ECONOMIC INCENTIVES FOR SOIL CONSERVATION IN INDIA

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Abstract
Land degradation, which affects about 50 percent of the geographical area in India, is a serious problem due to soil erosion, degraded command areas and intensive cultivation. The government lent strong support to soil conservation through institutional set up including research and development as well as huge investment in soil conservation measures like bunding treatment of river catchments and operational research projects. Farmer participation in these programs was passive because incentives embedded in conservation programs were masked. Hence, farmers' response was very poor although they had invested in profitable soil conservation measures. A new program 'watershed development project' that envisages enhancement of internal incentives to promote soil conservation and achieve multiple goals including environmental concerns was launched using incentives and participatory approach. Direct incentives provided were input subsidies, distribution of tree seedlings, implements under subsidy, compensation for wages, investment in water harvesting structures, livestock activities, etc and indirect incentives were extension, credit, preferences in other services to participant farmers, etc. In response, farmers adopted and sustained conservation practices, which ensured internal economic incentives and were reluctant to accept conservation practices like vegetative barriers, contour cultivation etc. These results suggest that there is need to promote what farmers actually want so as to attain sustainability in production systems.

Additional Keywords: watershed development, internal economic, incentives, history

Introduction
Soil erosion as a serious problem was prevalent even in the ancient times in India. Land degradation is a serious problem in more than half of 329 million ha of the geographical area of the country. British government recognised the problem of soil erosion in India much before the occurrence of dust bowl in U.S. during 1930s (Shah, 1999). The British government initiated soil conservation works, research activities and even passed the first Soil conservation Act in Punjab state in 1900. After the independence, the government supported soil and water conservation (SWC) in several ways such as policy support by way of model acts on SWC, research & development, huge investment on conservation measures and many other programs. Economic incentives from the conservation influence greatly adoption and effectiveness of SWC, as farmers as rational decision makers weigh economics of adoption of conservation measures. In the present study an attempt has been made to trace the evolution of SWC programs in India, the pattern of economic incentives embedded in SWC, and the impact of incentives on the adoption and maintenance of SWC practices/assets. These objectives are addressed based on the secondary data and published research studies on SWC in India.

Evolution of SWC Programs in India
We can identify three distinct phases in the evolution of SWC programs in India (Table 1). During the pre-independence period, SWC was not a major program, as it was often linked with programs like dry land farming or famine mitigation (Shah, 1999). In the post-independence period, the planned development paved the way for evolution of well-formulated programs for SWC. The government evolved various programs, research institutions, policies and activities including establishment of All India Soil Survey and Land use organization and evolution of model bill on SWC to tackle the problem especially during the period 1950-60. A milestone in this area was evolution of river valley projects (RVP) on a large scale covering major river basins (Table 1). The conservation research initiatives came in the form of dry farming research schemes to develop SWC techniques at four locations in semi-arid regions (Tejwani, 1994). Evolved in 1975, Operations Research Project (ORP) demonstrated effectiveness of various SWC technologies in controlling erosion on farmers' fields with higher benefit cost ratios. But a glaring lacuna in these approaches was lack of farmer participation in these programs. A serious lapse in these programs was greater emphasis to soil conservation and neglect of other goals. But, SWC received secondary importance during the seventies as irrigation development was accorded top priority to augment agricultural production in the country. As a result, SWC activities were scattered under various schemes and drought relief programs. A shortsighted approach of giving subsidies was adopted by the state to promote SWC, which later on emerged as a major limitation in the promotion of watershed programs (Shah, 1999).

Table 1. History of evolution of SWC programs in India.

