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# Bhima Revisited: Impact Evaluation Of A Large Irrigation Project

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## INTRODUCTION

Much has been written in recent years on the problem of increasing desertification of arid lands for various reasons. One of the major alternatives available for increasing the productivity of arid lands — irrigation — has come under some criticism because of its adverse long-term impacts and poor performances. While some of the criticisms are justified, others are imaginary and baseless. A major reason for irrigation development raising great hopes in certain quarters but simultaneously a subject of despair in others is due to the paucity of regular monitoring and evaluation of irrigated agriculture projects [1]. Without regular evaluations, it is not possible to make any definitive statements. Thus, whatever biases one holds tend to be perpetuated, or even accentuated.

Success of any irrigation project depends on proper planning and then management after construction. Since planning and management varies significantly from one project to another, even in the same country, it is difficult to make any generalized statements on their overall performance. The situation becomes even more complicated if one considers the preponderance of pseudo-evaluations that are carried out at present by both national and donor agencies (both bilateral and multilateral), who are primarily more concerned with the protection and enhancement of individual and institutional reputations than with determining the real costs and benefits stemming from the projects. Furthermore, not only are there methodological problems that need to be resolved to find cost-effective and reliable evaluation techniques for the evaluation of specific projects, but there are often built-in institutional inertia and sensitivities which need to be overcome before a serious evaluation can even be undertaken.

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If these constraints could be overcome, the information available after completion of evaluation should be disseminated. On the basis of past experiences, this could be a problem because the agencies concerned often do not wish to disseminate the information unless it is properly 'sanitized'. The bilateral and multilateral donor agencies often do not disseminate their evaluations and claim that they are forced to take such a step due to national sensitivities. However, in contrast, many development experts feel that one of the main reasons could be the poor performance of the donors, who do not wish to publicize some of their mistakes which become evident during an evaluation and thus prefer to hide behind the so-called national sensitivity issue. Bottrall [2] points out that the four detailed case studies he carried out for the World Bank had to be marked "Not for Quotation", and they "could not be published because of the supposed sensitivities of the governments of the countries concerned. For the same reason, the text of the final comparative study was 'sanitized' to the extent that all references were removed not only to the particular projects studied but even to the countries in which they were located." Such restrictions, which are generally unwarranted, seriously reduce the potential usefulness and impact of the evaluations carried out, and thus tend to defeat the very purpose of the evaluations.

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**One** of the very few irrigation projects that has been properly evaluated in recent years is the Bhima Command Area Development Project. A comprehensive evaluation of the project was carried out in late 1983, when only about 10,000 ha of the planned total of 126,000 ha was receiving irrigation water [3]. This was followed up with another evaluation three years later. Both the evaluations provided information on the performance and socio-economic impacts of the

project. The present paper provides a summary of these two evaluations.

## BHIMA PROJECT

The Bhima Command Area Development Project is located in the province of Maharashtra, India. Rapid industrial growth of 4.8 % per annum during the past two decades has made Maharashtra one of the most industrialized and urbanized provinces of India. Most of the industrial growth, however, has taken place in its two principal cities — Bombay and Pune. In contrast, agricultural growth has been low, 0.7 % per annum. Thus, both regional income distribution and rural-urban migration have become problems.

Currently, some 59 % of the provincial area is under cultivation. The area of an average farm is 5.3 ha, but the average farm size varies significantly from one district to another. The vast majority of the farms are owner operated (92 % according to the 1970 census). Maximum landholdings allowed in Maharashtra for a family of five (husband, wife and minor children) depend on the degree of water availability and control, and are shown in Table 1.

