ECONOMIC EVALUATION OF PEOPLE'S PARTICIPATION IN THE MANAGEMENT OF COMMON PROPERTY RESOURCES

KANCHAN CHOPRA,
G.K. KADEKODI AND
M.N. MURTY

NO. APRIL 1988

This paper is part of a detailed study on 'Participatory Rural Development' being undertaken by the authors with the generous financial assistance of Planning Commission, Government of India. We are grateful to Professors S. Chakravarty and C.H. Hanumantha Rao for encouraging us to conduct this study. We are benefitted from the comments of many of our colleagues at IEG, Delhi and participants in a seminar at NIPFP, New Delhi and statistical assistance of Mr. Sarkar, Mr. Ravichandran and Mr. Yadav of IEG. We express our deep gratitude to all of them. We acknowledge with thanks the computer programming assistance of Mr. Gaurav Kishan and K. Lal.

1. People's Participation as an Alternative to Market Mechanism and Government

Failure of market mechanism in the management of common property resources like forest lands is well known. Because of this, in the historical evolution of property rights the ownership of such resources is finally rested with the state. Given such property rights, the governments of nations assume responsibility to preserve and adopt planned exploitation of many natural resources such as forests. But, due to the public goods character of these resources the preservation and policing costs to the government are prohibitively high. Moreover, having very high potential for conferring immediate benefits, there is a tendency on the part of the government (due to political and other reasons) to opt for a developmental use of natural resources as against the preservation alternative. This choice may imply irreversibilities in deciding between developmental and preservation alternatives for the utilization of such resources[1]. Having, once opted for developmental use, it may not technically and economically feasible to revert back to recreational or preservation use even if it is found that this alternative is more beneficial at some point of time in future. Furthermore, the history of failures on the part of governments in bringing about preservation has made development a preferred option. But the experiment that is going on in the lower Shiwalik range of Haryana state in India as seen through the sample of five villages reveals that a third alternative of 'development with preservation' seems to be possible with the emergence of 'people's participation'.

Forest resources are important means of livelihood to village people and a source of recreational and other benefits to urban dwellers. Therefore, people living in both rural and urban areas should have interest in preserving them. They are indeed aware of the benefit of perennial income from preserved forests against immediate 'once-for-all benefits' due to their over exploitation. However, there are various factors that are inimical for participation of village people in the preservation of forests. They are (1) poverty, (2) non-availability of alternative productive opportunities to earn income in the village economies, (3) lack of infrastructural facilities to reap the benefits from preserved forests, (4) inability to possess private assets which are complementary to preserved forest to earn income, and (5) lack of institutional arrangements to participate in preservation.

Conventional poverty alleviation programmes are found to be not very effective to preserve forests in India as the links between common and private property resources are not taken into account in planning these programmes. For instance, investments on irrigation dams to harvest water from forest, and on rope and essential oil producing machines to use increased forest produce like bhabber and lemon grass more productively are complementary to preservation; and therefore poverty alleviation programmes should be tied to these investments. Ownership of private assets like milch cattle makes the village people take interest in preservation, since a preserved forest may increase the fodder supply and hence increase milk yield.

Existing rigid legal structures that unequivocally keep the property rights on forest lands with the government are also not conducive to people's

participation in preservation. New institutional arrangements for sharing the management of forest by government and village people's societies may be an alternative. These institutional arrangements can be contractual arrangements between government and village societies either for harvesting certain forest products or for sharing the management of forest land[2].

The investments in the village economies (I_1) that are complementary to preservation can be in either community asset creation (such as irrigation dams) or private asset creation (e.g. milch cattle, rope and essential oil producing machines etc.). These investments are of the nature of enabling agents that make it possible for villagers to use preserved forest productively and therefore provide them incentives for preservation. Therefore, in a more general way, people's participation is an increasing function of investment in the creation of community and private assets that are complementary to preservation. Over and above these investments in the village economies, there may be direct governmental investments (I_2) in aforestation and soil conservation through conventional preservation programmes. In the absence of people's participation, there may be uncertainty regarding the development of the village economies even with direct governmental investment on preservation. It all depends upon the relative composition of the two types of investments (i.e. I_1 and I_2) as well as the degree of people's participation. In that sense people's participation emerges as an important alternative to market and government.

2. People's Participation as a Production Externality in the Management of Forest Resources

People's participation through village societies[3] may be regarded as a production externality which increases the productivity of investments mentioned above. Two specific instances of it are stall feeding as a substitute for free grazing and practicing the concept of social forestry to have a renewable supply of fuel wood which in turn make the forest managed by either government or society more productive. In the case of the surveyed villages, the economic benefits from conservation are in the form of increased bhabber and fodder grass production, the reduction in erosion of cultivable lands and fall in the sedimentation of Sukhana lake. There are recreational benefits to the people of Chandigarh due to increased scenic beauty of forest in the catchment of Sukhana lake and the improved facilities for sports fishing, boat riding etc., in the lake. These recreational facilities may be regarded as consumption externalities generated by people's participation in forest conservation.

As stated earlier, a contractual arrangement between government and village societies may provide an incentive for people's participation in conservation which is assumed to be an increasing function of the amount of forest land managed by the village society. Evaluation of people's participation as a production externality therefore, is possible only along with the evaluation of the contractual arrangements for sharing the management of a given forest land R, such that,

$$R_1 + R_2 = R \qquad (1)$$

where R_1 and R_2 represent respectively the shares of government and society. A measure of people's participations (S) be defined as a function of investment in the creation of community and private assets which are complementary to preservation (I_1) and the amount of forest land managed by people's society (R_2)

$$S = S(I_1, R_2), \quad -\frac{\partial S}{\partial R_2} \geq 0 \quad \frac{\partial S}{\partial I_1} \geq 0 \qquad (2)$$

People's participation as a production externality enters the production functions of both government and society in the management of forest. Let the production from the forest resources held by the government (Q_1) and society (Q_2) be defined as:

$$Q_1 = F_1 (L_1, R_1, S_1,) \quad \text{and} \quad Q_2 = F_2 (L_2, R_2, S) \qquad (3)$$

where L_1 and L_2 are labour employed by the government and society, respectively at an institutionally given wage rate $\overline{W}$.

Participation of people is not without any cost to them. For example, stall feeding of cattle increase cost in terms of labour time required to fetch cut fodder grass from the forest instead of letting their cattle for free grazing. Raising social forestry by the village societies for renewable fuel wood supply has costs associated with it. Let the cost of participation to people's society (C) be an increasing function of S so that,

$$C = C(S), \quad \partial C/ \quad \partial S \quad \geq 0 \qquad (4)$$

While participation augments the productivities of both the government and society, it is also instrumental in arriving at a fair rental on the leased resource. One of the important effects of this new institution is to generate income distribution benefits to the village people through contractual arrangements. Also, such contractual arrangements may reflect the distributional preferences of government.

