

## **The North Gujarat Sustainable Groundwater Initiative**

### **Proposal for Science-based Coordinated Action by**

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# **The North Gujarat Sustainable Groundwater Initiative**

## **Executive Summary**

North Gujarat region—consisting of the districts of Banaskantha, Mehsana and Sabarkantha—is in the throes of a water crisis. This has been building up over the past two decades; but the successive droughts of 1999-2001 have placed the dimensions of the crisis in bold relief. And it looks as though the agrarian economy and rural livelihoods will come under inexorable stress unless the region is able to bridge its long-term annual groundwater deficit of 0.6-0.8 km<sup>3</sup>. Doing this will only stem further deterioration. An effort on a larger scale is required in order that groundwater levels are restored and maintained at their pre-1970 levels—so that the huge energy costs of pumping are saved and well-yields are raised, high fluoride-contents in groundwater are lowered, losses in vegetative growth and biodiversity on account of groundwater depletion are retrieved, base-flows of the few small rivers flowing through the region are recovered and the desertification of western Banaskantha is checked.

A big dent on the region's groundwater problem can be made if electricity is charged on consumption basis at a full-cost rate. IRMA has estimated that the Mehsana farmers use 0.38 kWh of power to produce 1 m<sup>3</sup> of groundwater; at Rs 2.50/kWh, groundwater pumped in North Gujarat will begin to cost over Rs 1/m<sup>3</sup>; at this rate, most groundwater-irrigated agriculture would collapse. And so would the region's dairy economy; at Rs 1/m<sup>3</sup> the irrigation cost of alfalfa would rise to Rs10, 000/ha and would raise 3-fold the farm-gate cost of dairy production, which is the mainstay of the region's rural economy. In such a scenario, North Gujarat would fully validate the Falkenmark thesis that civilized human life can not be sustained where per capita water availability is less than 500 m<sup>3</sup>; it will also reinforce the myth that the road to environmental sustainability is paved with human misery.

The recent long drought has however shaken North Gujarat out of its slumber. People, communities, village institutions, NGOs, co-operatives have virtually run amuck digging up the tanks and ponds they neglected for decades, and haphazardly building check dams often where they can not do anyone any good. North Gujarat has taken a leaf out of Saurashtra's decade long popular water conservation movement which seems to hold a promise for that region's water future. This has spurred in North Gujarat a groundswell of local enthusiasm to produce and manage their water locally—rather than waiting for Narmada or to find the elusive Saraswati flowing 2500 feet underground. The drought has unleashed unprecedented levels of awareness and social energy; but this social energy can pose effective challenge to the region's water problem only if it is harnessed and directed through skillful co-ordination and orchestration and by imbuing it with a scientific approach.

This concept note suggests that what may work in Saurashtra may not work in North Gujarat. Uncoordinated check-dam construction and tank-desilting spree may only lead to a Peter robbing a Paul of his water, rather than augmenting total water available to both. Even if total water captured increases, North Gujarat may not progress an inch towards sustainability if farmers bring even more areas under irrigation to use the new water. Efforts to increase water availability can only produce desired results if equally effective interventions are made to economize on water use primarily through improved productivity of water. And, the impact of both supply as well as demand side interventions may become transitory without powerful interventions to gradually inculcate and propagate among the people a new water ethic of sustainable use. Co-equally, environmental sustainability can be consistent with steady growth in livelihoods and incomes, provided the region's socio-ecology is helped to make an effective transition to a higher level of natural resource management.

In order to give proper direction to this social energy, and to provide co-ordination, orchestration and scientific back-up that North Gujarat's myriad local water initiatives badly need, this concept note proposes a 5-year North Gujarat Initiative for Sustainable Groundwater Management with 12 action items in three areas of intervention: [1] Augmenting local water availability (1,2 &3); [2] propagating water saving approaches in the cultivation of alfalfa (4 and 5) and non-fodder crops (6 &7); [3] Awareness, education and propagation of a new

'water ethic' (8,9,10,11 and 12). Besides these, it is suggested that a unit be created to provide monitoring and research support to the implementation of the 12 action items.

### North Gujarat Sustainable Groundwater Initiative

Action Items	Primary project input
1 Tank rehabilitation program	Catalytic intervention; seed grants; 'honest brokering' with resource providers; co-ordination; resource mobilization; sub-basin perspective
2 Promotion of private well-recharge work	Promotion and extension; technical support
3 Support to community water conservation and recharge structures	Planning and design; mobilizing communities and govt. resources; technical support; sub-basin perspective
4 Promotion of the use of chaff cutters among dairy farmers	Collaboration with dairy co-op field staff; Intensive promotion and marketing; user feedback and product improvement; strengthening Appropriate Technology International presence and fire-power
5 Promotion of low-cost micro-irrigation & water saving technologies in alfalfa cultivation	Engaging International Development Enterprises to implement an intensive promotional program; getting other irrigation equipment majors to set up shop; Collaboration with dairy co-op field staff; Intensive promotion and marketing; user feedback and product improvement; field trials with leveling and plastic mulching;
6 Promotion of water saving farming methods in non-fodder crops	Collaboration with dairy co-op field staff; Field trials of technologies and best practices; farmer demonstration and promotion;
7 Promotion of water-saving, high value crops, especially orchards	Farmer participatory trials; package promotion
8 Roof water harvesting for drinking and cooking water security	Demonstration and promotion of roof water harvesting structures; linking up with GWSSB scheme of financial support
9 Communication campaign to support demand & supply side interventions	Design and implementation of messages, medium and communication strategy; bi-weekly water education posters at dairy co-ops; video-films about best practices and show-case villages like Khopala and Dudhara
10 Community Monitoring of Groundwater table fluctuations	Establish and run the participatory monitoring systems in a learning mode on a pilot basis to start with.
11 Dairy Co-ops' intensive member-education program on Best Practices	Design and package key messages; organize training of co-op field staff; monitor and evaluate training effectiveness; built on the GCMMF's tested approaches and methodologies for animating attitude change
12 Water Seller Education Program	Design key messages; work with select group of water sellers/companies in a learning mode; explore windows of opportunity for behavioral change; target water sellers as ambassadors of high crop-per-drop approaches and technologies.
Ongoing Support Activity: Planning, Monitoring, Evaluation and Research Support	Develop basin and watershed plans; monitor impacts; provide quality feedback; practical problem-solving research

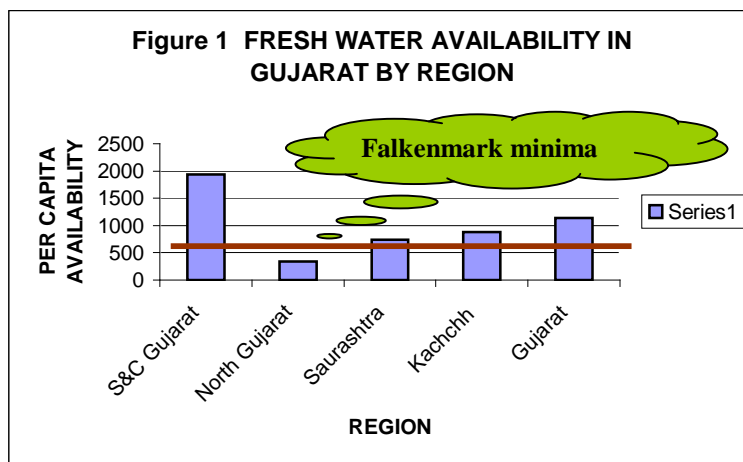
Starting October 2001, it is proposed that the Initiative be implemented on a pilot basis in three talukas of the region during the first two years and then extended to cover all the three districts over a 5 year period. The primary implementation structure will be a Project Management Unit governed by a Project Steering Committee representing promoters and all stake holder groups. A separate unit answerable to the Steering Committee will provide Monitoring and Research Support to the entire Initiative. The cost of implementing the Initiative will be the cost of supporting the Project Management Unit at around Rs 40 m for the first two years.

