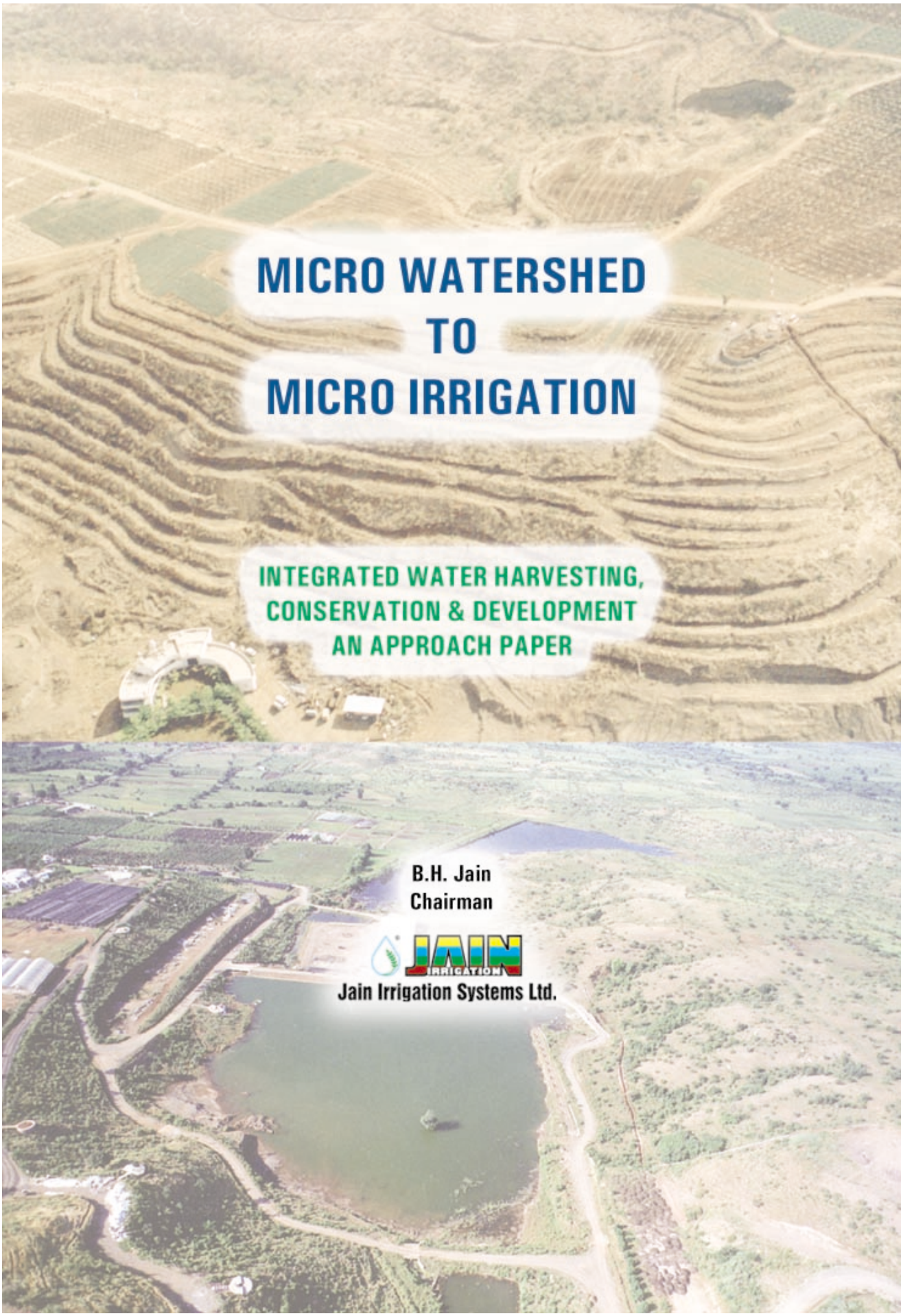


MICRO WATERSHED TO MICRO IRRIGATION

INTEGRATED WATER HARVESTING, CONSERVATION & DEVELOPMENT AN APPROACH PAPER

B.H. Jain
Chairman

Jain Irrigation Systems Ltd.

