A Strategy for Development of Rural Areas around the Nucleus of Numerous Water Conservation Works

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India is endowed with abundant supply of natural resources including water. It extends over an area of 328 M ha between 80°4′ and 37°6′ North and 68° and 97°25′ East with an average annual rainfall of 119.4 cm. About 180 M ham of surface water is available annually out of which only 15 M ham is stored in reservoirs and tanks and nearly 150 M ham goes to sea and other countries. Out of 400 M ham of annual rainfall 215 M ham infiltrates into soil and about 50 percolates to ground water. By 1976 less than 10% of total annual precipitation was used and direct use by vegetation is about 30%. Out of net sown area of 139.36 M ham the percentage of irrigation of gross/net cultivation are 23.53/22.67 only. Within the country, Madhya Pradesh with 20 M ha cultivated land has only 10% irrigation as compared to Punjab with 5.3 M ha and 83% irrigation. As a result MP produces only 40% more food grains than Punjab.

INTRODUCTION

Storages for water is needed for ensuring a certain degree of reliability or dependency to meet various demands like irrigation, drinking water, industry and several other beneficial purposes. There has been vast technological development in almost all fields in the past. Green revolution has brought in highly improved cultivation practices. Dairy, poultry, fishery etc, have developed. There has been significant advancement in mechanisation in agriculture, industry and several rural activities. Regulation on use of water and its effective application therefore need serious attention.

Indian human settlement system is sharply divided between small, homogeneous, largely unifunctional agricultural based villages and heterogeneous, multifunctional, non-agricultural based cities and towns. 76.27% of population as per 1981 census belong to villages. But decadal growth of 160 million people in town and cities is 46% (1971-81) and may go to 350 million by 2001 AD. Population density in India is 216/km² with 160 rural and 3000 urban density. Urban settlements occupy 1.6% of land but contain 24% population. Decadal growth of rural area is only 18.96% (both in 1961-71 and 1971-81).

LARGE WATER CONSERVATION BODIES

Most of the areas in our country depend on rainfall for a few months of year and that too is confined to few storms of short duration during monsoon period. The onset/withdrawal of the rainy season is also subject to great unpredictability and variation. Frequent failure of rains can affect very badly our economy based mainly on agriculture. To ensure a certain degree of dependability storage reservoirs small and big are needed. Bigger lakes can be designed for higher dependability and also are definitely more economically viable on the consideration of volume on water. Hydel power generation will require deeper lakes of larger area. But such large reservoirs have other aspects of serious environmental impact to be considered.

An aggregate of smaller lakes may be as important as a large one for an area. In countries situated in far off parts of the world like Bulgaria, Tanzania, Japan and Spain water resources management and inland fishery development are based on hundreds of small reservoirs.

It is quite viable to combine a large lake with numerous smaller lakes down below to serve for higher dependability and other purposes like power generation. A small garland or connecting canal can link the entire system. Groundwater support can also be used to improve the dependability in conjunction with the small reservoirs.

MAN MADE LAKES

Although similar basic physical and biological processes are at work in large and small water bodies, there are profound differences in limnology and management of ponds as opposed to large lakes. The transition from ponds to small lakes is commonly associated with mean depth of over 3 m or area greater than 10 km² and transition from small to big lakes as over 10 m mean depth or over 100 km² area. With greater depths and larger areas there is distinct thermal stratification and consequential development of complex dynamic physical structure in the lake body.

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From the view point of power generation and for major water storage, large lakes are economically attractive. Due to approximate parabolic shape of most of lake basins, increase in height results in progressively increased storage. Similarly increased storage with increase in height results in larger hydel production. But very deep lakes involve thermal stratification and development of a complex dynamical physical structure. These may cause changes in natural productivity and associated changes in ecosystem. As in some countries an aggregate of small lakes may also be resorted to for water resources management and inland fishery.

Large dams are hailed as milestones of technological advancement of human welfare by some and are lamented by many as ecological catastrophes. Such lakes involve massive human intervention in the environment. Short term monetary returns (cost benefit) on such man-made lakes are not accepted by some in view of intervention in the natural ecosystem of such lakes.

With the growth in world population unless more sources of energy are developed now we shall face a world energy shortage soon. Right at home in India, we are spending substanial amounts on drought relief in different parts of the country. Thus water conservation bodies are needed in large numbers and of all sizes.