The North Gujarat Initiative will curtail groundwater overdraft of the region, and over time, help raise groundwater tables, reduce costs and energy use in groundwater irrigation, thereby laying the foundation for a more vibrant, wealth-creating agriculture. An important spillover benefit will be the uniform reduction in the fluoride-related health costs through both supply and demand side interventions as well as the awareness-building activities. If it succeeds, such an initiative may offer a 'show-case' for sustainable local land and water management in water-stressed regions elsewhere in India and the world. The Initiative, therefore, is to be viewed as an intervention with major strategic learning value for global water resource management.

## I. Background and Problem

The North Gujarat region—comprising Banaskantha, Sabarkantha and Mehsana districts—is in the throes of a water crisis. It has been building up over the past two decades; but the successive droughts of 1999-2001 have put the dimensions of the crisis in bold relief. And it looks as though the agrarian economy and rural livelihoods in this region will come under inexorable stress if it persists with ‘business as usual’ approach in its water management.

Gujarat as a whole is a water-short region; by Falkenmark’s indicators, while all of Gujarat except south and central Gujarat are water-stressed, North Gujarat with just around 300 m<sup>3</sup> per capita of water availability faces absolute water scarcity, a condition in which it is impossible to support viable human life. North Gujarat’s problem is that it is trying to sustain a vibrant agrarian and dairy economy of a scale and sophistication that is out of sink with its water balance. The region’s water future can go only one of the two possible ways left: either its agrarian economy shrinks to fit its water availability or else it learns and adopts new ways to get a bigger bang out of its precarious water situation—by catching every drop of water it can find and by getting more crop per every drop.



One big problem is that North Gujarat has very little surface water; as a result, groundwater has been the mainstay of agriculture, industry as well as municipal needs. Agricultural demand on groundwater however has experienced a meteoric rise over the 1950-2000 period. In 1997, for example, of the 1.4 m ha of irrigated area in North Gujarat, less than 100000 were served by surface water; and over 1.3 m ha were irrigated by over 150,000 mostly deep tubewells powered by electric pump sets of 15-75 horse power; these tubewells account for over 3000 m cum of annual gross groundwater draft that sustains North Gujarat’s irrigated agriculture. While agriculture prospered, the groundwater use has been perennially in excess of the recharge; and, where bullock-bailers could lift enough water for protective irrigation 50 years ago, deep tubewells use up roughly 0.35-0.5 kWh of electricity to lift a m<sup>3</sup> of water. As a result, North Gujarat has, in recent times, emerged as the global symbol of the perils of unsustainable groundwater exploitation. Indeed, with its irrigation tubewells mining water from the depths of 10-

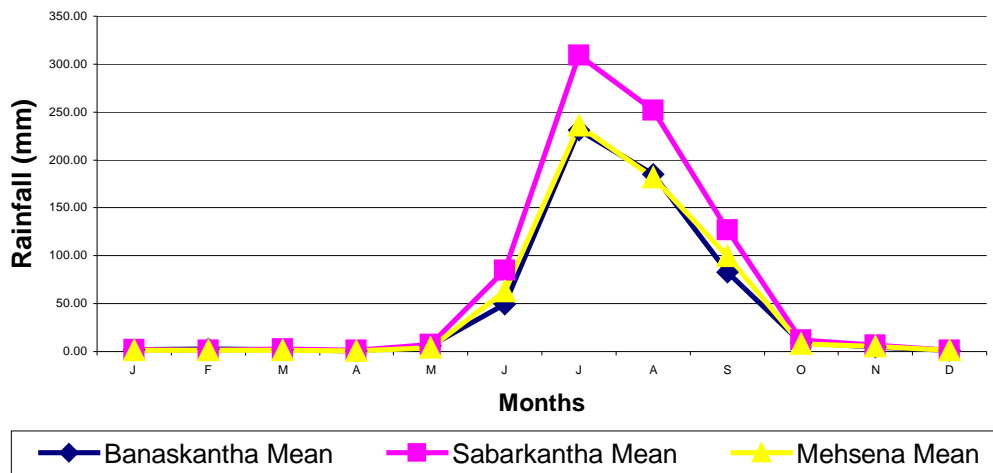
12,00 feet--and going further down a column or two each year—the region has become a standard fixture in the global literature on groundwater over-exploitation. In Sandra Postel's 'The Pillar of Sand'—in which she places the global groundwater overdraft at 200 km<sup>3</sup>—North Gujarat emerges as the groundwater basket-case, a socio-ecology where vibrant agriculture and rural livelihoods are clearly unsustainable unless a coherent strategy is put in place to arrest and reverse the secular decline in groundwater levels.

The key reason for this sordid state of affairs is the total absence of a region-wide natural resource planning and management regime. The farmers in North Gujarat are a dynamic, enterprising lot. Having witnessed the prosperity that surface irrigation brought to Kheda and much of South Gujarat, they have fought for—and succeeded in getting--groundwater irrigation nearly as inexpensive as surface irrigation. Even as water levels began falling, North Gujarat kept guzzling groundwater as if there were no tomorrow. But the successive droughts of 1999-2001 have placed in bold relief the precarious nature of the region's water situation; North Gujarat is now discovering that its profligacy with its groundwater resource is no longer sustainable.

The present and future consequences of pursuing 'business as usual' can be grave for North Gujarat—in terms of its environment, the sustainability of its agriculture and dairying, the health of its people. As groundwater tables recede, the surface ecology in many parts of North Gujarat—in terms of biodiversity, vegetative cover—is already undergoing drastic, often irreversible, degradation. Western areas of Banaskantha district adjoining the Little Runn are facing the prospects of growing desertification. Public health costs of groundwater overdraft may become prohibitive, too; it is now widely recognized that the high fluoride content in North Gujarat's groundwater—which is the main source of drinking water in the region—is the result of permanent decline in water tables. It is established that fluoride is released by the weathering of granite formations at high depths; and that the higher the vertical distance groundwater travels in such geological formations, the greater its fluoride content. The direct economic costs of groundwater depletion too are an area of much concern—to farmers as well as the state government which subsidizes electricity use in North Gujarat's tubewell irrigation to the tune of Rs 300 crores/year. Some protagonists of the Narmada project have argued that if Narmada waters used to recharge North Gujarat's aquifers can raise its groundwater tables to 50 feet, the savings in electricity used in pumping groundwater from the depths from which it is pumped now itself can pay for a big part of the cost of the Narmada project. Even with high power subsidies, North Gujarat's agriculture is becoming increasingly unprofitable because of high costs of groundwater irrigation. The White Paper on Water in Gujarat shows that costs of groundwater irrigation—which in Mehsana are 36% of total variable costs of farming in the case of wheat--are so high that the cultivation of all crops—barring a few needing sparse irrigation--is already unviable in this region. Local observers of the North Gujarat scene suggest that groundwater depletion is the prime reason why Mehsana has emerged as Gujarat's largest supplier of schoolteachers most of whom would have stayed back in their villages had farming been more profitable. This also seems to be the reason why many rural areas of North Gujarat face high outmigration of the permanent type, with occupationally active members of the family moving to towns and cities, leaving their old to care for the farming. Many analysts have also suggested that the reason farmers in North Gujarat have taken to dairying as a livelihood activity in a big way is the growing unviability and undependability of field crop cultivation as a source of livelihood. The leaders of North Gujarat's dairy co-operatives suggest that it is this changing equation that explains why

milk procurement by dairy co-operatives rises, instead of falling, during drought years. Since it is the only major source of cash income, farmers strive to protect their dairy production no matter what. In the process, North Gujarat's dairy industry has become highly water intensive. A mission fielded by IWMI to assess Banaskantha's groundwater situation concluded that the district's dairy farmers evaporated over 500 million m<sup>3</sup> of water a year in growing alfalfa on around 23,000 ha. Dairy production in Mehsana and Sabarkantha seems even more alfalfa-intensive. Overall, alfalfa cultivation may well be the biggest user of North Gujarat's groundwater.

