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WATER RESOURCE DEVELOPMENT IN THE DROUGHT-PRONE UPLANDS

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Improved agriculture in the Drought Prone Uplands (DPUs) depends critically on better water conservation and management. However, there is a high degree of uncertainty surrounding issues of water availability, allocation and local rights. Despite broad similarities in the goals of many programmes, there has been a lack of consistency and coherence among them. The focus of this paper is on the difficulties of developing a coherent analytical framework that would enable questions of technical and institutional choice to be addressed systematically. It is aimed primarily at development agencies interested in strengthening the effectiveness of programmes in DPU areas. Issues relating to the scaling up of appropriate approaches and technologies and the search for an effective research and development approach are also addressed.

Policy conclusions

- Competition for water is increasing in the DPUs owing to rising population densities, intensification of agriculture and upstream/downstream conflicts. The imbalance between supply and demand is accentuated by uncertainty over, on the one hand, the hydrological characteristics of watersheds and on the other, people s use of, and rights over, water at the local level.
- Development in the DPUs has been frustrated by policies which place the responsibility for agriculture with one government department and that for water with another.
- Choice of appropriate technology and institutions will vary substantially according to physical and socioeconomic characteristics; indigenous systems provide a useful framework for assessing the potential for improvement through water-based technologies.
- Support should be given to expanding a cadre of innovative water development technologists, with a commitment to building on the capabilities of local artisans, and to local joint action for water resource management.
- There is a need for more detailed analysis of project experience including reasons for adoption/non-adoption of practices and potential for scaling up approaches. This calls for specialised skill in process monitoring.

New perspectives for the drought-prone uplands

The Drought Prone Upland (DPU) environments with which this paper is concerned are mainly located in the upper catchments of river basins. The main focus is on undulating, hilly or plateau terrains. Annual rainfall regimes may vary widely (usually within the range of 400-1500mm) but either because of the total quantum of rainfall or its uneven distribution, the locations are subject to significant water scarcity and seasonal drought. Typically they are physically heterogeneous, socially and politically marginal with poor infrastructure and exhibit a wide range of land use and tenure arrangements. Improved agriculture and a sustainable resource base depend critically on better water conservation and management to reduce seasonal drought and erosion caused by excessive runoff. This paper focuses on the particular difficulties that many agencies have experienced in incorporating appropriate forms of water conservation and development within their programmes.

At the macro-level, even in regions where water resources are being heavily exploited, there is little reliable information about total water availability, how it is currently being used or how it might be managed differently. Within large catchments, rural DPU populations have little power to support lasting claims over water for future domestic or agricultural uses. Two conditions have to be met before upstream people can exert stronger bargaining power: increasing pressure on the total water resources of a river basin; and the emergence of political (often allied to financial) pressures for institutional reform. In many parts of the developing world (particularly in Asia) the first condition clearly applies, yet attempts to promote a national water policy on the basis of river basin planning continue to be effectively stalled by irrigation departments whose priorities lie in heavily subsidised construction-oriented surface water projects.

Until recently, DPU water resources were seen by planners as an exportable commodity for downstream use, especially for irrigation in the plains. Any agricultural programmes were characterised by enforced soil conservation. Only in the 1980s, when the attractions of large-scale irrigation investment dropped sharply and interest shifted towards more poverty-oriented programmes, did aid agencies and governments begin to allocate significant resources to agricultural development in DPUs.

Approaches to development in DPUs

Many now agree on the strategies appropriate for improving the livelihoods of poor upland farming communities. Analysis of selected project case studies across different agro-climatic contexts in India and Africa reveals co-existing (but rarely interacting) programmes under the auspices of four different agencies: rain-fed agricultural development often using a Farming Systems Research and Extension (FSRE) approach; forestry (social forestry on government owned land and farm forestry or agroforestry programmes on private land); Soil and Water Conservation (SWC); and small-scale irrigation.

Contrasting with these programmes are others that have been conceived within a watershed framework. The number of such programmes is increasing; the Government of India is investing over '150m/yr in the rehabilitation of >micro-watersheds, and under a SIDA-sponsored SWC programme participatory planning and management of micro-catchments is expanding in Kenya.

In the majority of cases the divergences between approaches have their origins as much in the conceptual and ideological differences among implementing agencies as in any significant differences in socio-economic and ecological contexts. A review of development experiences in DPU environments suggests that we are still a long way from having a coherent analytical framework that would enable questions of technical and institutional choice to be addressed systematically.