Year	SWC program
Period I: Pre-Independence period	
1900	First Soil and Water Conservation Act by Punjab State
1928	Recognition of soil erosion problem by Royal Commission on Agriculture
1930	Establishment of dry land research centres (Bombay dry farming practices)
1938	Scheme for dry farming development: Emphasis on contour bunding
1945	Famine commission: SWC was considered as a component of relief measures
Period II: Post-Independence period	
1950-60	Enactment of Soil and Water Conservation Acts by several states in India
	All India Soil Survey and Land use organization
1954	Starting of Central Soil and Water Conservation Research and Training Institute(CSWCRTI)
	Special schemes for drought /desert prone areas (SWC works mainly as relief programs)
1961	Launching of River Valley Schemes/projects
1975	Implementation of Operations Research Projects
Period III: Watershed development program era	
1982	Launching of 46 model watershed projects (WDP) for the development of dry lands
1984	World Bank Assisted WDP in four states
1986	National Watershed Development Programs for Rain fed Areas (NWDPRA) in 16 states
1989	Integrated Waste Land Development Program (National Wasteland Development Board)
1992	National Watershed Development Project for Rain fed Areas (NWDPRA)

Source: Shah (1999) and others

Need for Watershed Development Programs for Soil Conservation

Realizing the importance of reversing land degradation and sustaining production, the policy focus shifted to the improvement and stabilisation of productivity of rain fed areas through appropriate land management programs with emphasis on SWC (Chopra, 2002). An integrated program called the watershed development program (WDP) that envisages a synergistic relationship among various natural resources was launched in 1982. Though the state assumed the stewardship role in protecting degraded lands and transmitting feasible SWC technologies to farmers, their acceptance and maintenance were very low. On experimental basis and during watershed project periods, though most of SWC programs found to be economically viable, farmers did not sustain SWC practices to expected levels. Was it due to inadequate internal (private) economic returns from recommended practices? Was there any other factor that determined SWC acceptance and continuance? Are small and scattered holdings rendering the adoption uneconomical, as returns from small and scattered holdings may be inadequate to cover the opportunity cost of the investment? Perhaps the analysis of reasons for differential rate of acceptance of recommended SWC practices by farmers may give answers to these questions. In the pre-WDP period, SWC measures promoted were mostly related to bunding (earthen embankments of various dimensions to prevent soil erosion from plot to plot) activities and the importance of SWC measures like silvi-horticultural and other perennial species based conservation measures was not recognised fully in the erosion control.

Realizing the lacunae of erstwhile SWC programs, the state revamped entire conservation programs to improve incentive regimes and achieve multiple goals/objectives including environmental concerns. The planners realised the inadequacy of incentives embedded in the earlier SWC programs and need for enhancing level of internal economic incentives from SWC to induce its large-scale adoption rather than external incentives (subsidies from the state). As a result, WDP program underwent radical changes by inclusion of various income/incentive-augmenting components like, water harvesting structures, perennial enterprises, livestock and other components. In the quest for ensuring food sufficiency in a short span of time, priority was accorded to the development of irrigated agriculture and supporting sub-sectors overlooking the developmental needs of vast tracts of dry lands in the country, which aggravated inequalities in dry land regions. Hence, WDP has been promoted as a development strategy not only to develop dry lands by way of increasing and stabilizing crop yields but also to bring parity between irrigated and dry land regions in addition to augmenting growth in agriculture and achieving multiple developmental and environmental goals.

Economic Incentives for Soil Conservation in India

Economic incentives for SWC can be viewed in terms of external and internal incentives, which could be both direct and indirect. The external incentives are in the form of direct state investment in SWC measures on farmers' fields, input subsidies, supply of economically important saplings, farm implements and tools, drought relief programs, wages, employment programs etc. Indirect external incentives are largely in the form of farm extension services, credit, preference in other services/programs to participants of SWC programs etc. Before the advent of WDP programs, SWC programs (mostly bunding related programs) were taken up on both private and public lands without active participation of farmers. Though in effect, the investment on farmers' field could create long-term benefits in the form of increased yields, there were no apparent direct incentives as in the case of WDP program.

Table 2 shows the government investment on SWC measures under different plan periods in the country, which are direct economic incentives under different SWC and WDP programs. The data shown below is only a partial scenario and not an exhaustive one as we were unable to collate latest data from several agencies under different programs for soil conservation in the country.

