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Issues in project design: The Sardar Sarovar Project and its alternatives

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EXECUTIVE SUMMARY

1.1 The poor performances and adverse side effects of the earlier similar projects have led to two different schools of constructive thought. One seeks redressal through **technological and managerial innovation** leaving the basic design the same. The other stresses the requirement of fundamentally different **alternative in design and development** process.

1.2.1 The suggested technical and managerial solutions to problems accompanying big dams are sometimes as novel as any other alternative. While welcoming such entrepreneurship one must not overlook that they too are basically as experimental as any other alternative.

1.2.2 The innovative suggestions for increasing water use efficiency and for regulation of waterlogging and salinity in the Sardar Sarovar plan (SSP) need to be appreciated from this perspective. These are essentially untested alternatives. Yet the success in these two components of the plan account for a large part of the benefits expected from the SSP.

1.3.1 Preference for SSP type of project is in-built within the present administrative set up. One must not expect the evolution of a fully worked out alternative. Sometimes the anti-dam lobby draws attention to a valuable set of exercise, in the forms of development plans , for certain spheres of activity, prepared under special circumstances . Their basic approach can be, and need to be, developed into an alternative. These potential alternative plans too are technically sound and made by competent experts, often as the contingencies of activities of other departments of the government.

1.3.2 These potential alternatives have some common parameters and as a class belong to another modern technology which has its own challenges. These are known as : rainwater harvesting, micro-irrigation techniques, watershed development, minor irrigation etc. However, they need the following kind of improvement in order to qualify as an eligible contestant to SSP.

1.4.1 **The missing aspect :** Currently these are treated as isolated works. Instead they need to be planned and developed as an integrated whole, by augmenting rainwater harvesting structures with river diversion supplies. The principles are the same under which the SSP hopes to feed farm ponds

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in Bara tract, divert surplus water from South Gujarat rivers and augment the supply of Narmada by integrating it to National Water Grid. The current minor irrigation, watershed development, rainwater harvesting technologies must be developed into effectively major works through the application of this integrative principle and by thoughtful spatial planning.

1.4.2 As a part of this programme the diversion of 9 MAF water of Narmada awarded to Gujarat state may be planned. But this need to be done with an open mind and to meet the requirement of the overall plan. For example, lowering the dam height, or construction of anicuts at several points need to be considered along with the current design.

1.5 Both designs have their respective merits and demerits.

1.5.1 Storage in the alternative is less but highly dispersed. Subsurface storage resulting in more efficient utilisation is stressed. Area wider than the SSP command can be served.

1.5.2 Although areawise higher submergence occurs in the alternative, there are qualitative difference. Adverse socio-economic effects are nominal because displacement does not need separation from social, economic and cultural milieu. The displaced have a far better chance of sharing the fruits of development.

1.5.3 Even in the recent past the submergence areas of smaller works were cultivated extensively in many states. These areas, rich in subsoil moisture, produced very good cash (rabi) crops during the dry months. Certain administrative provisions guaranteed that the structures were not damaged or encroached. It is possible for an imaginative administration and irrigation department to revive this practice.

1.5.4 Evaporation is higher in the alternative regime. But efficiency of subsurface storage partially compensates.

1.5.5 Waterlogging and salinity problems under the alternative are likely to be far less compared to SSP.

1.5.6 Soil conservation effect of the alternative is an added benefit.

1.5.7 The alternative permits greater regional equity on the development process

1.5.8 The alternative offers a more easily sustainable package.

1.6 SSP plan may not have any formal difficulty in internalising these micro plan. But the support actually given is nominal. The massive SSP eats up the budget of the State. The local developments do not occur.

1.7 From the natural resource utilisation perspective at micro and macro levels, the SSP and the suggested alternative have many essential similarity. But the SSP builds on the basic inviolability of a dam of FRL 455 ft. and develops in a **top-down approach** the distribution and other details. The alternative builds from the local needs and resources of different localities in the State and in a **bottom-up approach** develops resource utilisation from many sources, which includes in the ultimate, utilisation of Narmada water. The difference in the two approaches are certain to result in **differences in overall designs, physical structures, operational rules and management methods.**

1.8.1 Another crucial difference is in the time-phasing of the two projects. Under the alternative the full utilisation of the water quota awarded by the Tribunal (NWDT) may be deferred. Instead, the micro-area developments should be taken up to start with.

1.8.2 As a consequence of such time phasing, operational efficiency will increase. In the top-down approach it is often found that after commissioning the available supply cannot be properly utilised.

1.8.3 In the top-down approach the different areas will start benefiting only after a big time lag. In the alternative, benefits will start flowing quickly.

1.9 People's participation occurs from the beginning in the case of the suggested alternative. The SSP model presumes an abrupt switching, from dependence on the government till the completion of the project to massive participation after commissioning. This is impractical.

1.10 Within the current administrative procedure this promising alternative can never be developed into a full scale project proposal. Certain administrative reorganisation is necessary precondition for pursuing this line of thought.

A sketch of this alternative has been included in the Appendix.

ISSUES IN PROJECT DESIGN : THE SARDAR SAROVAR PROJECT AND ITS ALTERNATIVES

This paper is concerned with the design aspect of the Sardar Sarovar Project proposal. We have not considered the hydelpower generation aspect for brevity and on the ground that this has been defined as incidental benefit of SSP. There are other questions regarding the project, e.g. its cost-benefit considerations, its environmental effect, rehabilitation of the dam-oustee or human aspect and social relevance. We will refer to those aspects only when they are germane to the design question that we discuss. There is no pretension that this paper discusses all aspects of the Sardar Sarovar project. That should not be misconstrued as undermining the importance of the environmental or rehabilitation aspects. This is merely to attend to the requirements of the analysis of design aspect - a sphere which has not been attended to as much as others were. But if an alternative is suggested one should check its cost-benefit implications, environmental impact , rehabilitation programmes and other side effects.

I
TWO APPROACHES

Undoubtedly, the Sardar Sarovar Development Plan (hereafter SSP) prepared by the Narmada Planning Group[2] is the most comprehensive and systematic project planning. The comparison however, is with other river valley project proposals, and their deficiencies at the proposal stage had their reasons. The SSP project was inaugurated in 1961 along with many other such river valley projects. Some of those, located in the favourable areas, were accepted earlier. It is the poor performances and adverse side effects of these completed projects which led to two sets of critical appraisal :

1. In the already completed projects additional works were undertaken, along with cost escalation, for meeting the objectives. These include from field channel construction to the recent efforts of costly reclamation of saline land and turn over of maintenance works to farmers associations. These are by nature **technical and managerial solutions.**

2. The overall effect led to questioning the appropriateness of this kind of project. Considering that the projects located in the favourable terrain were sanctioned earlier and that the recent ones face far too hostile locational features, the adverse effects and performance loss are expected to be of higher magnitude. This calls for **fundamentally different kind of alternative** in project planning and designing.