MULTI-PURPOSE TANK

Traditionally every village in India is identified with a source of water (usually village tank or well) and a place of worship (a social gathering place). This source of water is used to meet varied needs of the village. Same concept can be extended to bigger tank serving one or several villages. Each of such tanks can be developed to serve as a nucleus of multiphased development (Fig 1) including.

A green belt round the lake for grazing ground, social forestry and energy wood.

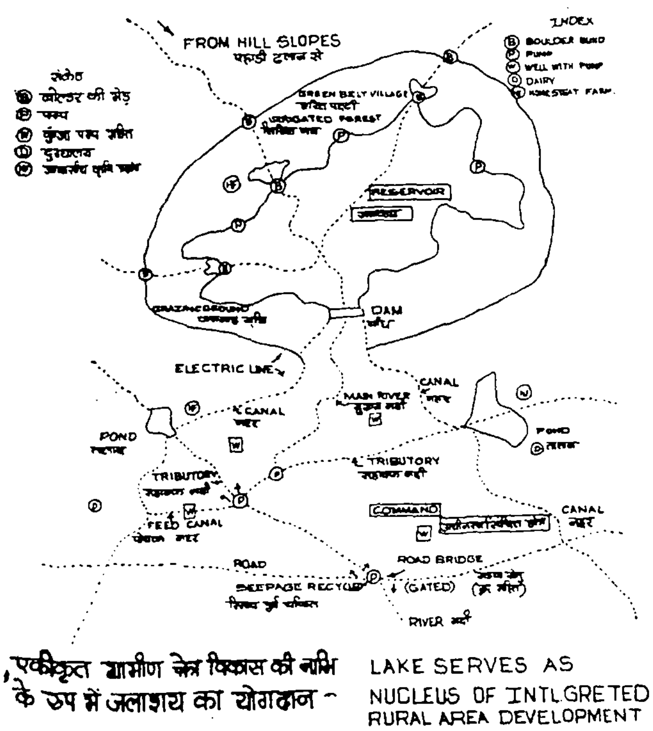

Fig 1 Lake as nucleus of integrated rural area development

Few homesteads, garden crops, fodder units.

Few smaller ponds or tanks near the command intercepting nalas.

Shallow wells (rectangular) with permanent and portable pump sets. Deep bore well, if possible.

Permanent and portable recycling pumps/pipeline units on nalas, bridge/culvert sites.

Dairy, poultry and other livestock rearing (both community and individual).

Biogas and solar/wind energy units (both community and individual).

Small industries (agriculture based), workshop/repair-units.

Grain storage, fodder storage and warehouse.

Institutional financing, sources of revenue for the community, management of local self-government.

Database collection, retrieval and supply of data research and advice units on all matters to be managed mainly be beneficiary villages.

Agricultural and rural based education centres and schools.

Demonstration farms, units, seed farms etc.

WATERSHED MANAGEMENT THROUGH NUMEROUS PONDS AND LAKES

Numerous small and medium lakes are best suited in proper management of a watershed. A man-made lake has the following components above the dam.

(a) Lake submergence which consists of area below lowest cill (dead storage) and area which emerges on depletion of lake level.

(b) Vicinity of lake submergence on the lake shore.

(c) Relative plains above the shore area.

(d) Steeper hill slopes.

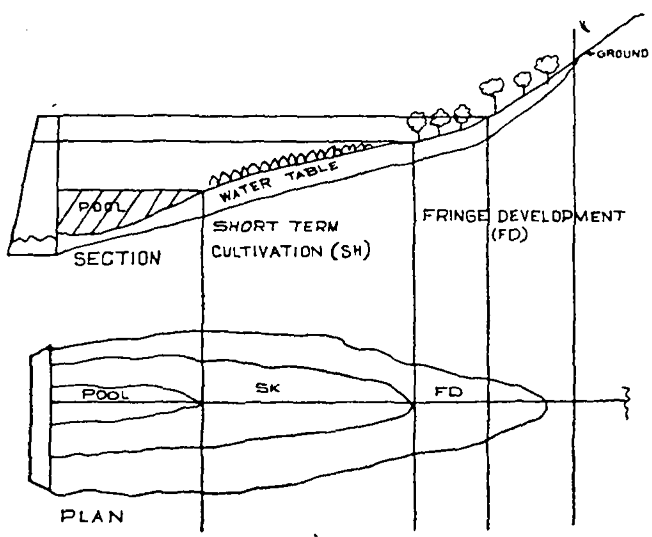

Fig 2 Representative sketch of man-made lake

It is not out of place to mention that huge cost of Rs 181.7 crore was spent in a period 1964-84 on only an area of 1.93 M ha out of 69.32 M ha area in 28 River Valley Projects identified as priority area on soil conservation. These 28 River Valley Projects covered hardly 21% of our country. Thus the watershed management on large scale is prohibitively costly. Numerous small lakes and their vicinity being treated will cover substantial part of the country. This will be in the nature of selected area management in all catchments in the country.