पाणी हेच जीवन... *Water is Life...* जल ही जीवन है...

CONTENTS

BACKGROUND & INTRODUCTION:

The concept of integrated water management is an attempt to address some of the most important issues and problems which are faced by irrigation industry, authorities and the users. At micro level, the problems are : Need for greater equity in distribution, economy in creation of storage, conveyance and distribution, necessity for higher productivity per unit of water and long term sustainability of any given system. It also seeks to improve the ecology and protect environment as these have emerged as its primary social obligations. The concept is based on local area specific total land and water use planning as against current command area crop specific water use planning. The concept assumes closer community involvement in all aspects of the land and water use management including planning, execution and maintenance of the systems. It also assumes liberal technical, financial and administrative assistance from the authorities; but assigns only a secondary / supportive & counselling role for the State authorities.

1.0 UNIT OF PLANNING & ADMINISTRATIVE STRUCTURE:

1.1 The unit of planning will be a village or group of villages covered in a watershed area. Taking into consideration the work so far done by GSDA, Soil Conservation, Remote Sensing Agency, Irrigation, Agriculture & Rural Development Departments under various State and Centrally sponsored schemes and provisions, an integrated map is to be prepared for land & water use in the area covered by a watershed.

Maharashtra State has been divided into about 1500 watersheds by the Ground Water Survey & Development Agency (G.S.D.A.) for assessment and status of ground water potential and its exploitation. Since mainstay of watershed development (W.S.D.) works is groundwater exploitation, it would be convenient to treat these watersheds as `unit' for perspective planning.

Consequently, 1500 integrated maps will be required for detailed planning and implementation of the concept. Compartmentalisation of administrative structure and piecemeal management approach has been the main hurdle in integrated development of land & water resource & use in our State. We, therefore, need to integrate the activities of various Departments, Agencies and Boards before we can embark on successful implementation of the model advocated in this paper.

2.0 WATER HARVESTING METHODS / WORKS :

2.1 As a first step, a status map of each watershed will have to be prepared by superimposing the following information:

(a) Command areas of completed, in progress and planned state sector & local sector irrigation projects.

(b) Locations of completed, in progress and planned percolation tanks & village ponds.

(c) Contour bunded area and remaining bundable area.

(d) Deep black soil area, area with very steep slopes and rocky area (where bunding activity is not possible).

(e) Forest area (where W.S.D. activity is not possible).

(f) City area & industrial area.

(g) Sub-watersheds where W.S.D. works are completed, in progress or planned.

(h) Isohyetal lines.

(i) 20 meter contours.

This map will indicate the scope, area and its extent where W.S.D. activities can be carried out.

2.2 Study of geology & geologymorphology of the watershed is very important because it indicates the possibility of seepage of conserved water in recharging the groundwater. Taking into consideration the agro climatic and geo-physical conditions of the given watershed, proper t ype of location specific water harvesting structures for harnessing of rainwater on and below the surface will have to be planned, designed and executed in the areas delineated in the status map.

2.3 Watershed development measures are:

(a) Soil Conservation Measures: Contour bunding, land levelling, contour farming etc. to prevent and arrest sheet erosion of topsoil.

(b) Water Conservation Measures: Engineering structures constructed to prevent free and unchecked flow of rainwater by conserving it wherever possible so that it permeates into substrata and recharges the ground water in the entire watershed area.

Similarly, 80% of the used domestic water can be used for irrigation, groundwater recharge or recycled for domestic use after proper treatment.

(c) Biomass Generation Measures: Planting of trees, bushes and grass along steep hill slopes, wastelands, field boundaries etc. to prevent soil erosion and meet fuel and fodder needs of people & cattle. Biomass generation is equally important even for development of catchment area.

2.4 Engineering structures such as percolation tank, village pond, masonry bandhara, check dam, underground bandhara will have to be designed to suit observed rainfall intensity, substrata met with at site, availability of engineering material in the vicinity and availability of local labour and artisans.

