# Watershed Development for Sustainable Agriculture: Need for an Institutional Approach

**Article** *in* Economic and political weekly · September 2000



**1 author:**

V. Ratna Reddy
Livelihoods and Natural Resource Management Institute (LNRMI)
**241** PUBLICATIONS **1,731** CITATIONS

# Sustainable Watershed Management

## Institutional Approach

*Irrigated agriculture in India has probably reached its limit and further sustainable increases in food production must come from dryland farming, especially watershed development and management. This calls for an analysis of situations under which watershed technology becomes economically viable, socially acceptable and ecologically sustainable. This paper attempts to lay the theoretical ground for a detailed and rigorous empirical work through collective action theories.*

**V Ratna Reddy**

Efficient and sustainable use of natural resources is necessary for economic development, especially in resource poor countries. More so in the agriculture dominated economies like India where two-thirds of the cropped area is dependent on rainfall without any protective irrigation facilities. These regions have long been the victims of neglect on the policy front. This neglect is mainly due to the concentration of public resources in the well-endowed regions for meeting the country's food requirements through irrigation development and green revolution technologies, which are complementary. But it has been realised of late that the optimum productivity levels in these (well-endowed) regions are being reached and their potential in meeting future demand is limited. Moreover, further increases in area under irrigation are not only limited but also expensive.

While the policy bias, resulting in intensive agricultural practices, has paid off in terms of meeting the country's food demands in the short run, it proved to be unsustainable, economically as well as environmentally, in the long run. This coupled with the limited scope for expanding irrigation (through traditional methods of damming the rivers) has prompted the policy shift towards dryland agriculture. Though recent policies failed to address the problems of irrigated agriculture through improving the allocative efficiency of crucial inputs like water, concerted efforts are being made towards improving the conditions of the dry farming. Development of these regions, in terms of enhancing the crop yields, holds the key to future food security. Besides, these regions are increasingly being confronted with environmental problems such as soil erosion. In fact, it is feared that the intensity of resource degradation is reaching irreversible levels in some of the regions. Promotion of appropriate technologies and development strategies in these regions would result in multiple benefits: (i) ensuring food security; (ii) enhancing the viability of farming; and (iii) restoring ecological balance.

Adoption of dry farming techniques dates back to the early decades of the 20th century. These were known as soil conservation methods used for controlling soil erosion in drought prone regions. These methods were adopted on a scattered basis and as relief measures [Shah 1998]. This piece meal approach continued till 1980s when the integrated watershed development programme was adopted and launched. In 1986, National Watershed Development Programme was launched for rainfed areas in 16 states. The programme was modified in the light of the suggestions made by the committee of secretaries constituted to review the programme. Thus, in the year 1991 revised guidelines were issued under the name of WARASA. For the first time the programme gave importance to planning for the watershed, and under primary activities preparation of a complete plan of the watershed was included. Secondly, the programme was made more people oriented and participation of beneficiaries was encouraged through 'Mitra Kisan' and 'Gopal'. Thirdly, the technical bias of the programme was reduced and the programme was directed more towards providing economic benefits. Lastly, the coverage was increased and inherent monitoring and evaluation component was included.

Given the magnitude and spread of the watershed development programmes, a number of research studies were undertaken to examine the ecological and economic impact of these programmes across the country. An overwhelming majority of the studies have endorsed the programme in terms of costs and benefits (Table). Some of them also highlighted the less quantifiable ecological benefits [Singh 1994; Deshpande and Reddy 1991; Chopra et al 1989; Deshpande and Rajasekhar 1995]. These studies not only vindicated the economic viability of the programme but also underlined the fact that it is the only alternative to the development of rainfed agriculture in India. In fact, some of the studies even proved that watershed development programmes score over existing intervention programmes like Integrated Rural Development Programme (IRDP), Jawahar Rojgar Yojana (JRY), National Rural Employment Programme (NREP) in terms of employment generation and natural capital regeneration in moderately degraded regions [Chopra and Kadekodi 1993]. In fact, it was suggested that JRY should adopt watershed development programmes instead of taking up purely employment generating programmes [Bhatnagar 1996]. Moreover, the desirability of watershed development progrmmes lies in providing long run ecological sustainability.

Although the economics of watershed technology is unambiguously in its favour, the magnitude of its impact differs across regions and locations. Watershed technology is observed to be more effective in scarcity regions when compared to assured rainfall regions [Deshpande and Reddy 1991]. On the other hand, adoption of the technology itself might be a difficult proposition in extreme scarcity conditions. For, poor households living on the margin cannot afford to follow conservation practices such as to stop grazing their animals [Singh 1991]. This is mainly due to the

long time-lag of benefits from the technology. Further, the favourable picture depicted by most of the studies is due to selection bias (i e, purposively selecting a successful watershed programme for evaluation). On the contrary, the overall picture is not all that rosy, as the success rate in some of the states is as low as 25 per cent. A study of these differences brings out the interesting aspect that watershed management ought to be differentiated from watershed development.[1]

While watershed development is associated more with technology, watershed management is more of a philosophy. While the success of watershed development as a technology is well established, the philosophy of watershed management is proving to be the main bottleneck for the widespread success of the programme. Watersheds have been studied from various perspectives such as economic efficiency of water use and investments, flood run-off, soil erosion, sedimentation, ground-water recharge, socio-political dimensions [Dixon 1992]. Understanding the interactions between land, water and people is equally important in studying watersheds. Therefore, watershed management is more than just the cost-benefit analysis of investments. The main distinction between watershed development and other traditional developmental programmes is that the former is essentially a community-based one. Given the nature of the technology, watershed development requires large areas cutting across households and even entire villages for its adoption. Hence, its adoption and success critically hinge upon inter as well as intra village cooperation. In other words, collective participation and action is a critical ingredient for watershed management. This throws up a wide range of issues, such as social organisation and property rights that need a careful scrutiny in order to sustain the programme. The problem of property rights arises when dealing with the treatment of common lands. Another distinctive feature of watershed technology is its relatively long gestation period. Farmers have to wait for 5-7 years to reap the benefits. This aspect further makes watershed management difficult.

The complex nature of watershed development and management calls for a comprehensive understanding of the situations under which watershed technology becomes economically viable, socially acceptable and ecologically sustainable in the long run. Hitherto the literature on watershed management has concentrated more on the techno-economic aspects of the programme. Though almost all the studies make a cursory statement at the end that "peoples' participation is a must to sustainable watershed development/management" few have attempted to analyse and understand the process of collective action, either theoretically or empirically. As a result, 'peoples participation in watershed management' has remained cursory even in policy formulations and the consequent low adoption (success) rates.

This paper makes an attempt to understand the various facets of collective action (CA) based on existing literature. The idea here is to lay the theoretical ground for a detailed and rigorous empirical work through collective action theories and their adaptability in the context of watershed management. This would facilitate identifying appropriate strategies for sustainable watershed management. The broad objectives of the present paper are to examine the issues involved in different aspects of watershed development and management, and identify the important strategies that need further attention. The important issues in this regard include:

– Economic and ecological viability of watershed technology;
– Theoretical framework for collective action in watershed management; and
– Strategies for sustainable watershed management.