Table 1. Maximum landholding in ha per family of five in Maharashtra

Land Type	Maximum Landholding in Ha
Irrigated land	
Perennial	7.2
Seasonal: Assured	10.8
Seasonal: Unassured	14.4
Paddy land (assured rainfall)	14.4
Other rainfed land	21.6

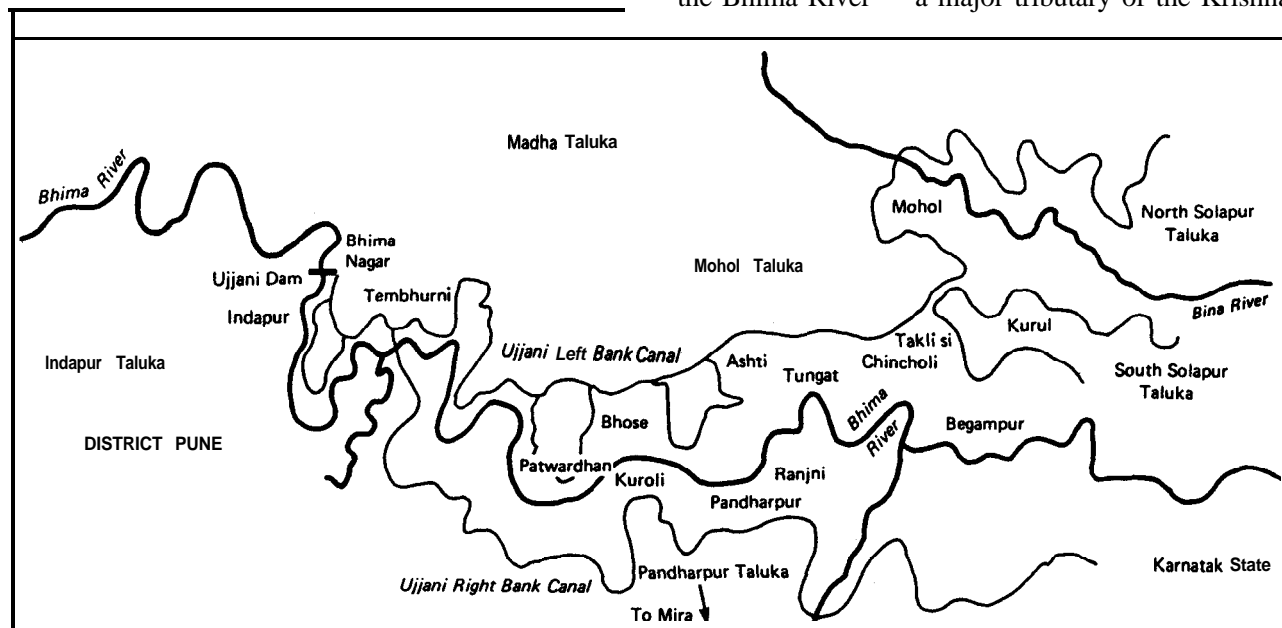


Figure 1. Bhima Command Area

Agriculture provides nearly two-thirds of the provincial employment but accounts for only one-third of the income. Since there is very little prospect for horizontal expansion of agriculture in Maharashtra due to lack of reliable water supply, emphasis has to be placed on better use of agricultural land, and substantially increasing the cropping intensity which is among the lowest in India. For a mostly arid region, such improvements cannot occur without irrigation.

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The government of Maharashtra has been conscious of the importance of irrigation for the provincial economy and welfare. Nearly \$1.3 billion was invested in major and medium surface irrigation works during the three decades after independence to bring additional 870,000 ha of land under irrigation. Compared to the average cost of Indian irrigation projects, at \$860/hectare, irrigation investment per hectare in Maharashtra has been 73 % higher. The high cost, however, can be explained to a major extent by more difficult physical and climatological conditions within which irrigation systems had to be developed.

Since water is the major constraint for further agricultural development, the provincial government has embarked upon an ambitious irrigation expansion programme under Maharashtra Composite Irrigation Projects (MCIP) I and II. The Bhima Command Area Development falls under MCIP II.

The Bhima Project consists of a storage dam across the Bhima River — a major tributary of the Krishna

River — near the village of Ujjani (hence often called Ujjani Dam), which is nearly 150 km from Pune towards Solapur (Figure 1). Since the construction of the dam, a new village of Bhimanagar has developed near the dam. The project has a gross command of 166,400 ha, but a net irrigable area of 126,000 ha. Since good dam sites are not available, the Bhima Reservoir has inundated an area of 29,000 ha. This means the ratio of the land inundated to the total land to be irrigated is 1:4.35 which is somewhat on the high side. The command area extends on both banks of the Bhima and Sina Rivers (see Figure 1).