The Sardar Sarovar project scene today witnesses the culmination of these two approaches. The basic structure of the project was proposed in the fifties. But the detailed proposal was prepared much later when the limitations of such projects were all too well-known. So the proposal could include several recent and innovative technical and managerial solutions to those limitations. In fact the claim of the Nigam Chairman (NPG, 1989 : iv) that "the project planners have taken into account almost all the major issues which need to be considered for project planning" is agreed to, without any hesitation. But that is the advantage one gets with the passage of time ; a comprehensive report is not necessarily technologically sound or administratively feasible.

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2. NPG (Narmada Planning Group), 1989 : *Planning for Prosperity - Sardar Sarovar Development Plan* , Sardar Sarovar Narmada Nigam Ltd. , Gandhinagar (Gujarat).

During this intervening years however, there has been a lot of development in other relevant sciences and technologies. From out of that some alternative to the basic design of the sixties may be developed. Indeed, there exists some applications of the new science and technological developments, which are alternative in a nascent form. Unlike what is commonly believed in the official circle about the anti-dam lobby[3], these alternative possibilities are based on sound and modern technology. For example, when Paranjpye made suggestions for alternatives he built it on three studies by renowned experts and government departments[4]. Internationally, the alternative technology is developing in rapid strides just as it was in the fifties, when the multipurpose river valley project was a young science full of promises. If there was the TVA then as the case of sterling success to inspire ; today the case of Israel[5] is there to encourage the new. In a couple of decades from now, when the SSP is supposed to come up, the climate may change more favourably in favour of the newer one[6]. It is from this perspective that an open mind is requested by the present advocate of this alternative.

II

SOME ASPECTS OF THE S.S.P. OPERATIONAL PLAN

It must not be overlooked that all those areas which the Narmada Planning Group boasts of as "pioneering effort" and laudable "innovation" qualify for being commendable but worth scrutiny. The basic planning objectives (NPG, 1989 : 88-89) are maximisation of use of the available water resources in the economically and socially the most desirable manner. In operationalization this was translated into priority of agricultural use, spreading the water thinly over the area in order to maximise total returns, covering a large part of the State in this manner along with very efficient use of water.

The Water and Land Management Institute at Anand, observed that the available water distributed over 1.8 million ha of irrigated area proposed will permit only 18 inches (450 mm) of water per hectare - *half that in normal post independence irrigation projects*[7]. If this efficiency in water use is not attained a very sizable section of the projected benefits will elude the project.

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3. For example, B.D.Dhawan wrote : "Then there is a motley group of individuals who are sold out on the philosophy that 'small is beautiful'. They would prefer a river to be tapped by a row-upon-ro of small dams .....", B.D.Dhawan, 'Mounting Antagonism towards Big Dams', *Economic and Political Weekly*, May 20, 1989.

4. These have been introduced later.

5. Israel, though a food sufficient country, uses only 447 cubic metres of water per head per year. India and China uses about five and a half times more, USA even more.

6. Somewhat comparable to what SSP expècts in the sphere of computer technology.

7. cited by Maloney and Raju, 1992 : *Farmers' Organization for Irrigation Management in India - Course Notes*, Technical Report No. 49, Water Resources Management Training Project pp. 79-81. The Report is one of the basic document prepared on behalf of the Central Water Commission and the USAID.

To attain such high water use efficiency two pronged strategy has been adopted:

Technological solution : High water use efficiency is to be built within the system. This includes computerized remote control and monitoring, dependable communication system, and lining of channels down to sub-chaks. Distribution will be regulated by automatic and semi-automatic remote control mechanism.

The use of computers for operating regulators is a new idea and its performance is not guaranteed. Some other components of these technical approaches have already been tried in other irrigation systems but with much less success than the projected kind of performance improvement.

Managerial solution: The other suggestion is to deliver water through farmers' association. This approach, called participatory management is, by now, an accepted way of improving performance[8]. But participatory management is still at its infancy in India and there is nothing to indicate that attainment of such a high level of efficiency through this approach is possible.

These are worth experimenting. But one should not fail to note that these constituent parts of the Sardar Sarovar's pampered project proposal, are just as unreliable and experimental as any alternative design. Yet, sterling achievements in these experimental areas are crucial to the realisation of the primary objective of the SSP.

Another innovation is in the arrangements made for vertical drainage to check waterlogging and salinity in the susceptible areas. Several monitoring points will be established and the groundwater level will be monitored regularly. It is expected that the farmers will extract sufficient[9] amount of groundwater with no threat to waterlogging. But in case they fail the project authorities will intervene and pump out the necessary water. This will be done if the private efforts do not develop up to expected standards on a predetermined time schedule and in any case, it is stipulated, before the groundwater table rises within 5 metres from the ground level[10].

These are only scientific possibilities but often not tested in the wider application. In the wider application their success depends on the administrative competence and efficiency, availability of enough skilled humanpower at nominal cost to install quickly and maintain those equipments in functional stage, their immediate repairs etc. Anyone familiar with the performance monitoring scene of irrigation systems in the country know how underdeveloped they are. The management will find it difficult to balance between the two of its objectives : using water very efficiently and draining it out unproductively. In the problem branches or distributaries the branch management who face the prospect of releasing canal water and draining it out through pumping - like digging pond and filling it up -- are sure to be criticised for poor performance. In all likelihood they will try to hide this fact caring much less about the long term land degradation problem.

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8. The present author is an enthusiastic proponent. See his book, *Managing Common Property : Irrigation in India and Philippines*, Sage Publications, New Delhi, 1991.

9. Some others believe that the private initiatives are not only sure to develop but will develop to the extent as of creating aquifer depletion problem. In that case the task of monitoring and management becomes as difficult as to retain the level within a specific range.

10. NPG, op. cit. p. 393

These are imaginative suggestions no doubt and are welcome. But they are not without problems. Such novel ideas generally get accepted after field experiments and pilot studies on a small scale. In the case of alternative to SSP this will be expected, and quite legitimately so. In the case of the SSP this basic scientific precaution is being forgotten. The success rates of the technical managerial solutions to standard problems have been over-assumed.