2.5 In short, for development of a particular basin / watershed area, one may have to construct a suitable engineering structure such as gully plugs in upper reaches of streams, trench-cum-mound construction on shallow soils with steep slopes, contour bunding of cultivable land having flatter slopes, nalla bunding in the middle reach, construction of gated / ungated bandharas, underground bandharas and percolation tanks in the lower reaches. Surplus, if any, will then be stored in Minor Dam.

3.0 BENEFITS OF WATERSHED DEVELOPMENT:

3.1 The watershed development measures will help greater infiltration of rainwater into the soil, reduce run-off and increase soil moisture. Together, these steps and structures will restore ecological balance, improve environmental conditions and local micro climate.

3.2 It will be observed that most of these watershed development works will essentially cater to the needs of the local population for meeting the domestic needs (human and live stock) as well as provide some irrigation for otherwise rainfed land owners.

3.3 Such a development is also feasible in upper reaches of the stream where soils are shallow and less retentive and people are unsure of getting even one monsoon crop. The existence of dryland farmers is precarious. Watershed development guarantees their survival needs because it harnesses rainwater where it falls and/or facilitates and increases the quantum of seepage into the underground aquifers.

3.4 The irrigated area will increase by 20 to 30% and get water through recharged wells for Kharif or Rabi or both. In certain areas this will mean increase in production and/or productivity upto 100%.

3.5 For example : 1,000 sand filled gunny bags are sufficient to construct dam capable of irrigating 10 hectares with MIS and also recharging 8 wells by increasing the water table upto 5 feet. If water can be stored for about 3 months after the monsoon, the water table in the wells will not normally decline till about February - March. This will enable the cultivator to take at least second crop in Rabi under MIS. Recurring expenses will be about Rs.3,000/- each year.

3.6 It has been stated that in a district which receives more than 500 mm of rainfall, about 30,000 tanks should be constructed each measuring 100m x 100m x 10m = 10 cubic hectare metres in volume. In areas where the annual rainfall averages 800 mm, assuming a collection efficiency of 50 per cent over a catchment area 30 times the tank's size, and an annual evaporation loss of 2 m, each tank will store water to a depth of 10 m. In areas of 200 mm rainfall, it will store to a depth of 8 m3.

The cumulative harvest of water would total to 90 mham, almost equal to 25% of total annual rainfall and more than all the surface water considered usable today.

[*3.5 & 3.6 are based on Dying Wisdom page Nos.351 & 315 respectively.*]

However, since construction of Tanks is location specific, availability of suitable site is found to be the main constraint at least in Maharashtra. In past 25 years (71-96), not more than 15,000 percolation Tanks and Village Ponds have been constructed under various schemes.

3.7 On socio-economic plane watersheds provide good scope for employment to local population, prevent migration to cities and also use locally available material and thus create purchasing power in the hands of rural people.

3.8 Given the unreliability of monsoon, seasonality of surface water source and exceptionally high expenditure that has to be incurred for providing water from long distances by Lift Irrigation Schemes etc., there appears to be no alternative to water harvesting structures which provide immediate and sustained benefits to those who are not covered by command area or other dam like works. To those located in upper reaches of the stream, WSD comes as a solace.

4.0 LIMITATIONS & PROBLEMS OF WATERSHED:

4.1 It is, however, very clear that cost of one unit of surface or sub-surface water storage through watershed development is higher than large reservoir and gravity irrigation works.

4.2 During the years with few wet spells of high intensity, the watershed works are less effective and the run-off is much higher (Most of the country receives rain for just about 100 hours every year and about 50% of this quantity is received in about 20 hours).

4.3 During drought years, WSDs do not conserve much water and consequently there is less recharge.

4.4 Traditional watershed systems are location specific, management intensive and heavily dependent on local community participation. Major investments in training & HRD will be needed.

4.5 Apart from topography, socio-economic and political environment is an additional factor that needs to be considered for the ultimate and continued success of watershed development.