Much of the emphasis of the evaluation was placed on the villagers — their perceptions of and attitudes to the project. We wanted to know the views of large, medium and small farmers as well as landless labourers on the impacts the project has had on their lives: if and to what extent it has changed their aspirations, their views of the project on their lifestyle and quality of life. We also specifically wanted to know the impacts of the project on women.

When the first evaluation was carried out by the author in October 1983, about 10,000 ha was under irrigation for the *rabi* (winter) 1983-84 season. By the time of the second evaluation in 1986, *rabi* irrigation had extended to about 17,600 ha, and only about 5,008 ha, less than 5 percent of irrigated command area, was receiving year-round irrigation.

In the absence of a reliable monitoring and evaluation system, both the evaluations depended heavily on questionnaire surveys of selected individuals from different villages. The interviewees represented large, medium and small farms as well as landless labourers. Special emphasis was given to determine the changing role of women.

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## **ASSESSMENT OF PROJECT IMPACTS**

Even though only a limited part of the Bhima Command Area has been receiving irrigation water, both the evaluations indicated that the impact of the project on people, biota and the environment has been substantial. On the basis of the two evaluations, various impacts will be reviewed under the following categories: income, employment generation, livestock, energy use, education, transportation, water supply, sanitation, housing, food and nutrition, health, women, public participation, and environmental impacts.

## **Income**

There is no doubt that incomes in areas receiving year-round irrigation increased substantially. Farmers are generally somewhat reluctant to provide correct income figures (assuming they themselves are aware of these) because of fear of possible taxations, reduction in benefits and/or increase in bureaucratic redtape. However, from the surveys of villagers, it is evident that the average net income of those farmers receiving year-round irrigation at present has increased from Rs. 455 (US\$1.00 = Rs. 12.80) per year from the pre-project period to Rs. 4640 at present. This 10-fold increase in income in only a few years of project operation is indeed remarkable. As is to be expected, the net average income of farmers receiving only winter irrigation is less, Rs. 1277 at present. It is interesting to note that in the case of year-round irrigation, it is the small farmers who have realized the highest average income per ha at Rs. 5339, compared to large farmers at Rs. 3919.

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In terms of poverty alleviation, the latest evaluation indicates that some 50 percent of all farmers having year-round irrigation are now earning more than Rs. 10,000 per annum directly from the project, compared to none in the control sample. Viewed differently, 68 percent of control sample earned less than Rs. 1,000 in 1985-86, compared to only 2 percent of the farmers receiving irrigation water all year. All irrigating farmers having more than 5 ha of land now have a net income of more than Rs. 10,000 per year, and some 34 percent of all small farmers having less than 2 ha of land now have a net income of more than Rs. 10,000 per year.

For farmers receiving only winter irrigation, the net income is considerably less. Only 5 percent of such farmers have now a net income of more than Rs. 10,000 per year and 35 percent earned less than Rs. 1,000.

Assuming a pre-project poverty line of Rs. 2,500 per year, that is, households having incomes below this amount were living in poverty, some 61 percent of households were living in poverty before the Bhima Project was implemented. Accounting for inflation, and using a current poverty line of Rs. 5,000 per year, about 26 percent of the households now are living in poverty. This means, within a limited period of time,

35 percent of the families have crossed the poverty barrier because of the irrigation project.

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When secondary benefits like income from livestock are included, the situation improves even further. Consideration of joint farm and livestock incomes means that nearly 83 percent of the families are now living above the poverty level. While only with farm income, 51 percent of the families having less than 1 ha had income over Rs. 5,000 per year, the percentage increases to nearly 66 percent when combined farm and livestock incomes are considered. This indicates that for poverty alleviation, it is necessary to encourage small farmers to have subsidiary income from livestock and other potential sources.