Following UNIDO (1972) these preferences can be quantified through the distributional weights which, in this case, also take into account the contractual arrangement and the rental emerging therefrom. Let the government charge a rental r per acre of forest land leased out to society. The incremental incomes to the government (T_1) and society (T_2) as a result of sharing the management of forest land as compared to the situation before the contracting are expressed as:

$$T_1 = P, Q_2 + rR_2 - \bar{W}L_1 - d_1$$

$$T_2 = P, Q_2 - rR_2 - \bar{W}L_2 - d_2 - C(S) \qquad (5)$$

where p stands for per unit competitive price of forest produce, and d_1 and d_2 represent incomes from forest before the sharing arrangement to the government and society respectively. Here the rental r can also be interpreted as an effective redistributive instrument of the government. Equations (1) to (5) sketch the structure of the village economy in the management of CPR with sharing arrangements and participation. Using this description of the village economy, norms of optimal sharing of CPR and the rental to be contracted shall be deduced. Pareto optimal sharing arrangement between the government and society can

be derived by maximising the joint incremental income defined as:

$$T_1 + T_2 = T \tag{6}$$

Denoting

$$P\frac{\partial Q_1}{\partial L_1} = m_{11},\quad P\frac{\partial Q_2}{\partial L_2} = m_{21},\quad P\frac{\partial Q_1}{\partial R_1} = m_{12},\quad P\frac{\partial Q_2}{\partial R_2} = m_{22},$$

$$P\frac{\partial Q_1}{\partial S} = m_{1s},\quad P\frac{\partial Q_2}{\partial S} = m_{2s},\quad \text{and given}\quad \frac{\partial R_1}{\partial R_2} = -1$$

the first order conditions for maximising T with respect to R, R, L and L can be written after some simplifications as:

$$m_{12} = (m_{1s} + m_{2s} - C)\frac{\partial S}{\partial R_2} + m_{22} \tag{7}$$

$$m_{11} = \bar{W} = m_{21} \tag{8}$$

Value of marginal productivity of the resource held by the government be equal to that held by the village society plus the net marginal productivity of people's participation. Values of marginal productivities of labour in governmental as well as village operations be equal to the given wage rate. Equations (7) and (8) constitute the conditions for Pareto efficient sharing of forest management by the government and village society. The set of equations (1) to (8) can be solved for Pareto optimal values of Q^*_1, Q^*_2, L^*_1, L^*_2, R^*_1, R^*_2 and T^*. While optimal sharing of CPR and employment of labour are thus resolved, the question of

distributing the total incremental income T^* between the government and the village society can be resolved only after accounting for the distributional preferences of the government and the presence of people's participation as a production externality. With a concern for welfare of village societies, the rental r is an effective instrument to redistributive incremental income (T^*) due to preservation in favour of them. As can be seen from equation (5), such a redistribution is possible because a lower r implies increased share of incremental income to society for given levels of p, w, Q^*_1, Q^*_2, L^*_1, L^*_2, R^*_1, R^*_2, d_1 and d_2. Suppose the welfare function of the economy consisting of the government and village society is of the form,

$$W = (T_1^{1-e} + T_2^{1-e})/(1-e) \qquad (9)$$

where e is the elasticity of social marginal utility of incremental income or inequality eversion parameter of the government. Maximizing (9) with respect to r subject to the constraint (6), for given optimal T^* yields the following condition:

$$T_1 = T_2 \qquad (10)$$

The Pareto optimal production and distribution of gains from sharing the management CPR with people's participation are illustrated in Diagram-1. Straight line AB represents equation (6) at the Pareto efficiency level. The condition (10) stating that incremental income gains be shared equally is satisfied at point E^*, at which the slope of welfare function (9), $(T_1/T_2)^{-e}$ is equal to that of Pareto

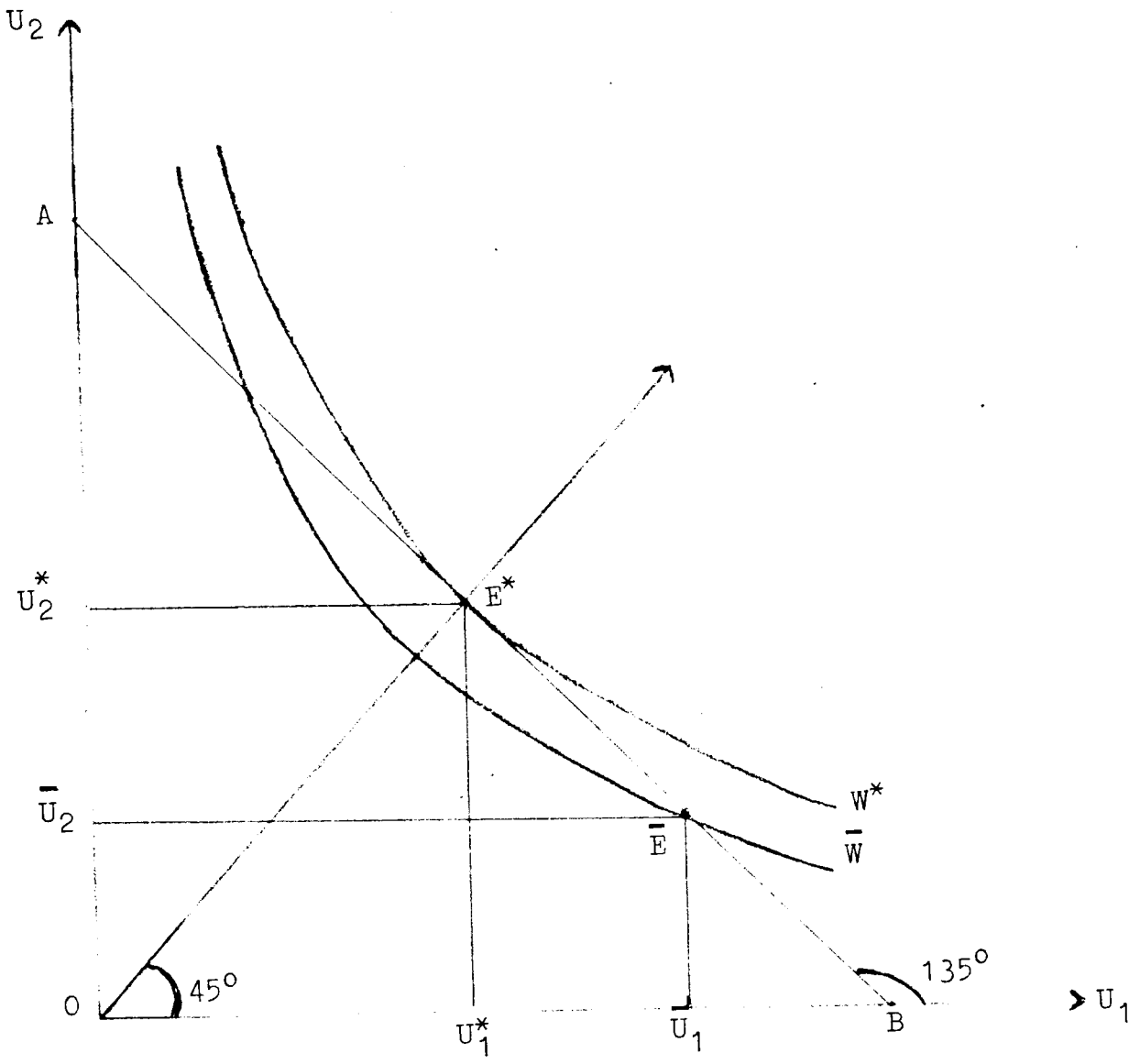

Diagram - 1

efficiency locus (-1) as implied by the condition (10). Furthermore, the welfare maximization condition (10) gives the optimal rental r as:

$$r = (P(Q_2^* - Q_1^*) - \bar{W}(L_2^* - L_1^*) - (d_2 - d_1))/2R_2^* \qquad (11)$$