Man-made lakes as distinct from natural lakes take a long time to settle and bring the desirable equilibrium in the echosystem. The water level fluctuates over a wide range and thereby thermal stratification, its change and several other factors come to play. Further human settlement, livestock rearing and cultivation may bring problems of pollution of water. The lake fringe has to be fully planned and correct practices adopted. Emerged area cultivation involves loosening of soil and as such silt/sediment may roll faster towards the dam. Correct cultivation practice will be able to check these problems.

As soon as a lake fills up the existing communication above the dam gets affected. A good road near about the fringe and lead or links to main roads are essential. Relocation of people to far off places even of command area may not be linked. In such cases settlement above the lake will help.

Rapid growth of industries or a mad rush in that direction in a developing country like India may be disastrous. Over 80% of population are connected with agriculture and activities connected with agriculture only can help majority of people. Industrialization is needed to some extent in certain areas. You cannot make a car in a cottage industry. To meet their needs, very small units of industry will help villagers better. A group of 8-10 villages as a cluster can be developed. Nylon ropes/plastic remoulding units, ferro concrete manufacturing units, processes food units. Dairy/poultry/processed meat units/bakery etc. can cover almost all the needs of the rural community and also supply to urban brothers. All such activities are possible if rural settlements are able to settle well without the periodic migration towards cities.

RECYCLING OF PRECIOUS WATER

Whenever a tank is built and irrigation is done some amount of seepage is inevitable. Further there will be rise in the shallow aquifers and perched reservoirs locally. A number of shallow open walls and few low stop dams on nalas in the command can be used for reuse of such wastewater. Intermittent pumping will be required to supplement tankwater. Few bridges/culverts in the command area can be gated to store water. Such recycling of wastewater and groundwater has to be treated as a part of operation and maintenance of the tank as a whole. Drinking water requirement can be easily met from such recycling units from shallow depth wells. Suitable treatment will be needed.

FERRO CEMENT

Ferro cement is a highly versatile form of reinforced concrete made of wiremesh, sand, water and cement which possess unique quality of strength and versatility. Minimum skilled labour is needed and available material can be used locally. It can replace wood, steel and other costly materials. Wide variety of use like grainsilos, soloboat, canal lining watertanks etc, are possible. It can also be used in house construction, biogas or gobar gas plant. Wiremesh can be prepared at village level from simple hand weaving machine using steel wire or nylon fibre. Plastering technique is very familiar to a farmer and is similar to leaping of cow-dung. Small leg-driven vibrators can be used. Limited use of local-fibre like coconut-coir, weeds from lake shore etc, is also possible.

BIOGAS

Production of methane gas or biogas from agricultural, human and animal waste is a profitable field for rural economy. In China they have developed traditional methods of converting human, animal and plant waste to produce high quality organic fertilizer and also a large amount of the energy including electricity for the village. In China biogas plants were extensively developed in 1970 mainly in Sichuan and later spread to other parts. About 100 to 200 people work for management of biogas unit. This supplied electricity, domestic gas, and manure abundantly. Community latrines and individual septic tanks can be used.

There are continuous sources of cheap energy which can be used by villagers alongwith biogas. Solar energy units and wind mills can be used in conjunction with biogas at community and individual levels.

Few additional storages and ponds in the command area will conserve and harvest water for use in conjunction with the main reservoir.

