

Saviours in saris for Bundelkhand pumpsets

Undeterred by male jibes, women of Manikpur block in water-starved Bundelkhand have ushered in a handpump revolution. Kai Friese reports

IN THE parched hamlets of Manikpur block in Bundelkhand, the spectacle of a gang of women disembowelling the local handpump still draws bemused looks. But never a murmur of protest except to ask why they didn't come sooner. The women for their part have little time for their onlookers' queries as they press to the task: "*Baara inch wrench. Vice kasso. Arre yaar, jor se*" Its the post-mahua off-season, and veteran handpump mechanics of Mahila Samakhya (MS) are training a fresh batch of women volunteers.

With 17 "master mechanics" at hand and a further 15 new recruits, this community handpump project has taken on responsibility for the maintenance of 350 of the 500-odd handpumps in Manikpur block. After one and a half years in operation the impact on water-availability has already been marked. According to project coordinator Madhavi Kuckreja, the onset of summer last year found almost half the hand-pumps in their area inoperative, whereas this year only 10-12 are out of order.

The project is one of a small handful of similar initiatives in community handpump maintenance across the country. But while many of these have a "women's component," the Manikpur program is somewhat unique in being "manned" almost exclusively by women, who take on the task without any remarkable perhaps, is the fact that the project involves two government agencies (MS and the UP Jal Nigam) and an international organisation, (UNICEF) working together. MS has solid base among women, particularly of the Kol community who are the backbone of the project's achievements.

MS's work in Manikpur block of Banda district was started as a programme of the Department of Education in April 1989 with the brief to enhance women's access to information and education. And education was defined as "the questioning of traditional norms, systems, beliefs and discrimination on the grounds of caste class and gender." In the event, what might have been a formula for vagueness was interpreted instead as a mandate for

active involvement in local struggles.

The programme developed a strong base of women's groups (Sanghas) in villages of the Kol and Harijan communities as well as a cadre of village level representatives (Sakhis) and fulltime workers known as Sahayoginis. An office in Karvi town acted as a resource centre, and coordinating point for the activities. But often, issues

of handpumps in the area, subsequent maintenance was handled with lassitude. Some pumps lay in disrepair for years, and 50 per cent of those in the villages where MS was active, lay broken for at least six months at a stretch.

Efforts by various Sakhis and Sahayoginis to elicit some official action on this front invariably ran into brick walls of bureaucracy. Shashi, a Sahay-

would tell us to teach them to fix handpumps." What began as fanciful speculation soon became a serious topic of discussion among Sahayoginis, until finally resource persons at the Karvi office were prevailed upon to contact UNICEF, which has been involved in a number of community handpump projects as a funding and technical support agency. Discussions with UNICEF led to

en their worth in helping to repair 21 handpumps, and things have not been quite the same since.

Today the batchmates of 1991 are trainers themselves, acknowledged as equals by the fitters and as "Masterains" by their communities. "People know us now," says Sumitra, a mechanic. "Men from distant villages recognise us as 'hand-pump meheriyas' and greet

committees that MS has cultivated, parallel to its Sakhis and Sanghas. Motivating the training people to take on these positions (with responsibility for the day-to-day maintenance of water sources) has been a considerable task, which MS took up at UNICEF's urging.

But the committees have proved an invaluable support to the women mechanics. "No one makes fun of the women

ies where they have hand work.

On the other hand, the still an enjoyable edge to women's appropriation technology from which are excluded and the h castes exclude themselves. Chamela, a mechanic, likerecount the tale of the Bralpradhan of Bhaori village with obvious condescension dismissed the visiting mechanics as "Kols and chame. Once they had fixed the vil handpump, Chamela turned the incredulous pradhan said, "We might be Kols Chamears, but look how if you keep your handpump form. And you are Brahmins

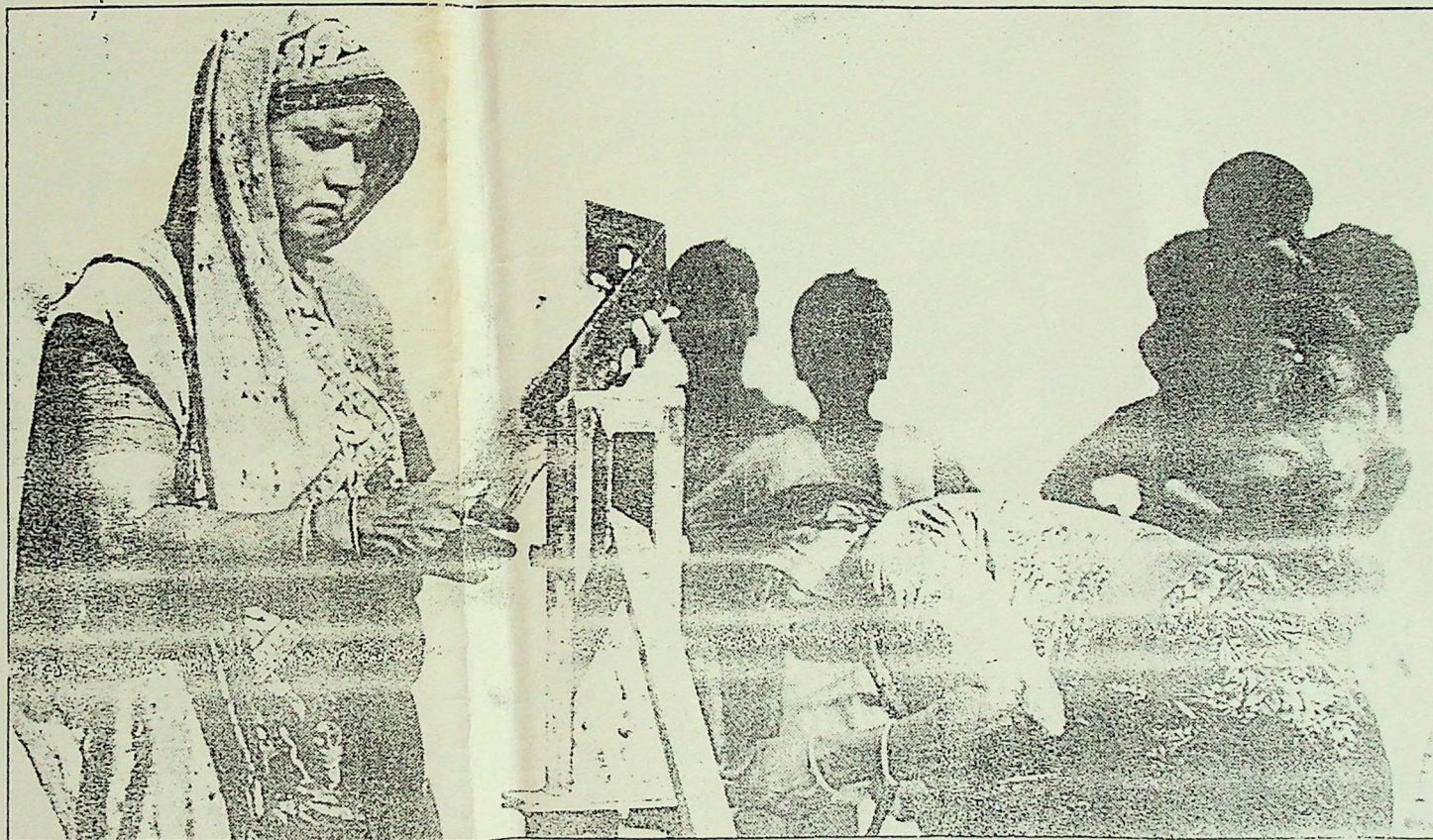
Similarly, suggestions men that it might be more practical to instruct them in hand pump repair are also de handled, with the argument that women are the primary users of the pumps, while men are often not around when problem occurs. After all, men are so busy. Spontaneous son at the end of a day of training also warn men not to meddle with the pump.

Despite this defiant spirit the women still face considerable odds. Their families and communities are often ambivalent about their new role and status, and traditional injunctions as well as new recentments bubble to the surface.

Their mobility, on the other hand, travelling in trucks with the Jal Nigam men, is a popular subject of innuendo. The long hours of unpaid strenuous labour can also be a serious burden on the women, whose domestic work load is considerable. Such adversities have contributed to a high initial drop-out rate among handpump trainees—approaching 50 per cent.

But those who have stayed with the programme are not coy about suggesting that some remuneration for their work would make things easier. Rajeshwari thinks that each mechanic should receive a maintenance fee of Rs 150. MS is in fact investigating the possibility of setting up an agency or cooperative of women mechanics.

And Mushtaq of the Jal Nigam thinks this is an excellent idea. The only problem is, he wants to join.



Women in Manikpur: Breaking barriers

taken up locally would be resolved locally. Struggles against landlords, tendu patta contractors, or small-time lumpens involved in cases of sexual harassment, were taken up by various Sanghas and their Sakhis and Sahayoginis.

But one persistent and widespread problem which MS confronted with little success was that of water. Banda is a drought prone district which faces grave scarcity during summer. Although in the 1970s and 1980s there was a profu-

gini, recalls that on one visit to the Block Development Officer (BDO) the illiterate women met with the taunt, "Do you know what a complaint is? Then write one." Rising to the challenge, they procured written applications but evoked no response for their pains.

It was in this context that women in MS began to talk about training local women to repair their handpumps. The suggestion came from the women," says a Sakhi. "When we had village meetings they

encouraging contacts with the Jal Nigam, and before the year was out a training session was being planned for MS's first raw recruits.

When it took place in October 1991 many of the trainees' families took a dim view saying it was a man's job. The Jal Nigam's experienced fitters were dubious saying these women are suited to working with bread and cow dung alone. The women, understandably, were far from confident.

But there are perks like tea in whichever village they happen to be in.

Some other attitudes have also changed in the process. Mushtaq, a Jal Nigam fitter working with the programme recalls that "until MS joined the maintenance work no one used to lift a finger to help us in the villages." The fact that villagers are now more inclined to assist in the repair of their handpumps has much to do with a new structure of hand-

any more," says Kuchreja. "there is that basic support."

Yet the new responsibilities and relationships entailed have also wrought some changes which the women have mixed feelings about. There is little time these days for many of the issues which once preoccupied them, or the confrontations with authority at which they had become so adept. Rajeshwari, a Sahayogini, acknowledges without enthusiasm that MS has been mending fences

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Water

Water resource management in Tamil Nadu

By Nishi Sinha

FOR the last five to ten years Tamil Nadu has been facing drought of various magnitudes, with the result that the saying "water water everywhere but not a drop to drink" is really applicable to the State. In the present circumstances, the Tamil Nadu Government has for the first time come out with water laws which have been framed by some of the most well qualified people.

The first step towards this has been the formulation of the Tamil Nadu Water Resources Act. The Act provides for Government control on all water, which includes surface, underground, atmosphere and drainage water. For making it effective, the provision requires an amendment of the Land Acquisition Act to eliminate the alternative of levy or penalty for encroachment and also a provision that the encroacher is evicted within a reasonable time.

The Act says that in allocating water resources the first priority shall be given to domestic and municipal purpose. After this requirement is fulfilled, allocation and regulation of water will be done according to the following order of preference. Agriculture will get the second, power and energy third, water for industrial and commercial uses fourth and the rest of the users will get the last preference.

Three types of licences are intended to be issued. Perennial licences for base run off stream, annual allocation from the Gov-

ernment constructed storage project, safe yield of aquifer and seasonal licence for water over and above base run off stream and conditional licence for water within the jurisdiction of Government projects under planning. The failure to use water under a valid licence for a period of five consecutive years without due cause will cause forfeiture of the licence.

This, however, does not prevent PWD from a temporary allocation of water during drought or water shortage as determined in the public interest. Provision will also be made for maintaining a current register of licensed water users and land benefited by the use of water.

The issue of compensation for easement and right of way is not taken care of, but must be considered in the light of the existing laws of the State. Compensation for taking of water rights under licence is provided, except where temporary diversion, reduction or anti-capacity closure is necessary due to emergency drought or water shortage period.

Application for licence to divert and use water for any other purpose allowed in the Act except Government construction and irrigation projects and production of hydro-power will be submitted to the Executive Engineer, PWD, in the district. Upon a favourable recommendation the Executive Engineer will issue a licence to the applicant.

How tricky can this be will be known in due course. Though most of the Government depart-

ments take a lot of time to act, PWD in every State is known for its delaying tactics due to rampant corruption in the Department.

For the development of ground water, the Government will conduct detailed investigation of potential resources throughout the State. Rules and regulations will be adopted for the development and exploitation of ground water. No person will be allowed to drill without first obtaining a permit from PWD. Registration of well drillers and pump installation contractors will be done by PWD. The Government is expected to develop proper standards for adequate protection of ground water quality. This is being done as in several areas of Tamil Nadu ground water, essential for municipal water supplies, is being extracted for irrigation, industrial and other purposes.

The potential danger of contamination of aquifer from sea water intrusion is also very likely. To safeguard against this the designation of certain aquifer for protection and management is also essential. As also the drilling of wells and installation of pumps should be undertaken by qualified parties. A permit should be obtained before drilling is undertaken. Standards for ground water development and utilisation should be set to ensure maximum protection and efficient utilisation of this valuable resource.

Conjunctive use of water should be encouraged. For this the use of ground water along with springs, lakes, streams and other

surface water should be done in such a way as to maximise the beneficial uses of water. PWD will approve private and public sector projects for artificial recharge of ground water. The proposal for recharge will contain source of recharge and determination of adverse effects on existing water users.

Eviction of encroachers during drought may need diversion of licensed water to priority areas as declared by the Government to ensure equitable distribution of water leased according to necessity during drought or shortage period.

The Government would determine revenue in the form of water charges for the construction of new projects and maintenance of the existing projects to be assessed against the land benefited according to the type of use and the benefit derived out of it. This will be treated as public revenue. The building and produce of the land will be considered first security payment of water charges.

Many of the old water cess Acts have been incorporated into this new Act to make water charge effective. From a brief examination of rates of cess method of calculation and assessment in various areas of the State one finds that there is little uniformity amongst district revenue offices. Very often rates levied are not collected. There is very little collection of operation and maintenance cost, specially from the agricultural sector.

The issue of water charges is

very complex and sensitive due to the various Acts under which charges levied. It is proposed that more uniform, systematic and equitable norms and process for cost recovery and cost sharing be adopted.

In the long run what happens is that the influential people at the district level manage things and are under irregular payment or have excess amount of dues to be paid since they connive with the powers that be. On the other hand, the poor villagers might not have the money to pay water charges on a regular basis. At the State headquarters things are more streamlined. At the district level it is easy to make laws but difficult to execute them unless the person dealing with it is a man of courage of conviction and a good administrator.

The owner of low-lying land will be entitled to make drainage channel. But it should be made in such a manner so as to minimise damage to land owners of low-lying areas. At the same time, it should not prejudice the interest of other users.

The Government should be able to declare flood control areas and construct necessary flood control structures. Land within the declared flood control area will not be cultivated or occupied by construction work without prior permission from the River Basin Authority.

PWD will be expected to establish a hydrological and water use data bank for the purpose of planning, allocation, distribution

and management of the States' water resources.

The Tamil Nadu Pollution Control Board should prepare a Tamil Nadu water quality plan. An important programme to ensure compliance with the water quality plan will include a system of penalty sufficient to encourage required compliance.

The formation of water court has been envisaged so that a party can appeal to the water court. No water court or civil court shall grant a stay or injunction on any matter or dispute arising out of the administrative decision. Stay may be granted in matters related to acquisition of land, designation of right of way, refusal of licence or eviction of encroachment from public property and any other matter provided by the rules.

The Tamil Nadu Water Resource Council and Institute for Water Resource would be notified by the Government. The Council will be manned by senior bureaucrats and the Chief Secretary would be the head of the Council.

Tamil Nadu is a water scarce State. The scarcity is more acute now because of below-normal rainfall during the last few years, resulting in drought condition and rationing of water for municipal and domestic use. Needless to say that less water is available for agricultural and industrial purposes.

One of the main hurdles in improving the water management in the State is the present status of water laws. There are presently

eight Central Acts and 20 State Acts related to water matters which are carried out by departments with numerous boards and committees. There is a lack of cohesive set of water policies to direct the agencies carrying out their duties.

At present there are several standing committees at the Central, State and district levels, in which the various departments concerned focus on co-ordinating these activities and establishing procedure to carry out their various programmes. But they are often limited in their authority and responsibility. Hence the need for a council for water resources.

There is also a proposal for the creation of a river basin authority which would develop and manage hydrological boundaries of the basin. Experience of many other countries clearly indicate that the basin management approach is highly desirable and successful.

In Tamil Nadu general control of water is at the district level which is an artificial administrative boundary as far as the hydrological characteristic of water resource is concerned. The authority's relationship with other authorities and agencies and the membership structure of the authority will improve. Its main work will be data collection and resource management through a basin master plan also and co-ordination of multiple uses in the basin.

The Government will encourage water users associations. Any

group of farmers, numbering not less than ten, receiving water from a common source of supply, be it a canal, well tank or otherwise, may form water users association. Such an association will be registered. The primary purpose of the association will be operation, maintenance, development and improvement of water supply, equitable distribution, drainage, management of water utilisation. A person can be a member only if he is either a land owner or lessee or a guardian of a minor who is a lessee or land owner.

Though the qualifications for becoming a member have been clearly spelt out, it is to be seen to what extent the Government will stick to this. In the end all powerful persons will become members, leaving the poor and needy high and dry.

Members of the association would constitute general assembly. A meeting of the general assembly will be convened every year. The members will elect members of the governing committee. The committee will be responsible for carrying out the general objective of the Act, byelaws and rules, and manage the activities of the association in delivery and distribution of water. It will also serve as the communication link with government departments in dissemination of information and all other matters related to the well-being of the farmers. The committee will con-

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Water resources management

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sist of a president, a manager and a treasurer.

The association may request the Collector to earmark land to be used by it for common agricultural purposes like special forestry, grazing ground, weirs and tanks under the provision of the Land Acquisition Act.

Already, there are significant examples of formal and informal water users associations in Tamil Nadu. It is necessary to grant

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Waste water for aquifers

by Usha Rai

WITH groundwater being overexploited in 630 blocks of the country and water shortage acquiring diabolical dimensions in metros like Delhi and Chandigarh as well as rural areas, the Central Ground Water Board (CGWB) has worked out a scheme for replenishing sub-surface water with treated urban waste water.

Treated waste water will actually be purchased from the civic bodies for recharging aquifers in the next three, four years. S.C. Sharma, director and secretary of the CGWB said the details were being worked out. The technology exists and pilot projects have been proposed for Delhi and Chandigarh.

With ground water accounting for 50 per cent of the irrigation in the country and, in the worst affected areas, ground water dropping by seven metres in 15 years, several methods of recharging the aquifers have been worked out. Use of waste water is just one of them, though a rather unconventional one for a country still steeped in traditions and superstitions of 'clean' and 'unclean'. However, it is also a telling comment on the acute water shortage in the country.

Forty years newspapers have written on the woes of rural women trudging miles for a *matka* of water. More recently there has been heightened awareness about inequity in water distribution — the classic case being of the sugar barons of Maharashtra, who with their enormous wealth and political clout have been sinking tube wells deep into the earth's belly to suck out water for sugarcane, while farmers on the periphery of their fields, who cannot afford to sink their own tubewells, do not have water for drinking — forget irrigation.

Alarm bells are sounded when ground water declines steadily over years at the rate of 10 to 50 cms a year. Even a steady 10 cms fall in ground water is cause for concern.

In the U.S. Israel and several European countries replenishment of ground water with waste water has become an accepted way of life. In Israel which has perfected the art of water management, 25 per cent of the ground water is recharged with waste water.

In Al Paso, Mexico, where six to eight million gallons of waste water is treated every day, people refused to drink and use for domestic purposes the treated water. They said it should only be used for watering the golf courses. At great cost, it then had to be injected back into the earth. After it was cleansed by nature in the bowels of the earth the objection to its use melted away. In India, too, there could well be a storm of protest. But in all major cities there is so much waste water that it seems a shame not to tap it after proper treatment to remove the solids, the residual detergents and other harmful contaminants.

The CGWB has divided the country into blocks of dark grey and white — dark grey denoting resource utilisation of 60 per cent and above. Punjab, Haryana, Andhra Pradesh, Gujarat, Tamil Nadu, Maharashtra and Rajasthan falls in this category. Despite all the irrigation canals and big dams constructed since Independence, 40 million hectares is irrigated by ground water today as against five million hectares in 1951. Eighty per cent of the ground water is used for irrigation.

Whoever has Rs 22,000 to Rs 24,000, prefers to have a personal tubewell with which five to eight hectares of land can be irrigated. So far there has been no law to prevent construction of personal wells. A source directly under one's control is preferred to a *sarkari* programme to deliver the manna. Ground water development is, therefore, largely a peoples' programme. As against 8.5 million privately owned and, therefore, better maintained tube wells, there are just 80,000 *sarkari* tube wells.

Traditional systems for water storage like tanks and village ponds have been neglected and new ones are not coming up. But now there is a growing awareness for water conservation.

The CGWB has identified 125 blocks of the country where the state of development exceeds the assessed replenishable resource. In Punjab where every farmer has his own tube well and the cropping pattern is changing from wheat to water-intensive rice, there has been a seven metres fall in ground water over 15 years in certain pockets like Sangrur. Other badly affected areas are Patiala and Kapurthala. There has been a two to four metres drop in ground water over 15 years — in Kurukshetra — Haryana; Gauri bidanur and Kolar blocks — Kar-

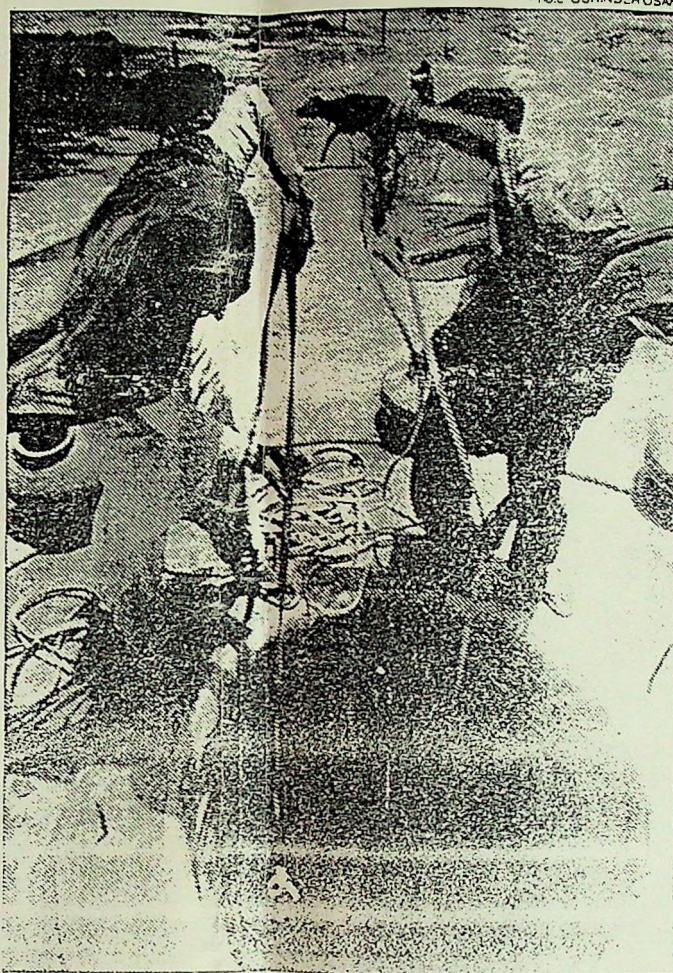


Photo: GURINDER OSAN

Handpumps or decorations?