It may be noted that here we have brought into question only the experimental nature of components. This is to make a fair comparison with the equally untested alternatives. Our domain is different from the general parametric variations that is dealt in the risk sensitivity analysis of cost-benefits assessment[11]. There are also political economic problems, power structure etc. whereupon the priorities may change from the ones projected. These are no doubt, problems deserving similar attention. We are adhering strictly to the issues concerning the design.

III

TOWARDS AN ALTERNATIVE

Under the existing administrative procedure the major and multipurpose projects of the state governments need to be approved by the Central Water Commission. Since the state government is required to undertake the task of preparing the project proposal, the state resources come to full aid as well as to the defense of the exercise. In the case of minor projects the state government is the approving authority. Whoever may prepare it there is no need for the state government, to mobilise a whole lot of resources for preparing an unassailable proposals. Therefore, these proposals for minor projects are generally rudimentary in nature devoid of much technical sophistication. It is only under special circumstances that some sound project proposals are made. Paranjpye in his study[12] mentioned three such works as relevant for developing an alternative. All the three had been developed - under special circumstances - by experts, some of them renowned, in the field. These are :

* One is by a well-known N.G.O., the Sadguru Water Development Foundation (SWDF) which has been active in Panchmahal district. The team of qualified engineers associated with the SWDF using the government sources and intensive survey prepared a plan for intensive utilisation of the water potential in five talukas of Panchmahal district. They had indeed submitted it to the Gujarat government for consideration in the Eighth Plan.

* The second one is the Technology Mission (July 1988) report on rural water supply and related water management conducted for the Kachchh region.

* The third is for power generation. It is a report on the natural gas demand and availability prepared by a committee of top-most experts in the field under the aegis of Gujarat Foundation for Development Alternatives.

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11. It addresses the question if the values of sensitive parameters in the project proposal deviate from the assumed values when does the project cease to be economically viable. World Bank favours this kind of analysis.

12. Vijay Paranjpye, 1990 : *High Dams on the Narmada - A holistic analysis of the river valley projects*, Studies in Ecology and Sustainable Development - No. 3 , Indian National Trust for Art and Cultural Heritage (INTACH), New Delhi, pp. 252-300.

It may also be noted that the SWDF has an impressive record of working in tribal areas of Gujarat. The Technology Mission undertook several pilot studies. This is in sharp contrast with the untested innovative remedies in the SSP proposal noted earlier.

That these were not developed further owes to the characteristic departmentalism and the centre-state relations problems. The very administrative procedure motivates the state governments to champion the causes of major and multipurpose works. If the centre differs on social or political grounds it becomes a case of high handedness worth opposing at all cost. If the difference is on technological feasibility the state would mobilise as much resource as it can to perfect it. It must be noted that the fascination for big dams arise not necessarily because of its many technological merits (no doubt so, in spite of many demerits) but because the preference for such structures are in-built in the current administrative procedure. It is necessary to understand that the whole circumstance militates against any fundamentally different alternative - even if it is full of potential, technically sound and far more meaningful from welfare considerations.

Some other adverse effects of departmentalism in the water related sector will be discussed later. For the time being we have to note that nothing can be done by the critics of any hue towards eliminating this limitation and that there is very little room within the present administrative set up for a kind of promising technology to develop into alternative development strategy. A detailed proposal can be made only by the state government on mobilising its immense financial resources, pool of expertise in different fields and the massive inventory of data and other kind of information, just as was done for the SSP. All that an individual or a small group can do is to indicate that there is such a potential. I will only indicate from out of the three studies cited by Paranjpye that there is a potential alternative.

The first two, the irrigation and drinking water related project plans, are based on extension of in-situ-water harvesting, checkdams, percolation tanks and other kinds of small storages, sub-surface dams, injection wells, contour bunding, field bunding, furrow bunding, land levelling and other catchment treatment methods. They stress on subsurface storage as it is safe from evaporation losses and natural catastrophes. Of the 13 regions in the command area of SSP in Gujarat, 2 have an average rainfall of 36 inches, 4 of 30, 4 of 26 and 3 of 20. No doubt this offers an excellent scope of rainwater harvesting. The harvest may not be insignificant compared to the 18 inch per ha of water supply promised under the SSP project.

The necessity of storing water in a monsoon country like India has been stressed excessively. What they equate to is storage in open reservoirs of gigantic size suitable for centralised operation. There are other kinds of storage facilities : subsurface storage, subsoil moisture content etc. In these types the water use efficiencies are much higher and although they do not compare with reservoir content volume by volume, that is often made up by their water use efficiencies. The region is very suitable for these later kind of storage and the techniques suggested simply do that.

Far from being rudimentary earthworks, these rainwater harvesting structures require considerable technical expertise in terms of detailed topographical and geological surveys and expertise in evolving custom tailored designs for various micro-areas. Because of the minute details of information needed there is considerable advantage in involving knowledgeable local people from the beginning. But a good structure needs very high technological application, as many studies on these systems show. Continuing technical support is also needed during supervision and management stages.

Later, in section V, we will indicate that this technology need to be complemented with spatial integration for being developed into a full-scale alternative. As we will argue, an integrated plan over

many micro watersheds lead to the development of a whole basin. It is not minor, but major if properly developed. But before we enter into that area let us first complete the microlevel discussions.

For quite some time now, well-designed and carefully planned rainwater harvesting techniques have been in use in the developed countries as artificial groundwater recharge methods. Somehow their importance in the developing countries were never appreciated by the development experts and irrigation engineers. Nor did they learn these techniques from the existing traditional structures in the developing countries. During the last decade however, there is a change. Several international and national agencies have conducted studies on these simpler methods for their importance in the third world.

IV

ON SOME ANTICIPATED CRITICISM[13]

 # One of the major arguments against substitution by numerous small dams and storage is that the submergence area will be higher.

The consequences of submergence in big dams and smaller ones are not the same and cannot be compared at par. Land characteristics vary and in the smaller dams it is possible, to a great extent, to choose only those areas which are less productive. Because they may be resettled in the vicinity the displaced have a far better chance of sharing the fruits of development. The economic loss they suffer because of displacement are likely to be compensated by increase in land productivity and additional economic opportunities created. Adverse socio-cultural impacts too are nominal because displacement does not need separation from social and cultural milieu. In essence, the resettlement task can be carried out in a more humanely manner, if not also in a cost efficient fashion.