A planning framework

There is a substantial literature relating to technologies for water conservation and development. However, few of these discuss the relevance of such technologies in the wider physical, socioeconomic and institutional context of DPU environments. The recent interest in indigenous SWC is a case in point: analysis focuses on the interplay of physical, technical and social factors in determining appropriate forms of management, but the influence of higher level organisation and policy contexts tends to be neglected. Recent work (Tiffen et al., 1994) has indicated that we need not only a better classification of problems in DPUs, but also an understanding of the processes through which farmers and support staff can evolve workable solutions. Identification of the conditions inhibiting local response to continued degradation is crucial before decisions regarding investment or policy change are made. The analysis by Tiffen et al. (1994) of agricultural intensification processes in Machakos where farmers have terraced their farms and used techniques such as trash lines, stone checks and vegetative barriers suggest that the following factors encourage farmers to adopt SWC technologies: (i) the evolution of land tenure from communal to individual forms; (ii) the existence of a considerable body of both indigenous and exogenous knowledge; (iii) a tradition of community organisation; (iv) favourable access to markets; and (v) remittances from migrants which is invested in technologies.

Table 1 indicates provisionally the factors on which development potential in DPUs depends, and so allows the reasons for the failure of certain programmes addressing water development in DPU environments to be detected. Many of the areas in Africa chosen for past interventions were inherently unsuitable not only because of their low and uncertain rainfall conditions (which in other socio-economic contexts Israel, Australia have proved amenable to very successful water-based development) but also because the socio-economic characteristics of the intended beneficiaries in those areas have not favoured such interventions. Examples of failed projects throughout India and Africa exhibit many of the following weaknesses: low priority to sedentary agriculture because of dependence on migratory pastoralism; very low population density with consequent acute scarcity of labour and capital to construct and maintain structures; and poor market access. The central reason for failure has been a fundamental mismatch between local people s needs and capabilities and the types of intervention offered.

There are however some low-rainfall areas in Africa where people are primarily dependent on sedentary agriculture and where significantly higher population densities provide them with both the incentive and the means to intensify their production systems with the help of water-based technologies. In parts of sub-Sahelian West Africa, climatic change has forced traditional cultivators to adapt their farming systems to more water-scarce conditions. In several areas of Burkina Faso, a range of SWC technologies have been successfully developed often by evolution from indigenous practices. Similarly, almost all DPU areas in India have relatively high population densities and hence the need to undertake significant water conservation and development work. Many communities in these areas would also tend to score well in terms of capacity to undertake such work, having abundant labour, extensive indigenous experience and a fairly high propensity to cooperate when under pressure. The key question in those low rainfall areas is not whether there is potential for improving livelihoods through water-based interventions, but what type of interventions may be most appropriate.

Table 1. Framework for assessing potential for water-based development

Potential for development/factors	limited	to	high
Physical			
Rainfall	low	to	high
Groundwater	not available		available
Socioeconomic			
Indigenous SWC practices	none/few	to	well developed
Population density	low	to	high
Social structure/propensity to cooperate	unfavourable	to	favourable
Migration	heavy	to	light
Market access	poor	to	good
Political - institutional			
Prices/subsidies	unfavourable	to	favourable
Available investment	limited	to	substantial
Land/water rights	tightly controlled	to	open access
Support services	weak	to	strong

Technical and institutional options in different environments

There is a growing awareness of the wide range of indigenous technologies and management practices that are found in DPU environments (see Critchley et al., 1994, and Kerr and Sanghi, 1992 for overviews of Africa and India). Optimism over the existence of indigenous practices must however be tempered by the reality that in some areas, such as recently settled DPUs of India or marginal semi-arid areas of Kenya, there are few indigenous practices to build on. In other areas, factors such as migration, adoption of tractor or oxen cultivation, changes in community structures or decreased rainfall may result in the breakdown of indigenous systems.

In response to physical conditions (including rainfall, soils and topography) and socioeconomic conditions (including population density) water-based technologies extend across the whole spectrum of technical and institutional complexity. At the simpler end of the spectrum, they include in-situ land management practices on individual fields and within-farm bunding. Next come larger and more complex technologies such as continuous bunding, drainage systems and gully plugging that require joint decision-making in planning, investment and/or maintenance but do not create sufficient water storage or flow to require formal arrangements for inter-farm water distribution. At the more complex end of the spectrum come water harvesting structures, such as the rainfed non-system tanks or eris of South India and the ahar-pyne systems of southern Bihar and Uttar Pradesh. These technologies provide not only the starting point for improvements but also a basis for the development of a more general typology of technical options likely to be suitable in different environments.