CONTRARY to earlier reports, the 1991-92 survey-cum-evaluation of the status of drinking water supply in rural habitations indicates that the number of villages without a source of water may be closer to 30,000 than the estimated 750. Even as more water sources are being provided some of the earlier ones have gone dry.

As satellite televisions beam down information from the remotest corners of the world and we talk glibly about the marvels of science and technology, an estimated 1.50 lakh households have no water to quench their thirst — no handpump within the mandatory 1.6 kms radius of their village.

This thoughtless deprivation of a basic resource is not limited to those three villages with 120 families perched on a hill near Tehri Dam where it would cost the government Rs 5,000 per capita pump up water.

The national drinking water mission, finds that no proper provision has been made for maintenance of handpumps and tube wells. In pockets of Bihar about 4 per cent of them are mere decorations on a barren landscape or play things for children. Sometimes the handpump is rusted and there is no water source. But the pump does not have the suction to draw out the required quantity of water. In eastern UP, 10 to 20 per cent of the famous Mark II handpumps don't work. All over the country tube wells that have outlived their life span of eight to 10 years need to be replaced.

While the mission, now named after Rajiv Gandhi, has been focussing on providing a source of drinking water, maintenance and care of the water sources has not got the same priority. The annual wear and tear cost of a hand pump is about Rs 400 a year. For a piped water supply scheme about five to 7.5 per cent of the value of the scheme is required for its maintenance. But this

kind of money is never provided. Government schemes are invariably paper dreams.

Ten per cent of the money from Plan funds is meant for maintenance and the rest is supposed to come from non-Plan funds. However, whatever is provided under the Minimum Needs Programme is diverted to drilling more wells instead of maintaining the existing ones.

Maharashtra and Tamil Nadu, however, have taken on the maintenance responsibility seriously. In Tamil Nadu, every day a handpump is repaired. Villagers are given postcards with addresses on them. When a handpump breaks down they write down the number of the pump and a mechanic arrives. Like the CPWD programme for house repairs, there is a full-fledged hand pump repair establishment. The *mission* gets a salary of Rs 1,200 a month. But in most states where unemployed, untrained youth have been engaged as *missionaries*, they collect their salaries without doing a jot of repair work.

With the introduction of panchayat raj, maintenance of handpumps, wells etc will be entrusted to the panchayats. What is needed, however, is a peoples' programme for handpump maintenance. The women mechanics scheme has been started only in few states with much success. In Solapur block, Junnar district of Bihar, when the handpump in a scheduled caste habitation stopped drawing water, villagers made personal contributions of Rs 500 and moved the handpump close to an assured supply. But such examples of people's enterprise are rare.

In the remaining years of the Eighth Plan, the Mission would like the focus to shift to maintenance with the Centre providing 25 per cent of the money required. With Rs 10,000 crores budgeted for water supply in the current Plan can we hope to end the water famine in our thirsty villages? **E**

Elusive Bill to check inequity

➤ Concerned about the growing inequity in ground water use culminating in further impoverishment of the poor and marginalised, the Centre has been trying to Regulate and Control the Development of Ground water through a model Bill, the final legislation vests with the states, from 1970.

➤ The Bill seeks to bring under its purview all ground water, allowing construction of personal wells only by small and marginal farmers. Though passed in Gujarat, rich farmers of North Gujarat brought pressure and the administration has not been able to implement it.

➤ MP has promulgated the Pajjal (drinking water) Adhiniyam. Tamil Nadu has introduced the Madras Metro Water Act to regulate use of ground water.

nataka, Chingleput and Thirunelveli — Tamil Nadu; Osmanabad, Ahmednagar, Latur, Beed, Amravati and Jalgaon in Maharashtra.

Economically viable artificial recharge of ground water should be taken up in the 630 seriously affected blocks and the necessary funds provided. Water basins will be identified based on study of the soil texture and

structure, percolation and chemical component of the inherent water and hydrogeology of the area. The scheme if properly supervised for mixing of non-homogeneous waters could accelerate evaporation and cause blockage of the 'pore' space with salts.

Trapped in the basin or pond, the water percolates slowly reaching depths of 20 and 30 metres in four to six

months. Waste water recharge will be done in a similar manner but after ensuring that the impurities are removed.

Sub-surface dykes or dams, each of which would cost of Rs 1.5 to Rs 2 lakhs, and can irrigate up to 10 hectares on a sustainable basis, are also proposed. These underground dykes are proposed in select, small catchments of two to five sq kms, five to six metres deep channels

are dug up against the flow of water. Constructed with bricks and mortar and with a polythene lining the dykes are a boon in areas perennially short of water.

Under a proposed centrally-sponsored Rs 81 crores scheme, aquifers are to be recharged in 200 critical blocks in the Eighth Plan. Despite a fall in ground water it is the only sustainable source available all over the country. **E**

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ENVIRONMENT: Swimming against the tide

By T. S. Vishwanath, M. Srinivas and A. Srinivas

For a bridge over troubled waters

By B. B. Vohra

It would be convenient to consider the problems of water management under two broad heads — those which can and should be handled by existing State Irrigation and ground water organisations, with such revamping and re-orientation as may be found necessary, and those which by their very nature are beyond their capacity to handle. Such a review will yield the startling revelation that the most pressing problems of water management, namely the abatement of droughts and floods, the saving of reservoirs from premature siltation and the replenishment of ground water resources, belong to the second category and can be tackled only by carrying out far-reaching reforms in the entire field of land management, afforestation and rural development.

The problems which it is possible and necessary for existing irrigations organisations to handle are fairly well-known even though for various historical reasons, there is a great reluctance to face them squarely. The storage and distribution of surface water through the construction of big dams and canal networks are our biggest achievement in the field of water management so far. We have spent something like Rs 25,000 crores between 1951 and 1989 to actually irrigate a net area of something like 16 million hectares through big projects. The sorry state in which this sector finds itself today is however best described in the words used by the Prime Minister while addressing the State Irrigation Ministers' Conference in July 1986:

"The situation today is that since 1951, 246 big surface irrigation projects have been initiated. Only 65 out of these have been

completed, 181 are still under construction. This is not a happy state of affairs. We need some definite thrusts from the projects that we started after 1970. Perhaps we can safely say that almost no benefit has come to the people from these projects. For 16 years, we have poured money out. The people have got nothing back, no irrigation, no water, no increase in production, no help in their daily life. By pouring money out to a few contractors or a few thekedars and labourers to build canals and may be Public Works Departments to contract the dam, we are not really doing our people a favour. The favour comes when the benefits of the project start flowing".

This is a very serious indictment indeed and needs to be taken to heart by all those interested in better water management. The following concrete issues require to be tackled with the utmost expedition in order to improve the working of this sector:

(a) The most urgent action must be taken to close the large gap between the gross irrigation potential of around 23 mh which has been created since 1951 and the potential of around 17 mh which has been actually "utilised". The creation of an additional capacity of 6 mh — which represents the size of the gap and is equivalent to around 25 per cent of the total potential created during the 38 years in question — would today require an investment of over Rs 24,000 crores. It would obviously make better economic sense to make use of available idle capacity than to create additional capacity at a time when we are desperately short of resources;

(b) High priority must also be given to the task of making fuller use of the post-1951 potential of

around 17 mh which, although it has been "utilised" in the parlance of irrigation departments, is in fact grossly under-utilised as is evident from the fact that the productivity of these lands is no more than around one-third of what can be achieved through improved arrangements for the distribution and application of water. This means that command area development programmes must receive much higher priority than is being accorded to them. However, in the Seventh Plan, out of a total provision of Rs 13,227 crores for big irrigation projects, as many as Rs 11,556 crores or over 87 per cent stand earmarked for the creation of additional potential and only Rs 1671 crores for command area development programmes. Irrigation departments must overcome their fatal fascination for new projects till such time as existing installed capacity has been put to proper use.

(c) The menace of water-logging (and consequent salinisation) of the soil which has already affected at least 8 mh of good agricultural lands, and threatens many more, must no longer be ignored but tackled in right earnest. It must be clearly understood that we cannot, under any circumstances, permit the blessings of canal irrigation to be turned into a curse and allow our renewable resources of water to damage our non-renewable resources of land. It is, however, surprising that no separate provision has been made in the Seventh Plan for drainage and anti-waterlogging activities — apparently these are meant to be financed, if at all, as part of command area development programmes;

(d) Ways and means must be found to put an early end to the very serious financial losses

which are being incurred by irrigation projects. These losses are already of the order of Rs 1,000 crores per annum and are steadily mounting.

(e) Our costly and irreplaceable reservoirs, which represent not only valuable irrigation potential but very often hydel and flood control potential also, must be saved from the threat of premature siltation. This, however, is a task which demands effective afforestation and soil conservation measures in the catchment areas of reservoirs and is therefore beyond the capacity of irrigation departments to handle.

However, the biggest single reform that is required in our irrigation departments is their re-orientation with regard to ground water which is still looked up as a source of "minor irrigation" and not considered to be anywhere nearly as important as what is called "major and medium irrigation". The fact must be faced that, thanks to the natural advantages it enjoys, ground water has developed extremely rapidly as a source of irrigation in the private sector in recent years. Unlike surface water which lies at the mercy of irrigation departments for its development and is even then available only to areas lucky enough to be situated in the command areas of projects, ground water is available, to a greater or lesser extent, in most parts of the country at fairly accessible depths and can be easily tapped by the farmer with the assistance, where necessary, of nothing more than a short-term loan. The installation of a tubewell can be completed within weeks if not actually days and since it begins to yield returns within a single season, it represents a most attractive investment. Above all, ground wa-

ter represents a source of irrigation which is completely under the farmers' own control and can be used to apply water to the land exactly when and to the extent it is required by the crop. It is this last circumstance, which explains why ground water irrigation has been found to be twice as productive as canal irrigation.

There are today well over 10 million electric or diesel-driven pumpsets in the country. At the end of the Sixth Plan, ground water already served a gross area of 26.1 mh as against 25.3 mh irrigated by "major and medium" projects. However, if the higher productivity of ground water is taken into account, the area served by it in 1985 was equivalent to around 52 mh of canal irrigated lands. There is thus no room for doubt that ground water is no longer a "minor" but the major and most productive source of irrigation in the country. It may be mentioned in this connection that while the total storage created by big projects upto the end of the Sixth Plan was around 17 million hectares metres (mhm), the country's ground water resources have an annual utilisable potential of nearly 42 mhm, of which only around 10 mhm have been utilised upto now. In the world as a whole, fully 98.4 per cent of all liquid fresh water resources are represented by soil moisture and ground water and only 1.6 per cent by water in streams, lakes and swamps.

It is time for irrigation establishments to appreciate the reasons why irrigation from big surface projects has to necessarily yield pride of place to ground water. Big projects require huge public investments, take years and often decades to complete, and demand large areas of valu-

able land for submergence as well as for distribution systems. Big projects also suffer from serious losses of water by evaporation and seepage during storage and transport — on an average less than 50 per cent of the impounded waters reach farmers' fields. Such projects also create grave problems of water-logging in areas which are not naturally well-drained. Further, they are not easy to operate efficiently and require large additional investments by way of command area development programmes in order to ensure that water is put to good use. Big projects also pose the most difficult problems of rehabilitation of communities displaced from lands which get submerged by reservoirs. Finally, they are weighed down by large bureaucracies which have become notorious for their corruption and inefficiency.

Thanks to these inherent disadvantages, plus the haphazard manner in which many big surface irrigation projects have been taken up in recent years — without full investigations and surveys and without making adequate provision for the funds required to complete them in reasonable time — the cost of creating irrigation potential per gross hectare of land through the "major and medium" route has shot up from about Rs 1,200 in the First Plan period to around Rs 40,000 in the current Plan. However, if the costs of command area development and drainage are also taken into account, the cost of creating "utilisable" irrigation potential in one gross hectare of land will, on an average, be found to be well above Rs 50,000 per hectare. This is an exorbitantly high figure by any standards and indicates why the future of irrigation

in this country will belong increasingly to ground water.

It is however necessary to note that the "big dam" lobby is still extremely powerful and well-entrenched. This is apparent from the manner in which it has been able to obtain clearance for the Narmada Project in the teeth of opposition by environmentalists throughout the country.

Be that as it may, it is clear that the country's ground water resources should not be taken for granted just because they represent a gift of nature and should be given much greater attention than they have received so far. The neglect which ground water has suffered is apparent from the fact that the Seventh Plan document contains no separate section on this subject, nor any discussion of the projects it faces.

It is time that the most serious notice is taken of the steep falls in water-tables which have occurred in many parts of the country as a result of over-pumping on the one hand, and on the other, decreasing rates of replenishment caused by increasing deforestation and denudation in our watersheds. In certain areas such as the coast of Saurashtra, excessive pumping has led to the intrusion of sea water into sweet water aquifers and has turned once blooming agriculture and fruit-growing areas into wastelands.

It is necessary that such developments should be anticipated and avoided in all sensitive areas so that ground water development does not become its own worst enemy. The following concrete suggestions need to be considered:

(a) State ground water organisations should be suitably strengthened and equipped and

made capable of carrying out scientific investigations into the extent and nature of aquifers and their recharge characteristics so that they may be able to monitor their behaviour and sound warning bells in time.

(b) State ground water organisations should also be equipped to give competent technical advice to farmers regarding the kind of tubewells and pump-sets they should install in their holdings so that there is wastage of either scarce materials or even scarcer energy resources;

(c) State governments must empower themselves to impose, wherever necessary, restrictions on pumping by individual farmers in the larger interests of agricultural production, and the farming community as a whole as well as of the health of the resource on which so much depends;

(d) State governments should ensure that installed pumping capacities are not under-utilised for lack of either electricity or diesel;

(e) State governments should take up time-bound programmes for the consolidation of holdings because this is one of the surest ways of encouraging ground water development on sound lines; The most important task in the field of ground water management, however, is to ensure that the replenishment of this invaluable resource is increased to the maximum possible extent.

However, this is a task which, like the prevention of floods and droughts and the premature siltation of reservoirs lies beyond the purview of irrigation organisations and belongs to the field of watershed management and soil and water conservation.

The reduction of run-off and soil losses through a greater

Continued on page 11

NAGALAND and Mizoram in north-east India, provide an example of where traditional and modern methods of water conservation exist, often in conflict. Tribal societies here, that have retained their traditional culture, have a unique understanding of the link between environment and their survival. Their methods of conservation, and of sharing, are aspects that the rest of India could learn from.

But instead of drawing a leaf from tribal genius and building upon this unique system, the Government of India is pouring crores of rupees into modern development schemes that are often of dubious benefit to a small segment of the population. Neglect of traditional methods of conservation has, in consequence, helped cause an environmental imbalance.

Despite the massive funds poured into Nagaland by the Central Government, ostensibly for development, there is little evidence of its use even in Kohima, the capital city. Here innumerable families suffer an acute shortage of water, despite the abundant rainfall caught in the thickly forested mountain ranges circling Kohima.

For Bano Merano, my young hostess, the problem of procuring water for her household is a constant thought that leaves no room for tiredness or morning sleep-in. Her house, situated on a hill slope, is still untouched by the town water supply scheme, as are various localities in and around Kohima. These areas depend on water tapped from natural springs and streams that are fast drying because of the onslaught of urbanisation and the depletion of trees.

Around midnight, Bano rouses herself to collect all available buckets and pots to fetch water from a spring hole, fortunately situated next to her house. Alternately, the household is up between 4 am and 5 am to fetch water before the rush hour. By 6 am, one is awakened to a babble of voices as householders from further down the locality gather around the spring hole. Within half an hour, the stone lined storage tank, adjoining the spring, is empty, and late comers patiently wait to catch the trickle.

The same pattern was seen in an even more acute form in the hill top town of Mokokchung. According to local residents, water had to be carried in tankers from the river and sold at Rs 5 per tin. Once a week in the dry season, residents collected their

families, dirty linen and utensils, and trooped to the river for a good scrub.

The situation has however eased recently, since the commissioning in part of the Mokokchung Town Water Supply Scheme, that pumps water from the Dikhu River. Since work started in 1980, the scheme, which created considerable controversy over misuse of funds, is way behind schedule. The original estimated cost of Rs 3.8 crores has now crossed Rs 10 crores.

Collection of water from springs and streams is the main traditional method of domestic water collection followed in Nagaland. In the villages every care is taken to protect these water sources by allowing the undisturbed growth of natural vegetation, and banana trees, which are a water retentive species. Bathing, washing of clothes and presence of cattle is strictly prohibited here.

In the matter of domestic water conservation, the Mizos have

"THE village of Kikruma has made rain water harvesting into a fine art... Even the down-flow of water along the hillside is caught and utilised for irrigation."

proved to be more adept than the Nagas. Facing a severe water crisis, necessity has forced the Mizo householder to be his inventive best. As in Nagaland, rainfall in Mizoram has so far remained plentiful and constant, averaging 250 cms, for eight months of the year. However in Mizoram water retention in the soil is reduced because of deforestation and soil erosion.

In Aizawl, every household has tanks made out of tin or concrete, in various sizes, which are situated on the roof or under the ground. A common method of catching rain water is to place horizontal rain gutters along the sides of the sloping roof, which is normally

Tribal societies in Nagaland and Mizoram have much to teach the rest of the country about water conservation, says RUPA CHINAI

corrugated iron sheets. The rain then pours into a pipe connected to the tank.

An innovative method of rain water collection by utilising the force of gravity was noticed in one household. Here rain water that splattered onto the flat roof, drained into a pipe, going down to ground level from the roof. Through the force of gravity the water travelled along to the front of the house over a gentle upward slope, and into a closed hume pipe, attached with a tap.

The Government of Mizoram in December 1988, commissioned an ambitious and expensive scheme for pumping water to Aizawl from the Tlawng River, providing water for a population of 80,000 and the capacity of delivering 2.5 million gallons a day. Presently the coverage is only half the amount. The original estimated cost of Rs 4.5 crores has now escalated to Rs 15.6 crores.

In the rural areas the Mizoram Government has covered forty per cent of the total 737 villages, with piped water supplied through gravity feeding schemes. By this scheme the water from a high mountain source is tapped and delivered to a village below, upto 18 kms away, when water travels over varying gradients through the sheer force of gravity. In a recent scheme rain water tanks have been provided as a community scheme to over hundred villages. Meanwhile the Government is pinning its hopes on groundwater explorations being presently conducted. Over the last two years drilling of deep tube wells has resulted in 26 being created in Aizawl. However a couple dried up within a year, indicating that ground water may only be available in pockets.

The Government of Nagaland has provided water connections to eighty per cent of the rural population by tapping existing water sources. Twenty per cent have been given expensive pumping facilities that lift water from a river to the hilltop settlement. The tap water flow is however below fifty per cent capacity, because of water sources drying up. And according to an official all villages in Nagaland are classified as 'problem villages' as there are no dependable sources of water,

and all schemes require pumping. Meanwhile availability of ground water sources, though believed to be low, have yet to be assessed.

The advent of government tap water has in many instances led to the neglect of the traditional water sources. During a visit to Pudunamai village, inhabited by the Mao Nagas of Manipur, close to the Nagaland border, it was found that the village has at least ten natural spring sources, of which four have been harnessed through the building of a storage tank around the spring. Of the

wards their traditional water sources, the nearby township of Mao Gate, hard pressed for water, has worked towards conserving available sources. Mao Gate has a larger population, living alongside the Kohima-Imphal highway, who run hotels and restaurants catering to the heavy flow of traffic. The locals catch every trickle of water running down the mountainside for their bathing and washing needs.

A huge storage tank, like a small house with a covered roof of corrugated iron sheets, was seen

ables while cooking. The leafy greens retain their fresh colour and natural sweetness of taste. Evidence of this was tasted at the simple and clean Mao Naga Hotel, that presented the local cuisine of boiled rice, boiled mustard leaves, curried chicken and chilly chutney.

THE advent of tap water appears to have changed the original power structures of Naga villages. In Pudunamai a handsome young

day, Genna (a religious ritual) will be observed, and prayers offered to God to give them good water. While Kings in other villages are known to have ordered the population to clean the traditional water sources, King Kaikho has yet to convince the villagers of this need, and appeared shy of exerting his authority.

Where Nagaland has scored is in its use of water for agriculture and irrigation. The villages of Khonoma, inhabited by the Angami tribe in Kohima district, and Kikruma, inhabited by the Chakhesang in Phek district, provide the best examples of how their remarkable and highly advanced system of conservation and sharing, works.

The Angami phrase, 'Kwunoria — Kelhukewiria' ('Khonoma — where life is good') is a term used by the villagers, to describe this beautiful settlement. The village offers the most breathtaking view of towering mountain sides, whose slopes sparkle with the emerald green of terraced rice fields. Here one of the most scientific methods of cultivation practised by ancient man, continues to flourish today.

The method of wet rice terraced cultivation has been practised here for over 700 years, brought by the Angami, who knew the art from wherever they came, probably Southern China or Philippines. This method was emulated by the Chakhesang, and Zeliangs to a lesser extent, neighbouring tribes, who adapted the Khonoma pattern to their conditions.

The Angami tribes took care to protect the forest cover on the mountain tops and took advantage of the perennial streams originating there, to irrigate their terrace fields. The Chakhesang, not having the advantage of perennial mountain sources, developed a rain water harvesting scheme, by simply catching every drop of rain water in the vicinity of the village.

In Khonoma, there are three streams that course down the mountain slope. Fields have been demarcated into small plots, terraced by a stone wall, which climb high onto the steep slope. At various points as the stream flows, horizontal channels divert water into the adjoining terraces. When the plot has enough for its needs, the flow is blocked off with a stone, and the flow continues onwards to irrigate subsequent plots.

Meanwhile there is also a vertical flow of water from the flooded irrigated field. At a particular high slope in the plot, a small opening is created whereby

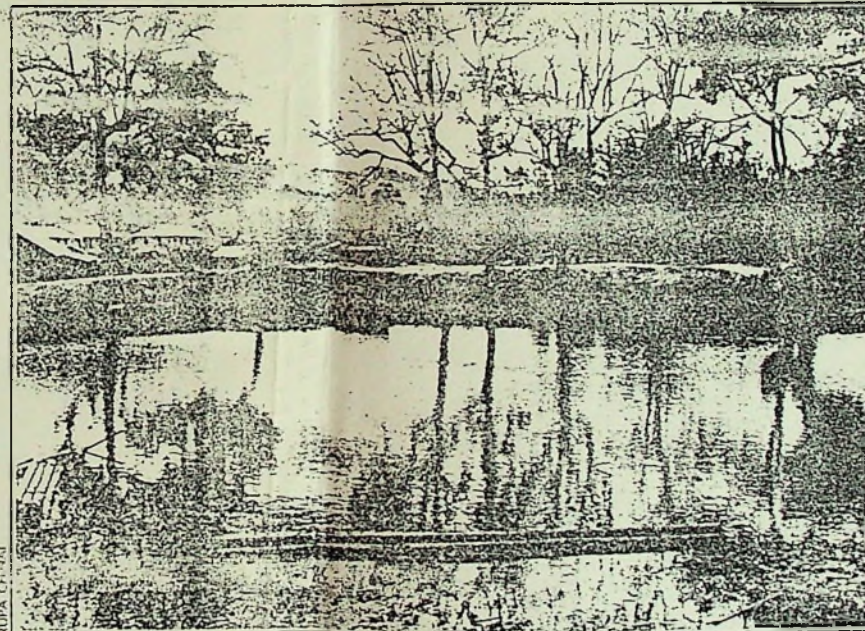
excess water can flow into the field below. The intricate pattern of horizontal and vertical flow continues all the way down the mountain slope. These points of overflow cannot be changed and remain as they have done since ancient times, the Khonoma elders said.

