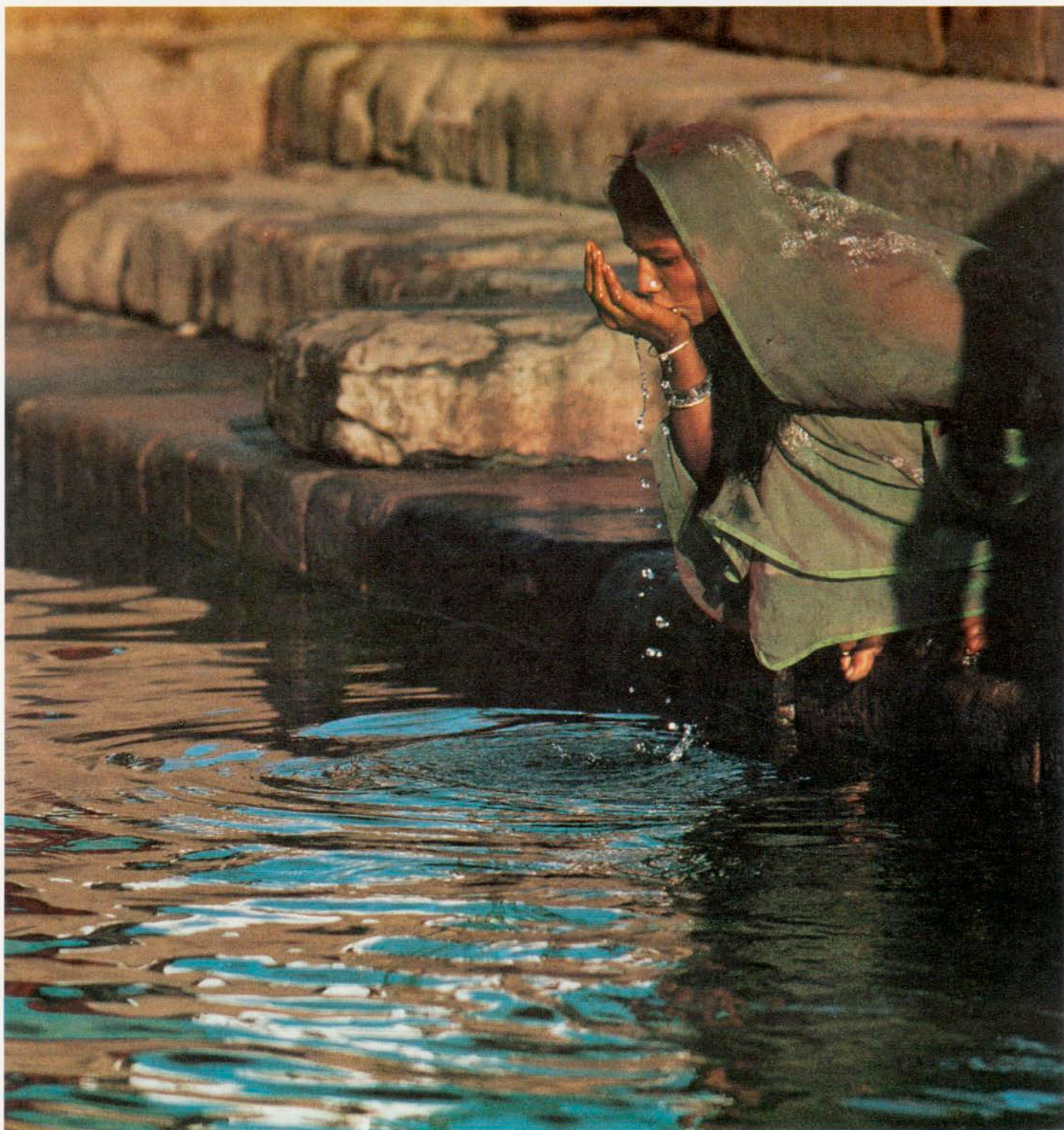


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INDIA'S TROUBLED WATERS

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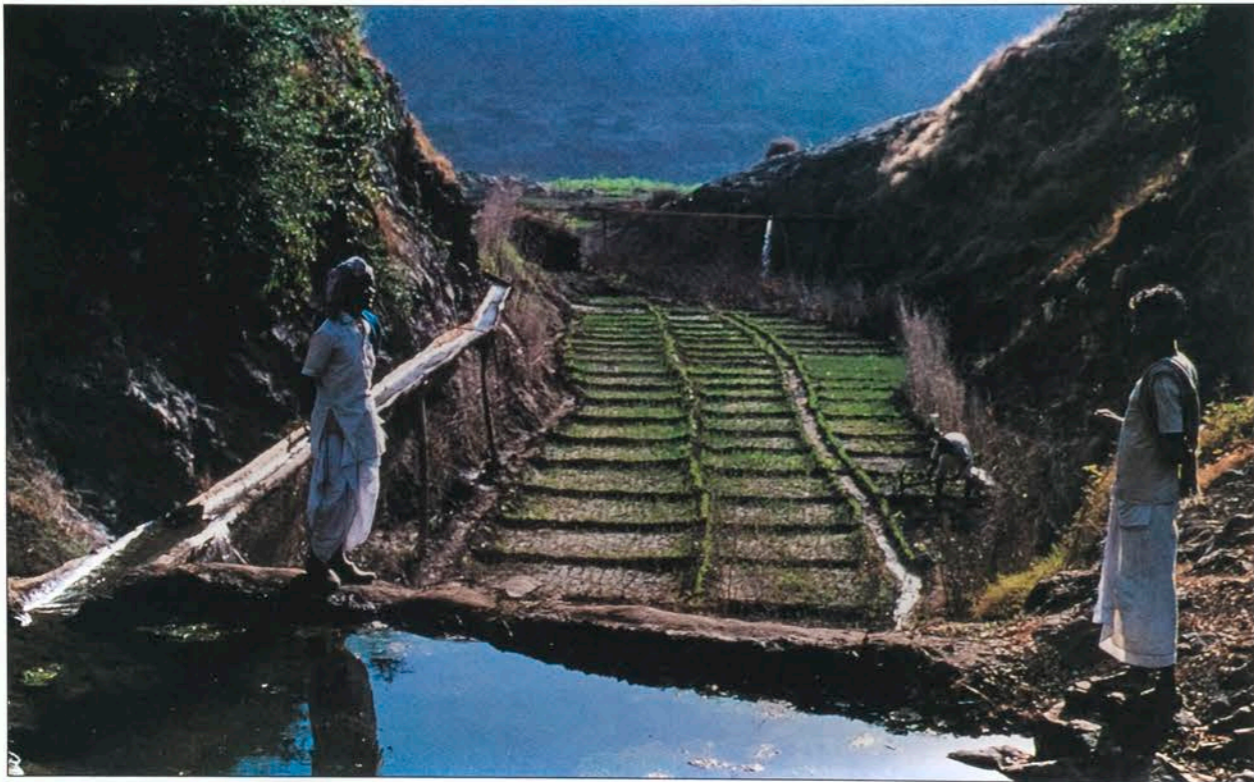
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India's troubled waters

The Indian government is convinced that only huge irrigation schemes will solve its problems of drought. Yet history shows that large dams are bad science

Omar Sattaur



LONG BEFORE you reach Vadgam village you can hear a deafening crash of broken rock as it falls into heaps at the cement factories. The rock, together with 6 million cubic metres of concrete, is to fill the second largest concrete gravity dam in the world.

Trucks filled with more rock rumble by on the dusty roads, cut from the sides of the Narmada Valley, in the Indian state of Gujarat. Clutching the top of the valley is one end of the massive concrete wall that is to form the Sardar Sarovar dam.

A kilometre away, on the other side of the valley, is its twin. Gradually the two ends grow towards each other. In this landscape the thousands of engineers and construction workers, with their jeeps and protective helmets, look as insignificant as ants trying to cross a puddle.

The Sardar Sarovar dam is huge. It is Gujarat's answer to the equally huge problem of recurring drought. Like large parts of India, the state has had no monsoon for the past four years. Rain was so scarce last year that the worst-hit areas



Contrasting cures for drought. Vadgam village must abandon small-scale solutions for the gigantic

received water for only 15 minutes every two days. Throughout the driest fortnight the government of Gujarat supplied Rajkot district with nearly 3 million litres of water each day at a cost of 46 million rupees (£1.8 million). The government claims a loss in agricultural production of 50 billion rupees because of the drought. It spent another 15 billion rupees trying to soften the blow.

The dam, 1210 metres long, will rise 139 metres above the river bed. With a width of 750 metres, the main canal coming off the reservoir will be the largest in the world. The canal will carry water from south Gujarat into Rajasthan, 445 kilometres to the northwest. The Gujarat government estimates that the stored water will irrigate 1.8 million hectares, supplying 3.5 billion litres of drinking water every day and producing 1450 megawatts of hydroelectricity. To do all that, and much more, says the government, the dam project will cost more than £3.5 billion and will take 22 years to complete.