Further, submerged land of small storage works are not totally unutilized. Tank-bed cultivation for example, was practised extensively in the past. The submergence areas are rich in subsoil moisture. During the dry seasons the left over water of small storages were drained out and the beds were cultivated for good cash (rabi) crops. Even in the fifties it was an existing practice in many districts for which the Revenue Department used to issue permanent and temporary land rights in tank beds in many states. The practice still continues in parts of central Bihar where ignorance of the irrigation department about tank (*ahar - eri*) irrigation permits perpetuation of many popular old customs in tank management. In Ramnathapuram district (Tamilnadu) this practice was abolished in the fifties after the PWD took over the tanks following zamindari abolition. The argument of the PWD was that the off-season cultivation obstructs desilting (which they rarely do). In Bihar, the farmers meet this obligation by tight scheduling of their annual activities, doing the desilting within the few days of gap between rabi harvest and kharif sowing. In fact, the farmers of Gaya-Jehanabad still sow water-resistant long variety kharif paddy in the tank bed at the very outset of the monsoon. In a good year the tank is full and the kharif yield of tank bed is nominal. The tank command however, reaps a bumper

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13. Most of the points included in this section have been discussed in greater details in my book, Nirmal Sengupta, 1993 : *User-Friendly Irrigation Designs*, Sage publications, New Delhi.

harvest. In a bad year, when the tank is not full, the water-resistant paddy flourishes and compensates for the loss in gravity irrigated kharif[14]. It may be noted that by all official accounts the ahar-irrigated areas of Bihar were immune to famine throughout the nineteenth century[15]

 # Another criticism is that evaporation rate is higher for smaller storages. No doubt, but again, the difference may not be as startling as it is often posed. While comparing the two, the environment of the smaller works are assumed to be the same as the larger ones. But that is rarely the case. Good vegetation around the reservoir will contain the rate of evaporation proportionately more in the case of smaller ones. The smaller storages can constantly replenish their evaporation loss by receiving rain. Besides, whatever is left is often better utilised than in bigger reservoirs. The absolute difference in quantities of water lost in evaporation may not therefore, matter as much.

It should also be noted that many of the smaller works are better suited for utilisation of the subsurface storage effects towards agricultural purposes. In storage structures like *khadin* and tank in the semiarid regions, gravity irrigation is restricted by community agreement. Irrigation is practised only through shallow wells in the command areas. In general, the subsurface storages, either as groundwater recharge or as subsoil moisture content, are used effectively for summer cultivation. Subsurface storage results also in major and medium irrigation. But it is not meant for planned utilisation. While some areas suffer from excess subsurface storages, some others get very little for any significant use.

Lately, attempts are being made for developing cheap surface treatment methods of containing evaporation loss. Some suitable options like use of floating covers can be used more easily in cases of smaller reservoirs.

 # A third criticism is that small storages do not provide assured irrigation. The difference with the major canal system like SSP in this respect is overstressed. Whatever may appear from the top, there are all kinds of supply irregularities. To the farmers the certainty of supply in major multipurpose projects is not that high. It is not uncommon that a crop schedule was adopted on the basis of promised water supply. But it failed since the promised quantity and kind of supply was not actually obtained. On the other hand the captive minor storage works provide perfect certainty of supply for a few weeks. That is often sufficient to plan cropping pattern and crop practices. If the farmers are sure of some water they adopt one practice, if they are uncertain, judging from the condition of the captive reservoir, they adopt another practice. It should be noted that this practise ensures more efficient utilisation of water by allowing operational flexibility to farmers.

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14. It also needs some property regulation for the perpetuation of this practice. I observed that during the land consolidation operations in Jehanabad district in many villages farmers were instructing the survey officials not to consolidate landholding of individuals in the tank bed and outside and to retain a minimum 1:2 ratio between ones holdings in the tank bed and in command area. The later ensures that the interest of a farmer in tank bed cultivation does not override his interest in using the tank primarily as an irrigation source.

For further details see my article "Spatial Distribution of Landholding" in B.N.Yugandhar and Neela Mukherjee ed. *Studies in Village India*, Concept Publishing, New Delhi, 1991.

15. Detailed evidence of these government records are in my book *User-Friendly Irrigation Designs*, pp. 87-88.

Our argument in reply to the three criticisms noted above have been that the relative inefficiencies of the alternative design on account of these problems are not as high as is usually believed. Major canal irrigation may perform better in these spheres, even if marginally so. For a fair comparison however, one should include some other benefits of this alternative design which makes it score over SSP type :

Waterlogging : Complaints of serious waterlogging have not been heard of rainwater harvesting structures[16]. Reasons can at best be a matter of guess. Probably the dispersed structure, the flexibility of operations or close monitoring and quick action by farmers contribute towards this end.

Salinity : Salinity problem too can be controlled in simpler manner. Rainwater is the best rinsing agent. Maximum use of rainwater minimises the threat of secondary salinisation.

Soil erosion : the techniques of run-off harvesting is excellent for soil conservation. It may be recalled that parts of Narmada basin is subject to heavy ecological degradation.

In *consequence of siltation* all storages tend to loose their capacities. For big dams this is an irreversible process and ultimately the structure goes out of use. For the smaller storages however, it is physically possible to desilt thoroughly and maintain their capacities for a much longer time. Also, because of the size, beneficiary participation is feasible here which help in bringing down the cost.

There is no danger of the same magnitude as of sudden *collapse* of big dams - which bring devastating loss.

Regional Disparity is inevitable consequence of big dams since the possibility of extending its command area is limited. The small structures are widely dispersed and can have, for the same net irrigated area, a much wider command area distributed over a vast region.

Decentralised management : the alternative requires peoples participation for management of the micro-structures. Although this is usually given a welcome, the authorities are doubtful about the realisation of this possibility. We share the concern since there is little as yet, in the way of achievement in extension of farmers participation in India. But this is a moot point since SSP plan too presumes sterling success in participatory management.

One may argue that these alternatives are not contradictory and can be easily incorporated into the SSP plan. We agree. Indeed, we like to point out that NPG has included among its objectives:

.....to explore options and alternative features to be able to mop up additional water for use, keeping within the framework of NWDT decision[17]

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16. Some traditional rainwater harvesting structures, like the *bandhis* of Madhya Pradesh - in Narmada basin - could easily have given rise to problems of waterlogging. But no such problem was ever reported. Probably, submergence for a limited period helped in containing this problem. Total control of the farmers on the run-off retention and discharge, helps in avoiding such problems.

17. NPG, op. cit. p. 89

But this is merely lip service. Paranjpye mentions (p. 286) that when he discussed the alternatives with senior members of the Gujarat bureaucracy the reply was that the government and city administration will gladly do all these and even invest in all of them, but that they would all be supplementary to the Sardar Sarovar water augmentation programme. There is very little resource left in the state development budget after meeting the requirements of the massive SSP project. Nearly 80 per cent of state's irrigation sector budget was going for the single project. In consequence at least 131 medium and hundreds of minor irrigation schemes of Saurashtra have been technically cleared but have come to a standstill[18].