The person whose field is closest to the water source is responsible for protecting the source. However the person whose field is right at the bottom of the canal is its owner, who has a major share of the water and controls how much is taken off along the way. He is also responsible for keeping the canal clean. While everyone has a right to pull out water from the stream, they cannot take more than their demarcated share.

Asked if disputes arise over water rights, a village elder said, "Like life it is so designed that everyone will get their share, and there will never be any dispute. There is mutual understanding as to how much each deserve."

The village of Kikruma has made rain water harvesting into a fine art, that has become a part of their being. So fastidious are the Kikruma villagers about water conservation, that even the down-flow of water along the hillside and the steep approach road to the village, is caught and utilised for irrigation. The villagers have built speed breakers on the road, which serve to block the water run off. The water drains into a channel along the roadside and takes a right angle turn when blocked by a stone. From there it is channelled into the nearest field. Meanwhile, spaced bamboos placed along the hill slope drain water into a pipe that goes below the road and flows cut into the channel on the other side of the road, before being diverted into the field.

The unique feature of Kikruma however, is the over hundred micro ponds all over the village to collect rain water for irrigation. At one such site close to the village, the pond was owned by five persons who had adjoining fields. Two channels, over a kilometre long, constructed along a hillside, drained water from the surrounding area into the pond, which also caught rain water. The villagers compact the channel and pond base by hammering it with an iron theros, which reduces water percolation to the minimum. When water is required for transplanting, the villagers dig a hole at the base of the pond wall to allow flow of water to the nearest field. The pattern of water distribution and water rights is similar to that of Khonoma.



A rainwater pond in Kikruma village: enough for everyone

two tanks one saw, both were unclean with moss, slime and undergrowth choking the purity of the water and the gush of the spring.

The Government has provided tap water to Pudunamai by harnessing a perennial source from a nearby mountain top and piping it through the force of gravity, over a distance of 13 kms. But this amount does not satisfy the needs of the villagers.

In contrast to the indifference of the Pudunamai villagers to

in the middle of the township. Here bathers filled pitchers from the shining brass tap attached to a wall of the tank, and gave themselves a thorough lathering of soap, as crystal clear water cascaded out in abundance.

The Mao Nagas of this area enjoy water with special mineral properties. One such spring hole close to Mao Gate revealed salty water coming out of the mountainside. The locals extract the salt, packing it into flat round cakes, and use it to flavour veget-

boy, bathing near the traditional water tank, was introduced as King Kaikho, ruler of 16 villages in the area. Since the recent death of his father, King Kaikho has assumed responsibility, issuing diktats from this picturesque palace, made distinct by the traditional Naga architecture, its front lined with animal skulls.

According to King Kaikho, who says he is still learning the ropes, his duty is to stand on a rock every month in May, June and July, to inform the villagers that on this

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Battle for more Himalayan waters

by Ranbir Singh

are getting now.

THE people in eight southern districts of Haryana have recently discovered a new truth. It is about inequitable distribution of Himalayan rivers water to their water-starved fields. These districts are Rohtak, Sonapat, Faridabad, Rewari, Gurgaon, Mahendragarh, Bhiwani and Jind. Here, not science but politics determines access to Himalayan waters. The people of these districts comprising half the population of the state, felt further wounded by revelation that annually about one million acre feet (m.a.f.) of the Ravi-Beas water, allocated to irrigate their fields was being diverted "illegally" to the Sirsa, Hisar and Narwana areas now for nearly 15 years. On account of this economic and social injustice, the people in this rain-deficit region have been impoverished of a wealth equivalent to Rs 6000 million. The investigated facts relating to this issue are contained in the 26th report of the Committee on Estimates (Budget Estimates for 1992-93-Irrigation Department) of the Haryana Vidhan Sabha. Realising the sensitive nature of para 16 of the report, the state government confidentially persuaded Mr Om Parkash Beri, its Chairman, to remain absent and not to place on the table of the House. However, Mr Beri chose to expose the truth and as a punishment faced expulsion from the party.

A close scrutiny of the above indicated report reveals that the inequitable distribution of canal water is mainly due to gross lethargy and several deficiencies prevailing in the functioning of the state Irrigation Department for the last 15 years. This is indicative of infrastructural decay both at institutional and administrative levels. Substandard material used in the construction of new canals, in "pucca" lining of the old as well as new canals and channels, poor and delayed maintenance and accumulation of silt have aggravated the situation of scarcity. Technical limitations grown out of human negligence combined with an unethical policy of political appeasement have made the life of the people in southern Haryana miserable. The canals which were designed to carry adequate water do not carry it to their full capacity or carry for less number of days. This water, besides irrigating the crops, is also used for drinking and filling ponds for domestic animals' use.

Haryana falls both in the Gangetic and the Indus river basins. At present Haryana receives water from the Sutlej, the Ravi and the Beas of the Indus system and from the Yamuna of the Gangetic river basin system. The allocation from the Yamuna water is 5.8 m.a.f. whereas from the Sutlej, the Ravi and the Beas, it is 3.5 m.a.f. Out of this, Haryana actually receives about 5.2 m.a.f. (3.4 m.a.f. from the Yamuna and 1.8 m.a.f. from the Sutlej). An expert's panel called the Food Committee had recommended in 1966 that 4.56 m.a.f. of Himalayan rivers water is absolutely necessary for attaining the optimum level of crop production. The assessment of the need to give 4.56 m.a.f. of irrigation was perhaps computed keeping in mind the size of the population and economy of the state at the time.

But recent administrative discrimination and political anti-unity have prevented northern waters from flowing towards the parched fields of southern Haryana. Two decades ago, 170-km-long Jawaharilal Nehru, feeder canal was constructed to carry the Western Yamuna Canal waters to Bhiwani, Rewari and Mahendragarh. But for the last more than 10 years this canal system with lift pumps on its way, is blocked with weeds and heavy silt. Years of neglect have reduced this canal system to rubble. The Irrigation Department has not been allocated sufficient funds for its desilting as Beri's report indicates. Most budgetary allocations have gone into payment of salaries and not for actual work of desilting. Unless desilting, weed clearance and repair of all the water channels in the state are not done on a crisis management level, the people of southern Haryana cannot get more water than they

In the case of taking sufficient canal water to southern Haryana technical, scientific, economic, cultural, social and environmental aspects need to be closely examined. There is also an immediate need to quantify the impact of canal irrigation water to southern Haryana when different irrigation techniques are applied, viz., drip irrigation, sprinkler system and surface irrigation.

The area is drought prone. Research suggests that only partial recharging occurs once in 10 years during flash floods as witnessed recently in Mahendragarh.

On the last 50 years, pressure of human and cattle population on the area comprising the northernmost Aravallis has increased. Geomorphological features, vegetation cover, lifestyles, land, cultural practices of the people of southern Haryana are undergoing change, though undetectable to an indifferent observer. Many cultural practices like folk songs, festivals, sayings and legends revolve around drought and land features of the area. Besides above, the design of houses and "baolis", i.e. step wells, is greatly influenced by climatic and geological conditions in the region.

Another remarkable feature through which purity of a water source in this area was maintained, was through the use of stone carved figures of gods and goddesses either on the walls and pillars of the "baolis" or on a large stone pillar erected at the deepest point in a pond. All the four sides of the head of the pillar bore figures of deities. The people never contaminated these water sources. It is regrettable that the local self-government administration abandoned the time-tested "baoli" technology and substituted foreign technology. The small catchment area of the village ponds has also been encroached in due course of time. It was never thought to preserve it by planting traditional species of trees. Englishmen used the indigenous watershed management techniques. Irrigation and Public Health Engineering Departments of the Haryana Government never bothered to follow the "desi" system.

More "baolis" are required to be built with

the help of local people and voluntary agencies. This project can ensure fulfilling of drinking water projections of the future. The revival of this activity will not only be culturally suitable but also be economically and environmentally sound to this semi-arid region. Regrettably, this aspect was ignored during International Decade for Drinking Water and Sanitation which ended in 1990. Recently the Society for People's Advancement, Technology and Heritage (SOPATH) at Rohtak achieved limited influence with political leaders of the area spearheading the movement for demanding canal water for southern Haryana. Another advantage of the traditional system of water storage and harvesting is that they can act as a standby measure and can effectively reduce the acuteness of the drought.

In recent times canal irrigation systems have created very difficult problems for environmental scientists, health officials, habitat and urban planners and sociologists. Though pressing to take canal water to southern fields in Haryana has become "a matter of political correctness" for certain political leaders, simultaneously they should seriously listen to the scientists for they have the knowledge to put matters in proper perspective. First, obtaining the Ravi-Beas waters in the present political milieu is like chasing a mirage. Therefore, two steps are immediately required to be taken. These were suggested at a political seminar on this issue organised on July 4 last year at Rohtak by the Congress M.P., Mr Bhupinder Singh Horda. These were: (i) recasting of the water needs of Haryana within the available quantum of Himalayan waters, and (ii) introduction of an annual canal water-audit system. These steps are essential otherwise within the next 50 years or so, the semi-arid zone of southern Haryana will be threatened with waterlogging, soil salinity and rise in vector borne diseases like malaria.

An important landmark study by Prof. V.K. Sharma published in 1991 indicates about the dangers involved in changing the crop and vegetation pattern in the rain-fed semi-arid southern Haryana. Through an excellent use

of satellite imagaries confirmed through ground observations, Prof Sharma provided valuable insights that can greatly help in arriving at a correct decision while planning intervention and changing the land use pattern. A scientific attempt to simulate impact of irrigation on this region will be useful in learning its influence on the ecological balance and biodiversity of this area. The valuable information buried in the Haryana Agricultural University, The National Remote Sensing Agency, Hyderabad, The Minor Irrigation and Tubewell Corporation, Haryana, and the Central Ground Water Board has not been adequately used. This knowledge needs to be disseminated to the people in this region. Maps should be distributed to the panchayats of this area and should be freely supplied to other interested agencies. Prof. Sharma's book "Remote Sensing for Land Resource Planning" exclusively deals with Sonapat, Ferozepur Jhirka and the Nuh and Rewari region. It warns that even a minute alternation in the land use pattern or introduction of unscrupulous irrigation without necessary precautions will damage the fragile and sensitive nature of the ecology of this area.

It may also be worthwhile to note that traditionally sown "bajra" (pennisetum typhoidum), the main staple food of the people of southern Haryana, is in no way inferior or less nutritious to wheat or rice which farmers readily substitute once adequate canal water becomes available for irrigation. Sugarcane is also being proposed as an additional and attractive cash crop for this region. This is disastrous. In fact, "bajra" is more nutritious than wheat because the quantity of nutrients like protein, fat, carbohydrate, calcium and iron is almost equal in both but what is surprising is the vast difference of a cancer preventive substance called "beta-carotene". In "bajra" it is 132 micrograms per 100 grams of seeds whereas in wheat its quantity is merely 29 micrograms according to an ICMR publication "Nutritive value of Indian foods".

In water deficient rural areas of southern Haryana, people mostly eat "bajra". In the afternoon, women moist and hand-pound the seeds and cook them by adding a little rice and "dal". In the evening, this "klichri" is served with fermented raw milk, called "gozi" in local dialect. The secret is that the surplus butter milk of the day is not thrown away as waste but preserved in an earthen pot. The cow or buffalo is directly milked over the pot and a desirable quantity of raw milk is thus directly mixed. This is "gozi". This is extremely nutritious. Unscientific use of irrigation water has made this crop almost extinct from large parts of northern and central Haryana. Along with the disappearance of gram from the northern region, the incidence of cardiovascular and digestive system disorders have increased in the population. Even young people can be seen suffering from heart failures, piles and "anal fistula".

Compared to many other countries of the world we have abundant fresh water resource, and are utilizing this gift of nature miserably and unwisely adopting the western pattern of utilization. This pattern first excessively and wastefully uses it, then pollutes it to a great extent and lastly in the name of advancement of scientific and technological progress, invents and develops high cost depolluting or decontamination technologies. We in India are foolishly ignoring our own safe, cheap, small, beautiful and maintainable watershed management techniques and technologies. The so-called foreign expert advice and money have done more harm than benefited our people.

To redirect people's energies towards indigenous (and truly survival oriented) science and technologies, a congress on traditional sciences and technologies of India is being organised during first week of December next at the IIT, Bombay, which, among other topics, will specially focus on water management.

Running for 123 years

by Padam Ahlawat

THE RAILWAYS in Haryana will turn 123 years on October 14 next. On this day in 1870 the first railway passed through Haryana. The first rail-line in Haryana, covering a distance of 70 km, was the Lahore-Amritsar-Ambala - Saharanpur-Delhi railway. This broad gauge rail-line was built by the Sindh Punjab and Delhi Railway. The Lahore-Amritsar rail-line opened to traffic on April 10, 1862, was extended to Delhi via Ambala Cantonment and Saharanpur in 1870. The Sindh Punjab and Delhi Railway continued to operate this route till 1886 when it was taken over by the North-Western State Railway.

Trains were then run by a number of private enterprises and state railways. On its first journey people watched this fearsome steel monster rolling by. India's first train ran 21 miles from Bombay to Thane on April 16, 1853. The train pulled out of Bori Bunder with a 21-gun salute. It was a great occasion for the public. The day was declared a holiday and many came to see this novelty.

Trains are not a popular mode of transport in Haryana except with commuters who go to Delhi by employees specials and the Himalayan-Ekta Express.

The next milestone was the Delhi-Rewari metre gauge rail-line constructed in 1873. On its first journey the steam engine was bedecked with garlands and women in "ghagra choli" came singing in large numbers carrying earthen lamps to offer prayers. The line was extended up to Hisar in 1883 and to Bathinda-

Fazilka in 1884. It covered a distance of 267 km in Haryana.

The other important rail-lines in Haryana were the Delhi-Bathinda railway passing through Rohtak and going on to Ferozepore and Lahore. Built by the Southern Punjab Railway, the route was opened to traffic in 1896. In 1904, the Rajputana-Malwa Railway built the Rewari-Mulana-Ajmer-Ahmedabad rail-line. The route was operated by the Bombay, Baroda and Central Railway. Then in 1938 came the Rewari-Budulpur metre gauge railway which was extended to Bikaner in 1941. This rail-line passing through 162 km in Haryana entered the driest parts of Rajasthan. One of the most important rail routes to pass through Haryana was the Delhi-Agra Chord Railway line which was built by Great Indian Peninsula Railway and opened to traffic in 1904. On this line run all trains to Bombay and South India.

The Delhi-Kalka Railway was built by the East India Railway. The Delhi-Ambala section was constructed in 1890 and extended up to Kalka in 1891. From Kalka a narrow gauge railway to Shimla was built in 1900 and opened to traffic in 1903. In British India, the Himalayan Queen wound its way through mountains, valleys, tunnels and on over-bridges on its slow journey to Shimla. From Kalka a fresh steam locomotive pulled the train on its slow climb into the hills.

The railways hold great potential for the development of Haryana only if its satellite towns around Delhi are connected by electric shuttles at frequent intervals.

Sensible use of groundwater

By Nila Umesh

Irrigation has been a kingpin in the planned development of Indian agriculture. Though conjunctive irrigation is the watchword in the day, minor irrigation continues to attract much attention all round. In fact, a thriving agriculture has become synonymous with private groundwater irrigation. Antagonism to big dams is now bringing in limelight minor irrigation. But groundwater has its own importance.

Interest in groundwater irrigation heightened in the wake of the HYV technology of the early sixties. Both in the popular media and within the academic portals agricultural growth came to be identified with groundwater development in general and private tubewell irrigation in particular. Lately, the growing opposition to the big dams has focused attention on minor irrigation, of which groundwater irrigation has been a leading component.

Irrigation works in India are classified in three categories: minor irrigation, medium irrigation, and major irrigation. Generally the categories of irrigation schemes are on the basis of their cultural command area (CCA) as per the following norms: minor work less than 2000 ha of CCA, medium work 2000-10,000 ha of CCA and major work 10,000 ha and above of CCA. All on-site water-based schemes are classified by the above-mentioned categorization. Every groundwater-based irrigation scheme, whether of the public or the private sector, is deemed to be in the minor irrigation segment. More specifically, minor irrigation works in Indian planning comprise the following 15 types of schemes.

1. Groundwater related: new open or dugwells, new tubewells, filter points, artesian wells, water-lifting appliances, well boring, major repairs to wells and deepening of existing wells.

2. Surface water related: tanks; diversion schemes, including 'kuhls' or hill areas, lift irrigation, flood protection works, drainage works, anti-erosion water-trustion works and water conservation cum groundwater recharge works.

During the course of nearly four decades of economic planning in India, most of the additional minor irrigation capacity have been from groundwater resources. More specifically, while the created minor irrigation potential from surface water resources is officially estimated to have risen from 6.4 to 11.1 million ha in the aforesaid period, the same potential from wells zoomed from 6.5 to 34.8 million ha in the same period. It is because of such a predominant place of groundwater irrigation within the minor irrigation segment that the former has come to be identified with the latter in the minds of water planners.

Just like canal irrigation, now it is groundwater which is playing a critical role in our agricultural transformation, since the advent of high yielding variety (HYV) seeds. In fact, innumerable research and other investigations have highlighted a close relationship between the success of HYV programme in the area and the use of groundwater irrigation, especially individually owned tubewells and wells fitted with power pumps. The advent of HYV seeds has once again revived interest in owning one's own source of irrigation so as to meet timely irrigation needs of the new varieties.

Since these varieties are not a product of natural selection, they are bound to lack in hardiness for coping with vicissitudes of weather or with untimeliness in agricultural operations. In view of the critical importance of water in their

agronomical regime they have imparted a tremendous spurt in investment in groundwater irrigation. For a variety of reasons — such as (a) concentration of agricultural development effort in areas already irrigated and (b) better availability of farmer's own investible funds in canal-irrigated areas — one now finds that farmers in canal-irrigated tracts have evinced keen interest in developing their own resources of groundwater irrigation. This conjunctive use of groundwater with surface water in canal tracts is a very welcome development from the viewpoint of optimal use of our water resources.

The continued use of groundwater resources is the real answer to the long-run danger of water-logging and consequent soil salinity in canal-irrigated areas. Where farmers are too poor or too small to undertake investments in groundwater irrigation, the State can invest in large tubewells which would also augment and firm up canal water supplies.

In order to attain complete control on a water resource its ownership is a must, a condition that is easily fulfilled by groundwater as compared to surface water (ponds and small tanks being minor exceptions). However, the ownership of resource is only a necessary, but not a sufficient, condition for ensuring timely irrigation. In the event of failure of rains, dug-wells become an unreliable resource of irrigation precisely when there is pressing need for irrigation. Likewise, tubewells, which are relatively less susceptible to drought, can become an unreliable resource of irrigation if the electricity supply system is inefficient and inadequate.

In such a situation, diesel tubewells appear an attractive proposition for supporting HYV cultivation, though these tubewells too make rather exacting demands of repair and preventive maintenance services are not readily available to distant villages. In short, the ownership of a groundwater resource is no guarantee for timely irrigation to a farmer operating in an environment of underdeveloped infrastructure — comprising electricity, roads, repair and maintenance skills.

The development of science and technology has helped fit different ways agricultural developments. Whereas the advent of HYV seeds has generated widespread appreciation of groundwater resources, some fanciful and some totally erroneous notions do persist about this vital resource. For example, many people are under the illusion that unlimited water supplies exist below the land surface. If wells cannot reach this water, dug-cum-bore wells or tubewells should be constructed. They do not know that quite often deeper strata of groundwater are saline and brackish wherever scanty water is encountered in the upper portions of the ground. Such saline water, if used for irrigation, can lead to salt accumulation on soil surface, thereby rendering land unfit for cultivation for long.

In appraising groundwater resources, it is important to keep a clear distinction between stock and flow dimension. From the stock viewpoint, groundwater is probably an immense resource in many parts of India. But judged from the flow angle, it is a bountiful resource in the eastern Gangetic plains only. But when some concerned hydrogeologists caution against overexploitation of groundwater resource, they are taking a flow or 'safe yield' view of groundwater resource. The two views can generate quite contrary impressions or reactions unless one is on the guard as to whether the stock or the

flow view is implied.

The stock of groundwater has been built gradually from times immemorial. Evidently, this water cannot be exploited on the same principles as other mineral resources for which new resources of deposits or substitute minerals are often discovered before long. Prudence requires its utilisation at a long-run annual rate of no more than the annual recharge of the groundwater stock. Preceptions from this prudent policy are conceivable in two circumstances. One such circumstance is when there is water-logging in the crop root zone, which tells upon crop production. Despite the low intensity of irrigation in canal commands, considerable water-logging has occurred in the old canal areas.

Overdraft above annual recharge would be a sensible policy in such areas so long as the water table is lowered appreciably below the crop root zone. The other permitting circumstance for overdraft on groundwater stock may be one in which prolonged overdraft gives rise to a new equilibrium level of water table. This depletion in groundwater resource may be beneficial in areas which are cross-crossed by rivers and where streams are found under coarse sand deposit with the result that "induced" recharge of groundwater goes up sufficiently so as to match the overdraft. In a way this is essentially a scheme for augmenting the groundwater potential. However, it needs to be implemented with great care.

It is surprising that estimates of groundwater potential of India are lacking at the moment. One scientist Raghay Rao employed indirect methods of estimation in which rainfall and soil percolation quality were used to assess groundwater recharge. The estimate found was about 219 million acre-feet (26 mhm) in which Madhya Pradesh was having a lion's share of 26.7 mhm on a crest of groundwater. The Groundwater Board, which is the apex groundwater body in India, now claims that our groundwater resources can annually irrigate about 80 million ha of crop area (not land area). But this figure seems to be high. One cannot also overlook the possible inbuilt upward motivational biases in the new estimates, two of which might at once be suspected here. One stems from considerations of ascribing institutional credit for establishment of tubewells, dugwells, pumps, etc., while the other is linked with a sense of neglect by groundwater bodies and their personnel at the top in the matter of redressal of their needs of put the resource promotional avenues vis-a-vis canal-related issues and their top personnel.

The credit angle applies to state governments, always keen to keep the channels of bank finance open. Since the banks — especially NABARD which is the apex body for disbursement of farm loans — shut off credit for new groundwater schemes in a block if 85 per cent of that block's groundwater potential is already tapped, state administrations as well as politicians are susceptible to inflating the estimated groundwater potential on the one hand and understating the existing level of groundwater utilisation (i.e. draft).

It is noticeable that the 8th 5th group on minor irrigation, unlike the 7th Plan group, was under some compulsion to adopt the revised estimate of groundwater potential. One conceivable compulsion could be the impossibility of playing the "number game". By the end of 7th Plan, the created irrigation potential from groundwater resources was feared to touch a level of around 35 mil-

lion ha, leaving a balance of only 5 million ha to be developed in the subsequent 8th Plan period. As the target for additional groundwater potential for the 7th Plan period was 7.1 million ha and the achievement too was anticipated to be very near the target (near about 6.98 million ha), it would have been a climb-down for the "planners" to target for groundwater development on a lower scale than before — more so when the then Prime Minister announced (on his own) ambitious programmes of establishing new tubewells and dugwells.

In general, groundwater resource inherently tends to be much less plentiful than surface water. This differential arises because a smaller fraction of rainfall tends to infiltrate down to the groundwater table than the fraction flowing into the rivers. To take an example, in arid area like western Rajasthan natural groundwater recharge amounts to about one per cent of the annual precipitation, in hard rock regions like the Deccan and the Bihar plateaus the percentage may be 5 to 9 of annual rainfall and in flat, alluvial regions like the Gangetic and the Indus plains, the percentage is about 20 to 22 of rainfall. On the other hand, surface run-off (that portion of rainwater that fails to infiltrate into the ground) may range between 20 and 60 per cent of the precipitation depending on the slope and extent of vegetal cover of the land.