This paper is organised in the following manner. A review of studies pertaining to economic and ecological impact of watershed technology is presented in the following section. Section II presents a critical review of the collective action literature with regard to natural resource management in general and watershed management in particular. Based on the preceding two sections, Section III pulls together appropriate strategies for watershed management. Finally, the proposed empirical study is introduced along with its objectives and methodology in the last section.

## I
## Review of Studies of Impact

As mentioned earlier, numerous studies have shown the positive impact of watershed development programmes on crop yields, cropping intensity and cropping pattern changes. Review of existing studies in this regard indicates the variations in the magnitude of the impact across regions and crops (Table). The magnitude of the impact is also dependent on the nature of the components adopted.[2] All the studies, however, have shown that net incomes have gone up substantially and have favourable benefit-cost ratios. Recent years have revealed stabilisation of B-C ratios at around 1.75.

Impact assessment of watershed technology can best be accomplished by incorporating all the components. The study of Sukhmajiri watershed [Joshi and Seckler 1981; Chopra, et al 1989] showed exemplary results of the integrated programme. The incremental benefits ranged from Rs 1,800 to Rs 2,000 per hectare. In a similar experiment, watershed projects in Hyderabad, Solapur and Akola districts [Sarin and Rayan 1983] recorded stabilisation of cash flow and substantial increase in productivity, incremental income and employment. Walker et al (1990) reviewed the overall impact of the application of watershed based technologies at different locations in Maharashtra, Madhya Pradesh and Karnataka. Their results indicated incremental net income ranging between 49 and 203 per cent of the base level. The B-C ratio worked out in the range of 1.08 to 3.81 across the locations.

In an analysis of the state level Comprehensive Watershed Development Programme (COWDEP) of Maharashtra [Deshpande and Reddy 1991], significant changes in the household economy were noted. The study covered 30 blocks in the state and indicated concentration of certain specific components and overall good results of the technology. It was noted that employment generated in each of the watersheds ranged between two and 30,000 mandays depending on the agroclimatic zone. The crop pattern, crop intensity, proportion of wasteland and yield per hectare changed substantially. Moisture availability has increased in the watershed regions. The study also made a comparative analysis of the cases of active beneficiary participation as against passive participation. It was noted that participatory process acts as a powerful catalyst for the programme, a result supported by Chandrakant et al (1989); Singh (1991) and Chopra et al (1989).

In another detailed study of Maharashtra [Deshpande and Reddy 1991a] covering three agroclimatic zones (scarcity, moderate rainfall and assured rainfall regions) watershed technology revealed differential impact. In the scarcity region water-

**Table: Economic Impact of Watershed Technology – Review of Studies**

| Study/Year | Region | Activity | Crops | Impact | | |
|---|---|---|---|---|---|---|
| | | | | Yield (Per Cent) | Net Income (Per Cent) | B-C Ratio |
| (1) Ram Mohan Rao et al (1967) | Maharashtra | Contour bunding | Jowar (R) | +25 | – | – |
| | | | Bajra | +25 | – | – |
| | Tamil Nadu | | Jowar (R) | +36 | – | – |
| | | | Bajra | +25 | – | – |
| (2) Lal Gupta et al (1970) | Varanasi (UP) | Soil conservation | All crops | +112 | 215 | 4.6 |
| (3) Joshi and Seckler (1981) | Chandigarh | Rain water harvesting | All crops | – | Rs 1,812/ha | – |
| (4) Sarin and Ryan (1983) | Andhra Pradesh | Integrated watershed | All crops | – | +4 –300 | – |
| | Solapur (Maharashtra) | -do- | Sorghum | – | +517 | – |
| | | | Castor | – | +600 | – |
| | | | Sorghum | +300 | – | – |
| (5) Walker et al (1981) | Mahaboob Nagar (AP) | -do- | All crops | +203 | – | 1.37 |
| | Medak (AP) | -do- | All crops | +130% | – | 3.81 |
| | Medak (AP) | -do- | All crops | +52% | – | 3.02 |
| | Akola (Maharashtra) | -do- | All crops | +28% | – | 1.08 |
| | Gulbarga (Karnataka) | -do- | All crops | +52% | – | 1.03 |
| (6) Ghodke (1981) | Tadapally (AP) | -do- | All crops | – | +71 | – |
| | | -do- | Sorghum | – | –45 | – |
| | | | Pulses | – | +1000 | – |
| | | | Pigeon Pea | – | +960 | – |
| | | | Fodder | – | +230 | – |
| (7) Gupta and Mohan (1982) | Rajasthan | Tree plantation | Trees | – | Rs 1,640/ha | – |
| (8) Tejwani and Babu(1982) | Farm Pond | Farm pond | Jowar | – | – | – |
| (9) Reddy and Kanwar (1985) | Andhra Pradesh | Agroforestry | | – | – | 1.45 |
| | | Silvi-agri | | – | – | 1.30 |
| | | Silvi-pastoral | | – | – | 2.25 |
| (10) Agnihotri (1985) | Shivalik Hills | Vegetative cover | All crops | 64 q/ha to 85q/ha | – | – |
| (11) Government of Punjab (1986) | Punjab | Soil conservation | All crops | – | +84# | – |
| | | | Maize | –13 | – | – |
| | | | Paddy | –30 | – | – |
| | | | Wheat | +16 | – | – |
| | | | Potato | +4 | – | – |
| (12) Itnal and Narayan (1987) | Bijapur (Karnataka) | Farm pond | Jowar | – | +Rs1,300/ha | 0.95 |
| | | | Sunflower | | +Rs1,800/ha | 1.11 |
| (13) Pant (1989) | Madhya Pradesh | Integrated watershed | Sorghum | +127 | – | – |
| | | | Wheat | +111 | – | – |
| (14) Deshpande and Reddy (1990) | Maharashtra | Integrated watershed | Paddy | +18 | – | – |
| | | | Ragi | +34 | – | – |
| | | | Pulses | +7 | – | – |
| | | | Bajra | +46 | – | – |
| | | | Wheat | +11 | – | – |
| | | | Jower | –2 | – | – |
| | | | Sunflower | +64 | – | – |
| (15) Rao (1990) | Andhra Pradesh | Integrated watershed | Paddy (K) | +54 | +13# | – |
| | | | Paddy (R) | 135 | – | |
| | | | Sorghum | +17 | – | – |
| | | | Pigeon pea | +7 | – | – |
| | | | Castor | +6 | – | – |
| (16) Singh (1991) | Karnataka | Integrated watershed | All crops | – | Rs 1970/ha | – |
| (17) Singh et al (1991) | Punjab | Integrated watershed | Forestry | – | – | 2.74 |
| | | | Animal husbandry | – | – | 1.14 |
| | | | Soil conservation | – | gross margin 0.90 | |
| | | | Horticulture | – | Rs 825-2,780 | 7.05 |
| | | | All components | – | – | 0.95 |
| (18) Mahnot et al (1992) | Rajasthan | Integrated watershed | Maize | +21 | – | 1.03 |
| | | | Wheat | +20 | – | – |
| | | | Oilseeds | +52 | – | 8.37 |
| (19) Singh et al (1993) | Kandi (Punjab) | Integrated watershed | Maize | +5-14 q/ha | – | 1.72 |
| | | | Paddy | +5-13 q/ha | – | (avg) |
| | | | Blackgram | +4-6 q/ha | – | |
| | | | Wheat | +8-22 q/ha | – | |
| | | | Gram | +4-9 q/ha | – | |
| | | | Mustard | 0-8 q/ha | – | |
| (20) Singh et al (1995) | Udaipur (Rahasthan) | Integrated watershed | Maize | +2 q/ha | +Rs 1,100 | – |
| | | | Paddy | +2 q/ha | per year | 1.76 |
| | | | Jowar | +2 q/ha | | (avg) |
| | | | Blackgram | +4 q/ha | | |
| | | | Wheat | +2 q/ha | | |
| (21) Nalatawadmath et al (1997) | Bellary (Karnataka) | Integrated watershed | Bajra | +16 q/ha | +50 | 1.75 |
| | | | Jowar | +13 q/ha | | (avg) |
| | | | Sun flower | +22 q/ha | | |
| (22) Joshi and Bantilan (1997) | ICRISAT Asian Centre | Integrated watershed | Chickpea | – | +40 | – |