Table 2. Investment on SWC and watershed projects under selected programs

Year of start	Watershed Nos/ area/SWC program	Agency/ Scheme	Investment (Rs millions)	Cost /ha
1956	42	CSWCRTI	Experimental	
1961-62 (RVP)	3.3 m ha upto eight plan	Central govt in 29 catchments in 18 states	6826	2068
1974 (RVP)	4	CSWCRTI	ORP	
1980-81 (FPR)	0.83 m ha	10 catchments in 8 states	2640	3180
1983	47	CSWCRTI and CRIDA	ORP	
1987	12000 ha	PIDOW	300	25000
1991	2497	NWDPRA	11285	
1991	0.5 m ha	World Bank	8210	16420
1991	0.13 m ha	DANIDA	600	4615
1993	0.242 m ha	EEC	1065	4400
1994	0.254 m ha	MRAE	2157	8492
1995	0.035 m ha	ISPWD	203	5800

Source: Samra (1997) Rs. 45.00 = 1US$, RVP- River Valley Programs, FPR-Flood Prone Program, CRIDA-Central Research Institute for Dryland Agriculture, PIDOW-Participatory Integrated Development of Watersheds, MRAE-Ministry of Rural Areas and Employment, ISPWD-Indo-Swiss Participatory Watershed Development.

Clearly, the state investment on SWC under different programs provides substantial direct external economic incentives to farmers. Up to the end of eighth five year plan under RVP and related programs about 4.23 m h of degraded lands had been treated at an outlay of Rs. 9392.10 millions since inception. This works out to about Rs.2220 per ha which other wise would not have been invested by resource poor farmers. Under the World Bank assisted WDP, the Karnataka state gives farmers an average amount of Rs 7000 per ha for SWC. Unit cost for bunding program varies between Rs. 2500 and Rs.4500 per ha depending upon soil type and bund type. For water harvesting structures, the unit cost varies between Rs. 15000 and Rs. 200000. On silvi-horticultural activities, the average investment varies between Rs. 6000 and Rs.19000 with farmers' contribution of 10 to 20 percent of the investment for all the components. This clearly reiterates the state efforts to provide sufficient incentives for SWC.

Need for economic incentives in SWC

As soil erosion occurs largely on dry lands, inherent risk in dry land agriculture deters private investment on costly SWC measures as the rate of return from capital intensive SWC is often very low and spread over a long period. Farmers' predicament in SWC is further compounded by the divergence in conservation goals of farmers and scientists. While recommended SWC envisage largely single objective of conserving soil, farmers on the other hand will have multiple objectives including economic and non-economic ones. Kerr and Sanghi (2002) point out that farmers' opportunity cost of investment as well as time are the two important factors that influence their decision on SWC in addition other factors. While farmers may have internal incentives from SWC, they may be insufficient to achieve socially optimal level of conservation. Hence, society has to compensate the opportunity cost of farmers for achieving socially optimal level of conservation as argued by Huszar (1999). Wherever SWC treatment is uneconomic, farmers need to be supported with external incentives particularly if the problem manifests in both off-site and on-site situations and there is forced adoption of SWC. Thus, use of external economic incentives is justified when the benefits from SWC accrue not only to the farmer but also to the entire society both for present and future generations (Cahill and Sanders 1999). But the influence of such external incentives on the conservation could be short-lived. Internal economic incentives from the recommended SWC measures should generate sufficient economic incentives for long-term sustenance. Therefore, the state should promote conservation measures that are acceptable to farmers as suggested by Kerr (1999). State funding for SWC could give sufficient external incentives as explained above but in the long run SWC measures should generate sufficient internal incentives to make SWC a self-propelling conservation activity.

Effectiveness of SWC Programs in India

The effectiveness of SWC programs is an important performance and efficiency indicator. We can identify three broad effectiveness indicators:(i) conservation of degraded lands (ii) economic returns (internal incentives) and (iii) adoption and maintenance of SWC treatments.

Conservation of degraded lands

The government has invested several billions of rupees on SWC and has conserved vast tracts of degraded lands, as the private investment on SWC is inadequate due to various factors including inadequate economic incentives. Despite such huge investment, paradoxically, the rate of degradation continues to be more than the rate of conservation, which may be an indication of lack of post-project sustenance of SWC practices by farmers in spite of profitability of majority of SWC measures (as revealed by research studies). Is it partly because of withdrawal of subsidies by the state after the project period as pointed out by Pagalio (1999)? Is it an indication of lack of sufficient internal incentive from SWC? Perhaps an in depth analysis of farmers SWC investment pattern may give some clues to this behaviour. Farmers view SWC as an investment and economics plays a decisive role in the adoption (Kerr and Sanghi, 2002). Thus, private SWC efforts are largely oriented towards measures, which have irrigation components rather than exclusive soil conservation. Further, if the objective of SWC is more of social, then farmers' (private) optimal level of SWC may be different from social optimality and external incentives are unlikely to be effective as argued by Pagalio (1999). Shah (1998) argues given options, farmers prefer yield-augmenting technologies to resource conservation technologies or programs and are willing to bear the cost. This is a clear pointer to the hypothesis that the success of the SWC largely hinges upon the magnitude of economic incentives from SWC programs and thus conservation of degraded lands.