Given this relative scarcity of groundwater vis-a-vis surface water under natural conditions; the widely-shared belief that groundwater irrigation is superior to surface irrigation in the matter of raising land productivity, and groundwater can be conveniently tapped under individual enterprise, it is easy to visualise the emergence of pressure on groundwater resource either in the shape of over-extraction or overcrowding of wells in a given aquifer (or both).

The task of groundwater regulation boils down to controlling location of wells and controlling groundwater draft by well-owners so that their aggregate withdrawals in a year tend to equalise in a magnitude which ensures long-run sustainability of groundwater table. In short, groundwater regulation on the lines of industrial licensing is indicated whence some statutory control on location of a well and annual groundwater withdrawal by such a well is exercised. In contrast of the problem of mutual interference, the problem of overexploitation of groundwater resource is far more intractable and with far more serious consequences in certain situations. If decline in water table in a tract continues unabated, the rising cost of groundwater table/and irrigation may prove inadequate to arrest the process of decline in water table.

In fact, even before the depth in water table reaches a level where marginal cost of exploitation equals the marginal benefit from a unit of water, groundwater resource may be damaged due to intrusion of saline/brackish waters from the neighbourhoods. Attempts to control both the density of the wells and the well spacings in a tract through indirect means have proved rather ineffectual. Linkings of the grant of electricity connection for a pumpset with a prior certification that there is no other pumpset or well within a specified distance has been overcome by farmers procuring the needed certificate through bribing of officials. Short of total exploitation of groundwater resource under governmental aegis, one sees no ideal solution to the twin-problem of overexploitation and overcrowding in groundwater utilisation.

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2-3

Water
(Gen)

DRINKING WATER

FE 13/89

... But will there be drops to drink?

AFTER nearly four decades of planning and despite the country being endowed with vast fresh water resources, there is a chronic shortage of drinking water — a basic necessity — especially in the rural areas. Rural water supply, carrying waterpots on their heads may present a picturesque picture but one hardly realises the strain of the arduous trek they have to make every day before they get access to water.

Realising the gravity of the problem, the Government set up a Technology Mission on Drinking Water to co-ordinate the working of the rural water supply programme and bring a water supply within 1.6 kilometres of problem villages. Mere supply of water is not enough; what is equally important is that water should be safe since water-borne diseases play havoc in the villages.

A problem village is therefore defined as one where there is no safe source of drinking water within a distance of 1.6 kilometre, where water is available at more than a depth of 15 metres and in hilly areas where the elevation difference is more than 100 metres from the habitation. The definition also covers the village where the water sources have excessive salinity, iron, fluorides and other

worms; control of fluorosis, control of brackishness, and removal of excess iron.

The work by the Mission has made total eradication of guinea worm a real possibility. At the last count, the number of treated villages has come down from 12,840 villages in 1984 to 3,111.

There are plans to set up 130 de-salination plants by 1990. In all 144 locations have been identified for installation of these plants. So far 13 desalination plants have been set up in the coastal areas.

In the current year, 3,500 iron removal plants are to be installed. Of this, 500 will be set up by the National Environment Engineering Research Institute and 3,000 by the state governments under the overall supervision of the Mission.

Likewise, 100 defluoridation plants are to be set up in the country. The feasibility reports from 119 sites for installation have been received from nine affected states.

The Mission is planning to have 100 district level laboratories for constant water quality surveillance.

For financing the drinking water schemes, the Mission provides assistance under the Accelerated Rural Water Supply Programme to the

Mission's New Programme (MNP) provision on operation and maintenance, for the first time the Government has decided that out of the funds released to the state and Union territories for Accelerated Rural Water Supply Programme up to 10 per cent may be utilised for operation and maintenance of assets created as well as quality improvement and purification of drinking water. This is subject to a ceiling of matching grant provided by the states out of the MNP provision. It also the approved norms.

The Mission has decided that there should be specified disincentives as well as positive incentives for proper maintenance of drinking water facilities.

The UN has declared 1981-1991 as the International Drinking Water Supply and Sanitation Decade. Hopes have been expressed that India will have the distinction of being the only developing country to achieve 100 per cent coverage of rural water supply in this period.

Despite such achievements the Technology Mission is facing criticism on certain issues. The Mission

strategy, it is said ignores the vulnerability of communities in which alone the cause of water crisis can be located. The critics have also questioned the effectiveness and ecological soundness of the Mission's strategy of replicating the urban model of water supply system in the rural areas through borewells, pipes

and overhead tanks without concern for rates of depletion while tapping the ground water.

Similarly, when its schemes for eradication of guinea worm and ex-

Continued on next page

Drinking water

Continued from previous page

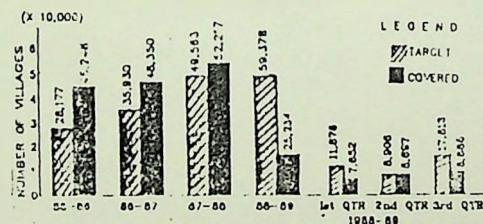
cess fluoride and iron are welcome, a major water borne disease, gastroenteritis does not figure in its action programme. The Mission's answer to this criticism is that gastroenteritis is spread through contaminated water. Once safe and quality drinking water is provided, this problem will be taken care of.

Some experts have also cautioned that without enforceable laws on regulation of ground water, the country is likely face a severe water famine. They feel that like the Panchayati experience in Maharashtra, the Technology Mission might provide impressive short run results but might prove disastrous in the long run. On this issue, the Mission points out that drinking water accounts for only a negligible four per cent of the ground water supply. The bulk of the ground water supply is used for agricultural and industrial needs where some economy is called for. In fact, the Mission stresses that it is in favour of using water in lakes and rainfed reservoirs as much as possible to provide good quality drinking water.

Groundwater is a precious natural resource which is not inexhaustible. Undoubtedly, drinking water is a priority area. What is needed is an integrated approach by various agencies for coordinated and sustained use of it.

VILLAGES COVERED**

** THESE INCLUDE PARTIALLY COVERED VILLAGES ALSO



toxic elements hazardous to health and which is exposed to the risk of water-borne diseases, such as cholera, guinea worm and the like due to the available drinking water.

At the commencement of the Sixth Plan there were about 231,000 problem villages to the provided safe drinking water in the country. About 192,000 problem villages and 47,000 non-problem villages were covered during the Sixth Plan raising the total number of villages covered to 306,024. The total expenditure under this head in the Sixth Plan was Rs 2,457.63 crores.

The Mission has set out with the objectives of covering 98,746 residual problem villages (As on April 1, 1988) by March 1990; supply 40 litres water per capita per day in all areas for people, and in addition 30 litres per capita per day in the desert areas for cattle. To achieve these objectives it will evolve cost-effective technology mix within the constraint of plan allocation. Taking conservation measures for sustained supply of water and improvement in the performance and cost effectiveness of the on-going programmes are the other goals.

The Mission has identified five areas of immediate concern. In this five sub-missions have been set up: conservation of water and recharging of aquifers by providing remote sensing technique; eradication of guinea

states which are then asked to contribute their share for the projects. The Mission Director, Mr G. Ghosh, however says that although the Mission sanctions the resources at the beginning of a very financial years itself, many states divert these funds for other schemes, leaving the drinking water programme stranded. This, he says, hampers the overall functioning of the Mission.

The formula for allocation of funds for implementation of rural supply schemes has been modified keeping in view the special needs of the difficult areas like deserts, hills and drought-prone areas.

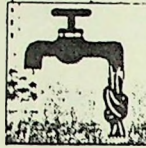
The new criteria has earmarked five per cent of the Annual Plan allocation for solving specific problems through science and technology inputs and research and development activities based on clearance of specific projects and another five per cent for need based schemes to meet the requirement of special areas suffering from chronic drinking water problems due to hot and cold desert ecosystems. These areas are in Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir and Rajasthan.

For ensuring efficient drinking water supply in the long run, proper operation and maintenance of schemes, continued with adequate investments is considered important. Although states have been permitted to utilise up to 10 per cent of the

Borewells in the backyard

by Prafulla Marpakwar

BOMBAY



DESPITE GOOD rainfall last year, more than 1.5 crore people (about one-fourth population of the state) living

in 11,075 villages and 6,240 hamlets in 29 districts, are facing the decade's worst drinking water crisis due to failure of the administration to involve and enthuse the masses in water conservation movement.

At the moment, drinking water is being supplied by tankers and bullock-carts to about 5,000 villages and 3,000 hamlets.

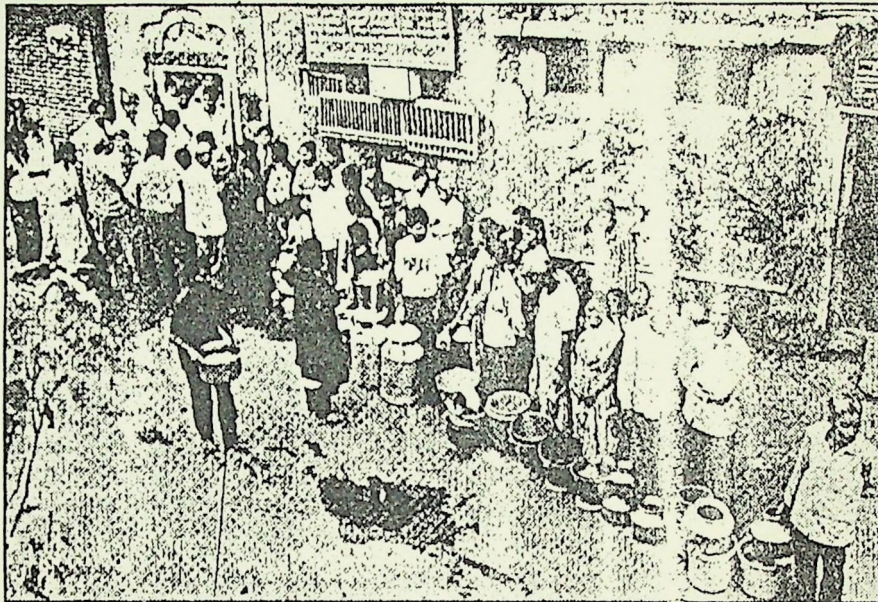
Alarmed by the unprecedented crisis, all the district collectors have informed the water conservation, rural and revenue departments about the immediate need to tackle the problem on a war-footing.

PAUCITY OF FUNDS: They have also demanded more funds for the purpose. However, none of the officials have either reported migration of the local population or fodder shortage in their districts. Meanwhile, rural development minister Ranjeet Deshmukh denied paucity of funds and said district collectors have been provided with more financial as well as administrative powers to tackle the problem.

"Upto March 1993, Rs 5 crore had been provided for tackling drinking water problem, while a provision of Rs 50 crore has been made for the summer season to meet the requirements", Deshmukh said.

Elaborating on the financial aspects of the various schemes,

Water situation: Maharashtra



OUT ON THE STREETS: Residents of Pune's Kasba Peth locality wait for their turn to get water from a private borewell. Express photo.

Deshmukh said Rs 1,960 lakh have been earmarked for completion of on-going schemes, Rs 460 lakh for borewells, Rs 196 lakh for deepening of wells, Rs 1,140 lakh for temporary water supply schemes, Rs 112 lakh for repairs of borewells, Rs 79 lakh for acquisition of private wells, Rs 460 lakh for repairs of water schemes, and Rs 715 lakh for supplying water by tankers and bullock-carts.

The minister said a total of 145 most-difficult villages, five in each district - without a water source -

have been selected for construction of water tanks. Despite the fact that a huge amount was spent on creating drinking water facilities, permanent remedial measures were not taken with the result that the difficult villages' list was getting longer.

DIFFICULT DISTRICTS: Ahmadnagar, Nashik, Pune, Satara, Kolhapur, Solapur in western Maharashtra, Osmanabad, Latur, Beed and Nanded in Marathwada and Bhandara, Chandrapur,

Gadchiroli, Yeotmal, Amaravati, Akola and Wardha in Vidarbha were the worst-affected districts.

A top official on condition of anonymity said assets for drinking water were created but these lacked planning and coordination as a result, the entire exercise turned out to be a purely temporary measure. The maximum number of incomplete schemes were reported from Jalgaon (64), followed by Solapur (140), Yeotmal (127), Kolhapur and Sindhudurg (105 each), Amangabad (94), Nagpur

(90), Ahmednagar (89) and Pune (85).

The major problem before the government was digging of private wells as well as bores near the water source developed by the local civic body. It was found that once the sources had been developed or detected, individuals in the nearby areas dug up wells or borewells thus resulting in the source developed by the department automatically drying up after a certain period.

Even as Ahmadnagar and Solapur emerged as chronically drought-prone districts, state administration had not taken adequate steps to meet the situation. A total number of 192 tankers were operating in Ahmadnagar, 167 in Solapur, 149 in Pune, 102 in Sangli, 78 in Satara and 23 in Kolhapur. The political leadership in these districts had failed to tackle the water crisis.

Meanwhile, 500-odd residents of the remote, scarcity-affected Menumbkhadi hamlet in Ambegaon taluka in Pune have devised a novel "drinking water rationing system", to make optimum use of water in the only well-existing well there.

Under the system, each family is allowed to draw three buckets of water during specified morning and evening hours. It is then duly recorded in a register maintained by the hamlet head.

The villagers have resorted to the rationing system, as they cannot depend on the water tankers and bullock-carts deployed by the state government, which come to the hamlet once in a while.

(With inputs from Arif Shulki, T.N. Raghunatha and Madhavi Gokhale.)

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Water
(City Edition)

Making every drop of water count

IT IS a desperate remedy for a desperate solution. Starting next month, every new building in Madras will have to install a complex network of pipes and storage tanks to collect rainwater.

"Collecting rain water isn't the permanent answer to Madras city's water shortage. But, the Madras Metro Water Board believes that every drop counts. "It is a complex way of alleviating, if not overcoming the water crisis," says a senior official of the Madras Metro Water Supply & Sewerage Board (MMWSSB).

As the Madras water shortage gets progressively worse, a host of ideas are being thrown up to solve it. From the Madras Metro Water Board there are grandma's remedies like collecting rain water. At the other end of the spectrum, the Manali Industries Association (MIA) wants to set up a Rs 100-crore desalination plant to supply water to the factories in the industrial belt.

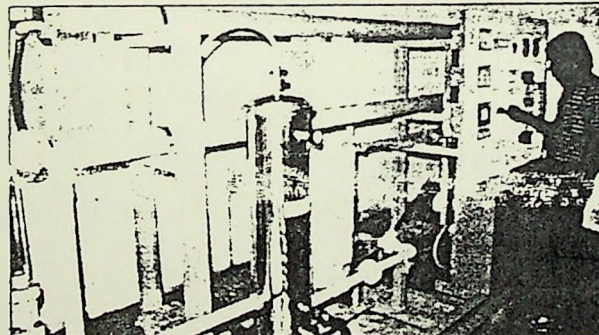
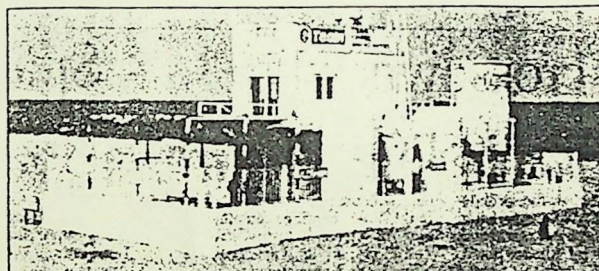
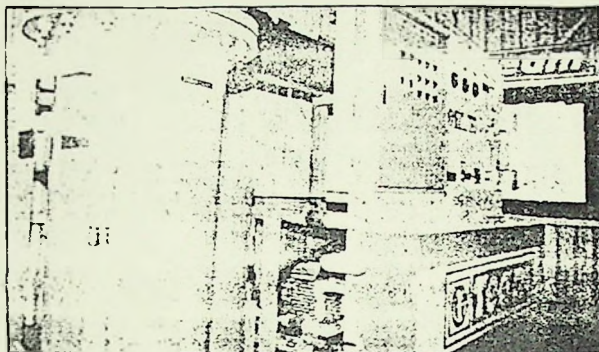
The government also has a number of expensive plans up its sleeve. By the end of 1995 it hopes to have the Rs 450-crore Veeranam pipeline scheme on line. The pipeline will bring water from Veeranam Lake to Madras.

But the Veeranam project and others like it are in the distant future. For the time being the government is looking at more homespun remedies. Last week Metro Water issued an appeal to homeowners to install a rain water drain system. What people will have to do is to dig a pit 10 ft deep in their back yards. These pits should then be lined with bricks, stones and pebbles and used to collect rain water which will be used to recharge wells.

Metro Water is even thinking about making it mandatory for all buildings in Madras to install equipment to collect rain water, says a water board official. "It is the only way by which pressure on Metro Water can be eased."

It isn't too hard to understand why the water board is so desperate. According to MMWSSB chairman P C Cynric, Madras city needs 55 million gallons per day (mgd). It gets barely one third of its needs - around 18 to 19 mgd. The shortfall is supplemented to an extent by bringing water from surrounding areas like Neyveli and Palar by tankers.

The government has taken a number of short-term measures to save every last drop of water. The state government has sanctioned Rs 60 crore for bringing water by tanker. It is also spending money to dig 6,000 bore wells and install 7,000 new plastic and steel tanks for storing water. The government has also, according to Cynric, identified 20 tanks that can be deepened.



Desalination plants: still a distant dream

There are private agencies too devising ways to beat the water crunch. The Manali Industries Association wants to tie up with the Tamil Nadu Industrial Development Corporation (TIDCO) to set up a plant which will desalinate 10 mgd. The plant, which will cost Rs 100 crore, will serve public sector and private companies in the industrial belt.

This plan is still awaiting ratification by several companies interested in parti-

cipating in the project. These include giants like Madras Refineries (MRL) and Madras Fertilisers (MFL). MRL marketing manager J Natarajan says the project is awaiting the green signal from the board.

Some of the companies in the Manali Industrial Area have already spent heavily to get water. MRL and MFL have installed an effluent treatment plant which converts sewage into water. The

Rs 28-crore plant which uses the reverse osmosis technique can convert 3.3 mgd of city sewage into 2.7 mgd of usable industrial grade water for the cooling towers.

Other companies too are putting up proposals for giant desalination plants. The Madras-based Titanium Equipment and Anode Manufacturing Company Limited (TEAM) has recently been trying to push the idea of putting up a one mgd desalination plant in south Madras. It also wants to put up a five mgd unit in the Manali Industrial Area.

Another company, Nuchem Weir Limited, has put up a proposal to set up two desalination units. Nuchem Weir is thinking on an extremely ambitious scale: it wants to set up a 50 mgd plant. Until this unit comes up it wants to start a smaller desalination plant to process 10 mgd.

The catch in all this is that desalination plants cost a lot of money. Nuchem's 560 mgd plant is likely to cost around Rs 475 crore according to Nuchem managing director Prathmesh Barar. The five mgd plant proposed by TEAM will cost around Rs 80 crore. TEAM's chairman and managing director C H Krishnamurthi Rao says the one mgd unit in south Madras is likely to cost Rs 18 crore.

Even the government's grandiose schemes are going to cost a lot of money. The Veeranam Project will cost more than Rs 400 crore. And other projects like the Krishna waters plan will also be extremely cost intensive.

That in turn means that water will cost a lot more. Cynric, for one, does not believe that desalination units will be viable. At present municipal water costs around Rs 30 per kilo litre. Desalinated water could cost as much as Rs 75 to 80 a kilo litre. The prohibitive cost is one reason, perhaps, why the government is lukewarm in the idea of putting up desalination plants.

Why is there such a water shortage in Madras? The fact is that Madras has been severely hit by insufficient rains in the catchment area. There are other factors too. Says P Natesan, the state environment secretary, "What has really contributed to water scarcity is the unbridled encroachment in lake areas by greedy developers and the growth in urban population."

Is there a way out? For the time being the harsh fact is that the government is totally dependent on the monsoons. Desalination is still a distant dream. And the only option left for people in Madras is an old one - to wait and pray for the rains.

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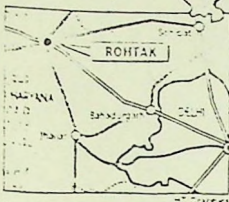
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(Late City Edition)

Rohtak



by Anil Anand

THE district headquarter supposed to be the show-window of the rest of the area, is in a crisis. The Rohtak Municipal Corporation, the premier body responsible for the maintenance of the city. Majority of the corporators in the 25-member house, are out in protest against the chairman, charging him with neglecting the city.

This is a typical example of Haryana politics which has brought together the ideological rivals to lodge a protest. A faction of the Congress members has been joined by the BJP members to raise a revolt against the chairman. The 20 members belonging to the two parties have come together under the banner of the Rohtak Vikas Panshad Dal and are on an indefinite dharna and relay hunger strike, seeking ouster of the chairman for his anti-people activities, alleged misappropriation of funds and misuse of power.

The ongoing feud in the civic body has strongly hit the city on the developmental front. The existing set up of the water or power supply, maintaining roads and lanes or providing health care facilities, was already bursting at the seams and now all in the civic body has dealt it a blow. The administration is out of the local political leadership is amidst the crisis and the people are suffering.

A visit to the interior of the city reflected the state of affairs. Filthy gutter and overflowing drains almost waterlogging the poorly maintained streets with stray pigs is a common sight.

Most shocking is the drinking water situation. A storage tank is connected to the water treatment plant which constitutes one of the oldest water works scheme in the city. Over three decades old, it still remains to be the main source of drinking water. It is horrifying to visit the storage area. What has been

A victim of civic body feud

stored in the name of raw water, is the storage tank which is floating all over. A small canal which feeds the tank, has now been converted into a drain full of filth.

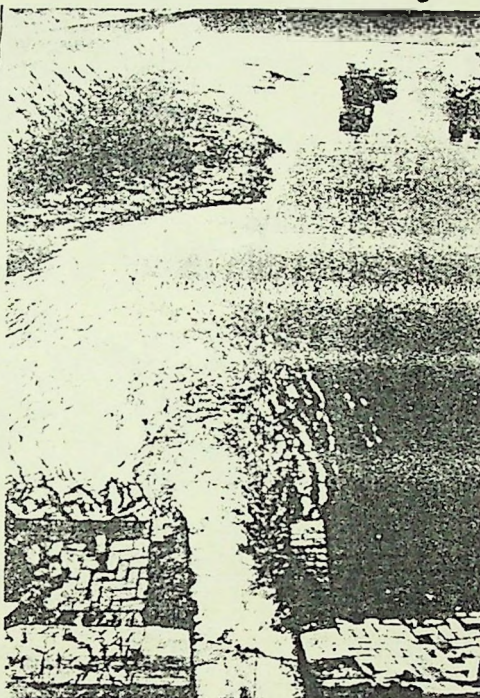
This is a scenario caused due to the apathy and neglect of the authorities as well as public. Surprisingly, the pond area has a free access and the canal feeding it seemed to have been neglected. Neither the pond nor the canal is being regularly cleaned. On questioning one of the district officers regarding neglect of the water supply system evoked a strange reply. The storage tanks are not being cleaned because the fact is that the tank has not been desilted for the past many years. It has been desilted four times but only on papers, alleged Mr Gulshan Narang, one of the protesting members.

This water supply scheme accounts for 35 lakh gallons of drinking water daily. The second scheme has the capacity of 22 lakh gallons. There is a net shortage of 63 lakh million gallons as the total demand for three lakh population of the city is 120 lakh gallons. A third scheme which had incur an estimated cost of Rs 10 crore, has been lying in cold storage.