The distribution of these indigenous technologies indicates that the choice of potential alternatives expands as water availability increases and suggests that it may be useful to adopt a farming systems approach to assessing the potential for water-based development (Table 2).

Table 2. Typology of farming systems

Farming system	Prominent features (all/some of which will be present)	Some implications for intervention
Low potential systems	Low rainfall (Low population densities Labour intensive farming system Few market opportunities Poor accessibility Livestock dominated farming system	Propensity for community action is low Development of low cost labour saving technologies Build on indigenous systems Consideration of alternative approaches such as water conservation for livestock production
Transitional systems	High/increasing population densities High levels of out migration History of indigenous technologies Declining rainfall from climatic change	Evolutionary approaches - development of indigenous technologies Innovative R&D needed such as use of local materials, training of village artisan
High potential systems	Higher rainfall areas (>1000mm/yr) Favourable ground water conditions High population densities Access to markets Good infrastructure	Potential for transformational approaches to water conservation and development
Dislocated systems	Newly settled areas Increased market integration Increased accessibility	Innovative R&D for both low and high put systems Improvement of communication networks, information transfer or education and training

Tensions between evolutionary and transformational approaches

In low potential systems, evolutionary approaches to DPU development (based on rainfed SWC technologies, participatory planning and the development of indigenous technologies) are gaining ground. But, no matter how strongly farmers have participated in its development, a technology yielding only 10-15% productivity improvement will be slow to spread. In some DPU areas there is also scope for more transformational approaches to development, especially in areas with good market opportunities and favourable groundwater conditions. The affordability of relatively high cost water is dependent on the farming system. The concept of an appropriate farming system and crop production technology are essential features of transformational approaches to water management. Exceptionally, where social and economic norms do not favour sustainable and equitable development, water development has the potential to become an instrument of social transformation, by bringing about the redistribution of water resources and opportunities for the poor. Many agencies reluctance to embark on more transformational ventures may be based on fears that its impact will necessarily be inequitable. However examples from India challenge this assumption and many transformationists are strongly committed to equitable access to water managed as a Common Property Resource (CPR).

Individual or community-based development?

The debate surrounding the choice of technology also centres on the optimum degree of intervention and degree of farmer cooperation. In their comprehensive review of indigenous SWC in semi-arid areas of India, Kerr and Sanghi (1992) conclude that SWC technologies should concentrate wherever possible on technologies that require minimal cooperation. This concern is mirrored in continued doubts over the appropriateness of watershed approaches which, although logical from a water resources viewpoint, place heavy demands on joint action. There are also concerns that water- shed development may bypass the needs of the poor; Indian experiences suggest that the landless, households in upper catchment areas, women and tribal groups often miss out.

Information on organising around water as a CPR remains scattered. However, the considerable insights from research into small-scale farmer managed irrigation schemes over the last decade are relevant to water-based development in DPUs, as are also historical examples of communal management of water resources in DPUs, such as the management of rainfed tanks in areas of Tamil Nadu, Karnataka and Andhra Pradesh.

Scaling up

The challenge facing water resource development mirrors that apparent in other areas of rural development the need to identify means by which the benefits to be gained from water-based technologies can be scaled up to reach large numbers of the DPU rural poor. The question as to how the approaches developed in pilot projects can be more widely replicated on a sustainable basis has yet to be clearly answered. For example, in India most of the innovative projects in DPUs have been managed on a pilot basis by NGOs, but these are recognised to take long periods of empowering, face-to-face interaction with local groups (Fernandez, 1993). In Burkina Faso where NGOs have achieved some success in the development of SWC, current estimates suggest that it will take 100 years to treat half the area of cultivated land. There are, however, reports that some of the techniques introduced have been taken up spontaneously by other farmers how this happens is critically important and needs further analysis.