In actual practice, it may not be possible to attain the first best welfare maximizing point like E^* with optimum per acre rent charged by the government as given by equation (11). The government may have a constraint on incremental revenue it can earn from forest resources or it may have apart from income distribution, other economic objectives like growth. It may not prefer equal sharing of incremental income from preservation as implied from condition (10). Given a higher propensity to save of the government such an arrangement may contribute negatively to the savings in the economy. Let the constrained revenue of the government be T_1 which is higher than T^*_1. Then, under Pareto optimal production strategy, the maximum incremental income retainable by the society is $\bar{T}_2$ such that $\bar{T}_1 + \bar{T}_2 = T^*$. Clearly, $\bar{T}_2 < T^*_2$. The maximum welfare attained is $\bar{w}$ which is less than w^*. The rental to be charged r is also higher than r^*. Situations like this explain the trade-off between income distribution and revenue and other economic objectives of the government. Therefore, the economic evaluation of people's participation in preservation has to be made given the contractual agreement between government and people's society as represented by point $\bar{E}$ in Diagram-1. For values of incremental revenues; T_1 and T_2 of the government and the society, the corresponding social marginal utilities are obtainable from (9). Assuming the social marginal utility of the government as numeraire, the

relative social marginal utility of the society can be expressed as:

$$b_1 = 1,\ b_2 = \partial W/\partial T_2 \Big/ \partial W/\partial T_1 \qquad (12)$$

Here b_2 represents the distributional preference of the government in favour of the society. Hence it can be interpreted as an income distributional weight for incremental incomes enjoyed by the society. In the unconstrained situation since welfare maximization requires $T_1 = T_2$, $b_1 = b_2 = 1$ at E^* in Diagram-1. In other words, income distributional preferences are identical. However, distributional weights consistent with a constraint on governments revenue fixed at T_1 are:

$$b_1 = 1,\ b_2 = (\bar{T}_1/\bar{T}_2)^e$$

Therefore the distributional weight for the society is greater than unity for $T_1 > T_2$. Since incremental incomes (T_1 and T_2) consistent with Pareto optimality are functions of r only, b_2 becomes indirectly a function of the rental per acre of forest land charged by government[4]. Therefore, the distributional weights on the income of society depends upon the contractual rental r, the elasticity of social marginal utility (inequality aversion parameter of the governments, e), the production levels of the government and society (Q_1, Q_2) and finally the production externality measure (S).

3. A Concept of Income to Society from Participation

People's participation as a production

externality not only enters the production functions of government and society in the management of forest resources, but also contributes to increased incomes of village people by augmenting production from agricultural and dairying activities, rope making and other small scale industrial activities. Let the production function of i^{th} agricultural or industrial activity be

$$Q^i = F^i(K^i, L^i, R^i, M^i, S), \quad \partial Q^1 / \partial S \geq 0 \qquad (14)$$

$$i = 1, 2.....N.$$

Where K^i, L^i, R^i and M^i are capital, labour, land and material inputs, respectively in the i^{th} activity.

The generalized income of people's society can be now defined as:

$$T_2 = (P^1 Q^1 - WL_2^1 - rR_2^1 - C(S) - d_2) + \sum_{i=2}^{N} (p^i Q^i - \bar{w}L^i - m^i M^i - kK^i) \qquad (15)$$

where, p^i, m and k represent, respectively the competitive prices of i^{th} product, material inputs and capital services, and superscript 'i' against a variable represents variables relevant for the activity of CPR management. The conditions for Pareto optimality now become,

$$m_{11}^1 = m_{21}^1 = m_1^i = \bar{w}, \quad i = 2,.....N \qquad (16)$$

$$m_{21}^1 = m_{1s}^1 + (m_{2s}^1 + m_s^2 + .. m_s^N - c) \partial S / \partial R_2 + m_{22}^1 \qquad (17)$$

Again welfare maximization as in Section II yields,

$$T_1 = T_2 \qquad (18)$$

The optimal rental therefore becomes

$$p^1(Q_2^{*1} - Q_1^{*1}) + \sum_{i=1}^{N} p^i Q^{*i} - \bar{w}(L_2^1 + \sum_{i=2}^{N} L_i^1 - L_i^1)$$

$$r^* = \frac{- m \sum_{i=2}^{N} M^i - k \sum_{i=2}^{N} k^i - (d_2 - d_1)}{2R_2^{*1}} \qquad (19)$$

4. Social Benefits-Cost Analysis of Preservation Investment with People's Participation

The scenarios, of village economies with and without people's participation are relevant for the identification of benefits and costs of preservation. In Section I, investment costs of preservation are defined as those in the creation of community and private assets that provide incentives for people's participation (I_1) and direct investment through - conventional programs of government (I_2). With these investments, community assets are created in the form of irrigation dams and systems of water distribution and so on. Governmental investments through conventional conservation programs like aforestation, construction of check dams to arrest soil erosion etc., can be there even in a situation of without people's participation but is likely to be ineffective.

The beneficiaries of preservation through people's participation may be categorised as households in the village economy, village society and government. The problem can be simplified by assuming that village society and households constitute only one group of beneficiaries

It shall be assumed, further that T_1 the incremental income accuring to the government results in public expenditures meant to increase the average per capita income at the national level[5]. Society's net income T_2 on the other hand, implies an increase in income generated in the project area. In an empirical sense, the income distributional weight appropriate for the income class h in the project area can then be approximated[6] by,

$$b_h = \left(\frac{\bar{I}}{I_h}\right)^{(1-v)e} \qquad (23)$$

where

I — average per capital income class containing national per capita

I_h — average per capita income of income class h of the project region, h = 1,2.....H

e — inequality aversion parameter of the government

v — elasticity of private marginal utility of income.

Here I and I_h are simply linear transformations of T_1 and T_2 respectively. To recapitulate from Section III, the distributional preference of the government as reflected through b_h is the outcome of the contractual arrangement between the government and village societies. Therefore, distributional weights may depend upon r, the rental per acre of forest land, and other parameters.

People's participation in preservation with watershed management projects have two components: (a) investment in the creation of community and private assets defined to include government and private investment and conventional investment in conservation programmes, (b) the creation of village 'societies' to ensure the accrual and the desired inter-household distribution of the benefit from the preservation. Each component has its own set of benefits and costs. Further, these benefits and costs may accrue to the households, the village 'society' and to the government.

Block Diagram-2 lists the different kinds of investments, the groups to whom the benefits (net of costs) accrue and the costs incurred therein. Investments by the government in water storage mechanisms and conventional conservation programmes are supplemented by societal investments in plantation, and other community assets such as schools and roads. People's participation creates institutions that enable the benefits from these investments to accrue to households, village society and the government. These institutions create mechanisms for distribution of water, stall feeding of cattle and ensuring protection of forest cover. A part of the cost incurred in the building up of these institutions may have to be borne by the groups of beneficiaries. Existence of water rights, for all households, for instance, shall result in inter-household transfers of income, whereas stall feeding shall imply labour time spent in fetching fodder from the forest. Both these transaction costs are borne by the households in the village. These households may also contribute towards the creation of community assets. The government benefits from these institutions to the extent that expenditure on