A similar crisis has gripped the city on power front. Long hours of power cuts has affected the life. The scheduled power cut is supposed to be for two hours. But the power department hardly adhere to the schedule. In fact the power goes off for more than six hours daily, said Mr Vinay Kumar, a local businessman.

Failing to take timely action in desilting the drains and the main nullahs, the civic authorities pushed the city to a flood-situation during the recent rains. Most parts of the city were inundated for two days due to the choked drains. The resultant sanitation coupled with poor quality of drinking water has almost triggered epidemic in the city. The chairman, another corporator, Mr Ramesh Sehgal, He alleged that over 1,000 cases of jaundice have so far been reported in the city during the past three months.

Expressing concern over the failure of the system in delivering goods to the residents of Rohtak, was Mr Inder Singh Dhull, a senior leader of the Samajwadi Janata Party. Due to rampant corruption in the higher echelons of the State's administration, the district and the city is being starved of funds. The em-



The main reservoir from which water is supplied to Rohtak town is in a sorry state. Desilting has not been done for years, and the inlet into it from a canal collects all the waste of the town en route. — HT photo

ployees of the civic body have not got their salaries for the month of July. Although the foundation for the new bus stand spread over an area of 200 acres was recently laid by Chief Minister Bhajan Lal, but the work did not start due to paucity of funds, he said.

Rohtak is supposed to be counter-magnet town in the proposed National Capital Region (NCR) plan. The people and the political leadership of the district though aware of the plan, are unaware about any development having taken place in the city as per the requirement of the plan. The recent meeting of the NCR Board held in New

Delhi was attended by the Deputy Commissioner. Some new proposals were submitted by him to the meeting.

These include construction of new bus stand, two more by-passes to ensure free movement of traffic on the highways without any pressure on the city and six flyovers. The other proposals submitted were for four-laning of the national highway number 10, two-laning of Jhajjar-Rohtak Road and Jhajjar-Najafgarh Road, development of more housing sectors by the HUDA and development of central sewage system. Nobody here is sure about the time to be taken in the accept-

ance and implementation of these projects.

But apart from Rohtak has silver lining. It is in the grip of literacy drive launched by the district administration. "Saksharta abhiyan" as it is being called, is the thing "Jai Saksharta" has in fact become a popular slogan. The Government officials even wish each other by raising this slogan.

Mr T. V. S. Prasad, the young additional deputy commissioner of the district, seemed enthused on the success of this programme. He is spearheading the environment building campaign for the programme. It is being projected as the second step for literacy and response from the people particularly the women has been encouraging.

Yet another experiment being carried on by Mr Prasad is the setting up of modern farms with integrated activities. This is to encourage unemployed youth to take up their own ventures which are mostly agro-based. Quoting for instance, he told that how he encouraged two such persons to start a dairy farm in the eight acre land they had in a nearby village. As an integrated activity, they were taught to set up a bio-gas plant using the dung, grow fodder for the milk animals in another part of the farm and simultaneously planting useful trees.

On the health care front, he claimed that the district has achieved remarkable results in the field of family planning. The women has been more responsive and they constitute 30 per cent of the total beneficiaries. A visit to some villages did not prove the official conclusion of total success. It is very difficult to motivate the villagers regarding family planning programmes—said one of the city doctors. The electronic media be it television or the films shown by the department, have a quick effect on the people, he added.

As per the available figures, 902 family operations were done in the district during the last year. This year from April to July the number has touched 2,660. As per the 1991 census, as against the national growth rate of 2.11 per cent, Haryana showed a rate of 2.64 per cent. Against this the Rohtak district had a rate of only 1.7 per cent which is said to be the lowest in the State. The immunisation target had touched 41.2 per cent during last year.

(Next Muzaffarnagar)

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(City Edition)

A distant dream

ALMOST every other glossy carries the picture — the tall, slim woman balancing two pots on her head, veil billowing in the desert wind, one profusely bangles arm in swing, the other leading a child, perhaps. For the coffee table book, this is a romantic shot, one we are all familiar with. But the pots, however skillfully poised, is as good a symbol of social oppression as the veil, however colourful it may be.

We are talking of the water-bearing women of Rajasthan, who have, for centuries, been bearing this unacceptable burden of carrying water in large containers over miles of desert sand, fettered as they already are by clothes and taboos and the sheer curse of an overwhelmingly male-dominated society which so cunningly managed, until very lately, to foster that unspeakable atrocity on all humankind — sati.

This picture of the water-bearer has become all too stark in the last many years, with the pressure on natural water sources increasing without letup because of, among other things, widespread, uncontrolled, unorganised industrialisation and urbanisation. The women have to wander farther afield for the precious commodity, no longer sparkling, if it ever was, but often deadly contaminated.

Water — that natural source of health and succour — can bring crippling disease and with a potent political weapon in its hand, successive governments have been promising water to the people in villages and cities. But while the urban elite and middle-classes have been able to garner a more-than-fair-share for themselves, the village poor and urban slum-dwellers have been left dry. As Mr. Gouri Shankar Ghosh, Jt. Secretary, Department of Rural Development and head of the Drinking Water Mission, said at a round-table discussion with the media in Delhi recently, "My kitty is small and almost the whole of it goes to the one who hankers after it the loudest." He was alluding to the practice of rich industrialists who even use up the water allocated for drinking purpose to the villages.

One major reason for the scandalous discrimination in the distribution of water is the extreme reluctance of governments to cost the commodity at actuals, fearing stiff resistance and a backlash at election time, from



An ambitious programme, launched at the beginning of the International Water Supply and Sanitation Decade (1981-90), to reach safe drinking water to the whole of India by March 1990 has gone dry.

Statistics and target nonrealisation aside, what is safe drinking water? In some places in Rajasthan, for example, drinking water is severely contaminated, leaving a crippling effect on its users, writes Mary Mathen.

powerful and gluttonous industrial lobbies and even the urban citizenry, for whom piped water comes as easily as they pour them down the drain.

Consider the statistics. The situation in India and the rest of the developing world are broadly comparable. At the beginning of the International Water Supply and Sanitation Decade (1981-90), protected water supply facilities were available to only 31 per cent of the population in India. With the launching of the decade, the programme

gained some momentum. But what was the target of this ambitious programme? Hundred per cent coverage by March 1990! Translated into numbers, it meant reaching safe drinking water to 362 million people! The estimated cost (at the 1980 price level) Rs. 7,300 crore!

Statistics and target-nonrealisation aside, what, in practical human terms, is safe drinking water? This is better understood when one knows what happens when the deprived of the world drink unsafe water.

In Africa, of course, the horrors the guineaworm scourge is legion. But nearer home, we have again, the example of Rajasthan.

IN the small and unproductive Districts of Bikaner and Udaipur, live the tribal Bhils, driven to desperation and the guineaworm by crushing poverty. In the stepwells and other shallow water sources, drinking water is severely contaminated and disease-laden. Here, the guineaworm spares no one — not even the women, or the aged, or the children. The worm, one of the most, both from the infection itself and from neglect by the afflicted parents who cannot tend even to the barest extent that despondent poverty would have otherwise allowed them to. Here, the people writhe as they try, vainly, to arrest the progress of their marauding, wormy hosts.

A case study conducted by the UNICEF and NAMEDIA, Media Foundation of the Non-Aligned Research and Publication Centre, along with the Government of India's Department of Rural Development, describes the agony of a guineaworm patient, a 21-year-old school teacher of Udaipur district, Maramaya. He, in the courageous process of extracting a guineaworm from his own foot, broke it, and the part of the worm that remained in the foot, created a painful abscess. He was sleepless with pain for three days and bed-ridden for fourteen.

The plight of similarly afflicted women and children is heart-rending. Their agony has to be seen to be believed. Watching the ayurvedic surgeon draw out the long, white worm, all 150 cm of it, from an incision, say, on the leg of a little patient, makes one's stomach turn. Especially since it is done in the raw, without the benefit of anaesthesia, the trauma of a child subject to such surgery is unimaginable.

And yet, ayurveda is the only system that can offer even this: allopathy offers no comfort at all. Dr. Karl-Eric Knutsson, Regional Director, UNICEF, warned the country not to make light of the services of qualified ayurvedic doctors. "Ayurveda has developed a very ingenious, traditional surgical technique to combat the guineaworm. This popular, non-recognised system

Hopes sink as ground-water table dips

EXPRESS NEWS SERVICE

BANGALORE

DRINKING water is gradually becoming a luxury in Karnataka, with 90-95 of the cities, towns and villages having problems getting water barely sufficient to meet the demand of their residents. The challenges before the State are many: there's no perennial water source in Karnataka, so seasonal rivers alone offer some hope; then,



there are too many borewells, sunk too close to each other, that are depleting the State's ground-water level rapidly. The result is certainly not a happy one.

As per world standards, ideally, the per capita water consumption should be 200 litres a day, but, in reality, in Karnataka the daily per capita supply is 135 litres in cities and big towns, 60 to 70 litres in smaller towns, and hardly 25 litres in villages. Most of the districts of the State are reeling under the impact of a drinking water famine, and Bangalore is no exception to the rule.

Two Government agencies - Karnataka Urban Water Supply and Drainage Board (KUWSDB) and the Bangalore Water Supply and Sewerage Board (BWSSB) - are officially responsible for providing drinking water. But they are straitjacketed by a resources crunch that leaves them little leeway.

SEVERE DEPLETION: Practically every village in Karnataka has borewells, but the absence of proper maintenance and the depletion of groundwater reserves have started rendering many of them useless.

According to a study on the status of the utilisation of ground water conducted by the Drought Monitoring Cell in Bangalore, the level in many districts was low to such an extent that it indicated severe depletion.

Bangalore, which is situated on the ridge separating the Cauvery basin from the Pennayar basin, is poorly placed in respect of ground water resources. Even the supply of filtered water into the city is not commensurate with the population growth, ground

water extraction increased.

But this resulted in many open wells drying up and water table going down. Many single-family households got borewells drilled in their compounds. And, now, a host of industrial units in and around the city, hotels, hospitals, cinema theatres, schools, colleges and offices have their own wells. Nearly 2,000 wells are being drilled annually in the city.

WELLS KEEP GROWING: According to figures available, there were nearly 20,000 borewells in the city which has limited ground water resources. The water table, meanwhile, keeps going down as the number of wells grow. What is clear, though, is that with a static population of 5 million and a floating one of 5-6 lakh, and a rapidly expanding metropolitan and industrial base, Bangalore's drinking water needs is bound to increase.

Chronic water shortage is not a new phenomenon for many residents of the city. People are used to getting water frequently during odd hours of the night. Scarcity seems to be more acute in individual houses and particular streets that are either located at greater heights or have poor supply pipes.

Unhappy residents frequently form groups and meet higher-ups to get immediate relief, which on many occasions is only temporary. Some even resort to unethical methods such as bribing the local valve operator which is widely perceived to be the most effective means of getting water. And for those who can afford it, water tankers on hire offer an easy way out.

The city gets 429 million litres of water a day against the demand of 1,100 million litres. Its main water source is the Cauvery river. BWSSB is drawing 60 million gallons from Cauvery first and second stages, in addition to 27 million gallons from the Thippagondanahally reservoir.

The city's hopes now are pinned on the Cauvery third stage, which is expected to provide 60 million gallons when it fully operational by 1997. Incidental-

Water situation: Karnataka

ly, the Cauvery fourth-stage project, which carries a price tag of Rs 1,000 crore, is still waiting for a decision from the country's planners. In other words, by the time it gets off the ground, the project's price tag as well as Bangalore water requirements are sure to go up.

DESPAIR IN DISTRICTS: The scene in the districts also is uninspiring. In Dharwad, for instance, the main source of water supply is the Tungabhadra, which flows from south to north in the eastern part of the district. In the northern part, Malhaprabha is the principal water provider. Dams have been built only on Malhaprabha and Tungabhadra, which provide drinking water to cities like Hubli, Dharwad, Gadag, Harihar, Davangere and Ranibennur. The rest of the district is being supplied with water from natural tanks, ponds and borewells. According to M. Muniswamiiah of the Geology Department, about 15,985 hectares of ground water have already been exploited.

Incidentally, even in the case of water distribution, the scales are tilted towards urban areas. The water of Malhaprabha, for instance, is reserved for the urban areas, and released to the villages once a week or so. Similarly, at Nedleri village of Ranibennur taluk, people have to depend on water supplied through taps, even though the Tungabhadra is only 2 km away from the hamlet. On top of this, the river's water is so polluted with effluents released by a neighbouring polyfibres factory that it cannot be used even for cattle or for plants.

The twin cities of Hubli-Dharwad are supplied with water from the Malhaprabha and Neersagar projects. Both are managed by the KUWSDB. The local municipal corporation has been desperately trying to get them back under its administration, but politics has prevented this from happening.

D.K. Nicker, the local MP, says if the corporation is given back the Neersagar project at least, then the citizens would be assured of drinking water once a

day. Right now, they are getting water on alternate days, for about four hours, the timings being solely the discretion of the authorities. Despite this, even though the citizens are paying a cess in addition to the water tax, they are being charged for every drop of water they use.

Bangalore and Dharwad present a microcosmic view of the water problem in Karnataka. As these examples indicate, Karnataka's position is hardly enviable.

- Belgaum city gets water five times a week and its residents are keeping their fingers crossed because if it doesn't rain heavily this season, their lifeline, the Rakkasakoppa reservoir, may just dry up. But the city's plight is hardly comparable to that of the district's 80 'problem' villages.

- Ironically, water shortage is a part of life, especially during the summer, of even the port city of Mangalore (population: 4 lakh) which is situated on the west coast. Mobile tankers help the city meet its pressing water needs. Somewhat!

- In the water-starved Gulbarga district, some 210 villages have been identified as problematic. Of these, only 23 villages and the industrial town of Shahabad are supplied water by tankers. Such is the acuteness of the scarcity that the people have taken to the streets to make themselves heard by an insensitive administration. Recently, the residents of Nimburga in Aland taluka locked the office of the mandal panchayat for over a week in protest against the non-execution of sanctioned water supply schemes.

Despite the acuteness of the problem, precious little is being done to salvage the situation. With the completion of the third stage of the Cauvery water supply scheme recently, the situation in Bangalore seems to have improved somewhat. According to BWSSB's former chairman, H.S. Puttaketupanna, who was behind the execution of the third stage, Bangaloreans are not likely to face a major water problem till the middle of 1997.

He says, "If work on the proposed Cauvery fourth stage is not taken up immediately, the situation will be worse by the turn of the century as Bangalore is one of the fastest growing cities in Asia."

Business Notes

WATER RESOURCES

Concern down south

The alarm bells about Madras's water situation don't stop ringing. Earlier this year, it was low surface water resources, with the three reservoirs at Red Hills, Poondi and Sholavaram depleted. This time around, it's the city's groundwater resources that are causing concern.

Says professor Sundaramoorthy, Centre for Water Resources at Anna University, "At the time of Independence, groundwater was ten times the rainfall. Today, it is a one-to-one correlation." According to a March 1993 report by the Central Groundwater Board, Southern Region, groundwater resources are declining. From January 1993, only 14 million gallons per day have been pumped from the well-fields at Minjur, Tamarappakkam, Panjetty, Poondi, Kannigaipet and the flood plains.

The water table in Madras city used to be between 18 feet and 20 feet. That has now dropped to between 30 feet and 45 feet. Even with a good monsoon, experts say, the water table will not rise to the level of 20 feet. Recently-dug borewells average a depth of 140 feet, against 60 feet earlier.

The groundwater problems have various causes. In a year of below average rainfall, a significant amount of water is taken from the shallow basin below the city to meet the needs of piped water supply. The unchecked growth of flats, with their heavy withdrawal of water, has also made deeper tubewells and borewells necessary.

The problem is exacerbated by the private water operator, who dip into the groundwater reserves to supply water to certain pockets in the city and the outskirts. Madras has 400 to 1,000 of these. The current rate for one 10,000-litre tanker of water ranges from Rs.360 to Rs.450. At Palavakkam, for instance, the water level

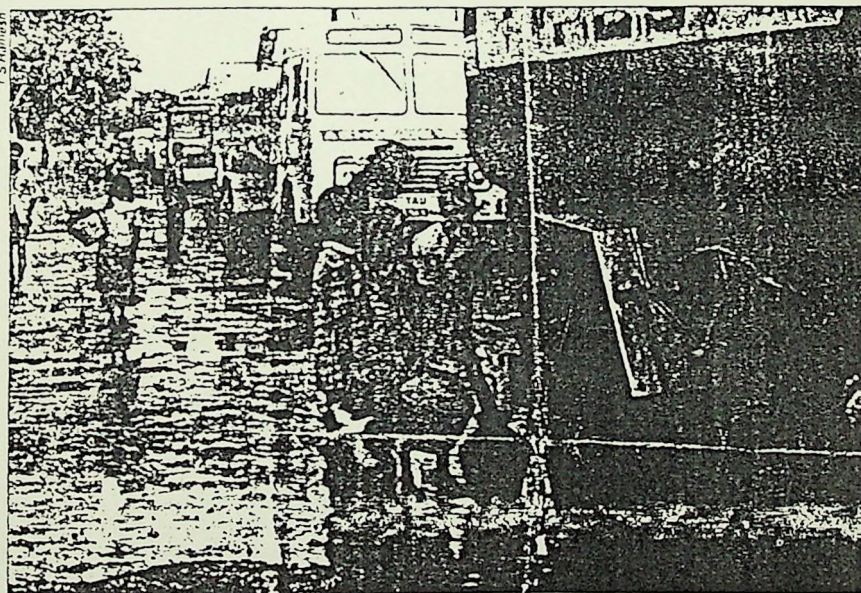
had receded to danger point. Sources at Metrowater, the city's water board, say, that constant monitoring brought it back to a rechargeable level.

In addition, there have been fluctuations in the groundwater table because of poor recharge, adds Sundaramoorthy. "The present culture of paving open areas on the side and car parks needs to be re-examined. Multi-storey buildings should have suitable rainwater harvesting." Madras city had 39 temple tanks, filled during rainfall with a network of pipes for recharging. Today, those connections have been cut and the tanks fill up only with local rainfall. In fact, while the gross groundwater recharge is only about 55.34 million cubic metres per year, the gross groundwater extraction is

resources have already been developed. To deal with the current crisis, three months back, Metrowater put 2,500 pumps into effect in the city, totalling up to 6,665 pumps.

Any further groundwater development should be done cautiously, as it may lead to mining of water, that is, the water going below rechargeable levels. The Central Groundwater Report raises fears about mining of water in the Besant Nagar area in Madras.

Another problem: groundwater contamination, through highly toxic industrial effluents from a large number of industrial units in Guindy, Ambattur, and North Madras. A few years back, even cyanide pollution in Cooum river was reported.



Private water operators: depleting the precious groundwater reserves

45.36 million cubic metres per year.

Another threat to groundwater resources is sea water intrusion due to extensive extraction. In the Minjur well-field, the interface between fresh water and salt water has advanced 8 km inland. Artificial recharge through injection wells, has been undertaken to check further intrusion. Says an official, "If there is sea water intrusion into one well, all others in the same line are endangered."

According to the report, nearly 82 per cent of the city's dynamic groundwater

Buckingham Canal, used as a sewage disposal line, also causes contamination.

Lessening dependence on groundwater is the only way to avoid depleting it. And that calls for long-term solutions, such as the somewhat delayed Krishna water project, (see *Business India*, May 10 1993) to increase the water supply to the city.

But as the first showers of the north-east monsoon hit Madras, will its decision-makers comfortably delude themselves once more?

■ ANITHA POTTARU, JAM

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Water schemes planned for over 8,000 villages

By Our Staff Reporter

BANGALORE, Sept. 16. — In order to augment drinking water supply in rural areas, the Government proposes to implement piped water schemes in 700 villages and mini-water supply schemes in 7,340 villages this year. Rural Development and Panchayat Raj Minister K.H. Patil informed the Assembly today.

Replying to the discussion on the demands for grants, he said that one borewell would be provided for a population of 250 under a Rs. 9.12-crore scheme.

Of the 27,023 villages and 25,595 hamlets in the State, only 5,600 villages were covered by protected water supply schemes, Mr. Patil said.

Another scheme had been proposed to provide latrines in every village within five years. Pointing out that there was no point in constructing latrines without first ensuring adequate water supply and drainage, he said this aspect would also be taken care of.

Hailing the contribution of the late Nazeruddin in Panchayat Raj in the State, he said the fact that the system had not taken roots in the manner he had envisioned was another matter altogether. Therefore, the time had come to bring in certain amendments to the original Act in the light of experience and in order to strengthen the democratic aspirations

of the people, he said.

COMPREHENSIVE LAW: Comprehensive legislation to replace the existing Act had been prepared in the spirit of the 64th amendment to the Constitution introduced by Rajiv Gandhi. It was his intention to introduce the Bill in this session itself if possible, he said.

Prime Minister P.V. Narasimha Rao had given him an appointment some time after September 20 to discuss the Bill, following which he would introduce it in the House during this session, if possible. However, the Bill needed the President's assent, which could take some time. An ordinance could be promulgated if the Bill could not be passed during this session, he said, but added that he was not in favour of such a step.

He said he intended to replace the existing Act with the new one before elections to the Zilla Parishads and Mandal Panchayats due in December. Allaying the Opposition members' fears, he said the elections should not be postponed as far as possible.

Under the new Act, a Mandal Panchayat would be set up for a population of between 4,000 and 8,000 instead of one Mandal Panchayat for a population of between 8,000 and 10,000 as per the existing Act, Mr. Patil said.

Pointing out that gram sabhas were

not functioning effectively in many places, he said steps had to be taken to revivise them, failing which the very purpose of Panchayat Raj would be defeated.

Mr. Patil also said he was against the large number of nominations provided for in Mandal Panchayats and said that all members, including those from reserved categories, should be elected.

CHECKS: He said that under the existing Act there were not enough checks and balances to ensure that the Zilla Parishads and Mandal Panchayats discharged their responsibilities properly. While 80 per cent of funds under the Jawahar Rozgar Yojana went directly to the Mandal Panchayats, these bodies were not accountable for how the money was utilised. The checks and balances required would be provided for in the new Act, he said.

Maintaining that few Government officials had the interests of the people at heart, he said this was the reason why development schemes remained unimplemented. If the officials were

Continued on Page 9, col. 1

Water schemes

Continued from Page 1

conscientious, they could implement many schemes for which the Central Government was prepared to provide funds. However, the funds remained unutilised for lack of initiative and interest.

Many Government schemes remained on paper and had not benefited people in any manner, he said.

The Karnataka Land Army Corporation employed 1,600 engineers who had no work to do. This state of affairs would have to be changed, he added.

The demands were passed by a voice vote.

Participating in the discussion earlier, Dr. Venkatesh (SJP — Heggadadevanakote) regretted that the Rural Development Department had not been rendering service expected of it to the people. He urged the Government to release more funds to the department to help it launch more developmental activities like the drinking water supply scheme.

Mr. Vatal Nagaraj (Ind — Chamarajanagar) felt that frequent change of rural development ministers had affected the functioning of the department. In the last two years the portfolio had been reshuffled among ministers four times.

Mr. Nagaraj said the rural people

were yet to get the amenities and facilities that their urban counterparts enjoyed. He underlined the need to take up rural sanitation on a war-footing. He favoured elections to Mandal Panchayats on non-party lines. Party politics at the village-level was not conducive to development.

FAILURE: Mr. Narayan (Cong-I) demanded abolition of the Zilla Parishad system. The experiment had failed miserably, he said, exploring the way to providing drinking water to the people and generating employment opportunities.