4.6 These structures would reduce total water flowing to Dams.

4.7 These are just not sufficient for today's needs.

5.0 MANAGEMENT STRUCTURE FOR WATERSHED :

5.1 The greatest difficulty in regard to management of this programme is the need for community involvement at every stage including planning, execution and maintenance. It is vital for its success and sustainability. However, the dire need for WSDs will give rise to local awareness and leadership - individual & institutional.

5.2 It is suggested that planning should be done by the state competent authorities. Execution entrusted with NGOs who would do so professionally as time bound programme under direct supervision of Gram Panchayat. The pricing, revenues (at least 80%) shall vest in Panchayats and so also the responsibility for maintenance. Proper guidelines and legal framework and administrative, technical & financial assistance will have to be provided by the State.

6.0 MINOR DAM IRRIGATION :

6.1 It must be clearly understood that water flowing through large streams & rivers having good base flow or those receiving replenishment in summer due to snowmelt can be diverted by constructing barrages, weirs, bandharas or anicuts, whereas water from non-perennial rivers can be stored in reservoirs and used for agricultural irrigation and other purposes by planned canals / conveyance & distribution systems.

It is for these reasons that such dams have come into being and they became synonym with development and prosperity of the command areas irrigated through them. Relatively speaking, the land/soil on banks of major rivers are found to be lot more fertile and as such irrigation adds greater value to them.

6.2 However, in Maharashtra, the outlays for the minor projects as percentage of major and medium projects together have increased from 9% during 1951-69 to 15% during 1969-92 and to 26% during 1992-97. This is so notwithstanding the fact that cost of storage and conveyance per unit of water is least for major projects and increases with decrease in size of the reservoir.

6.3 Consequently, medium and minor projects, though costlier and providing lesser dependable water, are being preferred because they dispense the benefit to the more needy land, they have shorter gestation period and they are comparatively easier to manage. Relative to the major dams, they are more equitable in dispensing the benefits.

7.0 LIMITATIONS & PROBLEMS OF DAMS/ SURFACE STORAGES :

7.1 In reality, not more than 16% of the total farming community have benefited from the surface structures - whether major, medium or minor. These affluent farmers are found to raise crops which are water intensive. Thus, in Maharashtra there is the spectre of a small percentage (about 3%) of land covered by sugarcane consuming about 60% of irrigation water. This situation has given rise to social tensions and concentration of economic and political power in the hands of few wealthy persons who receive the benefits at the cost of the State. As per Mr. V.M. Dandekar, percentage of the rural people below poverty line in Maharashtra has increased from 61 to 82 from 1961 to 1993. However, Maharashtra Govt. puts this figure at 72%.

7.2 What is worse, the farmers who are the beneficiaries of these schemes have started going deeper in search of water and thus have reduced whatever chance other farmers not covered by command had about the use of even the underground water in the command. Area irrigated by groundwater source has increased 4 times in past years. This has given rise to glaring disparity. Moreover, excessive and continued flow irrigation has given rise to increase in salinity in command areas.

7.3 Even the minor irrigation works & canals have become somewhat burdensome because of siltation, seepage, disuse and weeds. Considerable quantity of water released at canal head is lost due to seepage till it reaches the field. In some cases it is as high as 25 to 40%. Unlined conveyance from the major project causes about 35 to 40% seepage loss and deep percolation in the fields.

7.4 It is also acknowledged that about 15 to 20% of surface storage water, any way, gets evaporated.

7.5 To add fuel to the fire, the socio-political compulsions have authorised unplanned construction of medium and minor projects on the upstream of major projects. Consequently, the major projects are facing water shortages and do not get filled up, in many cases, to their rated capacity half the times / years.

7.6 Not to mention the deforestation which occurs in the initial stages in many cases and which causes significant damage to the local ecology and environment.

7.7 Moreover, the woes of those people displaced by such dams have become horror stories. Rehabilitation has proved to be unending and painful exercise.

7.8 In case of major projects, "people get nothing back, no irrigation, no water, no increase in production, no help in their daily lives for periods as long as 10 to 20 years".