*Notes*: Till the year 1991 studies are taken from Deshpande and Reddy (1991).
# Gross income.

shed technology has led to intensification of agriculture, higher diversification, risk spreading and increased stability in yield levels. It was noted that small and marginal farmers of the project area gained on income fronts compared to their peers from the non-project areas. Moderate rainfall zone also showed similar results. Except in the case of jowar and paddy, the watershed region has a distinct edge over the control region although the latter had a slightly higher area under irrigation. Beneficiary group also showed higher net incomes. However, the level of income inequality was higher in the programme area while the reverse is true in the case of scarcity zone. Assured rainfall zone also showed lower inequalities in the watershed region. This region is characterised by intensive agricultural practices and remunerative crops. Farmer's response in this region indicated increased yield rates with greater stabilisation, increased income, higher wages and employment.

Thus, hitherto the literature on watershed programmes is overloaded with evaluation of economic and ecological benefits. Though every study felt that collective action and people's participation is a must for sustainable watershed management, it remained as a cursory note at the end of each study. This is mainly due to the fact that for quite a long time the theoretical frame for collective action was stuck at the famous 'group size syndrome' [Olson 1965]. Olsan's seminal work has too narrow a framework to explain the present day collective action (CA) situations. Nevertheless, group size is among the most important factors explaining CA. A few studies based on Olson's framework tried to explain people's participation in watershed management in India [Singh 1991; Deshpande and Reddy 1991]. Of late there has been renewed interest in CA and a number of studies have expanded on Olson's initial work in order to explain CA situations the world over. In the following section a systematic review of these studies has been done with a view to provide a theoretical framework in the context of watershed management in India.

## II
## Collective Action Theories

Participatory management or collective action (CA) being the critical ingredient for sustainable watershed management [GoI 1994], it is pertinent to understand the theoretical aspects of CA. While the importance of CA in watershed management is recognised, how to evolve and promote CA remains largely ambiguous. It is in this direction that the present section focuses on the theoretical debate pertaining to CA (institutional arragements). Theoretically, different approaches are used to explain various institutional (CA) arrangements existing in rural areas for managing common pool resources (CPRs). Watershed is a common pool resource in many ways though a larger part of area covered under the watershed is private property.[3] These approaches include: property rights approach, game theoretic approach, transaction costs and limited information approaches of new institutional economics, and institutional analysis and development. In what follows we critically examine these approaches with reference to watershed management in India.

(1) *Property rights approach*: Basically, property rights are formal institutions which can be polarised as individual or private property rights and common property rights, though there could be a number of intermediate forms [Larson and Bromley 1990]. An efficient system of property rights should have three features: (i) universality, (ii) exclusivity and (iii) transferability [Posner 1977 as quoted in Bromley 1989a].[4] According to the property rights school private property is the only solution to the problem of resource degradation. In the absence of the transferability axiom in other forms of property rights institutions, externalities due to free rider problems cannot be avoided and hence the widespread degradation. It is also argued that even when common property rights satisfy the composition (exclusivity) axiom, groups are not capable of managing the resources in a socially preferred manner due to the defused authority. On the other hand, individuals with unique and absolute authority are assumed to act in a socially preferred manner in deriving the present stream of benefits. Therefore, individuals rather than community would be in a better position to allocate the resources more efficiently and maximise the societal returns. Though it sounds logical that clearly specified property rights lead to better and efficient allocation of resources, individual property rights approach has important drawbacks of conceptual and theoretical nature and, more importantly, fails in explaining empirical situations. Property rights approach is linear and single-minded as it explains efficiencies/inefficiencies in a narrow way.

At the conceptual level the property rights approach confuses between common property and open access resources and treats them as the same [Runge 1981; Bromley 1989 and 1989a; Larson and Bromley 1990]. Open access resources are nobodies' property and are bound to be overexploited and degraded. Compared to open access situations (where no property rights are assigned to anybody) any property regime (however poorly defined) would be a better institutional arrangement. As aptly pointed out by Bromley (1989a) "By positing a false polarity between the free-for-all of open access and the presumed wisdom of private property, Demsetz and others distort institutional arrangements and, more importantly, elevate one particular institutional structure (complete private property) as the only institutional form" (p 15). An objective evaluation of private property rights can only be made when private and common property situations are compared. When compared, analysis does not support the superiority of private property rights, ever if it does not support the superiority of common property.

If private property rights result in socially desirable and efficient outcomes there is no reason why there exist degraded and waterlogged private croplands. In fact private lands are used more intensively compared to common lands due to the constraints imposed by existing institutional structures on the later. This is more so in endowed regions (say irrigated) compared to fragile regions. Even the conditions of drought and famine did not lead to the tragedy of the commons in Dafur region, Sudan, due to the existing social institutions such as land tenure [Morton 1996]. Beaumont and Walker (1996) found in their study of Brazil that private property regimes do not result in best environmental outcomes in all circumstances which may be due to the access to other complementary inputs like technology and non-farm employment opportunities. In a study of western India, it was observed that the advent of irrigation led not only to intensive use (resulting in degradation) of private croplands but also to the neglect of common lands [Reddy et al 1997]. In the context of sub-Saharan Africa, it was shown that indigenous tenure systems might be more efficient than private rights [Sjaastad and Bromley 1997].

Watershed development programmes in India is a classic example of the failure of private property rights approach. For,

clearly defined property rights hinder the adoption of a common area based technology. A number of studies have shown that watersheds with common property regimes have fared better in terms of economic benefits as well as sustainability. In a number of states the success rate of government promoted watershed programmes is less than 25 per cent. This is mainly due to the fact that watershed development programmes are promoted as individual based technology rather than treating it as a common good. The noted success cases are those where appropriate institutional arrangements are in place, either due to local efforts, NGO efforts or government efforts. The low success rate in general at the all India level has prompted the government to appoint a committee to suggest guidelines for sustainable watershed management. The report by the expert committee clearly brings out the importance of CA in watershed management [GoI 1994]. But the crux of the problem is how to bring about CA. Even the common areas covered under watershed regions can be managed sustainably only with the help of appropriate institutional arrangements.