PEOPLES' PARTICIPATION IN PRESERVATION & MANAGEMENT OF RESOURCES

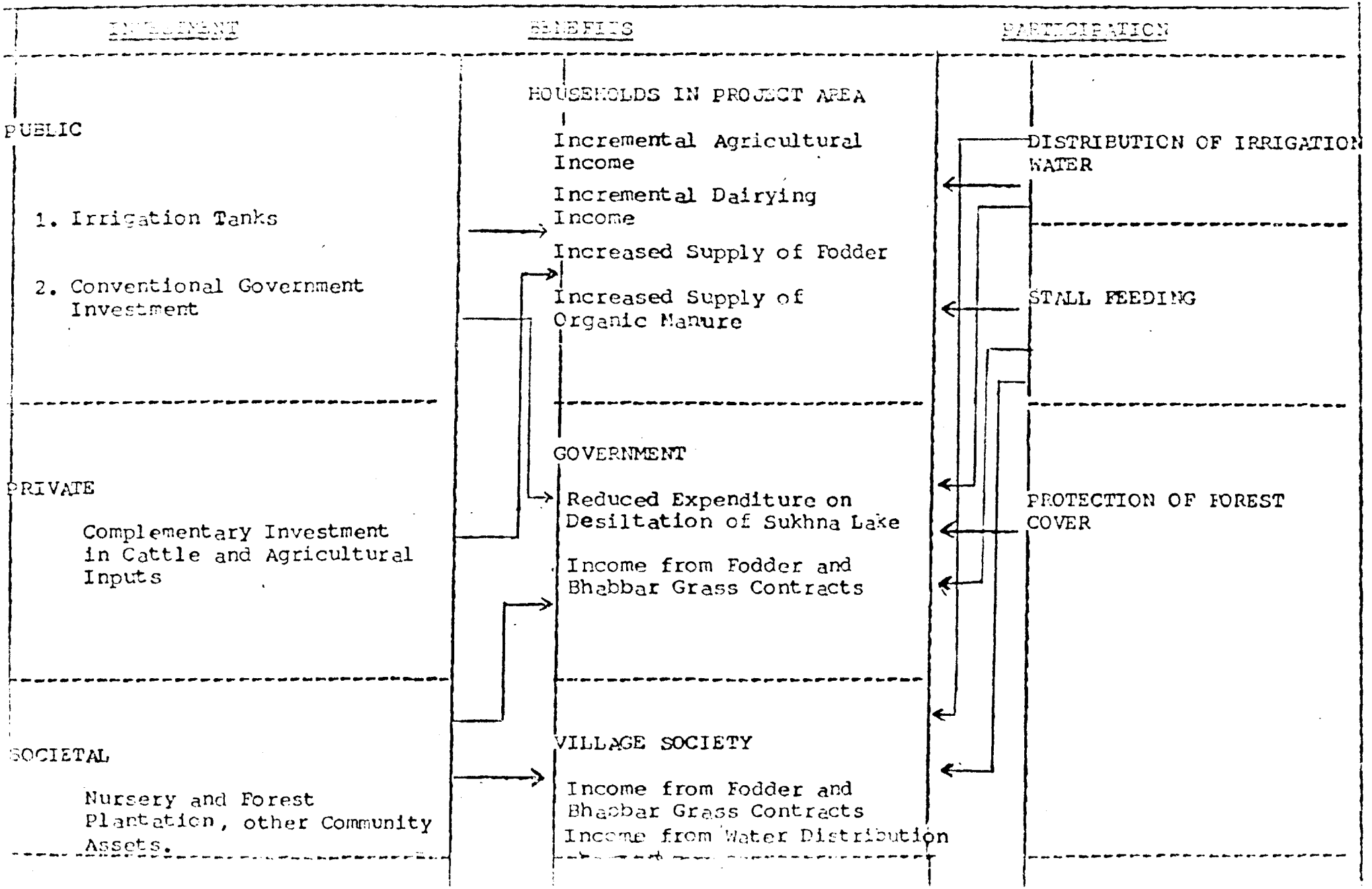

DIAGRAM-2

downstream desiltation and policing of forests is reduced. It may also get an incremental income from its contractual arrangements with village societies for bhabbar and fodder grass[7]. Additionally, the costs of training and organisational effort required for the creation of these institutions may be borne by the government (or by some other outside agency). The diagrametic representation in Block 1 of Diagram-2 illustrates all these inter-related links between agencies, beneficiaries and institutions. The final outcome of any watershed management project depends on an evaluation of such components individually and the net effect of all of them put together.

5. Estimation of Benefits and Costs

In the framework of social benefit-cost analysis, a village is considered to be a project area. The project itself consists of direct public investments in the construction of irrigation tanks and maintenance of forest ranges. The private investments include those on cattle, purchase of agricultural equipments, rope making machine etc. Indirectly, the community is investing in a number of ways through 'participation'. The next result of all these is the overall development of the village. Three villages, Sukhomajri, Dhamala and Jattanmajri, were selected from the cluster of surveyed villages with a view to represent the cases of 'with the project' with a diverse nature of participatory institutions, the timing of investments, and the characteristics of villages. Sukhomajri was included in the sample as it was the first village in which investments were made and participatory institutions evolved. Dhamala and Jattanmajri were selected as they chose to follow the Sukhomajri model though differing from Sukhomajri in a number of crucial respects[8]. The 'without project'

situation was represented by Prempura, a village where till 1986 no investments in community assets were made and no participatory institutions existed. It was therefore treated as the benchmark for the estimation of incremental income to households.

Irrigation structures were created in Sukhomajri, Dhamala and Jattanmajri during the ten year period 1976-86 with a total cost of Rs. 12,43,309 (at 1986 prices). The details regarding these are given in Tables 1 and 2[9]. Most of this investment cost was met by the Forest Department of Haryana Government (HFD) and Indian Council of Agricultural Research (ICAR). The total command area of irrigation dams is 114.5 hectares. Details of investment in conventional programmes for preservation in Sukhana lake are are provided in Table 3. Total investment through these programmes during the period 1976-77 to 1978-79 is Rs. 78,41,000 at 1976-77 prices.

The annual (recurring) costs of preservation in each village consist of cost of maintenance of irrigation structures and supply of water, both incurred by the village society and expenditure on the forest range incurred by the Forest Department. An independent study by SPWD provided estimates of annual cost of desilting tank S-2 of Sukhomajri. Using this estimate as an average norm and information on the capacity of irrigation tanks, the annual total costs of desilting the irrigation tanks in each village, are estimated. Recurring cost on distribution of irrigation water is estimated using data from Sukhomajri.

The Forest Department of Haryana incurs an annual expenditure of Rs. 25,000 on the forest range extending over three villages Lohgarh, Dhamala and

Sukhomajri. These are conventional investments on soil conservation including policing and plantation. The shares of Dhamala and Sukhomajri in this expenditure are estimated on the basis of forest area allocated to each village[11]. In the case of Jattanmajri, the same has been estimated using the average per acre expenditure at the state level.

Next to the government investment and the associated recurring cost, are the private investments by the households which also contributed to the overall social benefits. Field observation shows that the most important component of this is investment in cattle. Table 4 gives the value of the cattle stock in the three villages (at 1986 prices) for 1977, 1979, and 1981 as compiled from village-level benchmark surveys conducted in these years[12]. Cost of incremental livestock between 1986 and the benchmark years are to be accounted in estimating the net income from dairying.

The indirect costs in the project area consist of cost of maintaining water distribution, stall feeding, or forest protecting through the institution of community participation which are far more difficult to quantify. There is some evidence that in the initial years in Sukhomajri (and to a certain extent even in 1986 in Jattanmajri) intense conflicts arose on each of these issues. It is recorded that outside experts played a key role as catalysts in resolving these conflicts. These institutional aspects shall also be included in the evaluation.

The sum total of governmental, private and societal costs (both capital and recurring) in water harvesting mechanisms and the evolution of participatory

institutions has resulted in benefits that accrue to three sets of people, households in the village, the village society and the government.