**Figure 2 Mean Monthly Rainfall in North Gujarat**



If agriculture and rural livelihoods are to be protected, North Gujarat needs to restore its groundwater ecology. This task looks difficult, though not impossible. The region has excellent alluvial aquifers in most parts. It receives an average of 650-700 mm of rainfall though with wide inter-year variations. Unlike in Saurashtra, where agricultural activity comes pretty much to a stop during a severe drought, in North Gujarat, groundwater—although expensive to pump (for water buyers and for the State Electricity Board)—still acts as a good buffer. At present, the recharge rates are low; tanks, ponds and other water harvesting structures which were the traditional hallmark of North Gujarat's terrain for centuries have in recent decades fallen into disrepair. There are years, when very high rainfalls occur, during which excessive runoff and flash floods are generated, though in normal years the runoffs are in very small quantities. The intra-year as well as inter-year fluctuations in rainfall are large; as a result, monsoonal precipitation runs off—often to sinks--as 'rejected recharge'. As a result of growing draft and stagnant recharge, North Gujarat's groundwater balance runs a long-term annual deficit of 0.56 km<sup>3</sup> or some 20% of the current usable recharge. This deficit needs to be bridged—and kept that way—through an initiative that focuses on both demand as well as supply of groundwater by improving the productivity of water use in North Gujarat agriculture as well as by enhancing the local availability and recharge of groundwater. The Initiative proposed here aims to do precisely this.

Table 1 North Gujarat's Groundwater Balance

	Geographic area sq. km	Average rainfall m	Total precipitation (km <sup>3</sup> )	Utilizable recharge (km <sup>3</sup> )	Gross Groundwater draft (km <sup>3</sup> )
Banaskantha	12248	0.578	7.079	0.796	0.887
Mehsana	7390	0.651	4.811	0.862	1.420
Sabarkantha	9027	0.807	7.285	0.769	0.683
Total	28665		19.175	2.427	2.99

## **II A Strategy for Sustainable Groundwater Management in North Gujarat**

Despite all the perils outlined above, an Initiative of the type proposed here would have been premature a few years ago. But today, things are different. Successive draughts of 1999, 2000 and 2001 have heightened mass awareness about the need for sustainable water management like never before; and the spread of information about popular efforts for local water harvesting and groundwater recharge in Saurashtra region has dispelled the fatalism experienced by people about the inevitability of droughts and water scarcity. The Saurashtra movement has infused a new sense of enthusiasm among the people who no longer feel that government programs are the only way of solving their water problem. In sum, the popular mood is right for introducing and consolidating decentralized water resource management initiatives in North Gujarat.

Already, numerous local institutions are present in North Gujarat which are willing to mobilize local effort and resources to communities that wish to undertake local water initiatives. Some of the prominent NGOs working in the region include ANARDE Foundation, SEWA, Development Support Center, VIKSAT, Sarvodaya Trust, Utthan, Motibhai Chaudhary Trust and others. Saurashtra Jaldhara Trust, which played an important role in supporting the local water initiatives in Saurashtra and Kachchha has a North Gujarat wing which is yet to become fully active. Other national and international NGOs operating in Gujarat—such as International Development Enterprises and Appropriate Technology International—could be easily brought in if there was an appropriate role for them to play. Besides these, there are numerous village level formal and informal institutions, which can play a local role. Palanpur's Jain community are leaders in the world diamond trade; these could be an important source of financial contribution for physical work such as recharge structures and tank desiltation. Moreover, various government schemes offer funds and other resources for local initiatives. Above all else, we have three of India's largest dairy co-operatives with village level people's organizations covering over 90% of the villages in these three districts.

Many of these institutions are already in local water initiatives, mostly tank desiltation and check dam construction; and during late 2000 and early 2001, large volume of earth work—essentially in desilting village tanks—got carried out through local initiative and resources. However, the overall impact of the ongoing work is likely to remain limited and short-lived because of a number of reasons. Different agencies and institutions work in a fragmented and disjointed manner. Everybody works only on the supply side interventions, making physical structures aimed at improving immediate local availability

of water; no agency is working on badly needed demand side interventions; nor is anyone worried about the larger, river-basin level impacts of local structures. Even in the midst of acute and growing water scarcity, wasteful water use practices are rampant; and there is no attempt to intervene at the level of public attitudes through awareness-building and educational initiatives. While a great deal of action is in progress, there is little formal analysis and feedback about what is the present and likely future impact of such popular activism. There is a gung-ho element in the entire movement; and this is true even in Saurashtra where it is in progress for nearly a decade. Aside from isolated, unidimensional studies by local scientists and professors, there is virtually no formal analysis of the impact of the water harvesting and recharge movement. As a result, popular discussion on these interventions always focuses only on their short-term benefits and never suspect that there might be a downside to these interventions. Finally, there is too little by way of formal institutionalization of the water conservation and recharge work with too much action dependent on initiatives by well-meaning individuals. This implies that most action gets concentrated during droughts when public concern with water issues heightens; there is too much concern with construction of structures and little attention paid to maintenance; resources mobilization too occurs based on individual relationship of trust and goodwill rather than on formal relationships of accountability and transparency. Implications are many: the long-term value and sustenance of the benefits is in doubt; gains of water harvesting may be lost due to profligate water use practices; the tempo of work may slacken once we have a good monsoon; and resources mobilized are likely to be smaller than might be possible with formal, accountable and transparent management of decentralized interventions in a coordinated manner.

The final premise underlying this initiative is that the present cacophony of disjointed, disharmonious local water activities could assume a harmonious, programmatic format and achieve greater long-term impact if:

[a] these operate within a loose overarching basin-level framework of sustainable land and water resource management;

[b] there is balanced emphasis on supply as well as demand side interventions;

[c] there is a powerful educational and awareness building component;

[d] the entire initiative has regular socio-technical assessment and feedback; and

[e] an effort were made to raise resources for the initiative as a whole based on transparent, accountable yet decentralized governance of the initiative.

We also believe that an effective and credible co-ordination mechanism will help to expand manifold the overall scale and impact of the decentralized water initiatives. In particular, there is urgent need to undertake coordinated action in five areas outlined below.