Despite these valid criticisms, private property rights solution continues to have significant influence on policy-makers. The general picture regarding the status of common pool resources reflects a tragedy of commons situation. The various forms of local institutions hitherto existing seem to be breaking down under the pressures of population, market development and political reforms. "As the advent of participatory politics and social upheavals erodes the legitimacy of these traditional authorities, and as modernisation improves the options of both 'exit' and 'voice' for the common people, these solidaristic ties loosen and the old cooperative institutions sometimes crumble" [Bardhan 1995a:179]. But at the same time there are instances where local institutions, old and new, are found to be functioning efficiently in a sustainable fashion [see for reviews Ostrom 1990 and 1992; Ostrom et al 1994; Tang 1992; and also Wade 1988; Deshpande and Reddy 1991]. What could be the explanation for these contrasting developmental scenarios? Can these divergences be explained in a logical fashion (a theoretical frame) by the existing approaches? Let us examine how institutional arrangements involving collective action evolve and sustain.

(2) *Game theory and institutions*: Two influential writings in 1960s, namely, *The logic of Collective Action* [Olson 1965] and *The Tragedy of the Commons* [Hardin 1968] have led to formalisation of commons problems as a prisoner's dilemma game. This is conceptualised as a non-cooperative game between two prisoners [for details Ostrom 1990:3). In a general context with more than two players it is also known as the isolation paradox. The basic assumptions of this formulation are: (a) players possess complete information; and (b) communication among the players is forbidden. The prisoner's dilemma game is formulated in such a way that the dominant strategy of each player is always not to cooperate with the other prisoner (confess as in Figure 1) which results in an inferior joint outcome (getting eight years of imprisonment against one year each if they do not confess). This analogy is made with common pool resources where each herder has an incentive to increase his herd size (on a common grazing land with an upper limit of carrying capacity). When everybody follows the same strategy, the outcome will be that after a certain point (herd's size) the returns or profits to each herder tend to zero.

The prisoners' dilemma model does not reflect the reality as it treats all individuals in a community as prisoners. Rural communities or users of natural resources represent no prisoners and no dilemmas. We believe that strong ethical norms exist even in communities of thugs.[5] In fact, these attributes result in higher order combined welfare which Sen (1982) refers to as the extreme case of prisoners' dilemma game where neither will confess (cooperate). According to Sen "The result of each trying to maximise the welfare of other will, therefore, lead to a better situation for each in terms of his own welfare as well" (p 66). Even in situations where community cohesion and collective action are lacking individuals are very much aware of others' behavioural patterns. In small communities each individual has a clear prognosis of every other person and obviously there are no barriers to communication. In such circumstances it would be naive to think that users of natural resources are not well equipped and not capable of changing their constraints. Therefore, it is necessary to avoid taking extreme stands such as that all individuals are self-centred or all individuals are selfless [Sen 1995].

At this juncture, we are confronted with two basic questions. Under what conditions to users of natural resources indulge in playing games or using strategies? What kind of games do the users of natural resources, especially in rural communities, play? Organisation of rural communities is centred around group dynamics though certain individuals (leaders) play key roles.[6] CPR dilemmas arise or users/appropriators indulge in games when there is no coordination among the groups with common interests in the commons. Group coordination is required to create institutions. Due to the absence of common interests in the CPRs (mainly due to economic reasons, i e, economic benefits from CPR would be relatively low compared to other sources such as crop production) or due to high transaction costs involved in coordination and conflict resolution or negotiations reach a deadlock (mainly due to political reasons) either appropriate institutions fail to emerge or existing ones disintegrate. This results in open access situations leading to the tragedy of commons. Therefore, individuals in a rural community have open access and with some institutional arrangements. In the event of open access, there would be no appropriation dilemmas. The dominant strategy would be trigger strategy. Trigger strategies are a common phenomenon in the context of encroachment of CPR lands and groundwater exploitation which are typical problems associated with watershed development.

Thus, game theory helps, explaining individual or group behaviour when faced with different CPR situations. However, game theory does not provide any clues associated with first order CPR dilemmas, i e, evolving institutional arrangements, though the assurance game helps in solving the coordination problems.

Divergent views are held as regards how institutions are formed and how institutional change takes place. These include transaction costs and limited information schools, induced or supply-demand or market models of institutional change and institutional analysis and development approach. Here our aim is to examine how far these theories can explain the problems related to CPRs in transitional economies.

**Figure 1: Prisoner's Dilemma Game**

| | | Prisoner 2 | |
|---|---|---|---|
| | | Not confess | Confess |
| Prisoner 1 | Not confess | 1, 1 | 10, 0.3 |
| | Confess | 0.3, 10 | 8, 8 |

(3) *Transaction costs and imperfect information*[7]: These approaches are closely related, as information costs are part of transaction costs. Institutions, therefore, evolve in response to the existing transaction costs. Individuals or groups innovate institutions in order to reduce the transaction costs [North 1990]. In other words, institutions evolve or change when expected benefits from such changes are greater than the costs involved in undertaking such activities. Changes in relative prices, which affect transaction costs, are the main force behind institutional change. Similarly, efficient institutions replace old and inefficient ones if the net gains are positive. In the context of CPRs, collective action outcomes would be preferred when the expected returns are larger than the costs of coordinating collective action. It is not necessary that all existing institutions are efficient. There exist economically unprofitable and socially unpleasant institutions due to the fear of adverse repercussions of disobedience on the part of individuals [Akerlof 1984 as quoted in Bardhan 1989].

Imperfect information could block an appropriate institutional arrangement or could lead to degeneration of an appropriate institutional arrangement. It is not always a question of how costly the information is. Institutions could be evolved or adapted when information and market imperfections are removed, provided such innovations are individual based like high yield variety (HYV) technology or share cropping. But, if such innovations are community based and require collective action like watershed technology, their adoption requires more than removing the information or market imperfections. This could be in the form of internal leadership or external support from policy (administration) or non-governmental organisations (NGOs).[8] The process is further complicated in the case of watershed programmes where expected benefits are not known.

Therefore, information is a necessary but not a sufficient condition to explain institutional change in the context of watershed management where collective action is a prerequisite for institutional arrangements. The costs of obtaining such information are not large compared to collective economic benefits, let alone social benefits. However, other transaction costs such as coordination of the group may be high in a given socio-political environment. These costs, when high, act as disincentive for individual initiatives from within the group and require external forces.[9]

Though transaction costs' approach seems to be useful in understanding the problems associated with CPRs,[10] it cannot explain individual motives and behaviour when it comes to individual initiatives for promoting collective action. "Leadership, persuasion, influence: these phenomena represent social processes whose origins may lie in efforts by people to compensate for the imperfection of information" [Bates 1995:32]. These 'political transaction costs' make the transaction cost approach complex and problematic. Besides, political structure and political process influence transaction costs to a large extent. For instance, recent political developments, such as decentralised participatory politics and percolation of party system to the village level in India have immensely increased the transaction costs of coordinating and organising collective action.