7.9 Multiple delays, ever increasing monetary costs, losses, attendant environment & eco problems, displacement and uprooting of locals - all add up a huge cost per unit of water storage created.

7.10 It is not suggested that Major Dams are a curse to the society. The fact of the matter is that the way they have come to be created, funded and functioning, they create disproportionately large distributional problems compared with Small Dams and/or WSD structure.

8.0 SHIFTING EMPHASIS FROM MAJOR DAMS TO MICRO WATERSHED TO MICRO IRRIGATION:

8.1 It is, therefore, very natural that since independence priority for surface irrigation schemes has gradually shifted from major to medium to minor and lastly to micro watershed development works and more recently to Micro Irrigation Systems.

8.2 We need to begin with watershed, grid the small watershed of individual villages and integrate minor projects into the scheme and further use available water in Dams & Canals only through MIS. Briefly put, Micro Watershed will represent backward integration of the present Dam Irrigation practices and Micro Irrigation will be its forward integrating plank. Together they will form a modern Irrigation Package.

We have to work out a proper balance amongst mini WSDs, minor dams & micro irrigation methods. It has to be a healthy mix / matrics linked to each other coherently.

8.3 What we have so far realised, needs to be now accepted as a matter of strategy, necessity, policy and philosophy.

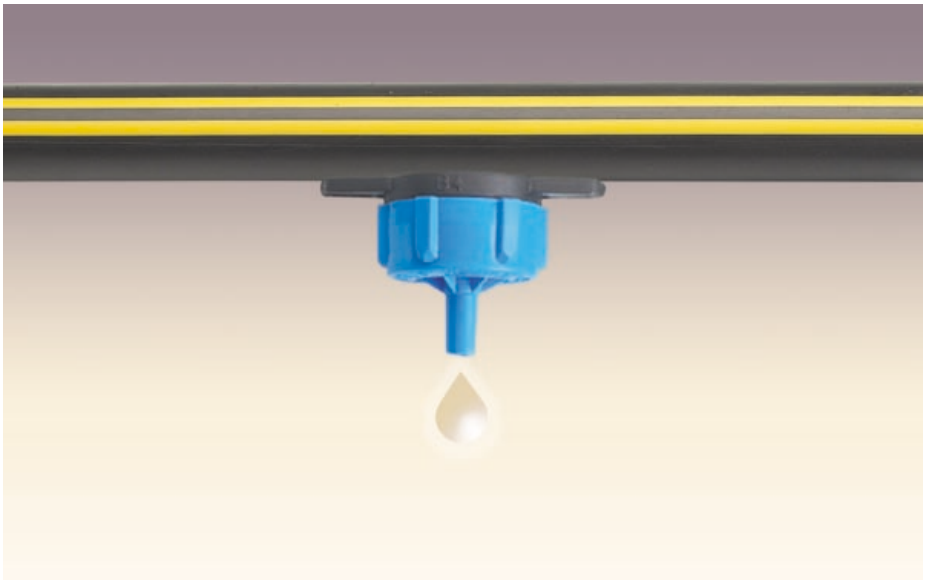
9.00 MICRO IRRIGATION:

9.01 It is a method of irrigation in which water is applied at low pressure over a long period of time at frequent intervals directly into the plant's root zone through network of main lines, sub-mains and lateral lines with emission points spaced along their lengths. The emitter / dripper / orifice applies precisely controlled uniform water, nutrient and other growth substances. Soil moisture is maintained slightly below field capacity. In this manner, with combined forces of gravity & capillarity, moisture and nutrients are replenished immediately and the plant never suffers from water stress and/or water overdose.

9.02 It, therefore, promotes uniform and optimum growth resulting in higher yields (30 to 100%) and lower consumption of water & fertilizers.

9.03 By creating more favourable root zone, it increases tolerance to salinity and improves disease control.

9.04 It brings under use undulated, hilly and problem terrain / soils.



9.05 It achieves 95% water use efficiency because it does not suffer from seepage, run-off, deep percolation and/or evaporation losses through leaves & soil.