The root cause of the problem lies here, in approach and priorities, not in any drastic differences in the technology.

V

SOME COMMON ELEMENTS

The two sets of techniques[19] are more complementary than conflicting as is often believed. In the more recent years some major irrigation systems have incorporated in their designs one the other of these micro-techniques. The D.V.C. has adopted watershed development works for catchment improvement. In order to increase the efficiency of major canal irrigation the Chinese introduced farm ponds in conjunction with the canals[20]. Theoretically, it has been shown that auxiliary storages at watercourse level may increase the productivity of water of Bhakra system by about 20 per cent[21]. On the other hand the traditional microworks and rainwater harvesting structures were often spatially planned ; they are not necessarily isolated works as is often believed. The *system tanks* of peninsular India, where tanks receive their supplies also through river diversion, have been extensive and in existence for a long time[22].

Following this principle an alternative to SSP can be suggested as : The rainwater harvesting structures should be integrated along the same principle as of auxiliary storages, melons-on-a-vine design or system tanks, whereupon they will receive the surplus water from each other and from the adjacent rivers. Interbasin diversion will help integrate the supply of these rivers. In the final stage the use of Narmada water can be made for augmenting supplies to these storage structures. It will be possible to utilise ultimately the NWDT allocation of 9 MAF.

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18. Medha Patkar, cited in Times of India, Bombay ed. August 31, 1993, p. 5.

19. The complementarity are between the technologies not between the development strategies. This must be clearly noted. We will indicate the differences in strategies later.

20. These are called melons-on-a-vine design.

21. A. Mishra and N.K.Tyagi, 1988 : 'Improving Canal Water Delivery with Auxiliary Storage' , *Journal of Irrigation and Drainage Engineering* , vol 144, No. 3 , August. Reprinted in *Water Resources Journal*, vol. 11, No. 3 , March, 1989.

22. For some other integrated designs see *User-Friendly Irrigation Designs* , pp. 61-65.

This is not to let loose one's imagination. The elements of such a complementary design are already there in the SSP plan:-

* For irrigation of the Bara tract it has been suggested that tanks serving 10 to 50 ha be excavated throughout the region and minor of the SSP serve as feeders to these tanks. Farmers can lift water for irrigation[23]

* The Mahi command has been included within the SSP.

* Also for augmentation of water availability of SSP at a future date it has been suggested that surplus water from South Gujarat rivers will be diverted into it.

* In a distant future links will be established with the National Water Grid should it come into effect.

One can use this wide spectrum technological package included in SSP in a different manner. Instead of appropriating the other technique only once-in-a-while one can use it to extract its full potential. Essentially, this involve four steps :

1. Extension of technologies known as *rainwater harvesting*[24] *methods* throughout the region concerned. However, the designs of these local structures should be decided from the perspective of the ultimate development potential. For example, the storage capacities should not be decided merely from the data on local precipitation, but should also take into consideration the potential water availability through river diversion in future[25].

2. Integration of these smaller units within a single watershed or a basin so as to ensure complete regulation of surface and groundwater flow within the watershed/basin unit.

3. Establishment of regional water grid which includes interbasin transfer of any surplus water. The diverted water can simply be led to the highest point in each watershed/basin network. Its distribution will not be a problem.

4. The ultimate grid structure envisaged includes Narmada source and even a National Water grid.

Storage facilities, both surface and subsurface, need to be planned within these structure. But they will be highly decentralised. Submergence effects will be extensive yet not as adverse as SSP for reasons discussed earlier.

Within the numerous histories of modern construction similar course of bottom up development are not altogether absent though very rare. Under the policy adopted by the Japanese government

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23. Interestingly, it was noted that this design effects judicious use of water and reduces the danger of waterlogging and salinity. Further, drinking water problem is solved because of supplies available at the adjacent shallow wells (NPG, op. cit. pp. 335-6). One wonders why then was not such designs extended all over the belt.

24. *Since we are not proposing to use these technologies merely for rainwater harvesting the nomenclature is confusing. A friend of mine suggested that runoff harvesting* will be a better choice of term.

25. In order to do that a Master Plan is necessary.

in 1923 as General Plan for Assistance to Irrigation-Drainage Improvement Projects, the existing irrigation systems sharing a single source of river were gradually integrated. Within the country the construction of Srivalkuntam anicut on Tambraparni river in 1874 has a comparable course. The river diversion was used to augment supplies in the existing rainwater harvesting tanks.

Let us repeat that the technological feasibility of the suggested alternative design emanates primarily from the technological package adopted in the Sardar Sarovar Plan. The two cases of parallel development cited are only as additional support. The SSP project design has used some modern techniques imaginatively , but more as patchwork for developing its need. As alternative we are only suggesting *full utilisation of the development potentials of these techniques*. In appendix a sketch has been drawn on that basis.

The most severe restraining factor in developing this plan is the current administrative set up in the water resources related sphere. At present, the micro-structure development works rest largely with the Agriculture and Rural Development Department. But they cannot develop it as an integrated exercise, not because they lack expertise, but because their jurisdiction ends once the bottom-up integration crosses the 2000 ha CCA level, the upper limit for minor irrigation. The Irrigation department, on the other hand, does not come in till this size is reached[26]. Recall that the National Watershed Development Project for Rain-fed Areas (NWDPRA) of the Ministry of Agriculture had set an upper limit of 5000 ha for the micro-watershed integrated development. Thus, the kind of alternative that we are suggesting is nobody's business, except for NGO's, the standby to be summoned for all difficult problems.

Complete reform of the departmental set up of irrigation administration in the country therefore, is an absolute necessity for initiating the integrative spatial-technological plan that we are suggesting as a potential alternative. Without this reform, without incorporating the micro-planning and micro-management within the Irrigation department[27] no advance can be made in this direction. During the last twenty years the world has witnessed tremendous advancement in the area of micro-construction technology for water resource management. It is time to appropriate those and locate them at par with the conventional technological knowledge. A great many engineers and other experts use the terms 'minor irrigation', 'dry farming', 'rainwater harvesting' etc. almost in pejorative manners[28]. Quite a few are ignorant and oblivious of the tremendous technological sophistication already attained in these areas.