Mr. Baba Gowda Patil (Raitha Sangha — Kittoor), wanted Taluk Panchayat Samities to be strengthened. He made it clear that he was not for legislators heading the committees. He favoured an elected mandal member being chosen as the committee's chairman. Zilla Parishads should have supervisory powers over the Mandals, he said and asked the Government to entrust itself with the responsibility of providing drinking water to all villages.

Dr. Nanjappa (Cong-I — Sivamarabelagola), said the creation of Zilla Parishads had led to wasteful expenditure. The present system had failed to deliver the goods.

Telephone : 630091

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*Water***Drinking water schemes
to get top priority in PUs**PRESS NEWS SERVICE
Madras, Oct. 4

Drinking water schemes will get top priority in the Rs. one-crore-per-panchayat union self-sufficiency scheme, Finance Minister V R Nedunchezhiyan said in the Assembly on Friday.

Replying to the discussion on the supplementary expenditure estimates, he said the TWAD schemes would continue with separate funding, while the Rs. one crore would be used for other schemes with priority accorded to water supply. Laying of pipelines for integrated water supply, and building of overhead tanks would receive special attention.

Participating in the discussion, Mr C Swaminathan (Cong-I) said several parts of the state, including Pudukottai district, faced water scarcity.

In his reply to the discussion on a bill on introducing prohibition, Mr Nedunchezhiyan said the government was keen to do away with IMFS also, but it was awaiting the appropriate time. At present, it was concentrating on eradicating cheap liquor.

The revenue loss on account of doing away with cheap liquor would amount to Rs. 390 crore in a full year, and the decision had been

taken despite it. The step to make VAOs and SIs responsible for enforcement of prohibition had produced results much better than anticipated.

Replying to Mr S Balakrishnan (Cong-I), Mr Nedunchezhiyan said the government could provide opportunities in the cottage industry or incentives to the displaced "poor illicit distillers" but it was unlikely that they would come forward and identify themselves.

The increase in vend fee and tax on the IMFS were aimed at reducing the consumption of liquor, and to meet, to some extent, the revenue loss resulting from the ban on cheap liquor.

Mr H M Raju (Cong-I) wanted implementation of total prohibition, and utilisation of fines for prohibition and drug offences for propagating the evils of drinking.

Mrs A S Ponnammal (Cong-I) called for more stringent punishment for prohibition offences, including making the offences non-bailable.

Mr C Gnanasekaran (Cong-I) suggested one-year mandatory jail sentence for prohibition offences.

The House passed without discussion four bills, relating to tax on entry of vehicles into local body areas and changes in sales tax.

29/4/93 Palamau villagers one up on the rain god

By Manoj Prasad

SHAHPUR (Palamau)

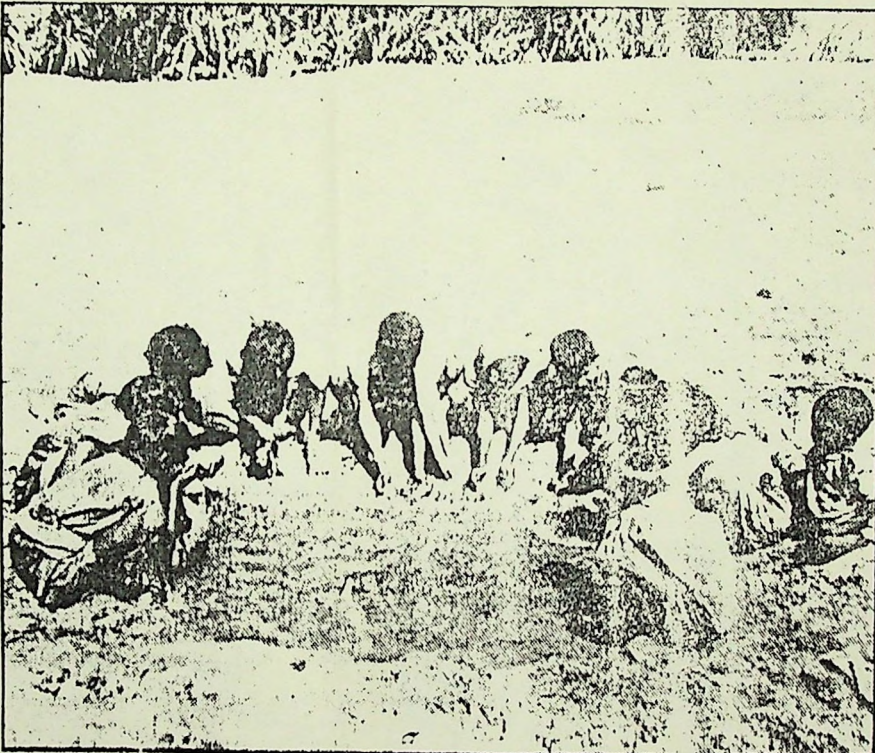
WITH THE onset of summer and hardly any rainfall for the past three years, the people of Shahpur in the drought-affected district of Palamau, this year too, are not depending on the rainfall for water. They have devised their own technique to survive - *chuals*.

There are half a dozen hand pumps, one pond and one river - Koel - which have all turned dry. So, in order to get water, the people dig up a *chual* on the dry river bed. To begin with, a proper site is selected, somewhere closer to the heart of the river. Then digging starts and at a depth ranging between two to seven feet, a small reservoir of water is found.

The water of the *chual* is pure. But then, the process of getting water from a *chual* is not easy as its hard to discover a proper place on the river bed and moreover, from one *chual*, the people say, only a few pitchers of water can be drawn. So, in order to meet their daily needs, they have to dig up new *chuals* every now and then.

WIDESPREAD PRACTICE: Interestingly, the technique of *chual*-digging is not new. Nor is its use a monopoly of the residents of Shahpur. There are thousands of people in Panki, Manatu, Kunkari, Iuraria, Dhuri, Laroo, Mahuantanar, Paraskhand and Barwadih villages in Palamau district, where drought is a perennial affair, who have been quenching their thirst by means of *chuals*.

To add to their woes, the ground water level has one down from the earlier 30 feet to 60 feet. The worst-affected are the plants and animals. However, the problem has taken a serious turn for the people of Daltonganj town, who, in the absence of a proper municipal water system and dried up hand pumps and cills, are faced with a situation similar to what can



Children of Shahpur village drinking water from a freshly dug-up *chual* on the Koel riverbed. Express photo.

safely be described as water famine.

In the high-altitude areas of Hamidganj and Shivaji Madan in Daltonganj, much before dawn, people stand before a lone hand pump in queues which are at times half a kilometre long. Or they wait for the tanker pressed into service by the district administration. There are others who can afford to rely upon the labour of others and buy water at a rate varying between Rs 5 to Rs 10 per two *bhars* (about 100 litre).

WOMEN GIVE UP PURDAH: The impact of the water famine is visible elsewhere too. The children skip classes, say the school principals, as "they have to help their parents fetch water everyday."

A resident of Hamidganj, Gupteshwari Prasad, told *Indian Express* that many Muslim women, who religiously donned purdah while moving out of their homes, have been compelled to give up this practice. "This is natural", he said, adding, "When they have to walk for long distances everyday to ferry water in the blazing sun, how can they afford to continue wearing a purdah", he said.

If the government officials are to be believed, the district administration has taken a number of remedial measures to combat the water famine.

Commenting on the district administration's move on water conservation, Girja Nand Singh, a hotelier, said, "Where there is a little water, its conservation becomes a nullity." Seriously enough, water scarcity is not confined to Palamau alone. It is prevalent, in varying intensity and form, in Garhwa, Lohardaga, Gumla, Chatra and Ranchi districts as well.

The state government's response has been far from satisfactory. But the Public Health and Engineering Department (PHED) minister, Gajendra Prasad Himanshu, told *Indian Express* on Tuesday that UNICEF has provided 1,200 sets of hand pumps, besides two rig machines and spare parts.

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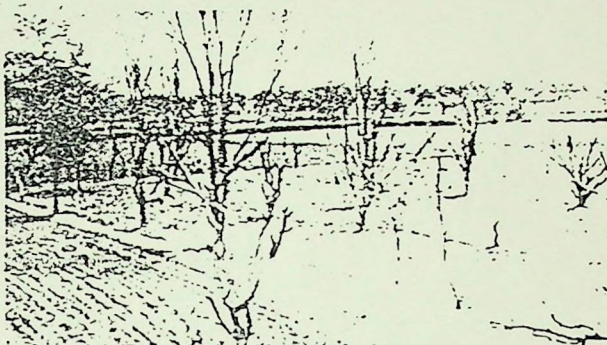
- Pollution water

- Water

Water, water, everywhere
Not any drop to drink.

THESE lines of Coleridge's came rushing into your mind as you entered the All-India Fine Arts and Crafts Society (AIFACS) building to take a look at the exhibition on water-pollution called — "The Scourge" in India. Organised by CSE (Centre for Science and Environment, a non-profit, voluntary organisation), the recently concluded exhibition brought to light the severity of water pollution in the various parts of India. In spite of being one of the wettest countries of the world, sources say 70 per cent of the available water in India is polluted.

Although domestic waste is much more than industrial effluents. However, the latter being toxic and



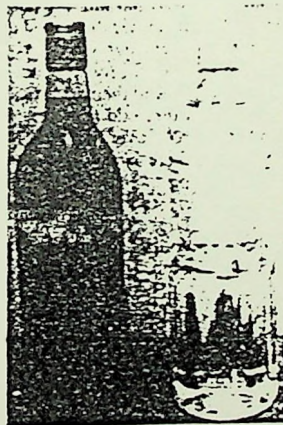
How many barren lands does it take till we know that nature has wept and sighed?

Not any drop to drink

harm pose a greater threat. The exhibitors had shocking revelations to make regarding water-pollution caused by industrial waste, which is limited not only to surface water sources like ponds, rivers, lakes, etc. but ground water sources as well.

One dramatic example of ground-water pollution is to be found in Bichhi, a village in Rajasthan. At least 60 wells in Bichhi are polluted, owing to the carcinogenic, aromatic compounds in the effluents from the industries manufacturing H-acid, a highly toxic dye intermediate. Interestingly, H-acid manufacturing has been stopped

places. Patancheru near Hyderabad was to be converted into an "Industrial beehive". But the so-called progress took its toll. Over 3,000 industrial un-



A bottle of village well water (left) adjacent to a bottle of city tap water

its pollute the surrounding area. Pictures show the lemons that children have developed from playing in the dirt. Surveys have confirmed the health hazards.

Says Dr Krishna Rao of that area "Three boys died of leukaemia... Our

cattle and goats are dying... I have seen a calf born without skin." In Pali official sources list the number of deaths due to water pollution up to 42, while independent sources put the figure to be 120 and 150. In Hussainabad a third of its wells have become saline, rendering them useless for irrigation or domestic use. The crop-yield of the area have declined by 30 per cent to 70 per cent along with deteriorated quality. In Ambur a medical team in 1980 revealed 500 tannery workers had a zero sperm count. Rajkot, Amhamath, Jetpur, Balotra, and Jodhpur are some more places stricken with water pollution, and threatened with an insecure future.

The exhibition, while exposing the near-tragic conditions caused by industries in the name of "progress", raises other disturbing but important questions: Is safe water a luxury? Who is responsible? How much can a community take? As to why we haven't been able to curb pollution, one possible reason is that initial no-objection certificates are not too difficult to obtain, in fact they have been called a "licence to pollute". Furthermore, prosecution, with its lengthy and expensive litigation is not a feasible answer for the poor labourers. On the other hand punishment for disregarding pollution-law is not sufficiently stringent, so, many adopt the motto of "pay and pollute."

By Harvinder Kaur

in the West because of its hazardous effluents.

The untreated liquid effluents are released into the gullies and irrigation canals, doing untold damage. A glass container filled with water from Bichhi was palced at the exhibition and looked more like Campa Cola than plain water. This has naturally spelled havoc for the inhabitants as far as health and agriculture is concerned. Says a pained Pandit Shivalal, an aged inhabitant of Bichhi, "This is worse than Bhopal. More people died here."

Conv. Bichhi is not alone with its tragic tale of slow death of people and places. There are many such afflicted

9570 villages facing drinking water problem

From Our Special Representative

NEW DELHI, Aug 26 — About 9570 villages in Assam were identified as drinking water problem villages as on April 1, 1985. After steps were taken to improve the situation and progress made in solving the problem of drinking water in these villages, 88 villages remained as drinking water problem villages as on April, 1991. Till June 30 this year one more problem village was covered with supply of drinking water and as on date now there are 87 drinking water problem villages in the State. These 87 villages in Assam have not a single source of drinking water. However according to a statement laid on the table of the Lok Sabha on August 21 by the Union Minister of State for Rural Development, Sri Uttambhai H. Patel, these villages alongwith 5095 other villages with no source of drinking water in different States of the country as on April 1 this year are likely to be covered by the scheme for supply of drinking water by the end of March, 1993.

The Minister was replying to two questions on drinking water problem villages of the country raised by Ashok Anand Rao Deshmukh, Sri Mriyunjay Nayaki and Sri Ram Naram Berwa.

From the figures of problem villages given by the Minister, in his replies, progress made in solving the problem of drinking water in Andhra Pradesh appears to be very impressive while as many as 16834 villages in Andhra Pradesh were identified as drinking water problem villages as on April 1, 1985, the figure turned into nil as on April 1, 1991 after steps were taken to improve the situation as a result, there is no "no source" problem villages now in Andhra Pradesh. West Bengal is another major State which has made cent percent progress in solving the drinking water problem of 5030 villages as identified on April 1, 1985. Its number of such villages dropped to nil, as on April 1, 1991.

Among the proverbially water problem States, Mizoram has been able to solve the drinking water problem of 595 villages identified as on April 1, 1985. Among the States in the country Meghalaya is still having the highest number of 1006 "no source" drinking water problem villages (as on June 30, 1991). Incidentally Meghalaya had

identified 3658 drinking water problem villages as on April 1, 1985.

In his reply, the Minister has also informed Sri Ram Narayan Berwa that the Government has sanctioned special allocation of Rs. 260 crores for coverage of "no source" problem villages within a period of two years. A special crash programme to be named after Rajiv Gandhi has also been planned by the Government to provide safe drinking water facilities to partially covered villages and population in rural areas within five years.

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Water

Waiting for taps to trickle

By a Staff Reporter

THE woes of the Delhiites, apparently, have no end. Change of season brings hordes of problems. Come summer and there are scarcities of all sorts. Boggled by erratic power supply, the populace has another irritant in the shape of water shortage.

Despite claims by the Delhi Water Supply and Sewage Disposal Undertaking that there has been no let-up in water supply, the city continues to face shortage. The situation is acute in South Delhi, West Delhi, the rural areas, North-West and East Delhi as well.

This, notwithstanding the fact that the water treatment plants are reportedly producing more than their normal capacity. This year again, DWSSDU has augmented the water supply capacity to 469 MGD from 417 MGD in the corresponding period in the previous year.

The reasons for the shortage are obvious. DWSSDU has not been able to cope with the growing consumption of water which reaches its peak during summer, especially in May and June. Either the water is at low pressure or the supply is simply discontinued for the better part of the day.

The bulk supply for the areas falling under South Delhi, for instance, comes from the Wazirabad and Gokulpuri water treatment plants, producing 120 MGD and 100 MGD of water respectively. DWSSDU sources disclosed that the bulk supply from these plants did not reach the booster pumping stations. At the Greater Kailash booster pumping station in South Delhi, only about 30 MGD of water reached on Wednesday creating panic among the residents.

The Wazirabad water plant, however, faces an impending closure in the event of the repair work at the Wazirabad barrage not being completed before the onset of the monsoon. The Additional Commissioner, DWSSDU, Mr. P. M.



The long wait for water at a public handpump in the Capital. — The Statesman.

Nair, however, denied that the supply had been affected due to the reported collapse of 14 gates of the Wazirabad barrage. "The repair work is in progress, normal water supply has been maintained throughout", he stated on Wednesday.

He told this reporter that DWSSDU was thinking of rationalizing the water supply in the Capital. He added that several projects had been undertaken to ensure adequate supply to the residents. According to Mr Nair, a 100 MGD plant at Haiderpur would be commissioned next year, plans to build reservoirs were underway. Work on six reservoirs had already started. Construction of another seven reservoirs would take place soon, he added.

The undertaking has also been working on the construction of a 100 MGD water treatment plant at Haiderpur, five

Renney wells in Alipur block, a 40 MGD water treatment plant at Nangloi and a 20 MGD plant at Bawana.

To make up for the temporary shortfall DWSSDU has installed over 200 tubewells across the city. Emergency water tankers have also been pressed into service. Mr Nair said that scores of tubewells would be commissioned in areas found to be receiving low water supply. Asked about the ground water resources, he said that it could be exploited further as even after considerable digging officials continued to get muddy water, emanating a nauseating odour.

Sources in DWSSDU disclosed that water shortage has also been due to the diversion of supply to the colonies that have come up on the outskirts of Delhi. They said that water is also being supplied to many "illegal or unauthorized" col-

onies of Delhi which has worsened the situation further. Water supply has hardly been commensurate with the ever-increasing demand for it in the face of the expanding residential areas.

Moreover, the Capital has to remain at the mercy of the neighbouring States for the release of water. The only indigenous source of water for Delhi being the Jamuna Canal.

Areas along the Delhi-U.P. border such as Seemapuri, Dilshad Garden, Surya Nagar, Seelampur and Nand Nagri receive a desparingly low supply of water during the day. Housing over 100,000 people the residential pockets of Dilshad Garden get water at odd hours. Water supply is restored only after 11-00 p.m and continues during the night. But it becomes a trickle before dawn, drying up finally even before the residents have woken up.

INFORMATION & DOCUMENTATION

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28/2/89

Water

Where water is more precious than milk

By Bunker Roy

IN November-December 1988 a small village based voluntary agency called Preyatna organised a walk through 45 villages of Dudu Panchayat Samiti barely 60 miles from Jaipur, capital of Rajasthan. It was a walk to make people aware of their drinking water problems.

You ask the so-called responsible people in Rajasthan if Jaipur district has problems of drinking water and the response you get borders on disbelief. Either I am being funny (which, in other words, means I need to get my head examined) or I just do not know Rajasthan. The answer invariably is that Jaipur has no problem; it is there in Barmer and places like that where villagers have to walk several kilometres for sweet water, where the Government services have virtually collapsed. Well, by sheer coincidence, some village sarpanches from Barmer were visiting the area and what they saw of the state of drinking water horrified them. Barmer is never so bad, they said.

Who will believe that 60 miles from Jaipur there are villages where women scoop out water by hand from puddles in drying ponds? Villages within a 10 km radius of the largest salt lake in India, the Sambhar Lake, are forced to live in the 19th century because we, you and I, have neglected them. We have taken it for granted that just because they live close to Jaipur they must have basic amenities. This is not true.

Ask for something to drink and they offer you milk, not water because that is more precious. Milk is available at their doorstep; for water they have to walk three

kilometres or more. Villages are decided on the basis of whether there is a perennial source of sweet water. More children attend a primary school if that school has a sweet water source. No primary or middle school in all villages we walked through has a safe water source.

We saw many signs that defy explanation. In Korama village, there is a sweet water source, but the villagers have been denied that water; the Government is pumping it to Nagaur in the adjoining district. Hand pumps have been installed but the water is unfit for drinking. Villagers ask, 'Why waste so much money when every one knows the water will be brackish?' But the year contracts have been given to Executive Engineers PHEO for more hand pumps!

In Sartala village an old man told us that out of 100 children born in the village only around 20 just survive; the rest die because of brackish water. In Nagaur, Barmer and Dohri villages we heard the same sad stories of neglect and callousness.

The Walk for Water resulted in 70 men from 11 villages going for the first time collectively to the Sub-Divisional Magistrate demanding water fit for drinking. Twenty-six women from five villages got together and agreed to form Panchayats of women members only. Ten women's groups in different villages have met several times to chalk out a long term plan of action.

A small beginning but in the right direction.

Traveller, there is no path
Paths are made by walking.

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SAFE WATER 2000

Venue choice, a tribute to Indian effort

By PREMA VISWANATHAN

NEW DELHI, September 9. STARTING tomorrow, India plays host to Safe Water 2000: a five-day global consultation on safe water and sanitation for the 1990s. The event will wrap up the International Drinking Water Supply and Sanitation Decade (IDWSSD), midway through which India's own National Drinking Water Mission got under way.

The choice of venue is somewhat ironic, considering that the Washington-based World Health Institute had warned just a few months ago that this country is in for a major water famine in the next decade. However, according to Mr Martin G. Beyer of the United Nations Development Programme (UNDP), which is sponsoring the consultation jointly with the Government of India and other agencies, it is quite appropriate that the subcontinent should be picked out for this honour, for it can lay claim to harbouring the biggest water supply system in the world.

Officials in the department of rural development as well as in the Planning Commission concede that the programme was limping along in the first half of the decade, despite the emphasis on rural drinking water supply in both the sixth and seventh five year Plans.

Mr Sam Pitroda entered the scene and launched the National Drinking Water Mission. "Actually, Rajiv Gandhi had announced the setting up of the mission in 1986, but we did not have a clear concept until Sam came along," reveals Mr Gauri Ghosh, joint secretary, department of rural development and director of the mission.

INITIAL HASSLES: Pitroda himself entered the picture only in 1987, "so we wasted a whole year", recalls Mr Ghosh. And then there were other bottlenecks. One was the attitude of officialdom. Although the 'management mode' introduced by Mr Pitroda ("dividing a problem into small, manageable pieces", as one of the mission officials puts it) was a revolutionary concept, it initially found no takers in the bureaucracy. Mr Ghosh attributes the resistance to the obsession with hierarchical norms within the administration.

For many officers, working with the mission was tantamount to learning. "It took me a year and a half to acquire an adviser," he recalls.

Another deterrent was the indifference of the state-level administration. One mission official dredges up bitter memories of the reception he was accorded by a belligerent chief secretary of a state. "I am meeting you only because you have come with Sam," was the latter's response.

The other equally persistent problem was the local administration and accounts for the setbacks faced by the mission. Although mission and rural development department officials claim that the target of covering the 55 lakh "problem" villages identified by the mission has almost been reached with only 3,457 of them remaining uncovered, some voluntary organisations dispute this figure. According to Mr Bunker Roy of the Social Work and Research Centre in Tilonia, Rajasthan, the mission's figure is wrong because it is based on a 1982 list which was never updated even after the severe drought which occurred thereafter, causing many "covered" villages to turn into "problem" villages. Mr Ghosh counters this charge with the assertion that what is important is not the question of numbers but the fact that at least some target has been reached as per the criteria set out by the mission. The criteria being the provision of 40 litres of water per capita within a distance of 1.5 kilometres, at least one water source being made available for every 25 persons.

However, the charge of poor performance does emanate only from voluntary organisations. Even Ms Ela Bhatt, member, Planning Commission, speaking at a recent colloquium on water management, related an instance of how she and other activists of the Self Employed Women's Association (SEWA) had gone to Santhalpur in Saurashtra, Gujarat, to do a survey on the impact of the official water supply programme on the women of the area. "We had to postpone our bath for seven days during the survey as there was no water for bathing," she revealed amidst laughter.

PEOPLES PARTICIPATION: Mr Tushar Kanjia, secretary of

the Tagore Society for Rural Development in the Sunderbans in West Bengal points to how even the best technological inputs can boomerang "unless they are augmented with people's participation."

"Unless the community feels that the assets, whether it is a handpump or any other source, belong to it, they will continue to use contaminated sources," he says. A former mission official describes this impediment as "a software gap," the inability to communicate with the people and get them to empathise with the government's goals. "Unless we stop treating people like 'targets' and more like human beings in need of help to stand on their own feet, we will never solve our problems," he asserts.