The main problem with transaction costs approach is their quantification. Unless these costs are measured, there is no way this approach can be tested empirically. As pointed out by John Toye, "transaction costs are often taken into account without any quantification and their existence is considered as a theoretical possibility. As a result, market outcomes still remain inefficient even when transaction costs are taken into account" [Toye 1995:65]. More importantly, new institutional economics underplays the importance of political aspects. Distribution of political power and political system has immense impact on the structure and performance of economic institutions, which determine the process of development [Bates 1989, 1995]. On the other hand, imperfect information paradigm while suited to individual choice situations; fails to explain collective choice situations.

(4) *Institutional innovation*: Ruttan and Hayami (1984) have extended the theory of institutional innovation and change by treating institutional innovation as endogenous. They analysed institutional innovation in a market framework by making a distinction between demand for and supply of institutions. While Ruttan and Hayami pointed out that supply side is less understood, Feeny (1979, 1993) emphasised its importance and further elaborated the supply side aspects of institutional innovation. On the demand side, based on the agrarian history of a number of countries, Ruttan and Hayami have shown that changes in relative factor endowments, relative factor prices, technology and product demand have resulted in changes in property rights and contractual arrangements in order to promote more efficient allocation of resources through the market (p 205). On the supply side they hypothesise that institutions will be supplied if the net benefits to political entrepreneurs are positive. In this regard, cultural endowments, including religion and ideology, exert strong influence on supply of institutions as they have direct influence on transaction costs involved in institutional change (p 214).

Feeny added changes in the constitutional order and market size as exogenous demand side factors. By constitutional order he means basic rules of government which can affect profoundly the expected costs and benefits of creating new institutional arrangements and thus the demand for them [Feeny 1993:179]. As the market size increases fixed costs per transaction decline and hence they will not be an impediment to institutional change. On the supply side the changes are attributed to the capability and willingness of the political order to provide change as an analogy to the factors that affect supply of goods in conventional product markets. The factors that influence capability and willingness of the political order include: costs of institutional design, existing stock of knowledge, expected cost of implementing the new arrangements, constitutional order, existing institutional arrangements, normative behavioural code, the conventional wisdom, and expected benefits to powerful decision-makers (p 183). These variables are again exogenous. Cost of institutional design depends on the prices of human and other resources used in evolving new institutions. The existing knowledge on institutional arrangements would facilitate institutional changes, as it tends to reduce costs of designing new institutions. Implementation costs include administrative or infrastructure and costs and benefits to political leaders. It was argued that "the provision of public goods frequently involves an element of coercion (or the potential for its use), leaders are in a strategic position to affect the supply of institutional arrangements and ensure that innovations are congruent with their interests" (p 191).

The supply-demand or market model of institutional innovation is questioned on theoretical and empirical grounds. The

market model typically values efficiency at the cost of equity. According to Bromley: "By endogenising institutional change in this manner one is left precisely where conventional welfare economics leaves us – able to comment on changes that seem to be efficient, but unable to comment on important distributional issues that are at the core of institutional innovation" [Bromley 1989a:25]. Institutional innovations take place and survive, even in the absence of equity and efficiency norms, due to the political clout enjoyed by the interest groups. For, if efficiency is the main criterion institutional innovations revert to old forms when factor endowments and factor prices change which is not supported by history [Grabowski 1988]. And most of the institutions well functioning are not necessarily equity oriented. But, in the absence of equity, institutions tend to be ineffective with a shift in the balance of political power.

More importantly, this model fails to explain the non-functional institutional situations (market failure) while it fits into situations where institutions are functional. That is, these models are shown to be only relevant for the assurance type of games (with information on expected individual behaviour) and not in the case of prisoners' dilemma type games (open access) due to high enforcement costs in the latter case [Grabowski 1988]. However, the reasons for the shifts from assurance game to prisoners' dilemma game (from common property to open access) even in non-transitory situations are not solely economic. Appropriate institutional arrangements tend to disintegrate (dysfunctional) even in the absence of economic growth and transformation due to changes in policy and political environments [Reddy 1996]. This truly reflects the state promoted CA institutions in two of the states in recent years. On the other hand, economic backwardness may also facilitate better community cohesion required for collective action [Deshpande and Reddy 1991; Reddy et al 1997].

These criticisms are directed more towards the demand side aspects of institutional innovation. It is true that either demand or supply alone cannot explain institutional innovation. Appropriate (equilibrium) institutional innovations take place when demand meets supply. The weightage of these factors is again determined by the distribution of political power in a society. In a society with higher levels of awareness, development and decentralisation, the weightage is in favour of demand side factors. Supply side factors dominate in backward, anarchic and low awareness societies. In most of the developing countries supply side factors dominate.

(5) *Institutional analysis and development*: Institutional analysis and development (IAD) framework adopts a multilayer analysis contrary to the linear approach of earlier attempts [Ostrom et al 1993; Ostrom 1990; Oakerson 1992; Ostrom et al 1994]. Unlike the earlier approaches IDA deals mainly with common pool resources. IDA perceives that each commons situation is different and requires its own language and explanatory theory. In the process it relies on and draws from various disciplines like neoclassical economics (including new institutional economics), game theory, political and social theories.

IAD framework focuses on seven important elements in order to understand various CPR situations. They are (i) attributes of physical world; (ii) attributes of community; (iii) rules in use; (iv) action arenas which include action situations and actors; (v) patterns of interactions; (vi) outcomes; and (vii) evaluative criteria. An action arena comprises of action situations and actors. An action situation consists of participants, positions, actions, potential outcomes, links between actions and outcomes, information and costs and benefits assigned to actions and outcomes. In order to predict the behaviour of actors, behavioural assumptions are required regarding preference evaluations that actors assign to potential actions and outcomes, the way actors acquire, process, retain and use knowledge contingencies and information, selection criteria actors use for deciding upon a particular course of action, and resources the actor brings to a situation. The structure of the action arena is affected by the attributes of the physical world, attributes of the community and the rules in use. Again, rules can be categorised into three groups, namely, operational, collective-choice and constitutional-choice. Operational rules concern day-to-day decisions made by participants in any setting. Collective-choice rules concern operational procedures, rights and responsibilities for changing operational rules. Constitutional-choice rules concern assignment of responsibilities and changing collective choice rules.

It is clear from the framework that IDA is flexible, as it does not provide any fixed theory to explain institutional innovation and change. Instead it provides a set of tools that can be used to explain different commons situations. Though this set is comprehensive and useful for situational analysis, the framework focuses mainly on institutional sustainability and does not address other important aspects such as institutional innovation and change. Besides, it concentrates on the demand side aspects to the neglect of supply side factors such as policy environment, political environment, external factors, etc, which are equally important not only for institutional innovation and change but also for institutional sustainability. Hence, the framework remains one-sided. For, studies have highlighted that supply side aspects are equally, if not more, important in understanding institutions [Feeny 1993; Bromley 1993]. Though these aspects seem to be implicit in the framework given their importance, they deserve explicit treatment.

