheds, that shall make it possible to address the equity and externality issues effectively.

- There is no provision in the NWP for a feedback mechanism on the implications of actions taken in the policy instruments of other sectors such as Environment, Forest, Agriculture, Watershed Development, Energy, etc. Slogans of the kind 'Stop the water where it drops' are made as part of some policies without even thinking about the repercussions. Intents of the kind 'forestry 33 per cent of the geographical area', and 'cultivating *Jatropha* on 40 million hectares of land' are made without bothering about the implications on ecosystems.
- The NWP does not even mention climate change impacts on water resources, in spite of the fact that it has been revised as late as 2002, when the general awareness of the issue was there and one of the ministries (namely MoEF) was already involved in making India's Initial Communication to the UNFCCC.
- The NWP does not attempt to tackle equity issues and other societal issues connected with water. It only stops at providing rehabilitation to those people uprooted by big projects but is not concerned when local level interventions (many times implemented by other ministries and departments) are made and are potentially capable of creating bigger impacts on the drainage basins.

On the contrary, the recently released National Environment Policy (NEP, 2006) provides ample emphasis and concern about water resources and the ecosystem services that freshwater ecosystems offer, as well as the implications of climate change on water resources and the possible adaptation measures required to be put in position. It is not true that our policy makers are not aware of these issues; it is more on account of lack of initiative and also many times due to the complexity of these issues.

Support for Governance

Solution to the problems and perverse outcomes identified above in relation to land and water policies and watershed development projects rests primarily in the realm of governance.

In this context, governance is considered to be the range of political, social, economic and administrative systems that are in place to develop and manage land

and water resources and the delivery of water services at different levels of society. The core challenge in Integrated Land and Water Resource Management (ILWRM) is that of land and water governance, particularly in relation to the deeper political and societal foundations on which day to day decisions and courses of action rest. Figure 1 illustrates that the administrative boundaries of governance systems do not match spatially with the physical boundaries of land and water systems, and should be taken into account within ILWRM (Calder *et al.*, 2004a). The macro-watershed is equivalent to the catchment defined earlier and one need to address the field and plot level as well if the objective is to address the livelihoods.

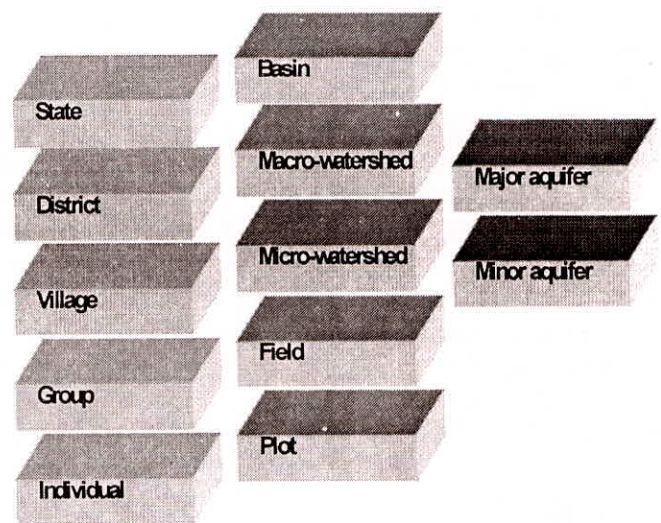


Fig. 1: Interaction between hydrological and administrative boundaries

It is also recognised that difficult ILWRM decisions will have to be made if both poverty reduction and environmental sustainability are to be addressed effectively.

Support for Infrastructure

Another segment that shall require maximum research initiative is to create infrastructure that shall be able to encapsulate the majority of issues described above and which shall act as a facilitator to provide a framework for integration, planning, monitoring and assessment. A typical framework, incorporating the Integrated Water Resources Management Cycle (Figure 2) shall include the following methodologies which can be operated in conjunction with support tools (Calder *et al.*, 2004b). Formulation, implementation and maintenance of such a framework are truly in the realm of research and must be taken up at the earliest.

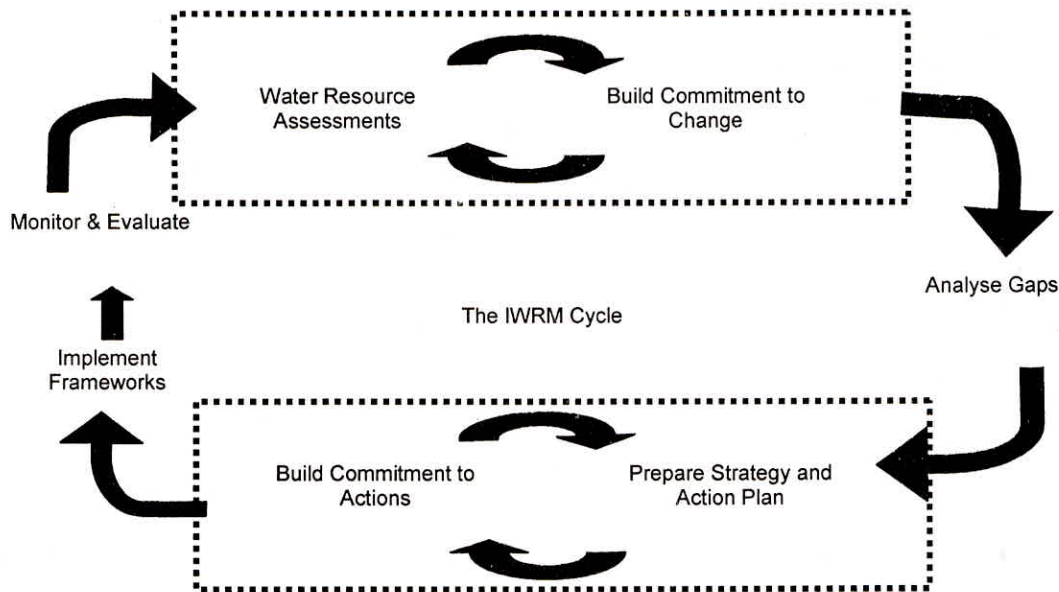


Fig. 2: The improved framework for IWRM cycle

Some of the components and functionalities of such a system are:

- Hydrological assessment of all water uses and users within a catchment
- Catchment Stress Assessment to determine to what extent the catchment is approaching 'closure', or not meeting aquatic ecosystem requirements
- Strategic Environmental Assessment to identify the economic returns and employment opportunities that arise or potentially could arise from water use in the catchment
- Negotiation support 'toolkit' becoming available to catchment water users
- Web and GIS based dissemination tools, incorporating Blue and Green water integrating methodologies
- An 'Allocation Equity Guide', providing guidelines to support stakeholder negotiations
- Environment impact assessment methodologies, primarily in relation to biodiversity and water quality
- Poverty reduction impact assessment methodologies, addressing the questions: who are the winners and losers of these policies? Will the outcomes of the policy instruments benefit key poor and vulnerable groups?
- Monitoring and evaluation. The impact assessment methodologies outlined above will also provide the basis for monitoring and evaluating the socio-economic, poverty and water resource outcomes of manmade interventions
- Such a framework should be able to effect convergence of scales to encompass the interventions being made at various levels. The effective adaptation measures to climate change impacts shall only be possible through reliable simulation of the future conditions which such a common framework offers.

CONCLUSIONS

The watershed development is a very powerful programme and needs to be planned, designed and implemented in scientific manner if we want the benefits to reach the society in a equitable and sustainable manner.

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