### **Component 1: *Decentralized Water harvesting and recharge:***

Like the Saurashtra region, the three districts of North Gujarat too are perennially water-short; and their first need is to harvest their limited rainfall run off and conserve it. The experience of Saurashtra's water harvesting and recharge movement has yielded many

lessons which are relevant to North Gujarat: [a] Every community—regardless of its location, geo-morphology, climate—can increase the water availability in its domain through local conservation and recharge work; [b] the marginal impact of each structure increases with the number and spread of structures in a domain, and this is more true in alluvial aquifers of North Gujarat rather than hard rock conditions of Saurashtra; [c] the sense of local ownership of water—and of right over it—strengthens as increased water availability results from private and collective conservational effort in domain; [d] demonstrating [a] and [b] in local context expedites the adoption of conservation and recharge technologies.

There have been much awareness and excitement in North Gujarat about the water harvesting and recharge movement in Saurashtra; and some villages have already begun to follow suit on their own. However, in Saurashtra's hard-rock geology, well-recharge activity is likely to work better than in North Gujarat since Saurashtra farmers modifying their wells for recharge are likely to reap *some* individual benefit from it. In North Gujarat, unless a large number of farmers take to it simultaneously, this is unlikely to happen; and the localized mounds developed through well-recharge may quickly dissipate. Saurashtra also has relatively high drainage density, which makes it amenable to structures like check dams, nalla plugs, etc. In contrast, in North Gujarat, conditions suitable for check dams are fewer and rarer; it is no surprise then that the Government of Gujarat's 60:40 check dam scheme has made much more progress in Saurashtra and Kachchha than in North Gujarat. However, water harvesting in North Gujarat has focussed more on tanks; every village here has one big village tank and several smaller ponds/tanks, which can serve as the water harvesting and recharge structures. Most of these structures are in a state of disrepair; tanks have got silted up; and encroachments have progressively reduced their size as well as catchment area.

In the slowly emerging rainwater harvesting movement of North Gujarat, tank rehabilitation has the potential to play a central role. At the heart of participatory tank activities of the village communities seems to be the easy availability of earthmovers in recent times. In Mehsana, many villages—like Salisana and Manund—have mobilized their own resources to desilt and even expand their village tanks. The Motibhai Chaudhary Foundation in Mehsana maintains a JCB and a fleet of tractors that it hires out at a concessional rate to any village which wants to desilt its tank. ANARDE Foundation took us to Gadh village in Banaskantha district where access to earth moving machinery was enough to catalyze the village community to undertake a major exercise in rehabilitating its village tank. Saurashtra Jaldhara Trust maintains a fleet of these machines and sends it out to any village, which is willing to pay for fuel; Gujarat Land Development Corporation even pays for the fuel in the machines it sends. In Gadh, the Village Water Committee got 3 such machines; and invited village people to remove the silt excavated from their fields at a rate of Rs 10/tractor load. There has been a good response to this call; 200-250 tractor loads of earth has been removed daily for over 20 days of desilting—which virtually tripled the water-holding capacity of the tank.

The idea of desilting village tanks as rainwater harvesting structures is gradually taking off in North Gujarat. The experience of villages like Gadh in Banaskantha, Balisana in Mehsana and Ratanpur in Sabarkantha suggests that this can easily develop into a tank rehabilitation movement energized by local initiative and resources. Gadh is a good example of what it might take to catalyze a large-scale program of desilting and rehabilitating over 4000 village tanks in North Gujarat. Like in Saurashtra, in North Gujarat too, it might not be difficult to generate local resources to invest in earthmovers.

Village farmers would in most situations gladly press their tractors into service in removing the silt from the tank-bed to their fields. The volume of this activity can be multiplied manifold through effective intermediation between village communities and farmers on the one hand and private donors, foundations, government programs on the other. The overall impact of this activity could be enhanced by guiding local players to carry out this work within an overall technical plan for the sub-basin and watersheds as also by providing some scientific expertise in the conduct of the activity.

Action Item 1 Tank rehabilitation program

Action Item 2 promotion of private well-recharge work especially on open wells and failed tubewells

Action Item 3 promotion of and support to community water conservation and recharge structures such as check dams and percolation tanks; improving the vegetative cover – not just but also grasses—in catchment area wastelands which is the best way of altering the overall hydrological balance to increase water availability by reducing the peak flows, moderating and reducing runoffs, and increasing the natural recharge.

## **Component 2: *Promotion of Water-efficient Technologies in Alfalfa Cultivation:***

During the past 50 years, dairying has emerged as the mainstay of North Gujarat's livelihood. Between milk and field crops, it is uncertain which contributes more to the rural incomes and employment; however, it is clear that during droughts—which is in 3 years out of 5—dairying provides a modicum of stability to rural incomes. Together, the three North Gujarat dairy co-operative unions pump in some Rs 7-8 hundred crores annually into the village economies as 'milk wages' (that translate into stable reliable annual income per household of some Rs 9,000 for the region's rural population). During droughts, ironically, the co-ops end up collecting more milk as distress sales by hard-pressed farmers increase in an effort to stabilize their cash incomes.

This booming dairy economy, however, takes its toll on the region's water resources; the groundwater that alfalfa irrigation evaporates is several times larger than North Gujarat's water deficit. The up-side is that alfalfa irrigation occurs in small plots by dairy farmers who can be effectively reached through co-operatives; moreover, it uses water so intensively that even small productivity gains can make a big impact at the level of the region. Although field irrigation of wheat accounts for a large proportion of agricultural water use, this water is spread over a large area. Against this, some 90-100 thousand ha of alfalfa cultivation for feeding dairy animals in North Gujarat evaporates some 1.2-1.8 cubic kilometers of water in these 3 districts. Alfalfa uses some 10,000 m<sup>3</sup> of water per ha; half of it is transpired and the rest is non-beneficial evaporation. And a major effort to improve water productivity in alfalfa cultivation can make a big difference to North Gujarat's water future while protecting the livelihoods and incomes of dairy farmers .

The first point of attack on water saving in dairy production is improving the efficiency of green fodder feeding system itself. The dairy co-ops are already conscious of this. In North Gujarat, green fodder is fed to dairy animals without cutting which results in waste of nutritious fodder of the order of 25-30%. Dairy co-operatives massively promoted simple manual chaff cutters (*suda's*) during the 1970's. These sold in large numbers due to subsidy offered by the co-op; but their use has been minimal. Appropriate Technology International has now come up with new design chaff cutters in manual as well as

electric versions. Their sale can be promoted through subsidy programs; but the real issue is of promoting their *use* through intensive extension campaigns.

Equally important to water saving in alfalfa is proper leveling of the field. In many western countries, huge gains in water productivity are secured through sophisticated laser leveling of irrigated fields. Luckily, since North Gujarat's alfalfa fields are typically tiny in size, leveling them well does not require sophisticated gadgetry. Effective messages and technical knowledge delivered through powerful extension campaigns can deliver valuable water savings.