Socio-political aspects have strong influence on individual/group behaviour, especially in the communities with low literacy and awareness. The role of political entrepreneurs or non-political leadership is increasingly becoming central to collective action. This is more so in developing economies like India, which are characterised by information, infrastructure bottlenecks and political uncertainty. In perverse political situations, which is a rule rather than an exception these days at village level, group/individual behaviour could be far from rational (including bounded rationality). Political aspects influence rural dynamics to such an extent that groups tend to work towards opposite objectives rather than working towards common good. This kind of behaviour is prevalent and on the rise in recent years resulting in the slide of common property resources to open access resources. We term this behaviour 'intended irrationality', that is, people act irrationally with intention and not due to lack of information.

Similarly, policy interventions though well meant may adversely affect the existing institutional arrangements. This may happen due to: (a) policy-makers fail to take local knowledge and resources (including social capital) into account while formulating policies; (b) policy interventions are biased in favour of interest groups and hence do not reflect majority demand; and (c) policy interventions are regarded as instruments to maximise the utility of policy-makers (in terms of political and financial gains) rather than the utility of community.

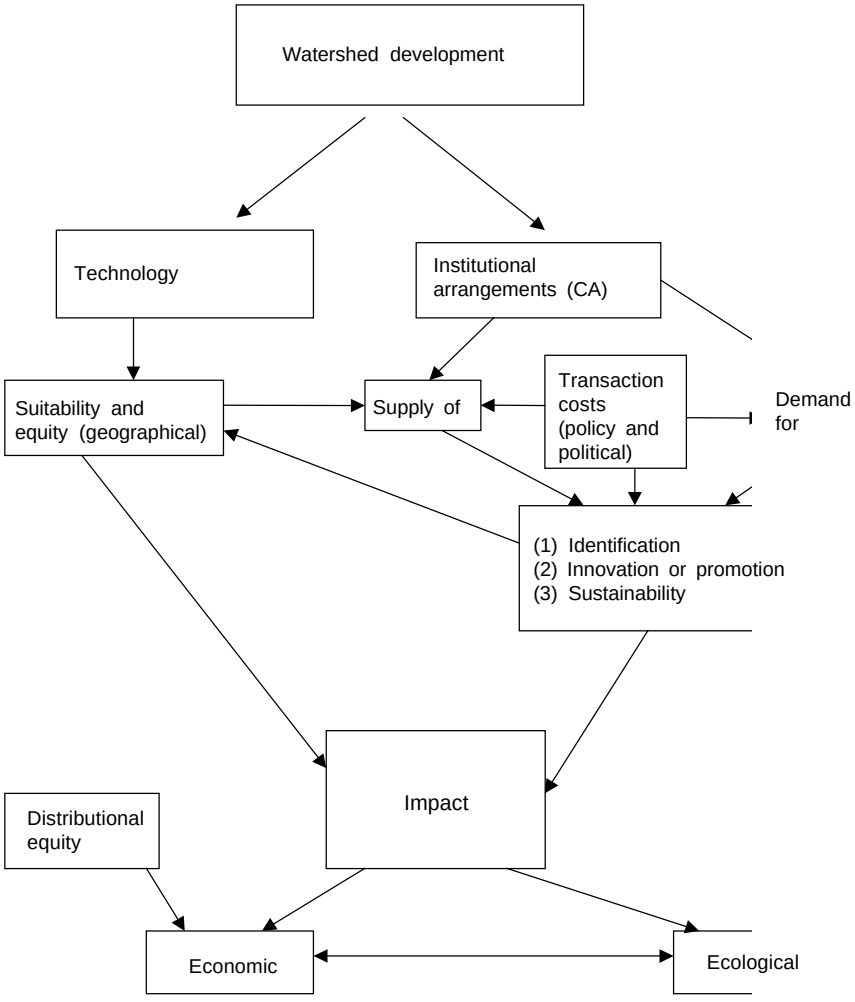
## III
## Institutional Approach

A careful look at the existing literature on watershed development programmes in India makes it clear that a majority of the studies emphasise technology rather than management aspects. While these studies helped in establishing watershed as a viable technology, its sustainability in the long run remained a problem. Though there are quite a few studies, which underlined the need and advantages of participatory watershed development programmes and identifying the factors responsible for sustainable watershed development [White and Runge 1995; Chopra et al 1991; Deshpande and Reddy 1991; Rao 1992], not much attention is paid to how collective action could be achieved and sustained in watershed management at the macro level.

The review of various approaches brings out that formal and informal institutional arrangements, other than private property, are important in the management of common pool resources. There is no evidence to support the efficiency of private property over other property regimes. Moreover, privatisation of commons would aggravate the existing inequalities in the less developed countries (LDCs). Open access situations occur due to weak institutions or state. As regards how institutional arrangements are evolved and sustained most of the approaches fail to explain the commons dilemmas in developing economies. For, the behavioural assumptions rely more on neo-classical individual rationality and non-cooperative behaviour. These assumptions do not reflect the reality of rural communities where trust, morality and ethics play an important role. In developing economies, leadership and political economy aspects are crucial for institutional innovations and changes. These aspects are not addressed duly in the approaches. Transaction cost economics provides useful insights in understanding institutional innovation but remains partial as it does not take the political economy and leadership issues into account. Similarly, IDA framework is also partial, as its focus is limited to institutional sustainability.

The review of CA literature helps us to understand the underlying problems in the process of CPR management such as watersheds. In the light of the above review, we propose a new approach/framework for sustainable watershed management in India.

**Figure 2: Watershed Management**




(1) There is a need to recognise watershed technology as a common good, which needs participatory development. For, the theoretical review clearly indicates the non-suitability of private property approach to watershed development. Hitherto watershed development programmes are treated like any other programmes, emphasising spread rather than sustainability. Unlike in the case of individual based technologies like HYV the watershed technology is subject to the CA constraints and hence the results are not dramatic. Unless this constraint is recognised and given due importance, it is unlikely to achieve the desired objectives. The expert committee on guidelines for watershed development emphasises this point. This aspect is missing in the case of government programmes. However, recent efforts by some of the state governments like Karnataka, Andhra Pradesh and Madhya Pradesh in this direction need careful analysis in order to understand their economic viability and sustainability. Similarly, programmes promoted by NGOs with foreign aid also require careful scrutiny in terms of their sustainability.

(2) The approach in this regard is to recognise CA as a primary objective in watershed development programmes. The process of CA is a three pronged strategy: (a) identification of CA situations (identification); (b) promotion of CA in the potential areas (institutional innovation); and (c) sustaining the CA (institutional sustainability). For this purpose, factors influencing CA at all the three levels have to be identified. The stress needs to be on innovation of CA institutions as most of the studies hitherto focus on institutional sustainability rather than innovation which is a first order dilemma. Moreover, there is a dearth of rigorous empirical studies of why and how CA institutions emerge and evolve.

(3) As the theoretical review indicates, a number of approaches help in understanding CA situations. The most suitable ones, in our view, are transaction costs and supply and demand model. An integration of these two will provide an optimum situation for collective action. This means that the state should supply institutions according to demand (at the grass roots level). These institutions should minimise transaction costs through conducive policy and political environment. A tentative framework is given in Figure 2.