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26. The Irrigation department utilises its expertise for planning these micro-structures once-in-a-while when they face a problem area or a specific problem within a major project. The exercise for the problematic Bara tract within the SSP plan is a fine example. In order to develop the plan for the Bara tract the department utilised knowledge of traditional irrigation practices, the soil conditions etc.

27. It describes a part of the accountability of Irrigation Department in the matter of field-level activities.

28. The choice of these group names are no less responsible. They tend to restrict the use of certain techniques into specific spheres, e.g. 'minor irrigation' as to remain stand alone as minor works, 'dry farming' suitable for areas destined to remain dry and 'rainwater harvesting' as techniques to be used only when water supplies better than rainfall are not available.

VI

THE REAL DIFFERENCES

Thus, from the natural resource utilisation perspective at micro and macro levels, and the technological/managerial milieu, the SSP and the suggested alternative have many essential similarity. But the SSP builds on the basic inviolability of a dam of FRL 455 ft. and develops in a top-down approach the distribution and other details. The alternative builds from the local needs and resources of different localities in the State and in a bottom-up approach develops resource utilisation from many sources, which includes in the ultimate, utilisation of Narmada water.

The difference in the two approaches are certain to result in differences in overall designs, physical structures, operational rules and management methods. The appropriate manner of diverting the Narmada water to feed the micro-structures in the alternative design must be decided from the requirements of the very design. It is true that the river course and other physiographic conditions are the primary considerations of locations and designs. But these do not cast deterministic effect as is often suggested by pro-dam lobby. The locational survey provides several options and the choice must be made from amongst those There is quite a lot of options. In the structural designs too, there exists a lot of option within those permissible under the given natural condition. For example, the dam height may be lowered. Even anicuts may prove to be sufficient for the purpose. What is needed is an open mind to consider all possible alternatives.

Another crucial difference is in the time-phasing of the two projects. Under the alternative the full utilisation of the water quota awarded by the Tribunal (NWDT) may be deferred. Instead, the micro-area developments should be taken up to start with.

As a consequence of such a time phasing operational efficiency will increase. In the top-down approach it is often found that after commissioning of a project the available supply cannot be properly utilised. For example, the kind of problem that would arise in the SSP is evident from the following citation[29]. :

> 16.5 According to the project phasing, irrigation in Phase I command in Narmada Mahi doab would commence after June 1990 when the dam would have reached 95 M (RL 312 ft.). In phase I of the project when irrigation development would be on a very small scale and water available will be in excess of the requirements, by strategy it has been decided to restrict the supply of water only to the extent of crop water needs based on evapotranspiration and system efficiency. Temptations to go in for water intensive agriculture involving perennials like sugarcane, bananas and seasonals like paddy will be strictly controlled. .....
>
> As soon as the ground water develops, the supplies will be cut back to those corresponding to the situation with groundwater development. It is proposed to enforce this practice rigorously in the initial stage.

Thus the SSP model necessitates strict bureaucratic control for curtailment of private initiative immediately after commissioning, to be followed by an abrupt switching in management style, resulting in massive participation by farmers when the bureaucracy desires. This is an unlikely course. Instead, if the receiving structures are developed first, the distribution will be easier. Peoples participation occurs from the beginning in the case of the suggested alternative.

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29. The NPG conducted a sample study of micro level layouts, design and operation at Narmada Mahi doab area. This citation pertain to the programme made for this sample study (NPG, op. cit. 1989 : 165-166). Underlines is ours.

Phasing of developmental benefit is better if this bottom up approach is pursued. In the top-down approach the different areas will start benefiting only after a big time lag. In the alternative, benefits will start flowing quickly. In turn this may foster participation.

The promises of the SSP are restricted to the command area[30]. This will create regional imbalance within the state. By using the alternative the whole of the State can be covered under this programme. It may not be possible to augment the local water resources to the same extent in all the places. But the differences between regions will be less glaring than under the SSP.

It is not within the purview of our exercise to make any estimate of the cost. But a note of caution is in order with the previous discussion. The standard cost-benefit comparison need to be applied with considerable care because of various reasons[31] including that the benefit categories in such comparison are not properly identified[32]. However, technological and operational perfection and feasibilities can be considered as yardsticks for judgement. Since the two alternatives have many similarities there is little need to mediate their comparison through market mechanism, which is the basic approach adopted in cost-benefit analysis.

The following are the major obstacles in pursuing this alternative plan :

(I) Foremost is the lack of courage to venture into a new area. It was in the influence of the nationalist struggle which had made the planners at that time courageous enough to accept the massive multipurpose projects. Then it was a bold new idea. By now it has become old, but there is dearth of that boldness for adopting the new. But for the popular protest and subsequent international pressure, the authority would have been content in pursuing the conventional programme.

(II) The second is the administrative set up. As discussed earlier, no government department is required to build up such a plan. Unless this problem is resolved any effort by a department to prepare a complete plan along this line will lack sincerity and commitment, leave alone questions of resource and expertise mobilisation.

(III) Farmers participation is essential for the kind of alternative suggested. But this is an unchartered territory for the concerned department. Although farmers organization and farmers initiative is implicit in the SSP plan, that is a task deferred, hence not worrisome. In the alternative this will be needed from the beginning.

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30. To set the records straight, drinking water facilities are extended beyond the command area. Also there will be indirect benefits for the command area. But these need no mention here since the same effects will occur also under the alternative programme.

31. For sustainable projects the benefit-cost calculations are highly sensitive to the choice of discount rate. Note that in the ultimate case when the discount rate is zero, the benefits add to infinity. The discount rate reflects the way the society weighs its future. At present it is equated to bank interest rates, for which there is no technical or social justification.

32. For example, soil conservation and environment effect may be considered benefits for one but only side effects for another. By defining the project goals differently the benefit streams relevant for assessment may be made to differ. So there is no point in carrying out this exercise unless these categories are unanimously agreed. Even after that there arises the problem of valuation.

(iv) The existence of powerful vested interest in the SSP cannot be denied.

(v) Considerable sum has already been spent for the project. This will be written off as sunk capital. But is there any rationality in spending more money to justify investment in otherwise sunk capital ? In any case, some of the investment made may be modified and utilised for the alternative in appropriate forms.

(vi) There is some apprehension that the NWDT award, if not appropriated, may wither away in future. There is an unwritten fear in all the States that after 2000 A.D. the water rights of States will be frozen at that level. The criteria followed in determining shares - e.g. in ratios of command area - makes room for such apprehension.