Income from different sources to people in the villages surveyed (at 1986 prices) are presented in Table 5. Prempura has the lowest per capita income (i.e. Rs. 919.4) while Jattanmajri has the highest (i.e. Rs. 3530)[13]. Incomes from agriculture is estimated at Rs. 192.56 per bigha of cultivated land in Prempura. With this average as a benchmark (i.e. case of without the project) and taking account of total cultivated land in each village, income from agriculture in a situation of 'without people's participation' is estimated as Rs. 1,05,715, 96,858 and 63,930 for villages Sukhomajri, Dhamala and Jattanmajri, respectively. On the basis of estimated incomes from our survey data[14] incremental incomes from agriculture attributable to people's participation in the presence of governmental investment in irrigation structures are estimated as given Table 5.

Income from dairying has two components[15]. The first measure of incremental income is due to increase in the number of animals for a well preserved forest that can provide fodder is necessary for sustaining an increased cattle population. The second component is the increased productivity of cattle, due to more availability of fodder. To determine the magnitude of the first component net income per rupee worth of cattle wealth is estimated. on the assumption that in the absence of the watershed management activities the cattle wealth would have remained constant at the 1977 level for Sukhomajri and Dhamala, and the 1979 level for Jattanmajri the 'without project' cattle wealth for the three villages are estimated (at 1986 prices) to be

institutions has resulted in benefits that accrue to three sets of people, households in the village, the village society and the government.

Income from different sources to people in the villages surveyed (at 1986 prices) are presented in Table 5. Prempura has the lowest per capita income (i.e. Rs. 919.4) while Jattanmajri has the highest (i.e. Rs. 3530)[13]. Incomes from agriculture is estimated at Rs. 192.56 per bigha of cultivated land in Prempura. With this average as a benchmark (i.e. case of without the project) and taking account of total cultivated land in each village, income from agriculture in a situation of 'without people's participation' is estimated as Rs. 1,05,715, 96,858 and 63,930 for villages Sukhomajri, Dhamala and Jattanmajri, respectively. On the basis of estimated incomes from our survey data[14] incremental incomes from agriculture attributable to people's participation in the presence of governmental investment in irrigation structures are estimated as given Table 5.

Income from dairying has two components[15]. The first measure of incremental income is due to increase in the number of animals for a well preserved forest that can provide fodder is necessary for sustaining an increased cattle population. The second component is the increased productivity of cattle, due to more availability of fodder. To determine the magnitude of the first component net income per rupee worth of cattle wealth is estimated. on the assumption that in the absence of the watershed management activities the cattle wealth would have remained constant at the 1977 level for Sukhomajri and Dhamala, and the 1979 level for Jattanmajri the 'without project' cattle wealth for the three villages are estimated (at 1986 prices) to be

Rs. 4,44,840, Rs. 3,01,089 and Rs. 2,52,316. Taking the 1986 cattle wealth into consideration, incremental income due to the effect of the project on cattle population is estimated as Rs. 37,392, Rs. 62,911 and Rs. 25,934 for Sukhomajri, Dhamala and Jattanmajri, respectively. After taking account of the differential productivity of the animals between the with and without project situations[16] the total incomes accuring to household on account of an expanded and more productive cattle population are estimated at Rs. 40,080, Rs. 69,117 and Rs. 38,198 for the three village economies.

Stall feeding is the most significant of the participatory institutions created as a result of the project. It implies that cattle do not graze in the forest. The fodder is cut and fed to them thereby implying a resource cost of the labour used in fetching it. On the other hand the increased collection of dung cake is an added gain. The consumption requirements[17] of the incremental cattle are treated as an approximation to the additional fodder collection. Further, the market price of fodder is Rs. 35 per quintal and the resource cost of collection is estimated at Rs. 25.71 per quintal[18]. The savings in fodder purchase cost therefore, are Rs. 24,338, 22,843 and 21,942 for Sukhomajri, Dhamala and Jattanmajri, respectively. The net benefits after paying rentals of Rs. 11,581 4,912 and 5,672 to the government[19] are Rs. 12,757, 17,931 and 16,270 for the three village economies[20].

The value of increased dung collection is estimated at Rs. 37.40 per animal annually[21]. Given the milch cattle population, indirectly the total saving in fertiliser purchase costs for Sukhomajri, Dhamala and

Jattanmajri are Rs. 7031, 6470 and 4413 per year, respectively. The total benefits from stall feeding to the three villages therefore, are Rs. 19,788, 2,401 and 20,683.

The village 'societies' of each of these villages (stated as water-users' associations) gradually took on other activities such as contracting forest land from the government, managing fishing in the irrigation tanks and so on[22]. While the 'society' does not collect any surplus from households for distributing irrigation water, the creation of water rights is its prime institutional contribution. This is a necessary component for the accrual of additional agricultural income the estimates of which can be assumed to have taken account of this institutional contribution.

Contracting forest land from the government for bhabbar grass is an important activity of the society. Bhabbar grass contracts were obtained by all three villages in 1986. The anticipated profits from selling it to the nearby paper mill are about one-third of the amount paid for the contract which can be treated as societal income from bhabbar grass harvesting.

Fishing was started in the irrigation tanks in Sukhomajri and Dhamala. After some abortive attempts at managing it by society[24], it was contracted out, resulting in a small income flow of Rs. 1,20 and Rs. 1,800 to the two village societies.

An externality benefit of creating participatory institutions in the project area accures to the Chandigarh Administration in the form of decreased expenditure on desilting the Sukhana lake[25]. On the basis of data on

decreased annual flow of sediment into the lake and cost of desilting a hectare meter of sediment the total saving in the annual desilting cost is estimated at Rs. 7,648 million[26]. The contribution of each village to this saving is estimated in proportion to the catchment of the lake under control of that village. It amounts to Rs. 31,712, Rs. 34,371 and Rs. 13,329 for Sukhomajri, Dhamala and Jattanmajri, respectively.

Income to the government from leasing out forest land to the village society is also shown in Table 5. This may or may not be included as a net benefit of the project depending on the situation in the 'without project' case. If the government was getting a similar amount from private contractors, there is no net benefit to the government (except perhaps in the income distribution sense).

Table 6 gives the incremental income accruing to different sets of beneficiaries. Between the households and village society, about 71 to 82 per cent of the net benefits accrue to this region. Externalities accruing to the government comprise 18 to 29 per cent of the net benefits[27]. The estimation of benefits to the project region has directly or indirectly allowed for the impact of participatory institutions. Agricultural and dairying incomes could not have increased if soil erosion had continued unabated. The contribution of the society in enforcing stall feeding, contracting forest land from the government and creating water rights has therefore to be included in the evaluation of the investments in the project' villages. The present analysis attempts at such an evaluation, the results of which are presented in Table 7.

The net present benefits at a social rate of

discount of 12 per cent and the internal rates of return are tabulated in Table 7 for alternative cases at three stages of cost-benefit analysis. At the first stage, all inputs and outputs are valued at market prices; at the second stage, labour and capital are valued at shadow prices; and at the third stage distributional weights calculated from income distribution patterns in the project region are used[28].