Indirect analyses tend to confirm an increase in income of this magnitude. As noted below, people have considerably improved and are continuing to improve their lifestyle by improving their houses and investing in livestock, better clothing and social functions (like marriages and festivals). Generally, they appear to have refrained from conspicuous consumption, though this may change in the future with further affluence.

### *Employment Generation*

Employment generation has been one of the major benefits of the project. Project-related construction activities have already provided substantial employment opportunities to skilled and unskilled workers. For example, the first evaluation [3] indicated that only construction-related activities had generated 1.786 million man-days of skilled labour and 37.106 million man-days of unskilled labour till 1983.

The work patterns of both small and large farmers have changed substantially. Prior to irrigation, family members usually worked as daily labourers after the *rabi* season. Small farmers worked as daily labourers even during parts of the *rabi* season since there was not enough work for them in the field. Irrigated agriculture, as practised in Bhima, is a labour-intensive activity. Thus in areas where water is available throughout the year, farmers do not now have time to work as daily labourers, with the exception of a few small farmers, who still may work for a limited number of days per month as labourers.

On the basis of the latest evaluation, 113 man-days of wage employment has been generated per year per ha in areas receiving year-round water. In areas having winter irrigation only, the corresponding figure is 33 days per ha per year, and in control sample only 10 days per ha. If additional employment of family members is considered, some 90 man-days of work per ha is necessary. Thus, one ha of year-round irrigation land provided 203 man-days of employment.

It is interesting to note that 37 percent of wage employment is accounted for by men: the remaining 63 percent by women. To a certain extent this can be explained by the fact that the wages for women labourers are significantly less than for men, Rs. 5-6 per day for women and around Rs. 10 for men. Furthermore, with increasing employment available due to the intensification of agricultural activities, family wages earned by the labourers from the farms have increased from Rs. 1,671 during the pre-project period to Rs. 5,416 in 1985-86. The dependence of the labourers on non-farm sources of income has declined markedly: from 38 percent of total income from the pre-project era to only about 11 percent in 1985-86.

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## **The wages for women labourers are significantly less than for men**

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As employment opportunities are being generated, people from outside are migrating to the command area in search for work. The labour scarcity during harvest time has become serious — many farmers are now being forced to go outside the command area to bring in labourers for harvesting. Thus, in terms of employment generation, the project has had a significant impact both within and beyond the command area. As more and more areas come under irrigation, the labour situation is likely to become even more acute — at least in the initial years.

### *Livestock Holding*

One of the main benefits from the project is an increase in the livestock holding of the people in the area. The first evaluation indicated that while farmers generally increased their livestock holdings, landless labourers have benefited as well — though not to the same extent. It appears that many landless labourers have invested in livestock from their earnings from the construction activities of the project. They are grazing their livestock along the canals and/or communal areas.

The latest evaluation indicates that 65 of the households surveyed had purchased 148 draft animals for

a total investment of Rs. 232,000 since irrigation began. Another 87 households purchased 325 milk animals valued at Rs. 421,100. Transportation requirements meant acquiring of 42 bullock carts by as many households during the post-irrigation period.

A major problem that still remains is the lack of suitable veterinary services in nearly all villages.

### **Energy Use**

Many of the villages have received an electricity supply under the rural electrification programme. However, domestic coverage is still poor. For example, during the first evaluation, it was found that in Takali village (population 3257), only one house had an electric connection. There are 30 street lights, which undoubtedly was an improvement. This sad state of affairs, however, is a country-wide phenomenon, where the main emphasis is on the number of villages electrified and not on coverages within villages. This policy needs to be changed.

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In the villages, kerosene is primarily used for lighting, and firewood and agricultural residues for cooking. Women generally collect firewood and spend an average of two hours each day on firewood collection and related activities. Firewood, however, has become scarce and many rural families are already forced to purchase it. An interesting observation is that the percentage of people purchasing firewood in areas where irrigation water is available all year round is much less when compared to other areas receiving water for only one season or no water all.