Scaling up the benefits of water-based technologies presents unique challenges in comparison with other areas of agricultural development. For example, the benefits of a new crop variety may spread rapidly via farmer to farmer dissemination of seed. Water-based technologies however do not generally travel independently of key, well-informed individuals. Additional barriers to rapid spread include their labour-intensive character, their need for joint action and the fact that benefits are rarely observable in the short-term. If the benefits of water-based technologies are to be scaled up, then the preconditions for scaling up need to be identified, and matched with biophysical and socio-economic baseline conditions in the areas targeted for expansion. In some settings, these preconditions will include political support, the combining of participatory approaches to watershed planning with sound technical advice, and the provision of finance only for technically sound proposals (Farrington and Lobo, 1997).

Searching for an effective research and development approach

New approaches to water resource development can only be successful with the support of appropriate on-going research. There will be differences in the research approaches needed for larger group-managed technologies and those for smaller individual farm-level actions. Action oriented agencies (such as many NGOs) usually prefer to work on a community basis, drawing on participatory approaches to group formation and technology development. Many village-level initiatives currently promoted by NGOs have little or no research link and no independent monitoring as an input to the scaling-up process. On the other hand, research organisations are usually mandated to work at the individual farm level. Biophysical scientists often have limited experience in the dynamics of forming the type of user group that is essential for water-based activities. Collaboration between NGOs and scientists could be significantly advanced if they could agree on a common framework for experimental action. But ways have only recently been found for dovetailing the processes of participatory planning and management and those of water technology research and development (Box 1 and see Farrington and Lobo, 1997). The shortage of suitably trained staff, not only with the right technological background but also with the necessary social commitment to work with and learn from artisans and farmers is a major constraint and the provision of training in new methods and techniques including Participatory Technology Development (PTD), FSRE and community-based planning is a key requirement. With respect to research on technology development, needs cover the whole spectrum, from support for low cost water conservation, conveyance and application to more innovative, sometimes trans-formational research, for potentially high return runoff systems. A critical gap is knowledge of the suitability of technologies for the wide range of social and physical environments in DPUs, signalling the need for adaptive, demand driven, participatory and site specific research.

Key issues for potential donors

The review suggests that there are a number of key issues to be considered by those development agencies interested in strengthening the effectiveness of programmes in DPU areas:

- Agencies engaged in supporting programmes in DPUs should: (i) make a commitment to work there on a long- term basis; (ii) ensure that the impacts of its own programmes as well as those of other innovators in the same area are carefully documented and analysed; and (iii) ensure that the relevant government agencies or other intermediaries responsible for programme replication on a larger scale assimilate the lessons learnt and adapt their own approaches accordingly.
- Agreement should be sought with national or regional agencies responsible for water resources planning to assess current water availability and future demands, to permit more detailed water planning and allocation of water rights among local catchments and sub-catchments.
- In areas with potential for innovative water development, participatory research systems need to be established for field testing alternative technologies, associated cropping systems and institutions for equitable CPR management, with the help of experienced PTD practitioners.
- Support should be given to expanding a cadre of innovative water development technologists with a commitment to equitable development and to building on the capabilities of local artisans.
- In many African environments there is a need for applied research on low cost, labour-saving technologies.
- Guidelines are needed for practitioners working in rainfed environments that would improve their capacity to build up a locally appropriate basket of alternative technologies for farmers to choose from.
- The preconditions for scaling up watershed and water- based programmes in DPUs need to be identified,and candidate areas for scaling up screened against these.

Box 1. CASAD the search for an effective research and development approach

Examples of innovative approaches to water conservation and development are noticeably lacking. One exception to this is the Centre for Applied Systems Analysis in Development (CASAD), an NGO based in Bombay and Pune in Maharashtra. Within it is a small group of engineers who have been working, since 1982, on designing and field testing new technologies for water conveyance storage and application in a range of DPU environments. Motivated by a commitment to improving the livelihoods of the rural poor. CASAD s primary aim has been to develop technologies that are low-cost, use local materials where possible and are capable of being constructed by local people. An important aim has been to find ways of ensuring that the scarce water made available through those technologies is shared as widely and as equitably as possible. Innovative technologies which have been successfully tested in the field, include earth and masonry dams, timber crib dams, lined tanks and ponds for storage and low cost pipes and hoses for water conveyance (Gore, 1992). CASAD reports that its approaches have encountered resistance from government officials who are linked to a market system dominated by large companies dealing with synthetics. It has therefore looked to action-orientated NGOs, but they have shown limited enthusiasm preferring to restrict themselves to rainfed techniques and have tended to reject the limited water application approach .

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