Economic returns from the SWC

In the pre-WDP period emphasis was on learning about the problems of SWC and evolution of appropriate SWC measures through research and development and testing their effectiveness both on research stations and farms. During this period, SWC programs were mainly in the form of bund related practices to conserve soil with secondary importance to that embedded irrigation component. Farmers were passive stakeholders and they did not recognise fully long-term economic incentives from SWC consequently adoption rates were low. As Chandrshekar (2003) laments though contour bunds and contour farming were recommended way back in 1930s, due to operational difficulties and lack of apparent economic gains from the practice, the program degenerated into strengthening of boundary bunds. But analysis of some of the success stories of SWC measures suggests that provision of irrigation components like water harvesting structures, farm ponds, earthen bunds, etc, induced the conservation primarily due to their positive economic impact. The investment evaluation revealed that values of B:C ratio, NPV and IRR were higher for these components than for SWC practices without irrigation component. The yield impact of the latter type of SWC varied between 5 and 25 per cent, which under Indian conditions inadequate to induce the adoption of SWC measures. Kerr *et al* (1999) observed that private investment in conservation measures like land levelling/terracing was conspicuously very high as these measures directly yield higher output and income. Table 3 indicates influence of internal economic returns from the selected SWC measures on their adoption and sustenance. It is clear from the table that farmers adopted and sustained those SWC practices, which generated sufficient economic returns (incentives) and did not favour practices like contour cultivation, vegetative barriers, compartmental bunds etc. These results support our hypothesis that the adoption and sustenance of SWC is a direct function of the level of economic incentives generated by SWC measures.

During the post-WDP era, SWC program was modified and new technologies were evolved and embedded in the WDP to enhance the degree of economic incentives for SWC. Due to this, in the post WDP era, the effectiveness of SWC in terms of economic incentives was quite conspicuous. For instance, Reddy (1993) reported that economic gains from selected SWC measures such as water harvesting structures were quite high with benefit cost ratio exceeding unity for majority of water harvesting structures as farmers could take up commercial crops due to increased irrigation in Southern Karnataka, India. Similar results were also reported by Lokesh (2004) exemplifying incentive augmenting effects of water harvesting structures in a Watershed in Southern Karnataka. Similarly, pilot projects undertaken by the watershed projects and Operational Research Projects had demonstrated significant economic returns from selected SWC practices. However, one must be cautious in generalising level of economic benefits (incentives) from SWC because, as Shah (1998) points out, the positive impact of SWC on crop

Table 3. Economic incentives and adoption level of selected SWC practices in India

SWC practice	Adoption / Sustenance rate[1]	Level of Incentives[1]	Reasons	Source
Contour strips in maize coupled with green manuring	High	High maize yields	Direct increase in yields	Agnihotri *et al*, 1998
Graded bunds to dispose excess water		Medium	Performed well	Anon, 2003
Terracing	Medium	High	Checks soil erosion & higher yield	Shah & Patil, 1970
Compartmental bunding	Low	Low	No additional Pearl millet yield	Anon, 1989
Opening of dead furrow	High	High	Easy to adopt with less investment	Reddi & Padmalatha,1993
Contour cultivation	Low	Low	Difficulty in farm operations.	Reddy, 1993
Vegetative barriers	Medium	Low	Insignificant/ marginal yield	Shah, 1998
Water harvesting structures	High	High	Direct access to irrigation water	Lokesh 2004

[1] Inferences based on the results of the quoted studies

yields could be due to better resource base of the farmers or even due to some kind of package of SWC measures including input supply for crop production (in the form of subsides) or persuasive approaches by project staff. However, the economic impact of SWC (WDP) was insignificant in areas having limited scope for water harvesting structures. Low-cost treatments are normally associated with insignificant economic impact, as gains in yields in most cases are associated with increased irrigation from water harvesting structures. Farmers generally feel that land levelling in addition to improving the existing earth/stone bunds increase yields perceptibly. Coupled with this the water harvesting structures enable them to grow high value crops even on small piece of land. Thus, during the post-WDP period, economic impact (internal incentives) of SWC was highly conspicuous as compared to the pre-WDP period.