The approach paper to the eighth Plan, interestingly, reflects this thinking, calling for more decentralisation and community participation. But decentralisation has its own snags, warns a former mission official. "Now everyone is intoning the Ela Bhatt model of decentralisation, which is not really the answer. Not that the Pitroda model of centralisation is to be applied in all cases. But to get something started and give it momentum, you do need a centralised structure."

Mr Ghosh and Mr T.R.Sankaran, secretary, department of rural development, do not concur with this view. "We must percolate to the people through local bodies like panchayats, they feel."

They agree that even panchayats have their own power structures which can militate against an egalitarian distribution of water resources, but hope that slowly, through the growing awareness of their rights, the people will see that these bodies do not fall prey to vested interests.

Indeed, the success of the mission in eradicating guinea worm, a water-borne parasite, in Jhabua, Banswara, Udaipur and Dungarpur districts in Rajasthan, is ample testimony to the effectiveness of community participation in a government-aided programme.

Says Mr R. Gopalakrishnan, deputy secretary, rural development, who was district collector of Jhabua when the programme was under way, "I think the entire

credit should go to the people. It is possible to repeat the Jhabua experience elsewhere if people are adequately motivated. After all, this was one of the poorest, most drought-ravaged districts in the country. If it was possible to succeed here, one could succeed anywhere else."

THE SOLUTION: Community participation, whether it be the communal ownership of water sources, or the responsibility for maintenance of assets like the handpump, seems to be the key to the problem. And Ms Indira Varadarajan, an NGO working with an Indo-Dutch project under the Ganga Action Plan in Mirzapur, UP, reveals, very often the term 'community' stands for women. And unless the women of the village are empowered to take decisions relating to water management, change will be slow in coming. "In Mirzapur, we have trained women to be *mistris* (handpump operators) for the first time, overcoming resistance from the men-folk. The acquisition of new skills has invested these women with a tremendous amount of self-confidence and they can now demand the right to select the site where a hand pump is to be installed and undertake the responsibility to maintain it."

Most NGOs echo her viewpoint and assert that since women are traditionally more involved than men in water management, it is time the government recognised their role and allowed them a say in the decision-making. If this had been done earlier, says Ms Varadarajan, the two million Mark II handpumps which are now in disrepair due to poor maintenance, would still be in working condition.

WOMEN'S PARTICIPATIONS: However, warns one former mission official, even a term like 'women's participation' has the danger of becoming just a 'buzzword', to be aired at seminars and taken out of context to the exclusion of other issues. "What we need is a holistic approach, for in the ultimate analysis, even issues such as deforestation, soil erosion, do have an impact on the procurement of water resources. So no one issue should be inflated out of proportion to the rest."

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 THE HINDU (MADRAS)

24/7/57

24/7/57
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 11/0016

Water mission to bunch villages

From Buroshiva Dasgupta.

THE ECONOMIC TIMES

JUL 24/57

CALCUTTA, July 23.

The National Drinking Water Mission, now only 20,000 short of its target of 1.67 lakh "problem villages," and with more than a year to meet it, is likely to shift its emphasis to village conglomerates in the Eighth Plan.

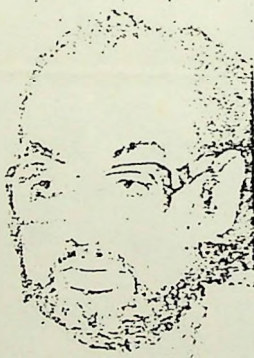
The steering committee of the Planning Commission has recommended a budget of Rs. 10,000 crore for its activity in the next five years.

Mr. Gouri Shankar Ghosh, mission director, told *The Economic Times* here on Friday that the Eighth Plan would be a period of consolidation for the Mission, with the development of institutions and laboratories, which could ensure quality water to the villages.

Since its inception in 1946, the mission did introduce a more organised search for drinking water sources through the help of satellite and sophisticated drilling bores, but it could not, Mr. Ghosh admitted, ensure quality. With a shift of thrust in the coming plan, the mission would not only continue to find out newer sources, but maintain the purity of water too.

The mission's experience had brought out that water from "spot sources" had been put as well as

cheaper than piped water. According to an estimate, if one litre of piped water cost one paise, water from a spot source would cost



Gouri Shankar Ghosh

0.001 paise. Haphazard drilling, however, had cost the nation Rs. 1,000 crore a year, so far. Satellite selection of water sources, followed by geophysical surveys undertaken by the mission, had helped cut

down 60 per cent of the average annual failure rate to less than 10 per cent. During the drought season in Rajasthan and recently in West Bengal, while the other sources dried up, those drilled by the Mission stayed functional.

Mr. Ghosh said steps were being taken by the government to make the water sources more effectively managed. The state governments had been asked to draw up a legislation, to ensure their control over the use of water. The Gujarat government had already passed a legislation while Maharashtra and Madhya Pradesh were contemplating similar action so that there could be a more planned use of water. A planned "water-shed management approach" to the availability and use of water is expected to be introduced by the Eighth Plan.

In the Eighth Plan, the choice of the new village conglomerates would be left to the panchayats. The state, according to Mr. Ghosh, had already been asked to make a survey, and suggest their choice of "problem areas." The selection and planning of the new conglomerates would be decentralised and would be done at the village level in the Eighth Plan. The public

health engineering departments would act as technical advisory bodies.

The various institutes and organisations associated with public health of the country were expected to come under one umbrella and be provided with a commonality of approach. The post-graduate courses in public health engineering will undergo revisions to impart more effective training in water management.

With the newer sources of water being found, problems of preserving the assets were being increasingly felt. Sense of hygiene and purity needed to be imparted to the villages. The new training courses were expected to cover all the aspects of rational management of water.

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Water for Indian Cities: Government Practices and Policy Concerns

Rumi Aijaz

Abstract

The demand for basic infrastructure and services in Indian cities has increased phenomenally due to rapidly growing populations. Such unmet demands often adversely affect the quality of urban life, the economic productivity, as well as the process of sustainable development. The main purpose of this brief is to highlight the problems involved in improving access to water supply in Indian cities faced with a severe water shortage crisis. A case study approach is followed, and the status of water supply service is described for three large cities of India, namely Delhi, Mumbai and Kolkata. The author argues that there exists an immediate need to build up the water infrastructure and institutions, and points out that the challenge for stakeholders lies in speeding up the reform process and in the replication/implementation of efficient water governance practices.

Introduction

Migration from rural areas and small towns to cities is quite common in India. Such movement is generally associated with the level of economic and social development of a place. Employment and education among males and marriage among the females are important reasons for migration. All-India data show that during the decade 1991-2001, more than 20 million persons moved from rural to urban areas, and nearly 15 million moved from one town to another (Census of India, 2001: 15). As a result of this movement, city populations have grown phenomenally over the years. During 1991-2001, the proportion of in-migrants' to the total population of Delhi urban agglomeration' (UA) was 16.4 %. It was 15.1 % in the case of Greater Mumbai UA, 13.4 % in Bangalore UA, 8.7 % in Hyderabad UA, 6.6 % in Chennai UA and 6.2 % in Kolkata UA (Census of India, 2001: 18). In addition to

migrants, there is a sizeable working population living in the adjoining areas which moves in and out of the city on a daily basis. Due to a high concentration of population in cities, there is a huge demand for infrastructure and services, such as housing, public transport, electricity, water supply, sanitation, sewerage, drainage and solid waste management.

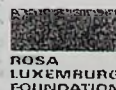
Access to drinking water

Several indicators have been identified to understand the availability and quality of drinking water in an area. A basic indicator included in the Indian Census is the 'proportion of population/households having access to safe drinking water'. Although the definition of 'safe drinking water' has been spelled out, there is strong criticism by analysts on the high proportions of the population being considered under the 'safe drinking water' category. In this respect, it is argued that while sources of safe drinking water have been



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The Rosa Luxemburg Foundation is actively involved in political education throughout the Federal Republic of Germany. It considers itself part of the political movement for democratic socialism. The RLP has its origins in the association "Social Analysis and Political Education", founded in Berlin in 1990. It became a provider of political education, a discussion forum for critical thinking and political alternatives, and a centre for progressive social thinking and research both in Germany and throughout the world.



listed, sufficient steps are not being taken by the service providing agencies to test the quality of water obtained from such sources at frequent intervals. Sample surveys are also conducted from time to time covering the whole of the Indian Union (with the exception of some remote areas) to collect information on the source and condition of drinking water. Some indicators on which national/state-level data are collected include: 'households (HHs) having their principal source' of drinking water within/near their premises', 'HHs having sole access to their principal source of drinking water', 'HHs sharing a public source', 'HHs served by tap/piped water/tubewell/handpump', 'HHs getting sufficient drinking water from their principal sources', 'HHs satisfied with the quality of drinking water served by their principal sources', 'HHs using supplementary sources' of drinking water', 'HHs boiling and filtering drinking water before consumption', 'HHs storing their drinking water', 'HHs dipping in a vessel without a handle to take drinking water out of the main storage container', etc.

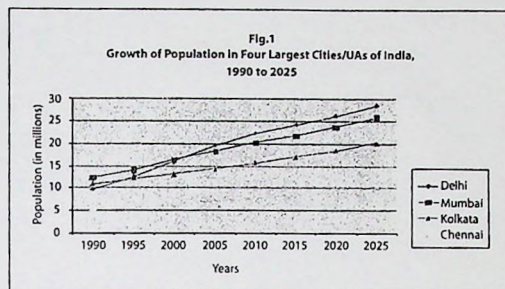
The Jawaharlal Nehru National Urban Renewal Mission³ (JNNURM) Directorate has identified a list of nine service level benchmarks in respect of water supply services in order to review the performance of service delivery agencies. The indicators are: 'coverage of water supply connections'; 'per capita supply of water'; 'extent of metering of water connections'; 'extent of non-revenue water'; 'continuity of water supply'; 'quality of water supplied'; 'efficiency in redressal of customer complaints'; 'cost recovery in water supply services'; and 'efficiency in collection of water supply-related charges'.

A recent study conducted by WHO and UNICEF (2010: 43) reveals that in 2008, 96 % of India's urban population was using an improved drinking-water source⁴. Of this total, one-half (48 %) had piped supply on premises and the remaining used other improved sources. According to the study, about 4 % of the population was using drinking-water from unimproved sources. The data compiled by the Census of India (2001) showed that 90 % of the households in urban India had access to safe drinking water facilities. Most Indian States fell under the 70–99 % category but percentages in many north eastern States and in Kerala were less than 60 %. A sample survey conducted by the National Sample Survey Organisation (1999: ii) during January to June 1998 revealed that 91 % of the urban households in the country were served by tap, tubewell or handpump. The survey also showed that almost

one-half (46 %) of the urban households reported boiling (11 %) and filtering (35 %) of drinking water before consumption.

The case studies

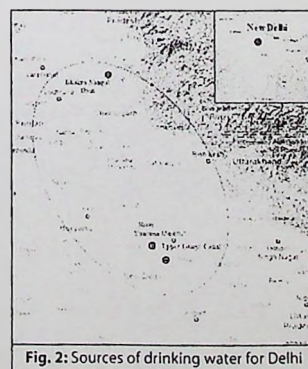
Indian cities are home to millions of people. In 2001, there were 35 UAs/cities, each having a population of more than one million.



Together, these accounted for 38 % of the country's total urban population. While most of these had just crossed the one million mark at the time of 2001 Census count, three (namely Greater Mumbai, Delhi and Kolkata UAs) recorded a population of more than 10 million. Their population (in million) was 16.4, 13.8, and 13.2 respectively. It is estimated that by 2025 the number of persons living in each of the three mega cities/UAs would be more than 20 million (UN, 2009). As per the UN population projections, other Indian cities/UAs are not expected to cross the 10 million mark by 2025 (Fig. 1). The three UAs are also included in the list of 30 largest UAs in the world ranked by population size. For the year 2025, Delhi and Mumbai have been ranked 2nd and 3rd after Tokyo, while Kolkata's rank is 8th after Sao Paulo, Dhaka, Mexico City, and New York-Newark.

The Delhi Jal⁵ (Water) Board (DJB) is responsible for the discharge of functions of water supply, sewerage and sewage disposal, and drainage within the National Capital Territory of Delhi⁶. It functions as per the provisions of the Delhi Water Board Act, 1998.

The agency currently produces about 820 million gallons per day (MGD) of water, 85 % of which is



obtained from surface sources' (such as river and canal; Fig. 2) and the remaining is extracted from under the ground¹⁰. Before supplying to the consumers, raw water undergoes conventional treatment for which treatment plants are established at six different locations in the city¹¹. Water for treatment plants is carried through dedicated trunk mains. The water produced at treatment plants and in the distribution system is frequently checked in laboratories to ensure potable supply. After treatment, water is taken to underground reservoirs and then distributed to different parts of Delhi. Most of the city is covered by a piped network. Up to April 2009, more than 17 lakh piped water connections had been provided. At other places (including slums/unauthorised colonies), water requirements are met through hand pumps, stand posts, tankers (supplies water free of cost), and private motorised wells/tube wells. DJB levies two charges (i.e., a service charge and a volumetric charge per kilolitre) on domestic water consumers to recover costs incurred in the production and supply of water. As per the prevailing rates, a household consuming up to 10 kilolitres (kl) of water has to pay Rs. 82 a month; Rs. 180 for consuming up to 20 kl and; Rs. 470 for consuming up to 30 kl. The monthly water tariff also includes a sewerage maintenance charge levied @ 60 % of water volumetric charge.

The Municipal Corporation of Greater Mumbai (MCGM) is responsible for the "construction and maintenance of works and means for providing a supply of water" to the residents of Mumbai¹². The civic agency

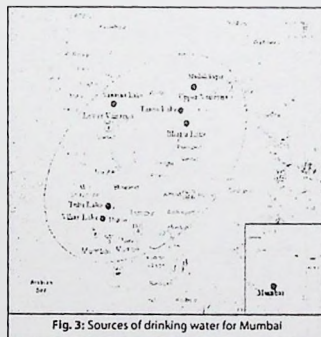


Fig. 3: Sources of drinking water for Mumbai

functions according to the provisions of the Mumbai Municipal Corporation Act, 1888. The quantum of water produced is about 860 MGD (or 3,250 MLD), all of which is obtained from six different surface sources¹³. Two sources are situated within city limits and the remaining lie at a distance of more than 100 kms. (Fig. 3). All sources (i.e., lakes) have been created by constructing dams on rivers (namely Mithi, Alwandi, Vaitarna and Bhatsa). The water is transferred to the city by pipe lines. Some sources such as Upper Vaitarna are situated at a higher elevation and thus water is conveyed to the city entirely by gravity.

For the treatment of water, plants¹⁴ have been established and the treated water is first stored in master reservoirs and then transferred to service reservoirs located in various parts of the city from where all consumers are served by piped supply. Furthermore, water samples from the distribution network and taps are routinely collected and tested to ensure a good quality of supply. The Corporation is empowered to levy a water tax, a water benefit tax, and/or a water charge for meeting the expenditure incurred on capital works for making and improving the facilities of water supply and for maintaining and operating such works. Presently, households with metered connections are charged @ Rs. 3.50 per thousand litres of water. This rate is Rs. 2.25 in case of slum settlements. The rate increases if the consumption of water exceeds 150 lpcd. Unmetered connections are charged @ 12.5 % of annual rental value of property. MCGM uses accrual-based double entry system of accounting for maintaining accounts.

The Kolkata Municipal Corporation (KMC) Act, 1980 empowers the civic agency to discharge functions in relation to water supply. Accordingly in Kolkata, the Municipal Corporation is in charge of "construction and maintenance of water-works and

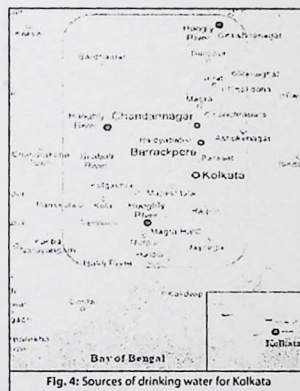


Fig. 4: Sources of drinking water for Kolkata

providing, by itself or by any agency, means for supply of water for public and private purposes". To meet the requirements of the city population¹⁵, 93 % of water is obtained from surface source (namely river Hooghly which flows more than 15 kms. along the western edge of Kolkata; Fig. 4) and the remaining is extracted from under the ground by installing tube wells. The total production from the two sources is about 291 MGD. Facilities have been created for the treatment of raw water, and the installed capacity of treatment plants is 393 MGD¹⁶. There are about 15 pumping stations with reservoirs established at different places in the city for providing piped supply of water. The municipal Act empowers the corporation to levy a fee for the supply of water to households. KMC supplies water free of cost to most domestic consumers. It charges only for bulk supply. Presently, the rate for bulk supply of

water to domestic users through meters is Rs. 7 per kilolitre.

Issues and challenges

An appraisal of the water supply situation in the three largest Indian cities reveals a number of problems (Table 1). Notable among these are: A huge water demand and supply gap; poor operation and maintenance of water supply systems; huge water losses mainly caused by leakages in transmission and distribution lines; significant proportion of non-revenue and unaccounted flow of water; large number of non-functional and defective meters; noteworthy intra-urban disparities; inadequate supply of safe drinking water to poor communities; insufficient quantities supplied; intermittent supply; poor quality of water, depleting ground water levels; low tariff for domestic connection/inappropriate pricing; lack of attention given to rationalisation of tariffs; low cost recovery; poor financial management and accounting systems; inadequate manpower and institutional capacity; lack of reliable data/information; lack of private sector involvement; lack of bankable projects to attract institutional financing and external funding; and numerous technical problems, including old pipe networks/trunk mains; lack of dedicated service connections; insufficient capacity to treat waste water; use of substandard material (such as valves, pipes); frequent pipe bursts, poor maintenance of reservoirs; and lack of apparatus for volumetric measurement.

Table 1: Status of water supply in select Indian cities

Indicators	Delhi	Mumbai	Kolkata
Demand-supply gap (MGD)	230	317	290
Water loss	Production loss at treatment plants, high leakage in the distribution system (40%), theft, insufficient leak detection	Leakages, theft, plant losses	Leakage in transmission & distribution line, illegal connections, theft, metering inaccuracies
Non-revenue water (%)	52	20-25	97
Unaccounted flow of water (%)	42	20	42 (based on a study of 62 wards)
Coverage/household connected to pipe network (%)	72	100	88
Metering of connections (%)	55 (many non-functional & defective meters)	100 (only 54 % are working)	0.08 % (functional metered connections as % to total connections); 200 metered connections for bulk users
Per capita supply (lpcd)	191 (intra-urban disparities)	180 (unequal supply)	133 (imbalances in distribution)
Average supply/day (hours)	2 to 3	2 to 4	10
Cost recovery (%)	42	95 % of the population clear their bills regularly	90 (for billed connection)

Note: Data provided in the table are approximate values, and are obtained from various sources listed at the end of the brief.

There is another set of problems such as the unplanned growth taking place in cities and frequent changes in city development plans which adversely affect the performance of service providing functionaries who do not find sufficient space to provide more service reservoirs and pipe lines. In Delhi, there are encroachments on mains by unauthorised colonies. If a problem occurs on the water mains, the agency is not permitted to resolve it since the repair work would involve removing some of the houses. Thus, in such situations alternate pipe lines have to be laid which involves unnecessary spending. Yet another problem observed in the case of Delhi is uncertainties in receiving a sufficient supply of water from the neighboring states of Haryana and Uttar Pradesh. In one instance, the supply received from the Upper Ganga Canal was blocked by the local community that vehemently campaigned for reservation of seats. In Mumbai, the staff is liable for inter-departmental transfers. This results in considerable wastage of time, since the new functionaries have their own priorities. In the case of Kolkata, it is reported that water politics affects equitable distribution of supply. Despite having piped connections, numerous households in the city do not receive a supply for extended periods of time. It is alleged that the "councilors are not interested in supplying potable water to middle class areas and their focus is only on slums where they have a larger chunk of their vote bank" (*The Times of India*, 2010). Furthermore, such problems also occur due to party politics. In this respect it is noted that councilors affiliated to the largest political party in local governments often ignore the preferences of those in minority.

Conclusion

Coping with the needs of a large urban population is a challenging task for the city governments/service delivery agencies. A brief assessment of the water supply situation in the three largest cities of India presented in this report confirms this fact. As more and more people migrate to cities, the demand for water as well as the pressure on civic agencies is likely to grow. While this movement of people can be gradually restricted to a large extent by laying greater emphasis on balanced development of regions in the country, there exists an immediate need to build up the water infrastructure and institutions to meet the current

needs of the growing economy and increasing population.

A large number of initiatives/reforms have been undertaken at the national, state and local levels to improve the situation of urban water supply¹⁷. The most significant among these is the support provided to state and local governments under the JNNURM in undertaking various fiscal, financial and institutional changes in the water sector. Furthermore, with the adoption of innovative practices such as energy efficiency, effective billing and collection, subsidies

and incentives for water supply to urban poor, use of ICT, public-private-partnerships (in service operation and maintenance, distribution, billing and revenue collection), institutional capacity building, and customer service improvement, some urban centers have already begun to display excellence in urban water management. In view of the fact that the issues and prescriptions in the water sector have been largely identified, the challenge now lies in speeding up the reform process and in the replication/ implementation of good governance practices in other centres.

Acknowledgements

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Municipal Corporation of Greater Mumbai:

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End Notes:

1. From within the State, from other States, and from other countries.
2. An Urban Agglomeration is a continuous urban spread constituting a town and its adjoining urban outgrowths or two or more physically contiguous towns together and any adjoining urban outgrowths of such towns.
3. If a household obtained drinking water from the same source throughout the year, that source is treated as a principal source (NSSO, 1999: 6).
4. If a household, during the last one year, obtained drinking water from more than one source, then the one most commonly used was treated as the principal source and the next one was treated as the supplementary source (NSSO, 1999: 6).
5. The mission, launched by the Government of India in December 2005, supports State and local governments in undertaking fiscal, financial and institutional changes for the creation of efficient and equitable urban centres.
6. "An improved drinking-water source is one that by the nature of its construction adequately protects the source from outside contamination. Examples of improved sources are piped water into dwelling, public tap or standpipe, tubewell or borehole, protected dug well, protected spring and rainwater collection" (WHO and UNICEF, 2010: 34).
7. Jal is a Hindi word, which means water. Delhi Jal Board is a department of the Government of National Capital Territory of Delhi.
8. The total population under the jurisdiction of Municipal Corporation of Delhi in 2001 was 9.8 million, of which 19 % lived in slums. The density of population in the MCD area was 7,026 persons per sq. km.
9. Water is received through river Yamuna, Bhakra-Nangal storage and upper Ganga canal.
10. Ground water depths vary from 10 to 40 metres.
11. The names/location of treatment plants are Chandrawal, Wazirabad, Haiderpur I & II, Nangloi, Bhagirathi and Sonia Vihar.
12. The name "Bombay" was changed to "Mumbai" in 1996. The total population under the jurisdiction of Greater Mumbai Municipal Corporation in 2001 was 11.9 million, of which 49 % lived in slums. The density of population was 27,209 persons per sq. km.
13. Names of water sources are Vihar, Tulsi, Vaitarna (upper and lower), Tansa and Bhatsa. In the case of Mumbai, it is perceived that ground water resources are inadequate (not more than 110 MLD) and are also contaminated.
14. Names of major treatment plants are Bhandup, Panjrapur, Vihar and Tulsi.
15. As per 2001 Census, Kolkata had a total population of 4.58 million, of which 33 % lived in slums. This figure excludes a daily floating population of about 5.5 to 6 million. The density of population was 24,499 persons per sq. km.
16. Names of water treatment plants are Palta/Indira Gandhi, Jorabagan, Watgunj, and Garden Reach.
17. As per the Constitution of India, "Water" falls within the legislative jurisdiction of the State Governments and States/city-level agencies are vested with the constitutional right to plan, implement, operate and maintain water supply projects. The Central Ministries (namely Ministry of Water Resources, Ministry of Environment and Forests, Ministry of Urban Development, and Ministry of Housing and Urban Poverty Alleviation) are responsible for formulation of policies, strategies and guidelines, and provides financial assistance and technical expertise for development of urban water supply and sanitation sector in cities and towns.
18. The three base maps of Delhi, Mumbai and Kolkata appearing in the brief are obtained from the Google Maps web site, and are used by the author for representational purpose only.