In areas like Nimar (MP) the shallow wells in command can be fed by feeder drains by obstructing nalas and streams. In a few cases pumping across the dyke obstructing subsurface transport may be needed. The dykes which are intermittent have to be delineated and

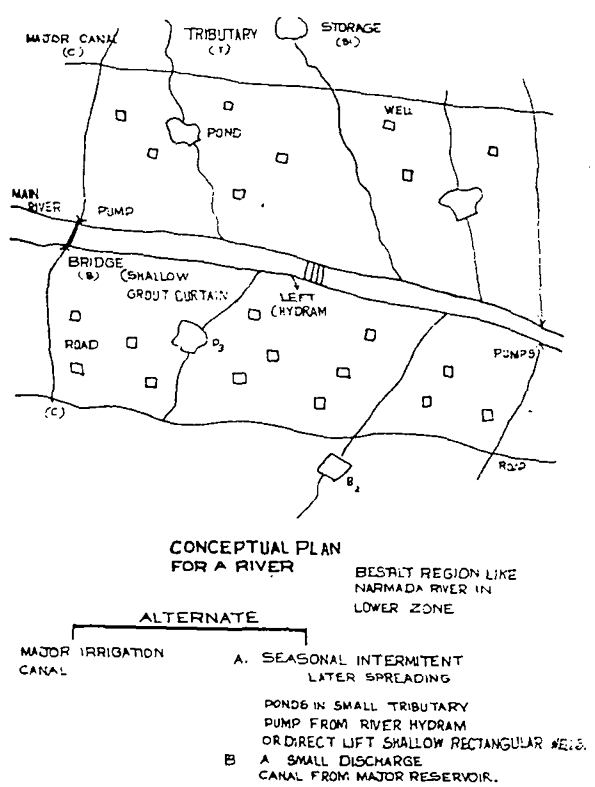

Fig 3 Conceptual plan for a river

used profitably to contain ground water locally. They can be joined or interrupted as needed. Direct pumping in stages from the main river during rainy season may be considered in years of lean rainfall.

Rectangular shallow wells in preference to circular wells when correctly oriented will trap more water. Recourse to horizontal bore to cut through dykes may be needed. The depth and location of such wells can be done properly by simple resistivity tests. Wells can be used both for pumping out and recharging to restore water supply.

All the villages cannot be engaged on agriculture only to meet all the needs. For each set of villages there may be need for several small industries based on agricultural produce and also connected with their needs. Single bench workshops, small electric and electronic shops, village industries like strawboard, fodder processed food, plastic industries (nylon rope, container etc.) can be established. Workshop will be needed for limited mechanization for agricultural and other aspects of villager.

ENERGY NEED AND ANIMAL POWER

There are about 250 million cattle in India (at an average 500 in a village of 1000 people). This can provide at the rate of 10 kg of dung/cattle daily about 5000 kg of dung or 60 kW power for 10 hours daily for each village. This is enough for pumping irrigation water, agricultural processes (seasonal) like drying etc, oil expelling, Gur making, street domestic lighting etc. Marginal deficiencies can be made good by biogas from human/dairy/agriculture waste at the village level. Fuelwood for use of the villages can be fully met from forest grown round the lakes and even canal system in some reaches. In some cases where villages are located near bigger streams/rivers. Mini hydel, micro units and hydraulic ram can be used for ground water recharge, and season power supply. An estimated 8 to 10% area in the country will be able to harness such energy for 6 to 8 months (mostly in the agricultural season) in a year. Few stand-by units and supply from the national grid can supplement deficiency in supply. Electric lines are to be planned along lake fringe and in the command.

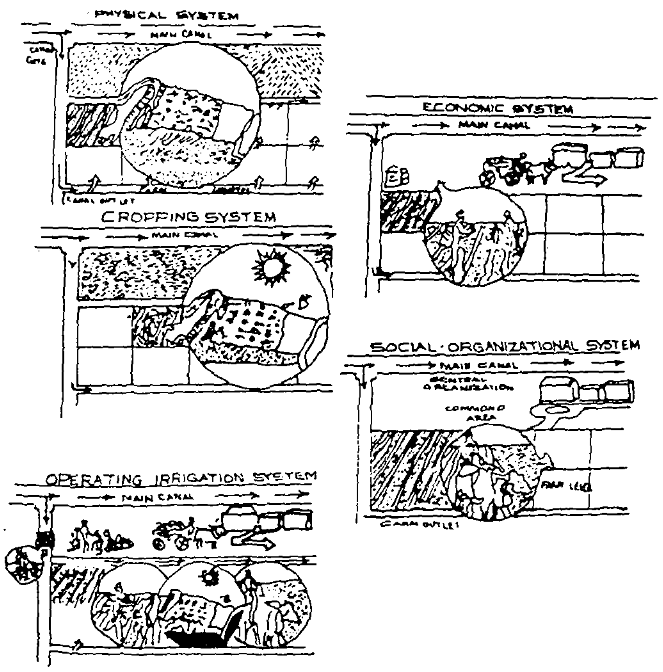

Fig 4 Componants of an irrigation system

SUBSIDY AND HELP FOR IMPROVED PRACTICES

Recycling of waste water, recharging ground water by pumping, putting up biogass or energy units, shallow well pumps, small workshops, community nurseries, village and rural based industry should be adequately subsidised and treated as a community work.