There are two principal reasons for the decreased use of fuelwood. First, agricultural residues in the areas receiving year-round irrigation is higher than surrounding areas, and hence this has tended to al-

leviate the problem of fuelwood scarcity. Second, people having continual irrigation have become more prosperous and have significantly increased their livestock holdings, thus increasing the dung available for cooking. This is a welcome development since it has reduced the pressure on deforestation in the drought-prone areas like Solapur.

### **Education**

There is no doubt that the children in the project area are becoming better educated than their parents. While the new affluence has some bearing on this, it cannot be exclusively attributed to irrigation. Much of it may have occurred without the project. Irrigation does not appear to have made any noticeable change on the number and type of schools or quality of teaching (number of teachers, their experience, educational materials, etc), and in fact a few villagers have complained about the quality of schools available (see also the impact on women).

It is not possible to make any comment on enrollment and drop-out rates since consolidated data are not available. It will be necessary to go from school to school to interview head teachers, and then aggregate the information for analysis.

### **Transportation**

It was a strategical error for an international agency like the World Bank to suggest only funding of the improvement and consolidation of the existing main road. Since the main road constitutes mainly district roads and state roads, this would have been funded by the Public Works Department of the Maharashtra Government as a matter of routine. Instead, the agency should have supported village roads and farm roads that could provide access to the main road. Currently no plan exists for village and farm roads. Because farm roads have not been developed prior to the arrival of irrigation and land-holdings are generally small, farmers are likely to be reluctant to give up land. This means that the construction of farm roads will now be a very difficult process. Another problem is that lack of farm roads also means lack of cattle-crossing on the channels. Accordingly cattle will damage the channels, and thus increase operation and maintenance costs and also seepage losses. This problem has already surfaced.

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**Currently no plan exists for village and farm roads.**

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**Table 2. Changing pattern of use of cooking fuel**

Type of Fuel for Cooking	Percentage of Fuel Used	
	Pre-irrigation 1985-86 Period	
Fuelwood	66.3	53.2
Cowdung	19.2	23.8
Agricultural wastes	1.4	13.1
Others	7.1	9.9

Another issue is the political agitation that has already started over the need for village roads. People in some villages have already organized *rasta rokoo* (close the road) movement in order to get authorization for the village road. Lack of village and farm roads means that access to market will be difficult and transportation will continue to be a problem.

Some 40 percent of the beneficiaries have now purchased bicycles and around 8 percent now have motorcycles. This is a significant improvement over the first evaluation, and it is likely that as farmers become more prosperous, they may opt for better and more transportation facilities.

### *Water Supply*

Sources of drinking water at present are hand pumps, tanks, wells and river. More and more hand pumps are being installed. However, this appears to be part of a rural water supply programme, and probably would have occurred with or without the project. The problem with the hand pumps now is maintenance — when breakdown occurs, it takes an average of three to six months before any repair work is carried out. All the four sources of water are used at present: the primary consideration for decision to use a specific source is its distance from the house. Generally female members of the household fetch drinking water.

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### *Housing and Sanitation*

There are clear indications that housing facilities in the project are improving rapidly. Review of housing conditions indicates that out of a sample of 140 beneficiaries, 22 have constructed new houses and another 12 have renovated their houses. Nearly 83 percent of the households have purchased new furniture, utensils, radios and other similar items.

There does not appear to have been much change in the sanitation practices during the post-project period.

### *Food and Nutrition*

There is no doubt that the food and nutrition situation has improved remarkably in the area receiving irrigation. Because there are two or three crops a year, both small and large farmers feel that for the first time they have food security. They feel that, whatever happens, their families will now not go hungry as they frequently did in the past.

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Without exception, people in the project area feel the quality of food has improved. Some 71 percent of the households sampled reported that the variety and amount of vegetables being consumed have increased. Similarly, an increase in livestock holdings has meant more protein consumption (milk, eggs and meat) by nearly half of the population. This consumption may be due to the absence of a ready market for the products, so it is likely that when such a market develops, most of such products may be sold for cash. This has been the general tendency in other parts of India.