It is not within the capacity of us to overcome these difficulties. It requires certain administrative reform which may be conducted under the aegis of the Planning Commission or some such authority. What we want to note as conclusion is:-

The very same technological spectrum used in preparing the Sardar Sarovar Plan also point to an alternative design. The SSP begins with the assumption of a big dam at Navagam. The alternative is to adopt a bottom up approach. The SSP uses novel approaches only for problem spheres within its basic design of the sixties ; the alternative must exploit full potential of these novel ideas and technologies.

If through administrative reform measures some agency is motivated to cut across the departmentalism, specialisation and accountability bottlenecks, a full-fledged alternative will certainly develop under its aegis.

Appendix

THE IMPLICIT ALTERNATIVE - A SKETCH

Selection of an appropriate region for any project planning of the kind suggested is always a problem. The scope of further and further integration lead always to wider areas as the appropriate choice for a planning unit. Such a plan may be made for the command area of SSP, for the whole state of Gujarat (and similarly for M.P.), for the whole region including the Narmada basin, or for a planned National Water Grid for the western region. It is for the legitimate authority to select an appropriate unit. Here, as a demonstration case, we will use **Gujarat State** .

Preamble :

Agriculture accounts for nearly a half of the state domestic product. About a half of the total land area in the state is under cultivation. Most parts of the state receive an annual average rainfall between 500 to 800 mm. which drops down to below 300 mm in the north west of the state. In addition, rainfall is highly erratic in nature, apart from being confined to a few months in a year. This affects also the flow of smaller rivers. The three major rivers, Tapi, Narmada and Mahi flow through the regions with relatively high rainfall. Thus, although the ultimate surface water potential of the state is estimated at 21 MAF, the irrigation potential is considered very low.

Rainfall and stream flow variability result in high dependence on groundwater. Even in this source there are problems. Well irrigation is not a reliable source as large parts of the state, where shallow wells are dug for irrigation, depend on rainfall for recharge. As per the latest data available groundwater sources account for 78 per cent of the area irrigated. This may have risen further because of rapid development each year. *It is certain that over-exploitation of groundwater is already a serious problem in some areas of the state and will aggravate further in near future if immediate remedial measures are not adopted.*

Till recently, the official estimates had been painting a very rosy picture of utilisable recharge of groundwater availability. But recent reports indicate otherwise. A 1992 report[33] of the Government of Gujarat notes that groundwater extraction is estimated to exceed recharge in 24 taluks and is greater than 65% of recharge in a further 36. Even in 1986 it was noted that groundwater in confined aquifers in north Gujarat were approaching full development. Groundwater maps prepared by the Central Groundwater Board for the period April 1979 to May 1987 show drops of above 2 metres throughout most of Gujarat. Seasonal depletion and saline intrusion in coastal areas in Saurashtra and Kachchh are being reported. Related with this is the problem of equity - as water extraction from deeper and deeper strata become costly the poorer tend to loose their irrigation source.

Drinking water availability is another very serious problem. Here too, groundwater is the main source[34].

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33. Govt. of Gujarat, 1992 : *Report of the Committee on Estimation of Groundwater Recharge and Irrigation Potential in Gujarat State*, Narmada and Water Resources Department. This and other details about groundwater depletion in Gujarat has been summarised by Marcus H. Moench working with VIKSAT, Ahmedabad in a booklet titled *Debating the Options : Groundwater Management in the Face of Scarcity, Gujarat, India*, mimeo.

34. Although SSP hopes to take drinking water even outside command area it will not serve all the villages in the state.

The groundwater crisis is a manifestation of the overall water crisis. Augmentation of surface water availability will reduce the pressure on the demand of groundwater. Also, this will augment the supply of groundwater by recharging.

The spatial aspect involved in this should not be overlooked. A project like SSP will augment surface water supply only for a part of the state. The problem however, exists for all parts of the state. Indeed, the areas neglected in SSP will undergo further degradation in groundwater supply. In consequence, regional disparity within the state will increase enormously under the SSP kind of project. This leads us to look for another solution.

Planning Objective and strategy :

The objectives of the Sardar Sarovar project have been given as[35] : (a) maximisation, for use, the available water resources and (b) to make economically and socially most desirable use of available water (which implies priority of agricultural use over hydropower generation). The same set of objectives apply here too. But the domains of the planning process are different. In consequence the planning strategies too differ. The areas of difference are as follows :

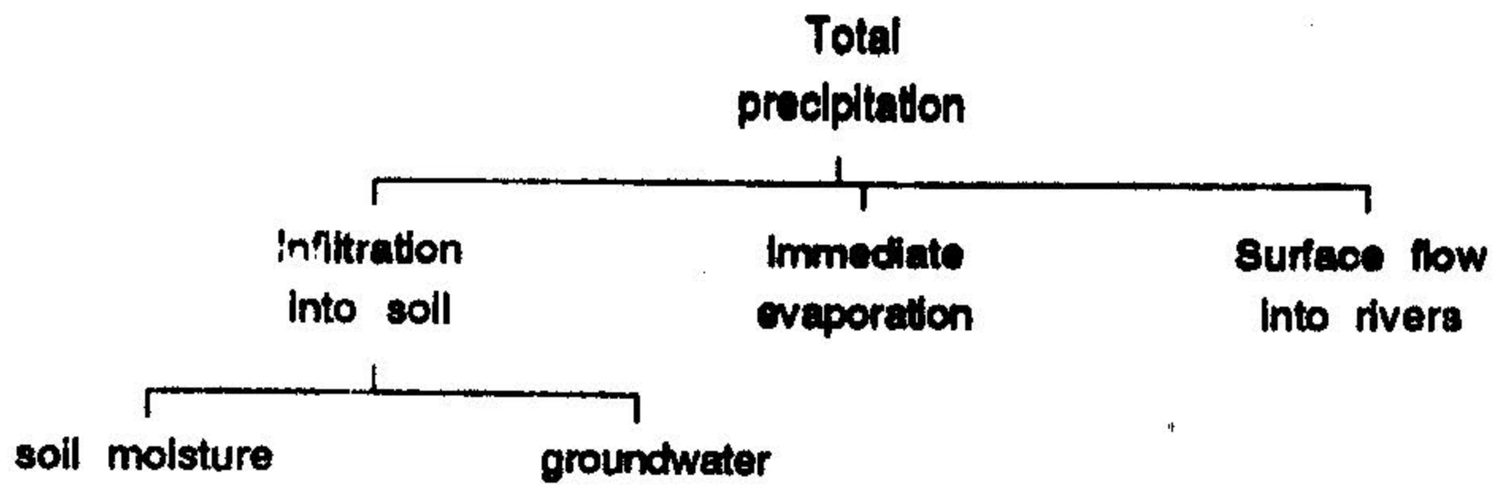
	subject	*top-down* S.S.P.	*bottom-up* Alternative
1.	source of water	Narmada water	All sources in the state
2.	planning region	possible commandthe	whole state of Narmada dam
3.	strategic initiative	construction of a 455 ft. dam at Navagam	collection and management of locally available water
4.	secondary strategy	construction of *distribution* network	*integration* of small units into watershed and basin plan
5.	challenges	covering special areas by small ponds etc.	appropriation of Narmada water

Naturally, planning issues and studies vary widely. We cannot go into those details ; from this stage onward considerable resource and information back up becomes necessary. However, some effort has been made in the following section to provide an idea of the potential benefits and the items of cost involved.