The internal rates of return for all villages are greater than 12 per cent, the cut-off social rate of discount usually adopted by Indian Planning Commission. The rates of return for Dhamala and Jattanmajri are higher than those for Sukhomajri, perhaps because the initial investment was higher in Sukhomajri. But, whereas shadow pricing of labour and capital reduces the IRR for Suykhomajri by about 5 percentage points, the corresponding decreases for Dhamala and Jattanmajri are by 12 and 8 percentage points respectively. The results for the latter two villages are also more sensitive to the use of distributional weights. The IRR's increase from 24.5-25.0 to 48.5-49.0 for Dhamala and 27.5-28.0 to 41.5-42.0 for Jattanmajri. For Sukhomajri the IRR, after using distribution weight is in the range 18.0-18.5. Though, the range in which the IRR lies is lower for Sukhomajri than for Dhamala and Jattanmajri, it is important to note that 81.5 per cent of the benefits from the project each year accrue to the village economy in Sukhomajri. This is perhaps on account of the higher level of development of participatory institutions in Sukhomajri.

While the evaluation of the participatory institutions may be claimed due to initial training, organisational and motivational inputs provided by the Ford Foundation, CSWCRTI and the government in general, its

direct effects are two namely, reduced desilting costs in the irrigation tanks and changed rental income earned by the government in forest leasing. The importance of all these three aspects is tested individually for the Sukhomajri situation. The corresponding B/C ratios and IRR for Sukhomajri are presented in Table 8.

Desilting of irrigation tanks, is done cooperatively by the village people. In the absence of such a community effort, investment in tanks would have to be undertaken at periodic intervals[30]. On the assumption that this reinvestment would need to be undertaken in every six years, it is found that, the IRR falls from the range of 14.5-15.0 to 11.5-12.0, the difference between the two is the direct indication of contribution from participation. This numerical estimate does not, of course, purport to measure the full implication of a participatory approach.

One of the assumptions made in the above analysis is that income from forest lease is a net benefit to the government. This benefit would not accrue if the same income were obtained from a private contractor in the 'without project' situation. In actuality, this income would, however, be lower due to ineffective government policing and the consequent appropriation of forest produce by the people. The net income from contracting out forest land could then very from 0 to the amount of the contract. Even if government's net benefit on this account is zero the IRR falls only by 0.5 percentage points, thereby implying that governments revenue benefit is not crucial in this participatory development model.

The role of training, motivating and promoting participatory institutions as carried out by government and

outside agencies is more difficult to account for. The official of the CSWTRI and two experts working in the area over a period of four to five years played a catalystic role. The cost of hiring these people was considerable[32]. While the initiation began only in Sukhomajri, the spread effects of it was felt all over the catchment. Villages such as Dhamala, Jattanmajri which followed the Sukhomajri model were also benefiting, in part, for it. To test for the relevance of institution creation, expenditure incurred on these specialised personnel and training are divided equally-over all the sixteen villages[32]. In the case of Sukhomajri, with this catalystic investment costs included, the IRR falls from 14.5-15.0 to 9.0-9.3. Though it may appear that this is less than the cut-off social role of discount of 12 per cent, some qualifications have to be made. Recent literature on environmental projects maintains that the cut-off rate of discount for them should be less than that for industrial and other developmental projects. It has even been suggested that benefits from projects that conserve resources for the future should not be discounted at all. The above results for Sukhomajri should be interpreted in the light of these observations.

The 'Sukhomajri model' has been examined in a number of studies[33] some of which are descriptive analyses illustrating the issues involved. Seckler and Joshi (1980) and the SPWD (1986) study carry out economic evaluations on the lines of the social benefit-cost analysis. The scope and results of these studies seem to vary from those of the present study.

Seckler and Joshi (1980) carried out their analysis in the very early stages of the project when irrigation and the benefits accruing therefrom seemed the

most significant component. Stall feeding and other participatory institutions which helped to consolidate and sustain the benefits from forest preservation have not been evaluated.

The SPWD study (1986) is more comprehensive and it accounts for additional wheat, grass, timber, fish and milk output and reduced soil erosion. Investment costs considered do not include conventional government investment in forest preservation or the resource cost of the additional labour used in implementing stall-feeding decisions. It is because of this that the B/C ratio at market prices obtained therein is higher than that obtained in the present study[34]. Accounting for the cost of outside experts is done in a different manner[35]. This brings down the B/C ratios considerably[36].

The present study also identifies the beneficiaries by categories. Further, it uses distributional weights which are derived from parameters emerging out of income distribution in the project region and government's contractual arrangements with village societies. It also spells out clearly the role of participatory institutions as essentially complementary to the investment in creation of community assets and in conventional programmes of preservation. Therefore, clearly the evaluation of the project with participation as dealt here is much more complete and representative of actual scenario, for which comparative study is on the avail.

Conclusion

Economic evaluation of people's participation in the management of forest resources has thrown up some new

problems which are not common in conventional cost-benefit analysis. An attempt is made to provide a methodology to take into account the effects of production externalities and complementary relationship between preservation and private assets owned by the households on the social benefits from the forest conservation.

The comparative cost-benefit analysis of investments in watershed management of villages Sukhomajri, Dhamala and Jattanmajri with varying degrees of participation has provided some important policy guide lines. Firstly, preservation investments with even a minimal rate of participation by the people has generated a significantly high rate of benefits (as compared to the situation of with out people's participation). Secondly, in the initial phases of participation when participation rate is much less, the benefits seem to accrue only to a few households owning assets complementary to preservation. With the scale economies peculiar to this case, the rate of returns in preservation is extremely high. However, with participation covering all sections of people (as is the case in Sukhomajri with more equitable distribution of private assets complementary to preservation) the spread effect of benefits reduces the overall rate of return. Thirdly, while at higher and higher rates of participation, the rate of return is lower, the benefits seems to be distributed more equitably. Finally, the overall development of the village economies is much more robust and harmonious with participation.

TABLE 1

General Information on Irrigation Structures in Sukhomajri, Jattanmajri & Dhamala

	Sukhomajri				Jattanmajri		Dhamala	
	S_1	S_2	S_3	S_4	J_1	J_2	D_1	D_2
Year of construction	1976	1978	1979	1984	1979	1979	1982	1983
Catchment area (hectare)	4.30	9.10	1.50	2.63	2.90	4.80	16.00	3.20
Storage capacity (hectare meters)	0.80	5.50	0.93	1.93	1.63	2.33	6.67	-
Net water availability (hectare meters)	N.A.	3.70	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Command area (hectares)	6.50	20.00	2.00	9.00	10.00	14.00	38.00	15.00
Total cost (Rupees)	72,000	2,47,000	22,000	1,50,000	27,000	35,000	1,25,000	1,00,000
Executive Department	ICAR	MAR	ICAR	HFD	HFD	HFD	HFD	
Cost in 1986 prices	159000	460309	41000	173000	50000	65000	171000	124000

Notes: - NA implies not available

S_1, S_2, S_3, S_4 are the four reserviors in Sukhomajri, J_1, J_2 the two in Jattanmajri and D_1, D_2, the two in Dhamala.