Droughts are never far from the thoughts of Gujarati farmers. The last four dry years have increased the government's drive to build the Sardar Sarovar dam across the Narmada River as quickly as it can. Glossy booklets published by Sardar Sarovar Narmada Nigam Ltd, the state-owned company that is in charge of the project, refer to the dam as "Gujarat's hope". Despite the booklets, the posters, the newspaper articles and the permanent exhibition with its working scale models, opposition to the dam has never been stronger.

The Sardar Sarovar Project will destroy the homes and lands of 70 000 people in Gujarat, Maharashtra and Madhya Pradesh. It will drown almost 14 000 hectares of forest land and, inevitably, much of the wildlife that inhabits it. The dam will create pockets of stagnant water that will increase the prevalence of malaria in the vicinity of the dam. The reservoir will also destroy important temples and shrines.

Indian environmentalists claim that irrigation on such a large scale is bound to cause waterlogging and a build-up of salt in some of the soils in the area to be served by the dam. Soils vary considerably in the amount of water they can hold. Organic matter holds water well. Soils that are rich in organic matter and little else may be prone to waterlogging. Sandy soils hold little water and very clayey soils may be impermeable. A good soil has a balanced mixture of sand, clay and organic matter.

Environmentalists criticise the Gujarat government for pressing ahead with the project even though it has studied the potential for waterlogging in only one-fifth of the soils in the area. Studies have yet to be completed on the impact of the dam on the ecology of the mouth of the Narmada River and on how best to manage the catchment area of the river.

Earlier this year 10 000 people marched to the site of the dam to protest against its construction. Some 200 lay down in the road to stop vehicles from reaching the site. At no other time in its 40-year history has the idea of exploiting the waters of the Narmada been so much in public view.

About 240 kilometres south of Vadgam, people have come up with a strikingly different solution to the problem of drought. From the top of a hillock near the village of Adgaon



you can see fields of sunflowers. There would be nothing remarkable about them except that, in midwinter at least, Adgaon's fields stand out like a green oasis in a vast expanse of dry, scrub land.

Adgaon village, in the Indian state of Maharashtra, was as dry as its neighbours four years ago. It receives an average rainfall of about 500 millimetres a year. Most of the rain falls between July and mid-October. Even then, the number of rainy days within the wet season may be fewer than 10.

In 1987 the area received only 300 millimetres of rain. The water in Adgaon's 153 wells had all but disappeared and

surveys showed that there was no water to be found even 90 metres below ground. From 1972 until 1986 the government of Maharashtra had to supply drinking water to Adgaon during dry spells. The streams were drying up and soil erosion was increasing. Government officials estimated that about 3 tonnes of soil disappeared each year.

A volunteer group called Marathwada Sheti Sahya Mandal encouraged villagers to use small-scale methods of conserving soil and water. It taught them to build small earthen walls, or bunds, along the contours of the fields, plugging the gulleys carved out by soil erosion and building small dams across streams. The idea is to trap water where it falls and to keep it in the soil for as long as possible. Villagers agreed not to let their animals graze on land newly planted with trees. Four years later Adgaon has peaceful, shady avenues and plots of acacia, neem, ber, eucalyptus and banana trees. The wells have water. Men and boys once again net fish in the main stream to the south of the village, even in December when it used to be dry.

Adgaon's modest attempts to save water and soil has cost about 1.7 million rupees in its first three years. The Swiss Development Corporation, a governmental aid agency, provided just over half of the money and the rest came from the Indian government. The project at Adgaon forced no one to sacrifice house and land. It destroyed no forests and no temples. Nor did it increase the prevalence of malaria or any other disease in the area.

Adgaon and Vadgam are as different as they could be. Yet the two projects share the same aim. How they tackle the common problem of drought illustrates the radical difference of opinion on what development really means in India today. The dam-builders have had more than a decade to prepare themselves for the objections of Indian environmentalists and opponents of the dam who question their government's chosen path of development. The government claims that small-scale methods could not provide enough water for India's growing population. Opponents of large dams say the government has not even investigated that possibility.

Sardar Sarovar Narmada Nigam Ltd (SSNNL) claims that its dam employs the most sophisticated technology which fully addresses the social and environmental issues. It claims to have paid more attention to such matters than any other company building dams in India. According to SSNNL, the entire length of the main canal will be lined with concrete to prevent water from seeping into the soil and waterlogging it. Only two other irrigation projects in the world employ computers to control the delivery of water. Gates every 10 to 15 kilometres along the main canal will open and close by remote control. The operators will similarly control the delivery of water to 37 main branches of the canal.