Adoption and maintenance of SWC measures

If SWC practices generate sufficient incentives and are able to stimulate adoption among farmers, sustenance of the practices in the post project period assumes even greater importance because it is very important for effectiveness of SWC in the long run. However, in the post-WDP period, farmers exhibited a mixed preference for improved/recommended SWC practices. Several research studies (Kerr *et al.*, 1999; Reddy, 1994; Shah, 1999) reveal that farmers' practiced on large scale traditional SWC measures that involve relatively less cost such as boundary bunds, water ways, outlet for excess water, in addition to compost manuring, sowing across slope, etc. Further, wherever there was divergence between farmers' objectives of conservation and scientist perspectives, the level of conservation activity would be low (Kerr and Sanghi, 2002). Some times negative incentives in the form of undesirable consequences from SWC (as Shah points out) may deter farmers from adoption. For instance, vegetative barriers are prone to pest attack and these barriers need reclamation, which involves higher maintenance costs.

How do recommended SWC practices such as vegetative barriers, contour cultivation, etc, perform in terms of both adoption and economic incentives to farmers? Shah (1998) and Kerr (1999) reported that the adoption of recommended practices like, contour bunds, contour cultivation, vegetative barriers etc was not so favourable among farmers as they fail to produce perceptible economic gains. Shah (1998) reports that vegetative barriers do increase yields in dry land region of western India but the yield gain was insignificant. It is much smaller than the generally expected yield gains in the range of 15-20 per cent. Similar results were also reported by Reddy (1994) that rate of adoption of contour cultivation by finger millet growers in Southern Karnataka was lower at about 13 and 17 per cent respectively, among small and large farmers ostensibly due to low additional yields. Kerr and Sanghi (1992) also make similar observations about farmers' reluctance to adopt contour bunds though they recognise their efficiency in conserving soil and water. But farmers feel that benefits (internal incentives) are not great enough to justify foregoing the other advantages of traditional boundary-based conservation systems. The low rate of acceptance of recommended practices can be attributed to the failure to fully account for costs and benefits from SWC as argued by Pagiola (1999). Often in the evaluation of SWC, opportunity costs of own labour, time and likely drop in productivity are not considered, which often lead to overestimation of returns. But in reality the practice may not be appealing to farmers due to opportunity cost factor, although the practice may be economically viable for the reasons indicated above. Many a time, in India, low agricultural prices for inferior cereals like finger millet, sorghum, pearl millet etc, (which are commonly grown in dry lands) make the productivity gains from the conservation less appealing to farmers to justify investment on SWC practices like contour cultivation, contour bunding, vegetative barriers etc. On the contrary, water-harvesting structures are well maintained by the farmers due to higher economic benefits because of irrigation. Therefore, without any appreciable increase in internal economic incentives from SWC, farmers will not prefer such practices. Thus, the foregoing discussion clearly convinces that the magnitude of internal economic incentives in addition to other factors largely influence conservation behaviour of farmers in India.

Conclusions

Though government is tackling land degradation in an integrated manner investing huge money on the ameliorative measures farmers' response to the state initiatives has been a mixed one. Farmers adopt and sustain only those SWC measures, which ensure adequate internal economic incentives, involve less cost and call for low collective action. Though majority of SWC practices are profitable from evaluation point, it is essential to focus on adequate internal incentives and multiple objectives of farmers in the conservation matters for long-term sustenance of SWC. A combination of subsidy and credit can be explored for certain type of SWC to enhance incentive regimes. Special emphasis need to be given to livestock component in SWC for fodder development and grazing facilities which not only fetch higher returns to farmers but also prevent soil erosion due to soil binding property of grasses and plants.

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