Promoting micro-irrigation of alfalfa can also yield substantial water savings of 20-25% besides improving crop productivity and quality. Sprinkler irrigation of alfalfa is very popular in northern Mexico where agro-climatic conditions are similar to North Gujarat and which has a prominent dairy economy. Since North Gujarat's dairy economy is dominated by small-scale milk producers, normal sprinkler irrigation systems may prove both expensive as well as capital intensive. IDE, an international NGO, has promoted low-cost micro irrigation sprinklers for vegetable crops in hill areas of Nepal and Himachal; there is much potential to promote these for alfalfa cultivation. VIKSAT, an Ahmedabad-based NGO, tried out IDE's micro-sprinklers with a few alfalfa growers near Kheralu in Mehsana. The system costs just around Rs 250/bigha, and is thus eminently affordable; and their experience of using it for a winter was good too; however, farmers found the sprinkler system problematic in summer; it delivered too little water; the its holes got clogged. So they abandoned them. With some more experimentation and adaptation, however, it might be possible to develop a micro-irrigation system that might be appropriate for small-scale alfalfa cultivation in North Gujarat. Besides agencies like the IDE, it is also important to bring in private sector irrigation equipment majors like NETAFIM, Jain Irrigation, Premier and others. cursory market studies by IWMI-India researchers in towns like Mehsana and Palanpur suggested that drip and sprinkler irrigation industry has hardly any presence in the region; some dealers marketed irrigation equipment a few years ago but have shut shop since then. Interviews with dealers suggested that like elsewhere in India, the marketing of irrigation equipment has been stuck in the quagmire of perverse subsidies; companies are primarily gunning for a cut in the subsidy through over-pricing their products; as a result, manufacturers as well as marketing channels devote most of their time and effort to skimming the subsidy rather than building a market for their product<sup>1</sup>. This is a serious issue and needs some careful policy advocacy as well as market development work.

Finally, under the prevailing regime of flood irrigation, the IWMI-Tata Mission on Banaskantha found that while water conveyance from the well-head to the field through buried pipelines is efficient, the on-farm water management itself is highly wasteful. There is much scope to cut non-beneficial losses through better on-farm water management. The IWMI-Tata Mission recommends the use of plastic sheets for on-farm

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<sup>1</sup> IWMI-Tata Program has explored the problems posed by government subsidy to the propagation of drip and sprinkler irrigation technologies elsewhere in India. However, in these explorations, we found that once a few risk-taking farmers experiment with it and learn of its direct economic benefits—as they did in the cotton growing belt of Maikal in Madhya Pradesh and mulberry growers in Kolar region of Karnataka—the technology adoption spreads like wildfire and is no longer affected by the invidious political economy of subsidy. Until this stage is reached, however, the internalization of the new irrigation technology remains stunted. Astute intervention in the irrigation equipment market is needed to break the hold of the subsidy and develop a competitive market for the equipment.

water conveyance; while this may reduce seepage losses, it does not reduce evaporation losses. VIKSAT has tried persuading farmers to use narrower, deeper channels to convey water, which seems to have found favor with farmers near Kheralu. This suggests that much can be done through field research and proper extension to get farmers to adopt water-saving farming practices.

Action Item 4 Promotion of the *use* of chaff cutters and field-leveling practices among alfalfa farmers

Action Item 5 Large-scale Promotion and marketing of low-cost micro-irrigation and other water-saving technologies in alfalfa cultivation

### **Component 3: *Water Saving, Wealth-creating Agriculture:***

Besides alfalfa, a great deal of North Gujarat's water gets used up to grow low-value food crops—especially, wheat and summer fodder crops—that guzzle water. The region is inhabited by dynamic, enterprising farmers who, given research and extension support, would be quick in uptake on more lucrative cropping options. In Mehsana district, for instance, farmers are already moving towards lemon, sapota and mango orchards away from field crops. Besides water scarcity, shortage of labour and scope for higher cash income is energizing this transition. In Banaskantha too, farmers are moving away from water-intensive wheat in winter to sunflower, castor and *raido*. This suggests that if new cropping pattern options are offered that promise remunerative markets and low water use, farmers may take to these on a large scale. There are similar opportunities for water saving farming methods.

From our discussions with orchard farmers in Mehsana, Rajkot and elsewhere—as well as from the experience the world over—there seems compelling evidence to suggest that water saving cropping systems and technologies are seldom adopted on a large scale for water saving *per se*. Attractive output markets, processing facilities, and a variety of other local conditions make a new cropping system or farming technology attractive for farmers; and water saving results as an incidental spill over benefit of such change. Lemon orchards have become popular along the Mehsana-Himmatnagar highway primarily because once they start fruiting, owners can lease their orchards to traders at attractive terms; the traders then take care of irrigating the trees, plucking the fruit, transporting and marketing, thus sparing the owner the hassle of managing the orchards. It is instructive, however, that we found not one orchard here using drip irrigation which is uniquely suited to such crops because, partly of the lack of promotion and partly because drip equipment market is virtually non-existent. There is then room for skillful strategic interventions that can wean away farmers from field crops to orchards, and from flood irrigation to precision irrigation technologies. In large measure, this is the task of high quality extension and farmer-level experimentation. We know that the grape orchard revolution in western Maharashtra—which led to the spread of drip irrigation was the work primarily of S N Dabholkar, a mathematician who worked with farmers and taught them how to raise drip-irrigated grape orchards and make five times more money with far less water than they used earlier to grow sugarcane. This route to improving water productivity in farming becomes relevant because we know that farmers of North Gujarat are enterprising and market suave.

Action Item 6 Promotion of water saving farming methods in non-fodder crops

Action Item 7 Promotion of water-saving, high value crops, especially orchards

**Component 4: Freedom from Fluoride**

The human health dimensions of North Gujarat's groundwater crisis has for long remained under-studied and under-assessed. Only in recent times do we see greater awareness spreading even in villages about the relationship between groundwater depletion and the dental and bone-related diseases that we find rampant in many parts of Mehsana. The approaches being advocated to rid groundwater of excessive fluoride—the Nalgonda technique, and the use of allum-filtration method—have been tried in many states of India but they are yet to find the acceptance they need before they can make a dent on the problem. Partly, it is a question of cost; but more importantly, it is awkward to use these techniques. Fluoride-conscious villages in many parts of Gujarat have experimented with alternative approaches. Now, in Saurashtra, it is widely recognized that shallow aquifers recharged through check dams or recharge wells have very low fluoride content compared to water pumped from deep aquifers. Even medical practitioners have vouched for this in public meetings; and Dr R N Athavale, a very senior hydrologist based at National Geo-Physical Laboratory at Hyderabad has even written a book that justified local water harvesting and recharge initiatives purely on improved quality of drinking water in local sources. Unjha town has recognized these benefits long ago; the town has deepened its tank, and has made two open wells along it; these are designated as drinking water wells and can not be used for any other purpose; the two wells provide fluoride-free drinking water to the people.

Once the local water conservation and recharge activities gather momentum, fluoride problem in rural drinking water use should get alleviated by itself, especially if village communities designate and protect their drinking water wells. However, NGOs like AKRSP and Utthan have actively promoted roof-water harvesting in parts of Saurashtra as anti-fluoride strategy. Utthan's reasoning is compelling: although total personal water requirement may be 90-125 l/d depending upon whose standard we use, the direct drinking and cooking requirement per person is barely 5 l/d. Rain water collection and storage by minor modifications in roofs can enable a household of 6 persons to easily secure and store 15-18000 litres of water it needs for its drinking and cooking requirements during periods of scarcity.