Piezometers in wells dotted around the command area will record fluctuations in the water table and will alert the operators to the risk of waterlogging. If the water table rises too far the operators will pump water out of the wells and into the main canal.

Officials of SSNNL, including its chairman Sanat Mehta and chief engineer I. M. Shah, imply that the project will employ drip irrigation. In drip irrigation, scientists calculate the amount of water that particular crops need and feed that amount from the canals into perforated pipes laid on the surface of fields. A volume of water, calculated to supply 30 per cent of the plant roots, slowly dribbles through the holes in the pipes. Examined more closely, however, it appears that drip irrigation is not planned for large areas. Mehta says that the project's engineers will initially study drip irrigation in three pilot projects in areas with different types of soil. The costs of buying and laying pipes in the area served by the dam have not been accounted for in calculating the total costs of the project. The World Bank, which in March 1985 approved a loan of \$450 million for the Sardar Sarovar Project, has not allocated any of that money for drip irrigation.

Salinisation, or the damaging build-up of salts, can occur when too much surface water is fed into the soil and the water

table rises. As water evaporates, salts that were once dissolved in the water crystallise at the surface. Vegetation dies back to reveal a salt desert. In some areas saline water underlies aquifers containing fresh water. Surface irrigation can result in saline and fresh water mixing. In this case the aquifer as well as the soil may become contaminated.

According to Shah, the water available for irrigation is so meagre that there is no chance that the twin problem of waterlogging and salinity would arise. However, he says, to be on the safe side the project includes a system to monitor fluctuations in the water table. The idea is to force farmers to use both canal water and ground water for irrigation. The amount of canal water allocated will depend not only on the type of crop grown but also on the level of the water table in an area.

One reason why irrigation projects have failed in the past is because farmers regard the water as free and use more than they need. That problem rarely arises in small projects such as that at Adgaon where water is collected and stored where it falls and so remains under local control. The SSNNL's solution to misuse of water is to introduce legislation that will bind farmers to a "water quota", using only previously agreed quantities calculated on the type of crop proposed, the soil characteristics of each area and the projected availability of water. The idea is based on legislation already operating in the northern Indian state of Punjab where, of all Indian states, irrigation has proved most successful.

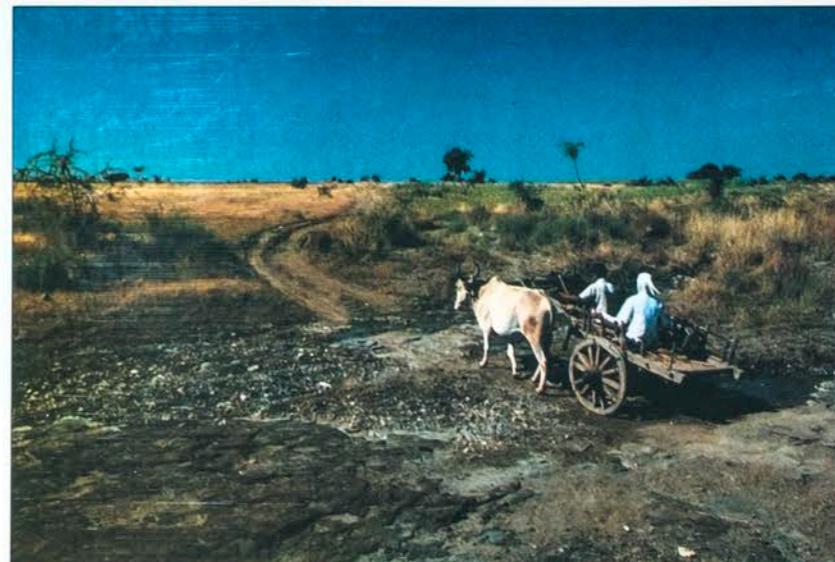
The best that science can offer?

At first glance, the Sardar Sarovar Project seems to be a well-researched project whose design exemplifies the best that science and technology can offer. However, many people in India's growing environmental movement say that the SSNNL has merely paid lip service to the problems that large dams present. Mehta himself gives some credence to that view when he says: "We are not taking this just as an engineering project. It's a multidisciplinary development project. If it were just an engineering project we would not have worried about soil." Nor does the history of large dam projects in India inspire much confidence that such a comprehensive scheme for managing the water resource of the Narmada and that of Gujarat will ever be implemented.

The Prime Minister, Rajiv Gandhi, drew attention to the sorry state of affairs in his speech to state ministers of irrigation in 1986 when he said: "The situation today is that, since 1951, 246 big surface irrigation projects have been initiated. Only 65 of these have been completed and 181 are still under construction. 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."