Potential Benefits :

Gujarat receives on an average about 65 MAF of rainfall every year. Part of it is lost in immediate evaporation and another part results into surface flow into rivers. A part of the quantity identified as infiltration into soil results into groundwater recharging. The rest is termed *soil moisture*, which leaves much room for confusion. Indeed, it is the category unaccounted for, in the water balance calculations.

35. NPG op. cit. pp. 88-90.



The official estimate of utilisable water resources is derived from surface flow into rivers and groundwater recharge (along with flow received from outside the state). The unaccounted category, termed *soil moisture*, are written off completely as unutilisable. In reality however, those are not. The rainwater harvesting methods are able to appropriate this source.

In case of Gujarat average annual receipt of soil moisture will be of the order of 30-35 MAF. A small part of it is used directly for evapotranspiration by vegetation. Even if a third of the rest is harvested methodically it will provide as much water as promised under SSP. Besides, this additional appropriation will be distributed all over the state, depending on the kind of rainfall received by a region. But the wider coverage than the SSP will result in greater regional equity. Further, it will result in augmentation of replenishable groundwater for use during the dry season. Water use efficiency too is likely to be higher than the SSP.

It should be understood that the estimates of utilisable water resources obtained as a fraction of the natural availability is only a guess. But the reasons why only a part, not the whole of it, can be utilised is well understood. It occurs because of physiographic conditions, socio-political environment, legal and constitutional constraints and the level of technological development. The estimate should therefore, change as these conditions change. Rainwater harvesting methods are still not regarded by the irrigation departments or CWC as options worth considering - a legacy of the past which need to be changed after significant technological development in this field. Along with this new technological opportunity if land levelling and management, afforestation and other physiographic alterations are made, appropriate socio-political environment and legal and constitutional supports are extended a new source with very great potential can be opened up. Thereafter, integrated development, interbasin coordination and finally diversion of Narmada water or any other source, like supply received from a National Water Grid, can totally alter the water availability and utilisation picture for a state like Gujarat.

Considerations of risk and uncertainty are integral part of any modern planning process. In sacrificing the alternative model suggested, the risk factor increases. This occurs in connection with the groundwater depletion problem. One does not know the exact magnitude of the crisis and no reliable forecast can be made. Undeniably there is some uncertainty about continuous groundwater availability all over the state. While not overemphasising it, one must include the uncertainty in cost-benefit and other project assessment tasks. Since the suggested alternative accompanies groundwater recharging everywhere in the state as a side benefit, the benefit-cost estimates do not change here. In contrast, during the next ten years or more , when the SSP construction will continue, the state will have little resources to spare for groundwater recharging activities on an extensive scale. Even after completion, the SSP project will not be of any help for many problem regions in the state. Should any contingency due to groundwater depletion occur within the construction period, the priorities for financial allocation may change and either the SSP or the contingent requirement or both may suffer. There is thus a serious risk factor which will go against the SSP in project assessment.

Cost comparison :

Unless the technological feasibility report for the alternative is prepared a cost-benefit analysis cannot be undertaken. So we are restricted here to identification of the different heads of cost.

During the last ten years several studies have been conducted on different micro- water appropriation structures. By compiling those one can get some idea of the financial requirement here. However, the costs of different kinds of micro-structure vary widely and their appropriateness are location-specific. Hence this exercise cannot be undertaken without some amount of technical work towards the Master Plan.

Implementation of this programm demands a high degree of technical input in terms of detailed topographical and geological surveys and expertise in evolving custom tailored designs for various micro-areas. The best manner of doing this is by involving people in the micro-planning exercise from the very beginning of the project. This is a discouraging factor for irrigation departments - although they emphasise their willingness to extend such management, it should not be overlooked however, that in order to achieve their target the SSP has repeatedly boasted of the co-operative spirit of Gujarat farmers and the government's eagerness to extend all support to participatory management. Why not then take up this challenge ? The Kerala Soil Sciences Department has already shown the way physiographic information can be collected on an extensive scale through peoples participation. Gujarat may immediately start working along this line.

In fact, that is the right approach for introducing participatory management. Theories on farmers' participation and formation of irrigation association insist that beneficiaries must be involved from the *planning and designing* stage itself for obtaining the best results. It is otherwise, difficult to imagine how the beneficiaries may be involved at the initial stages for a major project. The bottom-up approach suggested here provides an excellent solution.

The cost data cited above pertains only to the basic micro-structures. Those need to be supported by distribution networks and on-farm developments. If beneficiaries are motivated they may share a large fraction of the cost. This is not unlikely if a systematic effort for introducing participatory approach from the start, is adopted. But even if their contributions are of the same order as in other projects, the public investment requirement may not be formidably high. Similar expenditure was also included in SSP under the head 'command area development works'. It is true that the experimental watershed development works are costlier. But they also include such works like afforestation etc. These are desirable, but not so for comparison with SSP since those benefits are not promised under the later.

The next aspect in construction and cost considerations is the integration of these micro-catchments and basins. The SSP plan envisages construction of an immense network of canals with a total length of above 40,000 kms. This is enough to traverse the whole state by parallel canals at 5 kms interval. The need for public sector construction of feeder canals that the alternative design requires will not be substantially more. Down this level the construction works are parts of micro-structure network. Further, - the use of natural drainage channels may help in reduction of cost.

It is difficult even to visualise the structures needed for integration above this level. They are likely to include storages, anicuts, dams smaller than SSP etc. Only on the preparation of a Master Plan the exact details will be visible. Their costs can be assessed only at that stage.

The benefit cost assessment favours the alternative also because of the differences in gestation period of investment. In case of the initial investments in microworks, the time lag for completion is less than that in the big dam projects. Even in case of the big integrated structures at the final stage, the ready availability of a distribution network and organisation, help immediate utilisation of water.