Action Item 8 Roof water harvesting for fluoride-free drinking and cooking water

**Component 5: Propagation of a new Water Ethic:**

The last component would be of awareness building, education, information, communication about the water crisis, how it can be resolved if villages adopted a new water ethic (*Jalachar Samhita*). This is the difficult part since its impact will take time to build up and will forever be difficult to gauge, leave alone measure and assess. Nevertheless, in energizing and sustaining the water harvesting and recharge movement that took Saurashtra by storm during the 1990's, the most critical role has been that of communication and awareness-spreading by individuals like Shamjibhai Antala, institutions like Saurashtra Jaldhara Trust, NGOs and the ingenious communication machine of the Swadhyaya Pariwar. The program will carry out intensive campaign to rally support for the new water ethic through intensive education. As the program builds up, various forms of recognition and publicity would be used to showcase villages that adopt the ethic and become the so-called *Niyam-bandhi* (code-bound) villages. Public

disapproval can often be a powerful mobilizing device, which has been tried in the field of environment protection and natural resources management in many advanced countries. In the Murray Darling basin in Australia, failure to reduce salinity loads in surface water result in 'public shaming' of an entire province. Similarly, one approach used in Australia for local governance of groundwater resource is to involve users in monitoring the behavior of their resource; it would be useful to experiment with such approaches and try them out in our setting. Groundwater table in one or two wells in a village could be regularly monitored; and water level data displayed regularly in public places. After the monitoring gets internalized, chances are that the community itself will come up with its own homegrown rules about managing its resource. A redeeming aspect of this situation is the possibility to focus an initiative on tubewell owners. Unlike elsewhere in Gujarat, the bulk of North Gujarat's groundwater for irrigation is pumped by 125000 private electric tubewells; out of the region's over 7 million inhabitants, the 125000 who own and operate these tubewells are the most important target group because they pump over 90% of the region's groundwater. In some ways, their long term economic interests too are consonant with a strategy of sustainable groundwater; and in the few cases of water saving effort we came across, almost all were inspired by tubewell owners who are the agricultural water sellers. A communication and education campaign that targets this influential group can produce major pay offs in water productivity in agriculture.

The assumptions underlying this component are that :[1] It is possible to induce behavioral and attitudinal change through a well-designed program of awareness-building, consultations, exposure to successful experiences in similar contexts. [2] behavioral and attitudinal changes deepen when communication program is implemented as part of a larger program of achieving improved resource management.

There are instances—though not many—that suggest that new norms might get adopted and enforced by communities if these are introduced in a sensitive manner and as part of a larger supply and demand-side intervention. The water harvesting and groundwater recharge work by diamond merchants in Saurashtra, for instance, establishes the basic norms that: [a] everyone contributes Rs 300/bigha; [b] once a water harvesting plan is prepared, all those whose land is needed for constructing the structures surrender it to the village free of cost; and [c] nobody pumps water directly from water harvesting structures. Utthan, a local NGO too has met with successful experience in Rajula where people in several villages have accepted the norm of not allowing tubewells deeper than 200 feet. In Panch-tobra village of Gariadhar taluka, the community agreed that no new wells will come up within 100 feet to 100 meters of the water harvesting and recharge structures constructed. Similarly, in Balisana village in Mehsana district where Utthan has been working with the village community to create a fluoride-free drinking water source, the Village Water Panchayat has passed a resolution reflecting a new set of norms that will govern the villagers' use of the new tank. Shamjibhai Antala has asserted that 15 villages in Amreli and Bhavnagar have adopted a new social contract for more responsible water use after water harvesting and recharge structures have been constructed.

Action Item 9 Communication campaign to support demand & supply side interventions

Action Item 10 Community Monitoring of Groundwater table fluctuations

Action Item 11 Dairy Co-ops' intensive member-education program on Best Water Management Practices

Action Item 12 Water Seller Education Program

### **III. The North Gujarat Sustainable Groundwater Initiative: Proposal**

A few of these activities are already getting implemented, albeit in a haphazard, disorganized and uncoordinated manner. For example, many villages are deepening their tanks with support from private donors (mostly, diamond merchants), NGOs like the Motibhai Chaudhary Foundation (which has supplied nearly 5000 hours of JCB labor over the past 2 years) and government agencies such as Gujarat Land Development Corporation which has also been supplying JCB labor. Similarly, isolated private farmers are modifying their wells for recharge. NGOs keep experimenting with technologies and approaches: for example, VIKSAT tried sprinkler irrigation of alfalfa on 5 farmers, and Utthan has been working with farmers in Balisana village in Mehsana to deepen and expand their village tank. ANARDE Foundation has worked in several villages but their prime focus is on self-help groups for savings and credit. IDE has posted one professional to promote low cost micro-irrigation; similarly, Appropriate Technology International has plans to market improved chaff cutters but primarily through dairy co-ops. Nothing—or very little is happening in awareness building and attitudinal change through effective education and communication campaigns.

All these need to happen on a much larger scale, in a better coordinated fashion and with a far greater input of technical and scientific input than is use at present. For instance, with its one-man marketing army for all of North Gujarat, it is unlikely that IDE will bring more than 50 ha under micro-irrigation after 5 years of labor when the need is to cover thousands of hectares of alfalfa; similarly, it is doubtful if at its current level of promotional firepower deployed in North Gujarat, ATI will be able to ground more than a few hundred improved chaff cutters when the need is to push them in thousands. Dairy co-operatives are greatly concerned about groundwater depletion and would like to help ease the problem; they can play a powerful role provided appropriate space is created for them to do so without compromising their core business. Likewise, private donors, foundations as well as government programs—such as the 60:40 check dam scheme of the present government—can be an important source of funding support with prospects of accountable and transparent administration of funds. We believe that with a credible, effective and accountable coordinating mechanism focused on achieving sustainable groundwater management in the region, such as the one proposed in this concept note, it would be possible:

- to engage the vast and influential outreach of dairy co-operatives—and to some extent, the Panchayati Raj institutions--in the region to bring about large-scale change in the way water resources are locally managed.
- to get IDE and ATI fortify and expand their promotional and marketing capability in the region;
- to persuade donors to support these—and similar other resource institutions to launch intensive programs in a campaign format;
- to expand resource mobilization from local private donors as also from foundations;

- to engage scientific and research institutions to bring substantial technical competence to provide a scientific underpinning to decentralized water interventions;

The Initiative proposed to install such a mechanism by creating and supporting a Project Management Unit that will implement the 12 action items described in section II under the overall of governance of a Project Steering Committee.

The ultimate goal of the Initiative is to achieve sustainable management of water resources, drought preparedness and stability in agricultural livelihoods achieved in Banaskantha, Sabarkantha, and Mehsana districts of North Gujarat.

The immediate objectives are:

1. To introduce and scale up water harvesting and groundwater recharge mechanisms within a river-basin planning framework so as to sustainably enhance local ground and surface water availability especially during periods of water stress;
2. To modify agricultural water use practices in the program areas so as to reduce gross agricultural water use by 15% while improving profitability of farming through improved water productivity in agriculture;
3. To propagate a new ethic of sustainable water and natural resource management through intensive education, awareness and communication program; and
4. To introduce farming methods, cropping patterns, irrigation technologies to lay the foundation for a water-saving, wealth-creating, sustainable agriculture in the region.

The basic premise of the Initiative is that pursuing these objectives effectively will not only eliminate the 0.6 km<sup>3</sup> groundwater deficit the region but, over time, also help raise groundwater tables, reduce costs and energy use in groundwater irrigation, thereby laying the foundation for a more vibrant, wealth-creating agriculture.

An important spillover benefit of the Initiative will be uniform reduction in the fluoride-related health costs through both supply side interventions as well as the awareness-building activities. This gain will be consolidated through a roof water-harvesting program to ensure domestic drinking and cooking water security.

It is envisaged that, if it succeeds, such an initiative may offer a 'show-case' for sustainable local land and water management in water-stressed regions elsewhere in India and the world. The Initiative, therefore, is to be viewed as an intervention with major strategic learning value for global water resource management.