TABLE 2

Costs of irrigation structures in Sukhomajri, Jattanmajri & Dhamala
(Rs. in 1986 prices)

	Sukhomajri				Jattanmajri		Dhamala	
	S_1	S_2	S_3	S_4	J_1	J_2	D_1	D_2
a) Basic Construction Work	76590	221768	19749	83334	24086	31311	82371	59730
i) Domestic Material	16218	46963	4182	17646	5100	6630	17442	12648
ii) Skilled Labour	3976	11554	1025	4326	1250	1625	4275	3100
iii) Unskilled Labour	56396	163251	14542	61362	17736	23056	60654	43982
b) Watershed Treatment	5150	14909	1327	5606	1622	2107	5054	4018
i) Domestic	2575	7454	663	2803	811	1054	2770	2009
ii) Skilled	-	-	-	-	-	-	-	-
iii) Unskilled	2575	7455	664	2803	811	1055	2770	2009
c) Land Levelling	25760	74544	6642	28026	8100	10530	27702	20088
i) Domestic	5152	14909	1329	5606	1620	2106	5540	4018
ii) Skilled	-	-	-	-	-	-	-	-
iii) Unskilled	20608	59635	5313	22420	6480	8424	22162	16070
d) Water Conveyance System	51500	149088	13282	56034	16192	21052	55387	40164
i) Domestic	38621	111816	9961	42020	12145	15790	41537	30120
ii) Skilled	2575	7454	663	2804	810	1052	2769	2009
iii) Unskilled	10304	29818	2658	11240	3237	4210	11081	8035
Total cost (in 1986 prices)	159,000	460,309	41000	173000	50,000	65000	171000	124000

TABLE 3

Investment Through Conventional Governmental Conservation Programmes in Sukhna Lake Area

Area-hectare; Amount-Lacs rupees

Sl. No.	Particulars	1976-77		1977-78		1978-79		1979-80		Total	
		Area (Ha)	Amount (lacs)	Area (ha)	Amount (lacs)	Area (ha)	Amount (lacs)	Area (ha)	Amount (lacs)	Area (ha)	Amount (lacs)
1.	Agricultural Land										
	Trenching & terracing	-	-	200	6.00	244	7.32	200	6.00	644	19.32
	Tree cum pasture land	-	-	75	0.75	50	0.50	-	-	125	1.25
2.	Forest Land										
	a) Severely eroded watershed	50	1.00	275	5.50	200	4.00	200	4.00	725	14.50
	b) Severely eroded partially treated	50	0.75	300	4.50	300	4.50	270	4.05	920	13.80
	c) Eroded partially treated	25	0.25	250	2.50	250	2.50	235	2.35	760	7.60
	d) Severely eroded fully treated maintenance	-	-	45	0.10	-	-	-	-	45	0.10
	e) Eroded fully watershed management	-	-	462	0.25	400	0.25	1	0.035	862	0.50
3.	Choe terracing work	-	-	1	0.035	1	0.035	1	0.035	3	0.105
4.	Construction of i) dam for storing runoff water & its utilisation for agriculture.	-	-	1	1.00	-	-	-	-	1	1.00
5.	Stabilising the slopes of diversion channel	-	-	-	1.00	-	-	-	-	-	1.00
6.	Sediment Monitoring station	-	-	-	0.50	-	1.00	-	0.50	-	2.00
	Total	125	2.0	1607	22.135	1444	20.105	905	16.935	4207	61.175
7.	Adding 20% for establishment and tools & plants	-	0.40		4.427		4.021		3.387		12.235
	Grand Total	125	2.40	1607	26.562	1444	24.126	905	20.322	4207	78.410

TABLE 4

Cattle Wealth in Sukhomairi Dhamala & Jattanmairi

Year	Sukhomairi						Total* value
	Cow		Buffalo		Goat		
	No.	Value	No.	Value	No.	Value	
1977	28	29904	136	414936	89	-	444840
1981	16	17088	149	454599	50	-	471687
1986	6	6488	182	555282	10	-	561690

	Dhamala						Total* value
	Cow		Buffalo		Goat		
	No.	Value	No.	Value	No.	Value	
1977	21	22428	111	338661	-	-	301089
1986	12	12816	161	491211	5	-	504027

	Jattanmairi						Total* value
	Cow		Buffalo		Goat		
	No.	Value	No.	Value	No.	Value	
1979	2	2136	82	250182	2	-	252318
1986	2	2136	116	353916	2	-	356052

Notes: 1. Average price of buffalo and cow is used for valuation of cattle stock in all years in all villages. The average price is Rs.1,068 and Rs.3,051 for a cow and a buffalo respectively (at 1986 prices).

2. In valuation of cattle population the value of goats is not included.

3. All values are in rupees.

TABLE 5

Incremental Annual Income from the Project

(in Rs)

Beneficiary Group	Income stream	Sukhomajri	Dhamala	Jattanmajri
1. Households	1.1 Agriculture	1,80,187	24,385	72,203
	1.2 Dairying	40,080	69,117	38,198
	1.3 Staff-feeding			
	1.31 Fodder production	12,757	17,931	16,270
	1.32 Organic manure	7,031	6,470	4,413
	1.3	19,788	24,401	20,683
2. Village Society	2.1 Fodder & bhabbar grass contracts	3,667	3,667	3,500
	2.2 Water distribution	Neg.	Neg.	Neg.
	2.3 Fisheries	1,200	1,800	---
3. Government	3.1 Fodder[1] and bhabbar grass contract	22,581	15,912	16,172
	3.2 Desiltation of Down-stream lake	31,712	34,371	13,329
TOTAL		2,99,215	1,73,653	1,64,065

Notes : 1. This component may or may not be included in benefits depending on the situation in the "without project" situation. See text.

TABLE 6

Salient Features of Sukhna Lake

1. Total catchment area (hectare) (hectare)	Forest -	3214
	Others -	1013
	Total -	4227
2. Average annual inflow of sediment (hectare)		
	1958	40 ham
	1979-82	4.4 ham
	1982-	1.76 ham
3. The maximum depth of the lake during summer of 1982		2.1 m
4. Water spread area during the summer of 1982		118 ha
5. Average annual water yield in the lake during 1979-82	Forest catchment	207.3 ham
	Others	150.0 ham
	Total	357.3 ham
6. Reduction in annual inflow of sediments in the lake due to preservation programmes since 1979		(40-1.76) ham
7. Cost of desilting a hectare metre sediment from the lake		Rs.0.2 million
8. Saving in annual cost of desilting the lake due to preservation		(40-1.76) x 0.2 Rs.7.648 million

TABLE 7

Economic Evaluation of Participation

	Alternative Decision Criteria		
	NPSB at 12%	BC ratio at 12%	Range of IRR
Stage-1 - at market prices			
Sukhomajri	398	2.06	19.0-19.5
Dhamala	287	2.76	36.5-37.0
Jattanmajri	313	3.80	35.5-36.0
Stage 2 - with shadow price of labour and capital			
Sukhomajri	194	1.33	14.5-15.0
Dhamala	190	1.74	24.5-25.0
Jattanmajri	248	2.41	27.5-28.0
Stage 3 - with distribution weights			
Sukhomajri	518	1.89	18.0-18.5
Dhamala	758	5.30	41.5-42.0

TABLE 8

		NPSB	BC ratio	Range of IRR
I with reinvestment in tanks every year	Stage 1	275	1.55	17.0-17.5
	Stage 2	154	0.99	11.5-12.0
	Stage 3	323	1.42	16.0-16.5
II Withoug government contractual income	Stage 1	340	1.90	18.5-19.0
	Stage 2	135	1.23	14.0-14.5
	Stage 3	4589	1.79	17.5-18.0
III With training and organisation costs	Stage 1			11.0-11.5
	Stage 2			9.0-9.5
	Stage 3			12.0-12.5

NOTES

1. See M.N. Murty and Ajit Dasgupta, (1987) for a review of literature related to this problem and also Coase (1960). In this paper forest land shall be invariably used as an example of common property resource.

2. A theoretical model of such a contractual arrangement is developed in Chopra, Kadekodi and Murty (1987).

3. 'Society' is the generic name used here for all village-level institutions that "create and implement rules for the emergence of participatory institutions". They also bargin with government over the management of CPRs.

4. M.N. Murty and R. Ray, (1987a, 1987b) have defined income distributional weights of government as functions of commodity taxes assuming that distributional preferences of government are implicit in commodity taxes levied by it.