(4) Given that watershed development and CA are mutually inclusive, there is need for interdisciplinary approach of integrating technology and philosophy. This calls for an attitudinal change on the part of implementing agencies. The state should create congenial policy environment for promoting CA institutions. However, the present trend seems to be to the contrary. While participatory development is propagated on a large scale, one hardly finds any legislative, policy or political support for it.

(5) Along with the issue of economic viability, equity aspects are equally if not more important – expecially equity in the distribution of economic gains among the participants. Equity issues pertain to the neutrality of technology in terms of location (different geographic locations of the watershed) and well-being (economic status) of the participants. Inequity in the former case is purely technical while the later is institutional. For, no technology has an inbuilt bias towards a particular class. The bias is always due to the existing institutional structure (agrarian structure, credit markets, etc). In both the cases, inequalities could be minimised through institutional arrangements. In other words, technical inequalities can be corrected through compensating the participants of the disadvantaged locations. And distributional bias needs correcting of distortions in land, labour and credit markets. Failure to recognise the problems of inequity is fatal in understanding the process of watershed management. Equity aspects are also important from the CA point of view. EPW

## Notes

[Thanks are due to R S Deshpande for his valuable comments. The usual disclaimers apply.]

1 It is necessary to define and distinguish some of the watershed related terms such as watershed, river basin, integrated watershed management, watershed management practices and watershed approach.

(i) A watershed is a topographically delineated area that is drained by a stream system. It is a hydrologic unit that has been described and used both as a physical-biological unit and as a socio-economic and socio-political unit for planning and implementing resource management activities.

(ii) A river basin is similar to a watershed but larger in scale.

(iii) Integrated watershed management is the process of formulating and implementing a course of action involving natural and human resources in a watershed, taking into account the social, political, economic and institutional factors operating within the watershed and its surroundings to achieve certain socio-economic and ecological objectives. The process would include: (a) establishing watershed management objectives; (b) formulating and evaluating alternative resource management actions involving various tools and institutional arrangements; (c) choosing and implementing a preferred course of action; and (d) through monitoring of activities and outcomes, evaluating performance in terms of degrees of achievement of the specific objectives.

(iv) Watershed development are the changes in structural and non-structural activities taken up in a watershed and the resultant changes in ecological variables (such as land use, vegetative cover, in situ soil moisture, ground water level, etc) and their economic impact. Usually watershed development has nine land based structural components.

(v) Watershed management are the changes in the institutional arrangements required for collective action situations (adapted with modification from Dixon 1992).

2 Watershed technology is a package of nine components [for details see Deshpande and Reddy 1991]. The suitability of these components depends on the terrain and soil type of the region. All components are not appropriate in all situations.

3 Firstly, watershed apart from covering private areas also covers common areas because it is an area based technology. Secondly, collective adoption of the technology is a necessary condition for complete implementation of the technology. Thirdly, given the nature of the technology its management is a collective effort and hence a public good, i e, once the technology, transcending the individual boundaries, is adopted it aquires the characteristics of a public good. In other words, no participant can be excluded from deriving the benefits even if he does not participate or contribute towards maintenance (non-exclusion). Similarly, the benefits derived by one individual from the technology will not preclude others from deriving the benefits as they operate on individual properties. However, this may not apply in the case of resource created or developed due to technology such as groundwater. Here, the technology becomes a common good.

4 Universality means that all the scarce resources should be owned or ownable. Exclusivity is the right to exclude other potential users (attenuated). Transferability is the right to transfer the resource (through sale or will) to other users (highly concentrated). Resources can be shifted from low productive uses to high productive uses if property rights can be transferred. In the absence of exclusivity and transferability rights, resource use externalities cannot be internalised and hence result in high transaction costs due to the free rider problems. Therefore, "a primary function of property rights is that of guiding incentives to achieve a greater internalisation of externalities" [Demsetz 1967 as quoted in Platteau 1992]. Even the so-called Coase theorem suggests that when the rights to use a resource are clearly defined competing users will negotiate a use pattern that minimises the externalities they impose on each other, provided that the benefits from such negotiations are greater than the transaction costs of such negotiation. In fact, the rapid progress made by mankind during the last thousand years in contrast to the slow development during the earlier period is attributed to exclusive property rights [North and Thomas 1977 as quoted in Bromley 1989].

5 One of the tribal communities, whose main profession is petty thefts and robbery, in India (in the state of Andhra Pradesh) is known for its discipline of not revealing the names of accomplices when caught by the police.

6 In a feudal setup the individual was central to rural dynamics. With the advent of participatory democracy this is no longer true though one may find some exceptions.

7 For an exposition of these two approaches see Williamson (1985); North (1990); Furubotn and Richter (1991); Stiglitz (1986); Bardhan (1989). For applications of these approaches to rural institutions see Bardhan (1989); Nubli and Nugent (1989); Thilo (1994); Basu (1994).

8 This observation is based on the success story of Pani-Panchayat (water council) in Maharashtra state, India. It took seven years for an NGO to convince the villagers about the positive affects of watershed technology. This they could do only through demonstration [for details Deshpande and Reddy 1990].

9 Despite substantial improvement in the economic conditions of the villages where Pani-Panchayat model was adopted it did not spread as much as it should be. Its spread is limited to villages where internal initiative was strong.

10 For a general critique on transaction costs approach and new institutional economics see Stiglitz (1986), Nabli and Nugent (1989), Bardhan (1989a), Dietrich (1994), Harris, Hunter and Lewis (1995).

## References

Bardhan, Pranab (1989): 'Alternative Approaches to the Theory of Institutions in Economic Development' in Bardhan (ed).

– (ed) (1989): *The Economic Theory of Agrarian Institutions*, Clarendon Press, Oxford.

– (1995a): 'Rational Fools and Cooperation in a Poor Hydraulic Economy' in Basu et al (op cit).