It is proposed that the Initiative outlined above should implement 12 action items identified in section 2 of this concept note such as to cover the entire North Gujarat region over a 5 year period. Since this Initiative is the first of its kind, however, it is proposed that a two-year pilot project be implemented in a 'learning systems' mode beginning the winter of 2001 in three talukas, one each from Banaskantha, Mehsana and Sabarkantha. Results of the pilot should be reviewed in December 2003; and the experience gained should be used in developing the full North Gujarat Sustainable

Groundwater Initiative. What is proposed for immediate consideration now is the Pilot Project to be implemented in Vadgam, Vijapur and Idar talukas.

#### **IV Proposal for a two-year Pilot Project in Three Talukas**

The Pilot Project proposed will field-test the concept outline in this proposal by playing four crucial roles that remain unperformed today:

1. to co-ordinate and orchestrate decentralized water management initiatives by local institutions, NGO's and village communities to ensure maximum long term impact on livelihoods and sustainability of land and water systems;
2. to ensure balance between supply side interventions and demand-management interventions; and between the hardware ( i.e. physical interventions) and the software (i.e., educational, awareness-raising, information sharing programs designed to bring about attitudinal change towards natural resource management)
3. to raise and place at the disposal of local institutions larger pool of financial, technical and other resources to undertake local water management initiatives by playing the role of an 'honest, transparent, accountable broker'; and
4. to undertake regular, broad-based monitoring of Program impacts and to carry out and disseminate practical problem-solving research in ways that enhances the overall impact of the Program

At this juncture, it is not clear if it would be necessary or desirable to create a separate legal entity to implement the initiative. However, a simple organizational structure proposed for initiating the pilot is outlined in figure 2.

The Initiative will be governed by a Project Steering Committee of 15 members with representatives of promoters, stakeholders, participating NGOs and people's organizations, and research and scientific institutions.

The PSC will work towards its objectives through a Project Management Unit with four teams of 3-5 professionals each:

- Water harvesting and groundwater recharge
- Water Saving in Agriculture
- Water Education Campaign
- Planning, Monitoring, Evaluation and Research Support

The first three teams have a clear operating responsibility and constitute the operating system of the Initiative; their team leaders will report to the Project leader who in turn will be answerable to the PSC. The Planning, Monitoring, Evaluation and Research Support Team will be a service unit for both the PSC as well as the PMU, and will therefore be directly answerable to the PMU and preferably funded independently of the PMU. The primary role of the operating teams will be to *cause* local action through catalytic intervention, facilitation, networking, institutional development and resource mobilization.

Figure 3: Organizational Structure of the Project Management Unit

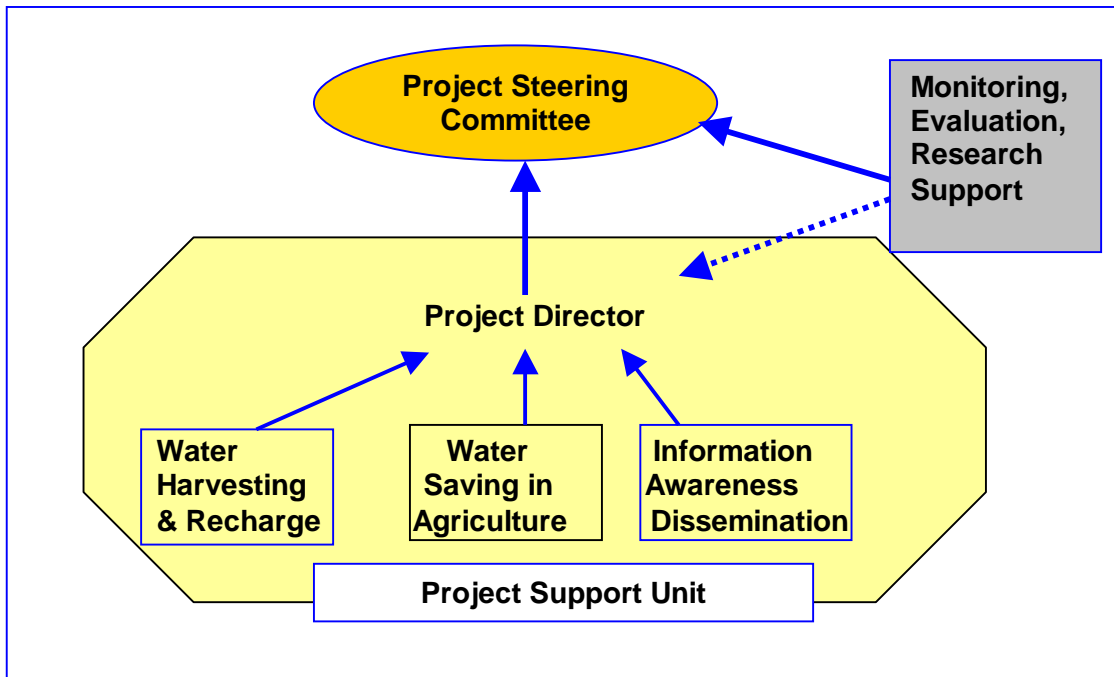
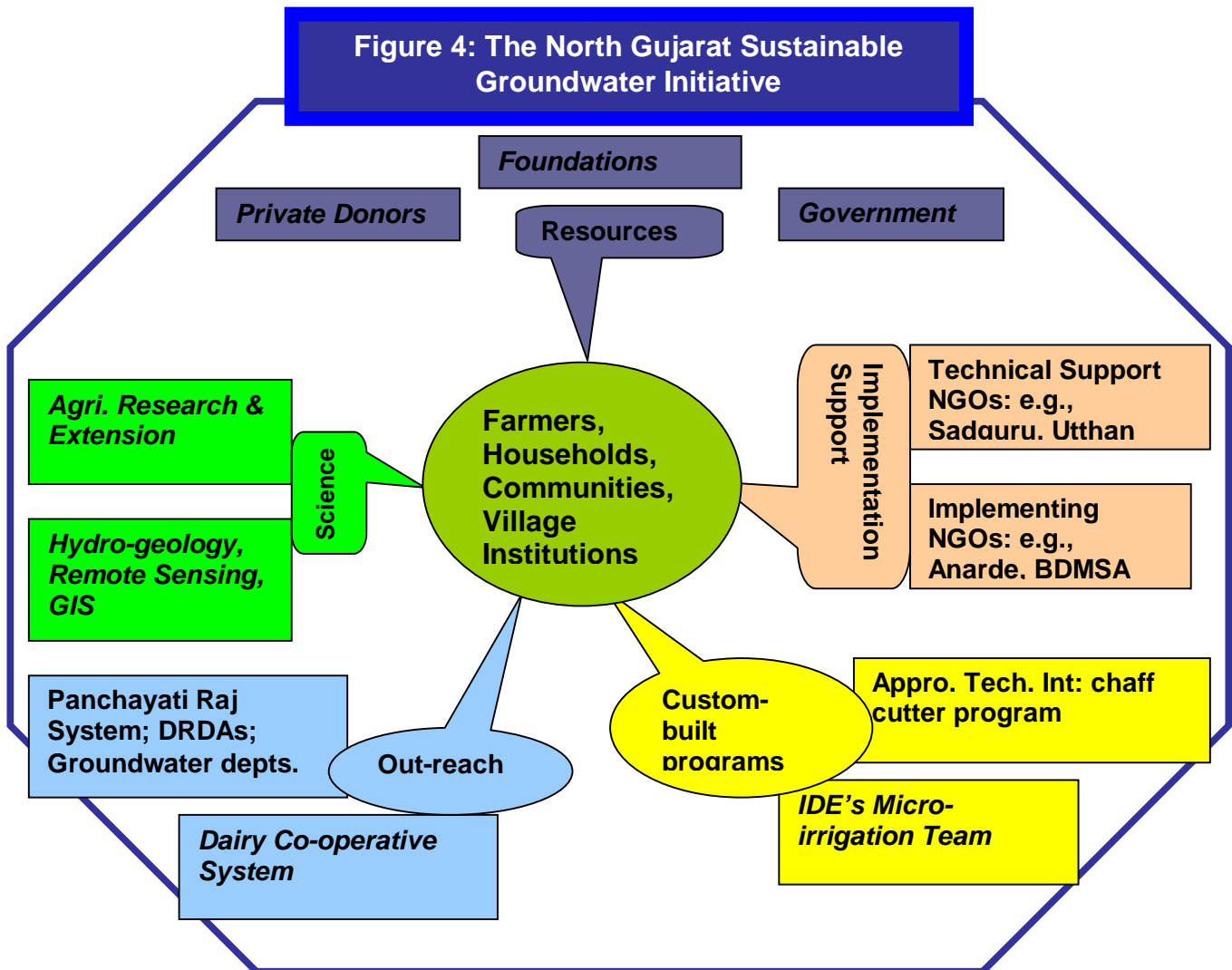