### *Health*

Comprehensive information on health is not available, but on the basis of limited information available it appears that women in the project area are more susceptible to malaria than men. It may be because of two reasons. First, women receive less nutritious food than men. Men eat first and are given 'better' food, e.g. fish, meat and more vegetables. Women eat last, and thus eat whatever is left. Second, women spend more time in homes and animal sheds and thus are more susceptible to mosquito bites. Increased concentrations of carbon dioxide in animal sheds are likely to attract mosquitoes.

No specific trend was visible for diseases like cholera or annual parasitic incidence. The number of primary health centres has increased from 16 in 1980 to 58 in 1985 in the project area. There is also a significant change taking place in the attitude of people to medicine: because of affluence brought about by irrigation, people appear to be moving from traditional medicines to visits to doctors and hospitals.

Health education appears to be one of the biggest problems in the project area. People are now living side by side with their significantly increased livestock holdings. Health hazards have increased markedly due to the presence of flies and other disease vectors. However, since the farmers are illiterate, they are still not aware of the health dangers posed by such insects, nor do they have adequate information on how to protect water stored in the home for drinking, or on family planning. This is an area that needs urgent attention.

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## Women

The irrigation project has already had many impacts on women, some beneficial and others adverse. The principal impacts concern work loads, attitudes to education, finance, wages, dowries, firewood collection and land levelling.

In terms of the work load, the number of hours worked per day has increased significantly since irrigation was introduced. This appears to be due to two primary reasons. 1) Because of the significant increase in livestock and the fact that women are primarily responsible for them, extra work needs to be carried out every day. 2) Introduction of irrigation means that two or three crops are being grown every year, instead of only one. Weeding for irrigation farming is mostly done by women, whereas very little or no weeding was done for dry farming. Additional tasks include application of fertilizer (little used before, if any), application of water to the fields, looking after labourers and an increased managerial role. Consequently, the average number of working hours appears to have increased by around two and a half hours per day, and by about four hours during harvest times.

There is now a general feeling among women (wives of both small and large farmers) that daughters should be educated. It appears that younger women have stronger feelings about the education of their daughters than their older counterparts. Interestingly, older women, whose older daughters were not educated, now feel the younger girls should go to school. How and why this change of attitude has occurred is difficult to say without further work.

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So far as wives of landless labourers are concerned, a similar change in attitude can also be observed, but this does not appear to be as strong as the views of the farmers' wives. One point made by several landless labourers was that before irrigation, they had to move from one place to another searching for jobs. Thus, they could educate only one son, who was left initially with relatives and in a few cases in hostels. Daughters invariably moved with parents from place to place, and thus were never sent to school.

With the introduction of irrigation, employment opportunities near the villages have increased significantly. Now they stay in one village and find work within the village itself or neighbouring areas. Because of this new stability, they are sending their daughters to schools. One common feeling amongst both types

of women — farmers and landless labourers — is to educate their daughters as far as possible, but only within the school available at their village. There is a general reluctance to send daughters to schools outside villages. Such reluctance is much less for their sons.

The irrigation project appears to have affected dowries: with increasing prosperity, dowry requirements for marriage of daughters have increased about two to five-fold.

## *Environmental Impact*

The subject of environmental impacts of the Bhima Project has been neglected right from the beginning. For example, in the 83 page Staff Appraisal Report on the project by the World Bank, environmental impact has merited only five lines. Lack of data and limited time availability for the two evaluations mean that no realistic review of environmental impacts can be made. However, on the basis of limited observation, the following comments can be made.

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1) The development of a reservoir with a large surface area, and consequent increases in vegetation due to irrigation, appear to have increased the number of birds in the area. Whether any species substitution is taking place is not possible to say without further studies.

2) The presence of a reservoir of surface area of 29,000 ha in an arid region would evidently have an impact on microclimate through increased evaporation and evapotranspiration. Meteorological observations are necessary to identify changes in temperature and humidity.