– (1995b): 'Analytics of the Institution of Informal Cooperation in Rural Development' in De Janvry et al (eds).
Bates, Robert H (1989): *Beyond the Miracle of the Market: The Political Economy of Agrarian Development in Kenya*, Cambridge University Press, Cambridge.
– (1995): 'Social Dilemmas and Rational Individuals: An Assessment of the New Institutionalism' in Harriss, Hunter and Lewis (eds).
Beaumont, P M and R T Walker (1996): 'Land Degradation and Property Regimes', *Ecological Economics*, Vol 18.
Bell, Clive (1990); 'Reforming Property Rights in Land and Tenancy', *The World Bank Research Observer*, Vol 5, No 2, July.
Bhatnagar, Pradip (1996): 'Growth Potential of Rural Employment Programmes: The Watershed Approach', JRD, Vol 15, No 2, April-June.
Bromley, Daniel W (1989): 'Property Relations and Economic Development: The Other Land Reform', *World Development*, Vol 17, No 6.
– (1989a): *Economic Interests and Institutions: The Conceptual Foundations of Public Policy*, Basil Blackwell, New York.
– (1993): 'Reconstituting Economic Systems: Institutions in National Economic Development', *Development Policy Review*, Vol 11.
Chopra, Kanchan (1996): 'The Management of Degraded Land: Issues and an Analysis of Technological and Institutional Solutions', *Indian Journal of Agricultural Economics*, Vol 51, Nos 1 and 2, January-June (Golden Jublee Number).
Chopra, K, G K Kadekodi and M N Murty (1989): *Participatory Development: People and Common Property Resources*, Sage Publications, New Delhi.
Chopra, Kanchan and Gopal K Kadekodi (1993): 'Watershed Development: A Contrast with NREP/JRY', *Economic and Political Weekly*, June 26.
Coase, R H (1937): 'The Nature of the Firms', *Economica*, Vol 4, November. Reprinted in R H Coase (1988), *The Firm, The Market and The Law*, The University of Chicago Press, Chicago and London.
Deshpande, R S and N Rajasekhar (1995): *Impact of National Watershed Development Project for Rainfed Areas (NWDPRA) in Maharashtra*, AERC, Gokhale Institute of Politics and Economics, Pune.
Deshpande, R S and V Ratna Reddy (1990): 'Social Dynamics and Farmer's Society: A Case Study of Pani-Panchayat', *Indian Journal of Agricultural Economics*, Vol 45, No 3, July-September.
– (1991): 'Watershed Development Approach in Fragile Resource Regions: An Analytical Study of Maharashtra', mimeograph series No 33, Gokhale Institute of Politics and Economics, Pune.
Dixon, John A (1992): 'Analysis and Management of Watersheds' in Partha Dasgupta and Karl-Goran Maler (eds), The Environment and Emerging Development Issues, Vol 2, Clarendon Press, Oxford.
Feeny, David (1979): 'Competing Hypothesis of Underdevelopment: A Thai Case Study', *Journal of Economic History*, Vol 39, No 1, March.
– (1993): 'The Demand for and Supply of Institutional Arrangements' in V Ostrom, David Feeny and H Picht (eds).
Gans, Oskar (1989): 'Economic Analysis of Ecological Dis equilibria in Industrialised and Developing Countries' in Gans Oskar (ed), *Environmental and Institutional Development: Aspects of Economic and Agricultural Policies in Developing Countries*, Verlag breitenbach Publishers, Saarbruken.
Government of India (1994): *Guidelines for Watershed Development*, Ministry of Rural Development, New Delhi, October.
Grabowski, Richard (1988): 'The Theory of Induced Institutional Innovation: A Critique', *World Development*, Vol 16, No 3, March.
Hardin, Garrett (1968): 'The Tragedy of Commons', *Science*, Vol 162, December.
Knudsen, C (1993): 'Modelling Rationality, Institutions and Processes in Economic Theory' in U Maki, B Gustafsson and C Knudsen (eds).
Larson, B A and D W Bromley (1990): 'Property Rights, Externalities, and Resource Degradation: Locating the Tragedy', *Journal of Development Economics*, Vol 33, October.
Morton, J F (1996): 'Land Resources in Dafur Region, Sudan: Prisoners' Dilemma or Coase Outcome?, *Journal of Development Studies*, Vol 33, No 1, October.
Nalatwadnath, S K, M S Rama Mohan Rao and Padmaiah (1997): 'Joladarasi Model Watershed Development Programme in Bellary District of Karnataka – A Diagnostic Evaluation', *Journal of Rural Development*, Vol 16.
North, Douglass C (1990): *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge.
Oakerson, R J (1992): 'Analysing the Commons: A Framework' in Bromley (ed).
Olson, Jr Mancur (1965): *The Logic of Collective Action: Public Goods and the Theory of Groups*, Harvard University Press, Cambridge.
Ostrom, Elinor (1990): *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge, New York.
– (1992),: *Crafting Institutions for Self-Governing Irrigation Systems*, ICS Press, Sanfrancisco, California.
Ostrom, Elinor, R Gardner and J Walker (1994): *Rules, Games and Common-Pool Resources*, The University of Michigan Press.
Ostrom, Vincent, D Feeny and H Picht (1993): *Rethinking Institutional Analysis and Development: Issues, Alternatives, and Choices (ed)*, ICS Press, Institute for Contemporary Studies, Sanfrancisco, California.
Platteau, J-ph (1992): 'Formalisation and Privatisation of Land Rights in Sub-Saharan Africa: A Critique of Current Orthodoxies and Structural Adjustment Programmes', DEP No 34, Development Economics Research Programme, Suntory-Toyota International Centre for Economics and Related Disciplines, London school of Economics, London.
Rao, V M (1992): 'Change Process in Dryland Communities', *Indian Journal of Agricultural Economics*, Vol 47, No 4, October- December.
Reddy, V Ratna (1996): *A Study of Willingness and Ability to Pay for Water*, Project Report, Institute of Development Studies, Jaipur, India.
Reddy, V Ratna et al (1997): 'User Valuation of Renewable Natural Resources: A Study of Arid Zone', Project Report, Institute of Development Studies, Jaipur.
Runge, C Ford (1981): 'Common Property Externalities: Isolation, Assurance and Resource Degradation in a Traditional Grazing Context', *American Journal of Agricultural Economics*, Vol 63, No. 4, November.
–(1986): 'Common Property and Collective Action in Economic Development', *World Development*, Vol 15, No 5, May.
Ruttan, V W and Y Hayami (1984): 'Towards a Theory of Induced Institutional Innovation', *Journal of Development Studies*.
Sen, A K (1982): *Choice, Welfare and Measurement*, Basil Blackwell, Oxford.
– (1995): 'Rationality and Social Choice', *The American Economic Review*, Vol 85, No 1, March.
Sethi, R and E Somanathan (1996): 'The Evolution of Social Norms in Common Property Resource Use', *American Economic Review*, Vol 84, No 4.
Shah, Amita (1998): 'Watershed Development Programmes in India: Emerging Issues for Environmental-Development Perspective', *Economic and Political Weekly*, June 27.
Singh, Karam et al (1993): 'Kandi Watershed Development Programme – A Critical Evaluation', *Economic and Political Weekly*.
Singh, Katar (1994): *Managing Common Pool Resources: Principles and Case Studies*, Oxford University Press, New Delhi.
Sjaastad, Espen and Daniel Bromley (1997): 'Indigenous Land Rights in Sub-Saharan Africa: Appropriation, Security, and Investment Demand', *World Development*, Vol 25, No 4, April.
Stiglitz, Joseph E (1986): 'The New Development Economics', *World Development*, Vol 14, No 2, February.
–(1989): 'Rational Peasants, Efficient Institutions, and a Theory of Rural Organisation: Methodological Remarks for Development Economics' in Bardhan (ed).
Tang, Shui Yan (1992): *Institutions and Collective Action: Self-Governance in Irrigation*, ICS Press, Institute for Contemporary Studies, San Francisco, California.
Toye, John (1995): 'The New Institutional Economics and its Implications for Development Theory' in John Harriss, J Hunter and C M Lewis (eds).
Wade, Robert (1988): *Village Republics: Economic Conditions of Collective Action in South India*, Cambridge University Press, Cambridge.
White, T A and C F Runge (1995): 'The Emergence and Evoluation of Collective Action: Lessons from Watershed Management in Haiti', *World Development*, Vol 23, No 10, October.