The management of institutional finance like banks, cooperatives has to be fully reoriented with major participation in management by the village community. Only watch and check on a well defined norms are to be done by the government and agency outside the villages. At present such effective and nice institutions like cooperatives/banks are not working well due to corruption, control by centralized agencies and lack of defined norms (and political interference).

MINOR IRRIGATION WORKS BY THE STATE AND AS A PRIVATE SECTOR WORK

As an example in Madhya Pradesh, over 2800 minor irrigation works were proposed in Sixth Plan and in Narmada Valley itself over 3000 minor irrigation works are proposed. So far utilization of Irrigation on minor irrigation works is 59% as compared to 65% and 89% on major or medium projects. Further, there is no agency or organisation to coordinate various connected activities with irrigated agriculture at the state level As a pilot project on U S AID Project, 50 minor irrigation works have now been taken up. Systematic planning, survey and monitoring of such small works are left to lower levels only and depends on individual interest. There is a good case for taking up such small work on a large scale as a specialized branch of irrigation and agriculture departments.

It is quite viable to enturst such works to properly formed cooperatives. At present individual wells/tubewells on very small works are entrusted to private sector which itself forms quite substantial part of irrigated agriculture in Madhya Pradesh.

GEODATA BASE

Village as a unit has developed over ages in India and is perhaps the best institution for such a vast country covering a wide range of agro-climatic and social conditions. There have been earlier attempts in developing all activities of the community on village level units. Entire revenue mapping at village level has been developed in our country.

In a developing economy several types of data are needed. Such data have to be initially collected correctly, compiled regularly, updated and retrieved in proper form easily. Several agencies of the government and non-governmental institutions have been working and collecting such data. Use of such data at present is done separately by each institution. Knowledge on available information and facility of use by others of such knowledge has great limitation at present. Several agencies like Revenue, Agriculture, Geological Survey, Survey of India, Groundwater Board, Engineering Departments, Banking Institutions etc, collect regularly enormous amount of data. They are also compiled and and published in various forms separately. Basically revenue village map and revenue village records are even now used by majority of the agencies. Main difficulty is that the data are not consolidated. updated and published in one place and made available to the villager and institutions working in an area.

It is suggested that the geodata base should be a village and at national level the village geodata base should be available at a single source. There will be certain features of regional at microlevel and certain features of local at microlevel. Both have use. For individual purpose there may be need for updating microlevel data. Micro level or regional data may require more time for revision and may lag behind by a couple of years but will be good enough for use by the rural community. Digital codes for each village level will enable people to compile and store data in a computer program and can be retrieved easily. Certain data connected with village/ villager intimately like soil tests, groundwater status quality, market information, meteorological data, health data etc, should be treated as a national work and handled by specialised departments. Participation at appropriate level and stage by villagers in the collection of such data is possible. Periodical orientation training of villagers will be needed which can be inparted in a school. A school teacher as village level worker (or any institution) can be used for such purpose. An active participation of people at village level is needed in every activity.