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Bacterial contamination in drinking water: a case study in rural areas of northern Rajasthan, India

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Sushma Singh



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Abstract The objective of this study was to determine the bacterial contaminations in drinking water samples collected from some rural habitations of northern Rajasthan, India. A total of ten bacterial species: *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter aerogenes*, *Klebsiella sp.*, *Proteus vulgaris*, *Alcaligenes faecalis*, *Bacillus cereus*, *Staphylococcus aureus*, *Streptococcus lactis* and *Micrococcus luteum* were identified from drinking water samples. The bacteria belonging to the family *enterobacteriaceae* (coliforms) showed the maximum occurrences in water samples. The total coliforms count, i.e. TTC^m (m = MPN index/100 ml) in drinking water samples was in the ranges of 25 TTC^m (village *Naiwala*)–41 TTC^m (village *Meharwala*). The data suggested that the drinking water quality deterioration in rural habitations of this region was due to poor sanitation

and unawareness about personal hygienic practices. The occurrences of some pathogenic bacteria in drinking water may increase the risks of water-related diseases and health problems in local residents.

Keywords Drinking water · Bacterial contamination · Water-borne disease · *E. coli* · Coliform bacteria

Introduction

The biological contamination in drinking water is a major problem of public health in developing world. WHO estimates that about 1.1 billion people globally drink unsafe water and the vast majority of diarrhoeal disease in the world (88%) is attributable to unsafe water, sanitation and hygiene (WHO 2003). The most common and widespread health risks associated in drinking water in developing countries are of biological origin. Looking at the 20 leading risks factors for health burden in developing regions, unsafe water, sanitation and poor hygiene are third, behind underweight or practicing unsafe sex (WHO 2003). Ten major water-borne diseases are responsible for over 28 billion disease episodes annually in developing countries (Walsh 1990). Of these diarrhoeal diseases are the big killers especially infants. According to the WHO estimations more

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than 3 million children below age 5 die annually from diarrhoeal disease contracted through drinking water in developing world. Nonetheless, the inadequate availability of water, poor quality of water at source, ill-maintained water pipelines and sewer lines, unsafe disposing of human, animal and household wastes, unawareness about good sanitation and personal hygienic practices etc. are some key factors responsible for poor drinking water quality in rural areas of India. Also, the infectious disease caused by pathogenic bacteria, viruses and parasites (e.g. protozoa and helminths) are the most common and widespread health risks associated with drinking water in rural habitations.

The quality of drinking water may be ascertained by its microbiological examination. The greatest risk from microbes in water is associated with consumption of drinking water that is contaminated with human and animal excreta, although other sources and routes of exposure may also be significant. The coliforms bacterial group may occur in water due to faecal contamination, i.e. discharge of faeces by humus and other animals in water. Coliform includes the members of the family *Enterobacteriaceae*, e.g. *Escherichia coli* (*E. coli*) *Enterobacter aerogenes*, *Salmonella* and *Klebsiella*. These enteropathogenic bacteria in water are responsible for a variety of diseases like cholera, typhoid, dysenteries, bacillary dysentery, etc. in human and livestock (Ashbolt 2004). The faecal indicator bacterium (*E. coli*) has been considered as a bioindicator of faecal contamination of drinking water. It is excreted in the faeces of all warm-blooded animals and some reptiles (Enriquez et al. 2001). The major pathogenic bacteria responsible for water-borne disease are spread by the faecal-oral route, in which water may play an intermediate role.

The public health burden is determined by the severity of the illnesses associated with pathogens, their infectivity and the population exposed. There has therefore been an increasing interest in the application of quantitative risk assessment for microbial load in drinking water sources. The aim of this study was to analyse the drinking water quality in respect to microbial contamination in rural habitations of the northern Rajasthan, India. The data of this study may provide some impor-

tant information about public health risks associated with drinking water quality in this region.

Materials and methods

Study site

The study was conducted in some rural habitations of Hanumangarh district of the Rajasthan, India (Fig. 1), India. Geographically, it is located between 28° 44' and 29° 57' N and 73° 47' to 75° 31' E. The total human population of district is about 1.58 million with population density of 120 persons/km². Nearly 76.8% of total population of the district resides in rural areas. According to the agro-ecological-zone classification, this part of the state is considered as Aeolian plain of northern canal irrigated sub region of Thar desert. The climate of this region is semi-arid with extreme temperature conditions in summer (up to 45°C) and winter (up to 1°C). The mean annual rainfall in this region is 253 mm varying spatially from 250 to 300 mm in different sub-regions of the district. In this area, the canal water is the major sources of potable water.

Water sample collection

A total of 86 water samples were collected from residential localities of 27 different villages/towns, i.e. *Salemgarh*, *Tibbi*, *Talwara Jhil*, *Saliwala*, *Masitawali*, *Ranjeetpura*, *Pakki Dabwali*, *Munda*, *Maherwala*, *Keharwala*, *Bhompura*, *Chaiya*, *Chahuwali*, *Rawatsar*, *Jeevannagar*, *Mirzawalimer*, *Bhuranpura*, *Gandheli*, *Sharni*, *Bropal*, *Rampura*, *Naiwala*, *Rattanpura*, *Shreka* and *Manksar*. The samples were collected in sterile capped containers by following method as described by Greenberg et al. (1985). To avoid contaminations disposable gloves washed with HCl 1 N were worn during water sampling. The water containers were kept in airtight large plastic ice-cold containers and were transported to microbiology laboratory with 6 h of their collection for the further processing. The work methodology used for whole bacterial analysis included: enumeration, isolation characterization and identification

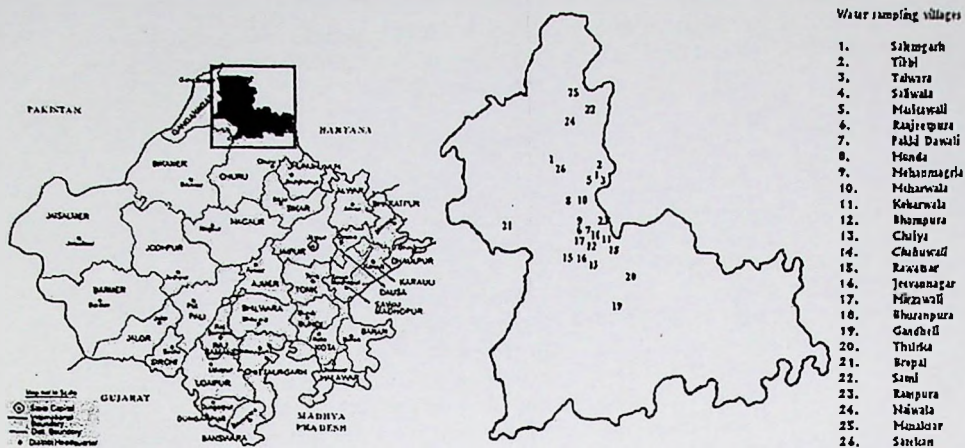


Fig. 1 Location of study sites in the map of Rajasthan, India

of microorganism following methods described by Williams (1989) and Aneja (2004).

Bacterial analysis of drinking water samples

Enumeration

The enumeration of microbial populations was accomplished using Total Viable Count (TVC) method. TVC was performed on nutrient agar media by means of serial dilution agar plating method (Williams 1989). Dilutions 10^{-6} , 10^{-7} and 10^{-8} of water samples were used for agar plating. One milliliter of appropriate diluted suspension was transferred in petriplates containing molten agar medium (45°C). The experimental petriplates were reared in replicates for each sample. The plates were incubated at 37°C for 24 h (Aneja 2004) to obtain viable colony.

Isolation

The isolation was performed following serial dilution, spreading and pour-plate methods (Aneja 2004). The viable bacterial colonies were then transferred into broth for further cultivations. The cultivation was performed with appropri-

ate incubation, temperature and time required for growth. Isolation of pure cultures was completed by the streak plate method on various agar media, i.e. NA (nutrient agar, $\text{pH} = 7.0$), MCA (MacConkeys' agar) and EMB (eosin-methylene blue agar). Gram staining was used on each step after the transfer of a single colony to check the purity of culture. The bacterial isolates were sub-cultured on agar slants of their respective media at regular intervals to maintain viability and metabolic activities. Agar slants were stored at a temperature of 4°C , which shows growth, protects from damage due to evaporation of medium and preserves the cultures. The isolates were maintained in replicates; one as the working culture to be used as a source for identification tests and other as stock culture from which new working cultures were prepared whenever required.

Bacteria identification

The primary identification of the isolates was carried out on the basis of their cultural characteristics on agar plates and microscopic observations. The secondary identification of the isolates was carried out on the basis of their biochemical characteristics, the detection of which aid in the

identification and classification of bacteria those were found morphological identical (Greenberg et al. 1985).

Detection of faecal coliform, i.e. *E. coli*

A specific media containing two substrates *O*-nitrophenyl- β -D-galactopyranoside (DNPG) and 4-methylumbelliferyl- β -D-galacturonidase (MUG) is used to detect the faecal coliform *E. coli* (Tortora et al. 1988). One hundred milliliters of sample was enriched overnight in 50 ml of triple-strength lauryl tryptose broth at 37°C and streaked on sorbitol MacConkeys' (SMAC) agar containing potassium tellurite. The sorbitol negative strains (SMAC⁻) were tested for enzyme β -D-galacturonidase using MUG as the substrate. A colony of test isolate was applied to MUG impregnated filter paper; moistened with a drop of saline and incubated at 37°C for 20 min. The absence of enzyme was indicated by the lack of fluorescence under UV light. The water samples, which showed

the presence of coliforms, were further used to enumerate them using Multiple Probable Number MPN test.

Total coliforms detection

A most probable number (MPN) test was used to detect the total coliforms in drinking water samples. MPN was determined by the Mackie and McCartney (1996) method. This test is performed sequentially in three stages: presumptive, confirmed and completed test. Lactose broth, i.e. double-lactose broth (LB 2x) and single lactose broth (LB 1x) tubes were incubated with different water volumes (10 ml, 1.0 ml and 0.1 ml) in presumptive test. Tubes that were positive for gas production after 24 hrs incubation at 35°C were inoculated into brilliant green lactose bile broth for confirmed test and positive tubes were used to calculate the most probable number (MPN) of coliforms in water samples following the statistical table described by (Mackie and McCartney

Table 1 Incidences of bacteria in drinking water samples

Sampling site No.	Village/town	No. of samples	SPC*	TCC ^m	FCC ^e
1	Salemgarh	3	21.3×10^4	32	+
2	Tibbi	6	19.3×10^4	38	+
3	Talwara	4	20.6×10^4	32	+
4	Silwala	3	19.3×10^4	32	+
5	Masitawali	3	21.6×10^4	31	+
6	Ranjeetpura	3	19.0×10^4	25	–
7	Pakki Dawali	3	20.3×10^4	32	+
8	Munda	3	28.3×10^4	31	–
9	Mohanmagria	4	13.0×10^4	28	–
10	Meharwala	3	24.6×10^4	41	+
11	Keharwala	4	15.0×10^4	31	–
12	Bhompura	3	23.0×10^4	32	+
13	Chaiya	3	19.3×10^4	32	+
14	Chahuwai	4	14.0×10^4	31	+
15	Rawatsar	5	22.0×10^4	28	+
16	Jeevannagar	4	21.3×10^4	32	+
17	Mirzawali	3	11.6×10^4	31	+
18	Bhurampura	3	9.3×10^4	26	–
19	Gandheli	4	7.3×10^4	32	+
20	Thalrka	4	7.3×10^4	38	+
21	Bropal	4	22.3×10^4	32	+
22	Sahrini	3	13.3×10^4	38	+
23	Rampura	4	8.6×10^4	32	+
24	Naiwala	4	8.3×10^4	25	–
25	Manksar	3	8.3×10^4	32	+
26	Sarekan	3	8.3×10^4	28	–
Total		93			

SPC Standard plate count, *m* Total coliform count (MPN index/100 ml), *e* *E. coli* bacteria

1996). Completed test, involving the inoculations of EMB agar plate, nutrient agar slant and brilliant green lactose broth and preparation of a Gram-stain slide form NA slant, was used to establish that coliforms were present in the sample.

Results and discussion

As summarized in Table 1, the drinking water resources were severely contaminated in this region. The standard plate count (SPC) which indicates the total microbial load in drinking water was in the ranges of 8.3×10^4 – 28.3×10^4 , in different localities (Table 1). A total of ten bacterial species, i.e. *E. coli*, *Pseudomonas aeruginosa*, *E. aerogenes*, *Klebsiella* sp., *Proteus vulgaris*, *Alcaligenes faecalis*, *Bacillus cereus*, *Staphylococcus aureus*, *Streptococcus lactis* and *Micrococcus luteum* (Table 2) were identified in drinking water samples. The microbial species, e.g. *M. luteum*, *S. lactis*, *Klebsiella* sp. and *E. coli* showed their presence in most of the water samples (Fig. 2). The occurrences and distribution patterns of microbial species varied greatly among different villages of this region. Three bacterial species, e.g. *E. coli*, *P. vulgaris*, and *S. lactis* showed the maximum occurrences (recorded from 73.1% villages/towns) followed by *M. luteum*, *Klebsiella* sp., *S. aureus* = *P. aeruginosa*, *E. aerogenes*, *B. cereus* and *A. faecalis* (Table 3). Although the sources of contamination is of primary importance for drinking water quality, other climatic and locality factors may also influence the bacterial-contamination rates in open water sources. According to WHO (1984) guidelines, the occurrence of pathogens or indicator organisms in ground and surface water sources mainly depends on intrinsic

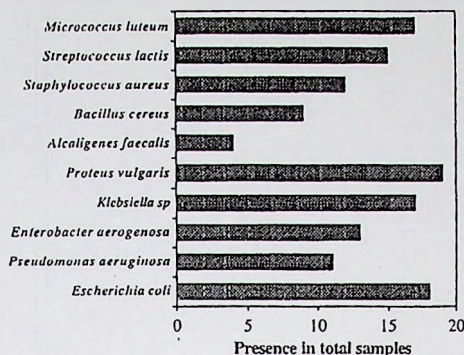


Fig. 2 Occurrences of bacterial species in water samples

physical and chemical characteristics of the catchment area and the magnitude and range of human activities and animal sources that release pathogens to the environment.

We recorded three important members of the family *Enterobacteriaceae* i.e. *E. coli*, *E. aerogenes*, *Salmonella* and *Klebsiella* in drinking water samples. The occurrences of these bacteria in drinking water are of primary importance because these constitute a major part of coliform organisms in open water resources. These organisms generally live together in water than other intestinal pathogens and, therefore can be detected easily as compared to real pathogens. We recorded all the three coliform bacteria, i.e. *E. coli*, *E. aerogenes* and *Klebsiella* sp. in drinking water samples of villages: *Silwala*, *Jeevannagar*, *Bhuranpura* and *Manaksar* (Table 3). The occurrence of coliform groups in water could be due to faecal contamination, i.e. discharge of faeces by humus and other animals in water. According to Klein and Casida (1967), coliforms may be used as water quality indicator, and if such bacteria are not detectable in 100 ml; the water can be said as potable water. The potable water samples from 78% villages/towns showed the presence of faecal coliforms (FCC) i.e. *E. coli* (Table 1), which indicates the contaminations of drinking water resources. The continuous consumption of such contaminated water may pose a serious health risks in local residents of this areas especially in children (>5 years).

Table 2 List of bacterial species isolated from drinking water samples

Gram ^{-ve}	Gram ⁺
<i>Escherichia coli</i>	<i>Bacillus cereus</i>
<i>Pseudomonas aeruginosa</i>	<i>Staphylococcus aureus</i>
<i>Enterobacter aerogenes</i>	<i>Streptococcus lactis</i>
<i>Klebsiella</i> sp.	<i>Micrococcus luteum</i>
<i>Proteus vulgaris</i>	
<i>Alcaligenes faecalis</i>	

Table 3 Occurrences of bacterial species in water samples of different rural habitations of northern Rajasthan, India

Village/town	Bacterial species									
	<i>Escherichia coli</i>	<i>Proteus vulgaris</i>	<i>Klebsiella sp</i>	<i>Enterobacter aerogenes</i>	<i>Bacillus cereus</i>	<i>Staphylococcus aureus</i>	<i>Streptococcus lactis</i>	<i>Micrococcus luteum</i>	<i>Pseudomonas aeruginosa</i>	<i>Alcaligenes faecalis</i>
Salemgarh	+	+	-	+	-	-	+	-	-	-
Tibbi	+	+	+	-	-	+	+	+	-	-
Talwara	+	+	-	+	-	-	+	+	+	-
Silwala	+	-	+	+	-	-	+	+	+	+
Masitawali	+	+	+	-	-	-	+	+	+	-
Ranjeepura	-	+	-	+	+	+	+	-	-	-
Pakki Dawali	+	-	-	+	+	+	+	+	-	-
Munda	-	+	+	-	+	+	-	-	-	-
Mohanmagria	-	-	+	+	-	+	+	+	-	-
Meharwala	+	+	-	+	-	-	-	+	+	-
Keharwala	-	+	+	-	-	+	-	+	+	-
Bhompura	+	-	+	+	+	-	+	+	+	-
Chaiya	+	-	-	+	+	-	+	+	+	-
Chahuwai	+	+	+	-	-	+	+	+	-	-
Rawatsar	+	+	+	+	-	+	-	-	-	-
Jeevanagar	+	+	+	+	-	+	+	+	+	-
Mirzawali	+	+	+	+	-	-	+	-	+	-
Bhurampura	-	+	+	-	-	+	+	-	+	-
Gandheli	+	+	-	+	+	-	+	+	+	-
Thalrka	+	-	+	-	+	+	-	+	+	+
Bropal	+	+	+	-	-	+	-	+	+	-
Sahrini	+	+	-	-	+	-	+	+	+	+
Rampura	+	+	-	-	+	-	+	+	+	+
Naiwala	-	+	+	-	-	+	+	-	-	-
Manksar	+	+	+	+	-	+	+	-	-	-
Sarekan	-	-	+	+	-	+	-	+	-	-
Total	19	19	17	14	9	15	19	18	15	4

Table 4 The pollution status of drinking water on the basis of *E. coli* contents (WHO 1984)

<i>E. coli</i> in per litre	Water pollution status
10,000	Heavily polluted
1000	Polluted
100	Slightly polluted
10	Satisfactory
3 or less	Potable

The total coliform count (TTC^m; *m* = MPN index/100 ml) was in the ranges of 41 (village *Meharwala*) to 25 (village *Naiwala*) in different localities of this region. As per the described limit of WHO, the drinking water samples were under the category of slightly polluted (Table 4). The presence of coliforms shows the danger of faecal pollution and consequent hazard of contracting disease through pathogenic organisms. Nonetheless, the disease-causing organisms (pathogens) mostly transmitted via drinking water are predominantly of faecal origin. Trabulsi et al. (2002) concluded that typical enteropathogenic *E. coli* stain is a leading cause of infantile diarrhoea in developing countries, whereas they are rare in industrialized countries. Moreover, *E. coli* is also responsible for causing a number of other health disorders: urinary tract infections, pulmonary infections, abscesses, skin-wound infections, etc.

S. aureus was also identified in drinking water samples of this region. It is a pathogenic bacterium responsible for several issues of severe health problems, e.g. food spoilage, chronic infections, abscesses, wound infection and vomiting in human (Table 5). In general, *Staphylococcus* occurs in

water that contained organic pollutants, i.e. minerals ions and organic matter contents (Tortora et al. 1988). The organic matter content provides a better environment for the development of this bacterium in water sources. The occurrences of this bacterium in drinking water samples (Table 2) indicated the mixing of runoff water in water sources, which contains organic pollutants such as organic debris, sewage sludge, plant litter, etc. Except for *E. coli* the, second largest recorded pathogenic bacteria in drinking water was *P. vulgaris* that may be responsible for a common disease in rural areas, i.e. urinary tract infections (UTI).

In surface waters, potential pathogen sources include point sources such as municipal sewerage, as well as non-point sources such as contaminated runoff from agriculture areas and areas with sanitation through on-site septic systems and latrines. Yan and Sadowsky (2007) summarized that faecal pollution of waterways may originate from wastewater treatment facilities, septic tanks, domestic and wild-animal faeces, and pets. Also, direct access of livestock to canal water in rural areas is an important source of potential pathogens in water. According to Pujari et al. (2007), the on-site sanitation that is increasingly adopted in India is possibly responsible for high levels of nitrates and bacterial contamination in drinking water sources. In rural areas, people prefer to eliminate night soils in open places especially in agriculture fields. In such conditions, there are more possibilities of contamination of open water resources through rainwater runoff mechanism.

Table 5 The major diseases by bacterial species isolated from drinking water samples

Name of bacteria	Major diseases
<i>Escherichia coli</i>	Urinary tract infection (UTI), enterotoxin, Traveler's diarrhoea, food born disease, vomiting
<i>Pseudomonas aeruginosa</i>	Opportunistic infection in man, giving rise to inflammations of middle ear, greenish pus
<i>Enterobacter aerogenes</i>	Food spoilage
<i>Klebsiella sp</i>	Pneumonia
<i>Proteus vulgaris</i>	UTI
<i>Alcaligenes faecalis</i>	Non-pathogenic
<i>Bacillus cereus</i>	Diarrhoea, vomiting
<i>Staphylococcus aureus</i>	Food spoilage, chronic infections, abscesses, wound infection, vomiting
<i>Streptococcus lactis</i>	Found on skin and non-pathogenic
<i>Micrococcus luteum</i>	A common skin flora

In this study, common skin bacteria, e.g. *S. lactis* and *M. luteum* were also recorded in several samples of drinking water from different localities. The occurrences of these bacteria in potable water indicate the mixing of bathroom drainage or sewerage water in drinking water resources. Nonetheless, people living in *Dhanis* (a community-based residential locality of farmers; often established near arable lands) used to drink and bath livestock at canal banks. Probably, it could be responsible contamination of canal water with skin flora. According to a report by Planning Commission, India (2002) the risk of water contamination resulting in water-borne disease is higher in rural areas under the following conditions: inadequate availability of water, poor quality of water at source, ill-maintained water pipelines and sewer lines, open air defecation is rampant, lack of disposal of human, animal and household wastes, and lack of awareness of good sanitation and personal hygienic practices. Out of these several features, the last fact, i.e. lack of awareness of good sanitation and personal hygienic practices, seems to be more practical for rural areas of this region. Total results suggest that the drinking water of Hanumangarh zone has low nutritional values due to the presence of coliforms. The increasing rate of infant mortality due to diarrhoea in rural areas of northern Rajasthan indicates the poor sanitation and hygienic conditions.

Conclusions

This study indicated that drinking water of this region contains a wide variety of enteropathogenic bacteria such as *E. coli*, *E. aerogenes* and *Klebsiella* etc. The microbial load in drinking water as measured through standard plate count (SPC) varied greatly 8.3×10^4 to 28.3×10^4 among different localities of the site studied. The data clearly suggests that people of this region are under severe threat of water-related diseases and health risks. The continuous consumption of such polluted water could pose serious health risks especially in infants.

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