5. This assumption is based on the empirical aspect of the functioning of government. All governmental income goes to a central pool and allocations from it are based on centrally determined investment allocations.

6. Government income is treated as numeraire.

7. The magnitude of this income depends on the rental emerging out of the contract.

8. Sukhomajri is a mono-caste village with 95 per cent of the households owning land, percentage owning cattle, whereas Jattanmajri and Dhamala are multi-caste communities with land-owners comprising a much lower percentage of the households.

9. No investment on irrigation tanks was undertaken in Tanda and construction of a tank was started in Prempura in 1986.

10. See SPWD (1986) Fifteen man days are estimated to be required for desilting the tank which has a storage capacity of 5.5 hectare meters. With a market wage rate of Rs. 20/- per day and a shadow price of labour equal to 90 per cent of the market wage, the annual desilting cost of a tank of one hectare metre capacity

comes to Rs. 49.09.

11. The area leased out by the Forest Department to the village societies is treated as forest area falling within the jurisdiction of the village.

12. The surveys for 1977, 1979 and 1981 were conducted by CSWCTRI, Chandigarh.

13. Note that within village income per capita is highest in Sukhomajri (Rs. 1,012.9).

14. See Chopra, Kadekodi and Murty (1988) for incomes accruing to households from different sources.

15. The total incremental income from dairying may be defined as $D=(C_1-C_0)+C_0(a_1-a_0)=C_1a_1-C_0a_0$, where C_0 and C_1 are number of milch animals before and after preservation, a_1 and a_0 are the corresponding net incomes per animal.

16. This is an assumption that will result in an underestimation of project benefits as there is evidence that in all situations of forest degradation, cattle population has decreased considerably.

17. See Table - Chapter-2 of Chopra, Kadekodi and Murty (1988) for a picture of comparative productivities in the with and without project situations.

18. Half a day's labour is required to collect 35 kgs of fodder grass. If the shadow price of labour is 90 per cent of the market wage of Rs. 20 per day, the resource cost of quintal comes to Rs. 25.71.

19. Fodder grass contract is given at Rs. 9.50 per acre. Land leased out is 1219, 517 and 597 acres to Sukhomajri, Dhamala and Jattanmajri. Information obtained from a communication of the Forest Department.

20. This follows from the following model specifications and assumptions. In the case of 'without project': (project being defined as 'stall feeding')

    1. Value of fodder consumption = cpx
       c = fodder per animal
       x = number of animals
       p = price of fodder

    2. Payment to private contractor = Z

In the case of 'with project':

3. Value of fodder collected = cpy
   y = number of animals.

4. Resource cost of labour = l.c.y
   l = unit resource cost of labour

5. Payment to government = G for lease of land.
   Therefore, the net benefit, under and assumption that Z = c.l.x. can be expressed as:
   C (y - x) (p - l) - G.

21. Fertiliser yield from dung is estimated at 30 kgs of nitrogen and 4 kg of phosphorus per animal per year. See Hufscmidt et.al. (1983) pp. 179-180 for the assumption behind this estimate arrived at for a project in the foothills of Nepal. Assuming that dung collection doubled (based on survey and interviews with the village people) the value of 17 kgs of fertiliser equivalent is Rs. 37.40.

22. See Chapter-2 of Chopra, Kadekodi and Murty (1988) for an account of the evolution of these 'societies'.

23. Chopra, Kadekodi and Murty (1988) lists investments in different community assets by the societies of these village.

24. See Chapter-2 of Chopra, Kadekodi and Murty (1988) for an account of the details.

25. This lake provide water supply and recreational facilities to the city of Chandigarh.

26. The average annual inflow of sediment into the lake was reduced from 40 hectare meters in 1971 to 1.76 hectare meter in 1982. Further, the cost of desilting a hectare-meter is Rs. 0.2 million. See Central Soil and Water Conservation Research and Training Institute, Status Report (1982).

27. There is, in this an over-estimate of benefits to government as all income from forest contracts is assumed to be additional income.

28. See the literature on project evaluation, in particular UNIDO (1973). As discussed in section III, the distributional weight would account for the type of contractual arrangement and the resultant rental thereof.

29. See P. 14 above. Village-level income distribution weights are estimated from inter-household distribution of income in each village. A combined income distribution weight is estimated from the pooled data for all villages.

30. Note, for instance in the case of Fakhot (in the Doon Siwaliks) where investment in soil conservation has to be undertaken every few years. See Dhruvanarayana et.al. (1986).

31. See SPWD, (1986).

32. This investment in organisational effort is a kind of lumpy investment for each village.

33. Seckler and Joshi (1980), SPWD (1986), Center for Science and Environment (1985), Mishra and Sarin (1987).

34. 3.11 as against 2.06 in our study.

35. The entire cost is attributed to Sukhomajri. The present study maintains that this is not correct as the spread effects of their initial organisational work were experienced in all the villages of the catchment.

36. After shadow-pricing the B/C ratio is 0.48 at 12 per cent SRD as compared to our value of 1.33.

REFERENCES

1. Atkinson, A.B. (1970). On the Measurement of Inequality, Journal of Economic Theory, 2, 244-263.

2. Central Soil and Water Conservation Research and Training Institute, Status Report, 1982. Dhruvanarayana V.V. et.al. (1986). People's participation in Watershed Management: A good means paper presented at the Seminar on 'Environmental Security and Watershed Management: Relevance of people's participation, Pant Nagar, India.

3. Centre for Science and Environment, New Delhi. The State of India's Environment: A citizen's report, I and II, 1982 and 1985.

4. Chopra, K., Kadekodi G.K. and M.N. Murty (1986). "People's Participation: An approach to the management of common property resources" Mimeographed, Institute of Economic Growth, Delhi-7, India.

5. Chopra, K., (1987). "Social Forestry Projects: An approach to evaluation", Resources Policy, pp. 142-158.

6. Chopra, K., G.K. Kadekodi and M.N. Murty (1988). Participatory Rural Development, Institute of Economic Growth, Forthcoming.

7. Coase, R.H. (1960). "The Problem of Social Cost", Journal of Law and Economics, Vol. 3, pp. 1-44.

8. Hufschmidt, M.M. James, D.E. et.al., (1983). Environment, Natural Systems and Development: An economic evaluation guide, Johns Hopkins University Press.

9. Misra, P.R. and Madhu Sarin (1987). Sukhomajri: A new model of economic development, Business India, November, 16-29, pp. 78-90.

10. Murty, M.N., and Ajit Dasgupta (1987). "Economic Evaluation of Environmental Pollution Abatement: A review of methods", Working Paper, Department of Economics, University of Otago, New Zealand.

11. Murty, M.N. (1987). "Economic Evaluation of Composite Watershed Management in Dryland Regions", ICRISAT, Patancheru P.O., Andhra Pradesh, India.

12. Murty, M.N. and R. Ray (1987a). "A Computational Procedure for Calculating Optional Commodity Taxes with Illustrative Evidence from Indian Budget Data". Discussion Paper ES190. Department of Economics and Social Statistics, University of Manchester, U.k.

13. Murty, M.N. and Ranjan Ray (1987b). Consumer Preference Consistent Distributional Weights for Social Cost Benefit Analysis, Mimeographed, Institute of Economic Growth, Delhi-7, India.

14. Singh, Daroga, Murty, V.V.,R. and Goel, B.B.P.S., Monograph on Estimation of Milk Production, ICAR.

15. SPWD, (1986). Case Studies of Sukhomajri and Jawala.