Vijay Paranjpye, an economist based in Pune, in Maharashtra State, points out that the government of India's National Water Policy of 1987 itself ignores the country's seventh five-year plan, which states that priority should go to completing unfinished irrigation projects. As is proposed in the Sardar Sarovar Project, the National Water Policy recommends parallel planning and use of surface and ground water, yet, according to officials at the Central Ground Water Board of the Ministry of Agriculture and Irrigation, such planning is there on paper only and has still to be implemented.

Indian environmentalists are convinced that even if the dam and its 72 000 kilometres of waterways were built according to plan, even if its sophisticated, computer-controlled system of water delivery worked flawlessly, the dam would not last long enough to make it economically worthwhile. Rivers carry sediment and reservoirs eventually become silted. It is no great problem for farmers to maintain small dams, such as those built at Adgaon. There, farmers regularly dig the fertile silt out of the pools and gulleys and spread it back on the fields.



Earthen walls and small dams transform Adgaon's dry land into lush and valuable green fields

Photographs by Tim Malvern

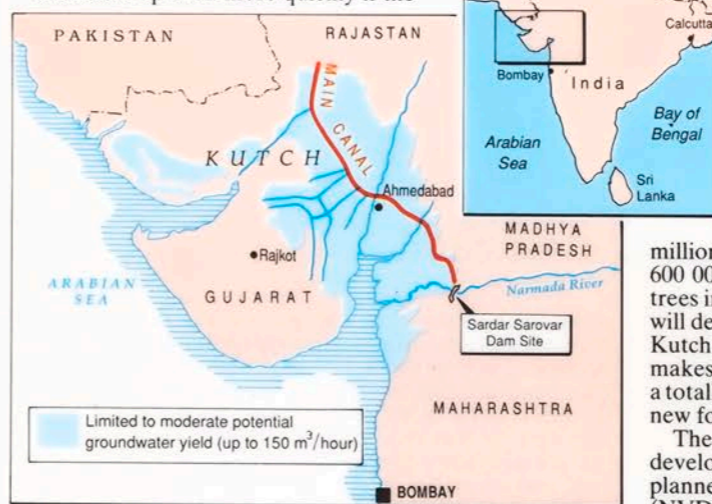
catchment area of the river is devoid of trees. Forests help to hold soil and protect against its erosion. The Narmada River is 1300 kilometres long. Its catchment area lies not in Gujarat but in the state of Madhya Pradesh,

hundreds of kilometres to the east. Thus Gujarat has no control over the treatment of the catchment area of the river that feeds the reservoir of the Sardar Sarovar dam.

Shah is quick to point out that even without a dam, the Narmada River will not avoid siltation. But it is difficult to understand how erecting a gigantic concrete barrier that stops the flow of sediment does anything to solve the problem.

Even if the government of Madhya Pradesh did everything it could to maintain and protect the forests of the Narmada catchment area it is unlikely that its efforts would be successful. Anil Agarwal, one of India's leading environmentalists, says that forests thrive only when managed by people who have a personal interest in their survival. "If somebody else is going to come and green the land, even if it be the government, the people will look upon this as the government increasing its property, but not theirs. They are not going to cooperate. The result will be very low survival rates of the trees being planted. This has generally been the experience of all soil conservation and afforestation work. The country is still desperately looking for solutions to this problem. I don't see any reason to believe that any plans made by the Madhya Pradesh government will be any different," Agarwal explained.

The Sardar Sarovar Project will submerge almost 14 000 hectares of forest land. The SSNNL claims that only a third of this is true forest. The Conservation of Forests Act, passed by the Indian government in 1980, says that if forest land is to be used for something other than forest an equivalent area of land must be planted with trees. However, the Ministry of Environment claims that this rarely happens. The SSNNL says that it will plant 30 million trees in "less dense and non-forest areas"; more than 600 000 trees in the vicinity of the dam and almost 12 million trees in an area equivalent to the size of forest that the project will destroy. The equivalent amount of land has been found in Kutch, in north Gujarat but, says Agarwal: "Ecologically it makes no sense to destroy forest in one region and find land in a totally different ecosystem. In any case, the ecological role of new forest is very different from that of the original forest."



The main canal of Sardar Sarovar dam and its branches will take water to areas that already have groundwater (Source: Central Groundwater Board and SSNNL)

The entire Narmada Valley Development Project (NVDP) is probably the largest scheme of its kind in the world. It entails building 30 major dams, 135 medium and 3000 minor dams on the Narmada river and its tributaries over the next half century. Environmentalists estimate that the completed