Figure 4: The North Gujarat Sustainable Groundwater Initiative



**Table 2: Three Taluka Pilot Project Outputs: 2001-2003**

Action Items	Responsibility Center	Key Partners	Probable Funders	Output Target for the 2 year pilot
1 Tank rehabilitation program	Team 1	Communities, Panchayats, NGOs	Diamond traders; got schemes; village dairy co-ops	300 tanks
2 Promotion of private well-recharge work	Team 1	Farmers; NGOs	Farmers; local funders	3000 wells
3 Support to community water conservation and recharge structures	Team 1	Communities, NGOs	Got schemes, GLDC, diamond traders	300 structures
4 Promotion of the use of chaff cutters among dairy farmers	Team 2	Dairy co-ops and unions, ATI*	Support to ATI team in the Project area [NDDDB?]	5000 users
5 Promotion of low-cost micro-irrigation & water saving technologies in alfalfa cultivation	Team 2	Dairy co-ops and unions; NGOs; IDE # manufacturers and assemblers	Support to maintain an IDE Team in the Project areas [NDDDB?]	5000 users
6 Promotion of water saving farming methods in non-fodder crops	Team 2	GAU+, NGOs, GAU's Extension center	Foundations; donors	10,000 ha
7 Promotion of water-saving, high value crops, especially orchards	Team 2	GAU; Extension center;	Foundations; donors	2000 ha
8 Roof water harvesting for drinking and cooking water security	Team 3	Utthan, AKRSP	GWSSB; local resources	10000 houses modified
9 Communication campaign to support demand & supply side interventions	Team 3	Panchayats; DESU\$; NGOs; dairy co-ops	Foundations; donors	50 messages to reach 300 villages
10 Community Monitoring of Groundwater table fluctuations	Team 3	Panchayats; Groundwater Dept.; NGOs; CGWB++	Foundations; Donors; NABARD?	20 village experiment with documentation
11 Dairy Co-ops' intensive member-education program on Best Practices	Team 3	Dairy Co-ops; NID**	GCMMF; unions	15 best practices disseminated to 300 villages
12 Water Seller Education Program	Team 3	Tubewell companies; NGOs;	Foundations; donors	100 tubewell companies covered
Planning, Monitoring, Evaluation and research support	Team 4	IRMA, IWMI@, GIDR@@	Foundations; donors	

\*Appropriate Technology International

# International Development Enterprises

+ Gujarat Agriculture University

\*\* National Institute of Design

++ Central Groundwater Board

\$ Development Education Support Unit

@ International Water Management Institute, India Program, Anand

@@ Gujarat Institute of Development Research

Table 2 presents some tentative, indicative ideas and estimates about the collaborative or partner organizations for each of the action items, possible sources of financial support for implementation and likely scale of output targets. The key point to highlight is that if the Project Organization develops the credibility and performance orientation we expect it can easily do, it can substantially leverage not only resources but also implementation fire-power from a host of partner organizations it can work with, and thus enhance both the quality and scale of impacts of decentralized water initiatives.

Thus, the financial resources to be found at this juncture are what is needed to establish the Project Support Unit and to make it functional. Once this is ensured, it is expected that the PSU will find other resources it needs to implement action items 1 to 12, albeit with support from the Project Steering Committee and other partners to the Initiative. Table 3 provides preliminary, ballpark estimates of the resources needed to get the Project Management Unit of the ground and going. More importantly, the table also presents the key inputs that the PSU teams will provide in implementing each of the 12 action items.

**Table 3: Action Item-wise Project Input and Professional Human Resources needed**

Action Items	Primary project input	Field Team
1 Tank rehabilitation program	Catalytic intervention; seed grants; 'honest brokering'; co-ordination; resource mobilization; technical support	Professionals: Agricultural/Civil Engineers: 3
2 Promotion of private well-recharge work	Promotion; technical support	Field staff: 3
3 Support to community water conservation and recharge structures	Planning and design; mobilizing communities and got resources; technical support;	
4 Promotion of the use of chaff cutters among dairy farmers	Collaboration with dairy co-op field staff; Intensive promotion and marketing; user feedback and product improvement	Rural Management/ Rural Marketing: 5
5 Promotion of low-cost micro-irrigation & water saving technologies in alfalfa cultivation	Collaboration with dairy co-op field staff; Intensive promotion and marketing; user feedback and product improvement	
6 Promotion of water saving farming methods in non-fodder crops	Collaboration with dairy co-op field staff; Field trials of technologies and best practices; farmer demonstration and promotion;	
7 Promotion of water-saving, high value crops, especially orchards	Farmer participatory trials; package promotion	
8 Roof water harvesting for drinking and cooking water security	Demonstration and promotion of roof water harvesting structures; linking up with GWSSB scheme of financial support	Rural Management/ Mass Communication/ Social Work: 5
9 Communication campaign to support demand & supply side interventions	Design and implementation of messages, medium and communication strategy	
10 Community Monitoring of Groundwater table fluctuations	Establish and run the participatory monitoring systems in a learning mode	
11 Dairy Co-ops' intensive member-education program on Best Practices	Design and package key messages; organize training of co-op field staff; monitor and evaluate training effectiveness	
12 Water Seller Education Program	Design key messages; work with select group of water sellers/companies in a learning mode; explore windows of opportunity for behavioral change	
13 Planning, Monitoring, Evaluation and Research Support	Develop basin and watershed plans; monitor impacts; provide quality feedback; practical problem-solving research	Hydrologists and Social Scientists : 5

**Table 4 Rough-cut Budget for the Two-Year Pilot**

Line Items	Year 1 (Rs million)	Year 2 ( Rs million)
1. Staff salary ( 1 Project Leader+18 professionals + 8 field and support staff) #	4.5	6.2
2. Operating funds # #	10.0	15.0
3. Establishment cost, mobility, communication, administrative support	1.5	1.8
Total	16.0	23.0

#All staff will be hired on 2 year contracts at consolidated salary and benefit packets that will be competitive with local market conditions.

## Operating funds cover seed money grants, costs of technical consultancy, costs of the design of communication products, field trials of technologies,