A UNIT FOR ALL GEODATA BASES

1. Geodata base at village level

   A. Location B. Index and code

   C. Data store D. Sesonal contours

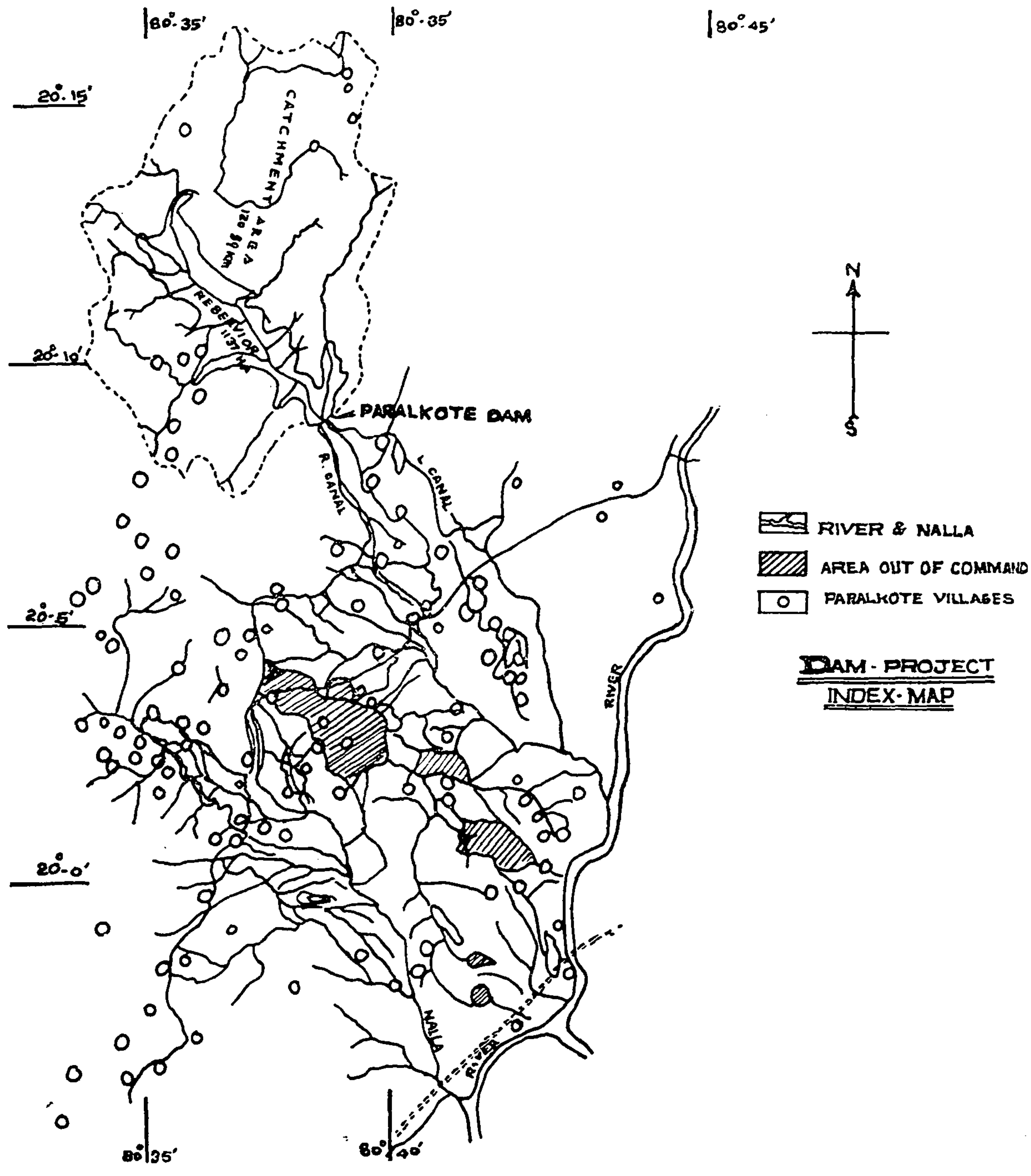

Fig 5 An irrigation project in Baster District (MP) planned under Dandakaranya project. An integrated area development was attempted in the project

2. Open wells and few auger holes to monitor twice premonsoon and post monsoon water level.

3. Water sample test—premonsoon and monsoon, end of each crop season test for chemical content—cotinuous graph for each location.

4. Publish data to permit analysis by any interested agency.

5. Any remedial measure to be coordinated and later evaluated honestly.

6. Data with any agency/department to be recorded on geodata base—include soil survey, chemical analysis, topography, ground water status land use etc.

MANAGEMENT

Strengthening village and villager in all aspects of rural development is the best solution to India. The state government, central government and beneficiaries should be fully and equally involved in all such activities. All grants and subsidies should be gradually reduced and sources of revenue increased. Institutional finance should be made available and to some extent controlled through the village level organisation.

RECOMMENDATION

An integrated planning of number of water conservation works through out the country at village level (or cluster of villages) round the nucleus of a multipurpose tank is advocated to prevent unhealthy migration of rural population to urban area and make each unit and thereby a large part of the country self-serviced. Equal participation by the state government, central government and beneficiary at the planning execution and running of the project is advocated. It will be possible to work out details for such a planning within the frame work of present administrative set-up.

Village as a unit of all geodata bases is advocated.

Few self-explanatory plates are included.

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