9.06 Water requirement varies with crop age and it is only through MIS that you can apply required & controlled quantity.

9.07 It conserves energy because compared to furrow / flood, you pump less quantity.

9.08 It saves on labour and cultivation costs.

9.09 It also saves on crop protection costs because there is considerably lesser weed.

9.10 It affords the grower with a better control over his crop. He can apply more or less fertilizers & irrigation to hasten or delay maturity to get better price in the market.

9.11 The most outstanding feature of MIS is that it is not at all location specific and it is capable of distributing the benefits completely, evenly and equitably like no other system of irrigation can do.

9.12 It is neither crop specific and is suitable for almost any crop. China is reported to be taking even Rice on MIS.

9.13 MIS can work through lift irrigation from canal or reservoir or thrugh well water. In Maharashtra, Districts with large number of irrigation wells with higher density of groundwater exploitation are also having maximum area under MIS e.g. Nasik, Jalgaon, Nagar, Solapur, Sangli, Aurangabad & Nagpur.

9.14 All in all, it saves water, doubles the area under irrigation with the same quantity of water, improves yields & quality as well as saves on labour, energy & crop protection costs, also deals with problem soils and terrain. It is much more than merely a method of applying water. It is a total plant support system and a management tool which rewards good design and careful management with high production, reduced cost and premium quality. With the advancement in software & hardware, it has become a preferred management tool for the progressive farmer. It also provides grater justice in distribution of water as a wital resource.

10.0 LIMITATIONS & PROBLEMS OF MIS:

10.1 Taking into consideration the quality of water, more often, the MIS needs a proper quality filtration system.

10.2 It also lends itself to complete automation and computerisation, making it rather sophisticated if so structured.

10.3 The hardware it uses for most part, is costly plastic petro-based polymers.

10.4 It, therefore, is found suitable and economically viable only for cash and high value crops, more particularly, Horticulture and Agro-Forestry for timber growing. e.g. Grapes in Nasik, Banana in Jalgaon, Oranges in Nagpur, Pomograntes in Solapur, and Sugarcane in Nagar & Sangli.

10.5 The initial capital investment is also heavy. The break-even point varies between 1 - 5 years.

10.6 It is relatively young technology in the third world, though very well proven in advanced countries.

10.7 It, therefore, needs initial support and subsidisation by the State to be popular and acceptable by the farming community at large. State subsidy brings in its wake host of consequential problems.

10.8 It further needs dependable and pressurised power supply and certain degree of skill to operate and maintain the system and adjust agronomic practices for optimum results.

CONCLUSION :

It is, therefore, suggested that the conjunctive surface & groundwater use planning should begin with micro watershed, integrate where needed, with minor irrigation dams and further be complemented by micro irrigation network. Watershed development, creation of minor dams and adoption of micro irrigation must not be seen as competitive or alternative methods of farm irrigation; but must be viewed as different links in the same chain.

This approach will ensure greatest benefit to the largest number at sustainable cost. The integrated approach can address and answer the problem of grave and glaring disparities which have arisen. It is only in this manner that the irrigation potential of Maharashtra can be increased from the present maximum envisaged level of 35% to at least 50% of the area under cultivation.

Earth and its resources are neither to be seen as an ecosystem to be preserved untouched nor as quarries to be exploited for mindless human greed & short range economic reasons. The relationship needs to be a "Creative Partnership" which doesn't seek to maintain statusquo for its own sake; but gives birth to a new set of values. The changed value system must satisfy and sustain human progress synergic with development of ecosystem's own potentialities. Water management is critically vital for human progress as well as eco development.

Notwithstanding the fact that the State has poured enormous sums of money (about 30,000 crores at current prices) for creating irrigation potentials in past over 40 years, the total number of people below the poverty line remains unacceptably high. On one hand we have 19th Century laws and administrative mindset and, at the same time, we clamour for 21st Century environmental ethos and social equity concerns. Not an easy task to deal with. Harnessing modern technology with bold policy initiatives can solve the problems. The approach needs to be total and not piecemeal: From Micro Watershed to Micro Irrigation.

● ● ●