3) Within the short period the irrigation system has been established, aquatic weeds have already become a problem. Unless immediate steps are taken to control weeds, environmental problems are likely to increase in the future. Among these could be health (weeds would reduce velocity and hence provide good habitats for vectors of water-borne diseases), decreasing water quality (decayed weeds would reduce dissolved oxygen content of water) and increasing water requirements (since water velocity in canals could be reduced, more water needs to be released from the reservoir).

4) The drainage system is very poor at present. Without piezometric observation, it is not possible to say definitively what is happening to the water table, and thus development of waterlogging and salinity. However, circumstantial evidence indicates that the water table has started to rise, and both waterlogging and salinity have become problems in a few low-lying areas. Our interviews with farmers in these areas indicated that crop yields have started to decline.

5) The Bhima Reservoir inundated 29,000 ha, which included 51 villages — 25 in Pune District, 23 in Solapur District and three in Ahmad Nagar District. Some 57,000 people had to be relocated due to the submergence. The relocation programme for such a large number of people leaves much to be desired — we met a few people who were very bitter about their experiences. Regrettably the Appraisal Report of the World Bank does not even mention these people. While the government of Maharashtra does have a relocation programme, again it appears that both planning and execution of plans leave much to be desired. It is a sad commentary that more than 20 years after the dam construction started, and seven years after completion, rehabilitation programmes are still incomplete.

## CONCLUDING REMARKS

Increasing the productivity of arid lands on a sustainable basis has been a major problem in many developing countries. The Bhima Command Area Development Project clearly indicates that not only is irrigation an important and viable option for arid land development but also the benefits of such projects can accrue to both large and small farmers as well as landless labourers. The critical fact is that such projects must be properly planned and efficiently managed.

As the two evaluations indicate, the benefits of the Bhima Project to all strata of the society have been substantial. Equally, like Bhima, any large development project anywhere is likely to have some short-

comings. For example, for the Bhima, three important planning problems stand out: absence of an adequate drainage system, lack of village and farm roads and incomplete resettlement of people. What is important is to identify these types of problems in the early stages of the project's life in order that they could be identified, and appropriate policy actions could be taken to resolve them speedily before they become more serious and affect the long-term sustainability of the project itself.

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## Any large development project anywhere is likely to have some shortcomings.

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Proper identification of design problems and an analysis of the impact of the project on the socio-economic conditions of the area can only be properly carried out through the presence of an effective monitoring and evaluation system. Any reliable monitoring and evaluation system will give the necessary feedback to the management on both the positive and adverse impacts of the project on a regular basis. The management can then take the necessary steps to further increase the positive impacts and minimize the adverse impacts. Such a management system will not only undoubtedly improve the overall sustainability of the project but also will maximize the benefits accruing from it.

## REFERENCES

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## CHANGES AT IAHS

Shortly after his election for a third term as Secretary General of the International Association of Hydrological Sciences (IAHS), and after having served as an officer of IAHS for twenty years, **John C. Rodda** has resigned as of December 31, 1987 to take up a position as Director of the Hydrology and Water Resources Department of WMO in Geneva. **H.J. Colenbrander** has been appointed Acting Secretary General until the new election at the next General Assembly in Vienna in 1991. Colenbrander has previously served as Secretary and then for two terms as President of the IAHS International Commission for Groundwater.

## UNESCO REPORTS

UNESCO wishes to advise readers of *Water International* that they have completed two important reports on water resources in Latin and South America.

The first report describes the results of a "First Workshop on the Hydrogeological Atlas of the Caribbean Islands," which was held in Santo Domingo, Dominican Republic, October 7-10, 1986.

The second report, in Spanish, deals with the results of a water-balance study in Latin America, which was conducted at a meeting held in La Paz, Bolivia, May 12-15, 1987.

Both reports contain a considerable amount of data that will be of interest to many researchers and managers of water resources in Latin America. Both are available by contacting the UNESCO Regional Office for Science and Technology of Latin America and the Caribbean, **Bulevard Artigas 1320, Casilla de Correo 859, Montevideo, Uruguay.**