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Water resource study for the wider Auroville area

a project of the Development Group and the Working Commmittee

Auroville, August 1995

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I. AUROVILLE

"Auroville is an exciting project for bringing about harmony among different cultures, and for understanding the environmental need for Man's spiritual growth."

Indira Gandhi

Auroville was founded by the Mother in 1968, who envisaged an international township of 50,000 people as a "site of material and spiritual researches for a living embodiment of an actual human unity."

On its inauguration day, the 28th February, young men and women from 124 countries and the Indian states placed handfuls of earth from their homelands in an urn, symbolising the creation of a city dedicated to peace and international understanding.

Today, Auroville is an expanding community with people, from India and from 25 countries around the world. Located in a rural area of South Arcot District of Tamil Nadu, South India, it is surrounded by 20 villages with an approximate population of 35,000 inhabitants.

"Auroville is to be looked upon as a vision that has great potentiality and this can be of tremendous value to our country and the world at large".

Shri P. Shiv Shankar,
Indian Minister of Human Resource Development in 1988

The Auroville area is situated on the east coast, with marine sedimentary rocks. The centre of the town is about 3 km from the sea. There are approximately 1200 residents over the area of 15 km^2. Three villages in the vicinity bring the total population close to 5000 persons at the moment. The core of Auroville: the city area, has a radius of 1.5 km from the town centre. Planning is geared currently towards an ultimate population of 50,000 persons.

Even at the present, there are water shortages in summer, especially after bad monsoons the previous year. Also, with rapid changes in population, the establishment of gardens and new industries, the problem of water availability and quality is of grave concern both in the short and long run. In the past decade, intensive groundwater use in surrounding areas has already led to saltwater intrusion near the coast.

Auroville has pioneered several measures to improve the water situation through surface water storage and by improving the recharge conditions by vegetative measures. These measures have helped the water resource condition, but it is believed that the future availability of water may be a limiting resource to the growth of Auroville.

The Development Group in a joint venture with the Working Committee of the Auroville Foundation, an autonomous institution created under the Auroville Foundation Act, 1988, has decided to commission a study to understand the water resource situation and to work out options for developing water resource to meet the current and future needs of Auroville.

II. BACKGROUND

Auroville area is situated in a sedimentary terrain. The sedimentary rocks vary in thickness from 200 to nearly 500 m. and contain four main aquifer zones. They overlay the Archean charnockitic rocks. Over the last 25 years the two shallower aquifers belonging to Tertiary formations have been extensively tapped by tube wells up to 150 m. depth. A few deep wells up to 400 m. have also been drilled.

25 years ago the Auroville area was mostly barren. Today afforestation and soil and water conservation work is well under way. Large tracts of earlier one crop fields and barren lands have been afforested with the result that runoff losses have decreased. However, growing water demand along with the building of new settlements and industries have increased ground water usage considerably. In the neighbourhood of Auroville area, the cropping pattern has changed considerably towards water intensive crops like sugar cane, rice, etc.

In summers, water shortages in some parts of Auroville have been reported. A decline of the water table has been observed in tubewells, especially where submersible pumps are used. This indicates that the shallow aquifer zones are already overtapped at least in some parts.

The Central Ground Water Board (CGWB) carried out hydrogeological investigations in this area in 1984. That study recommended further development of shallower aquifers on moderate scale. It also has indicated that the water from deeper aquifers has higher quantity of dissolved salts (mainly chloride) and hydrogen sulphide and is hence suitable for limited irrigation alone.

III. OBJECTIVES

1. To understand the stocks and flow of ground and surface water in Auroville and its immediate neighbourhood.

2. To quantify the ground water draft at present and likely changes with different scenarios of development and management (at least three each).

3. To identify possible ways of sustainable management of water and possible limiting constraints on water availability with different population sizes.

4. To establish mechanisms for long term monitoring of water resources.

IV. RATIONALE

Auroville provides an example of successful implementation of soil and water conservation measures taken up by the community that is replicable at any other place in India.

At the same time Auroville community has also increased the water usage to meet its growing needs. As Auroville community is interested in remaining environmentally sustainable, water management with a long term perspective is essential. Setting up a sustainable water management system can go a long way in promoting this much needed action also elsewhere. A baseline study on water resources is needed to understand the water resource conditions, present usage pattern and possible options for improving use efficiency.

Water is likely to be one of the limiting constraints on further expansion on a longer time scale. Before the planned expansion of Auroville community to 50,000 residents is taken up, this issue needs to be resolved. Because unless the future growth and expansion is planned in consonance with water availability, water shortage and water quality problems are inevitable.

The groundwater will allways be the main source of water for Auroville as there are no perennial sources of surface water in the area under Auroville's control. With increasing depletion of existing water bodies in the neighbourhood, the dependency on external resources may not be desirable. At the same time, the medium term option of using the deeper Cretaceous aquifers may not be advisable as they are reported to be containing high dissolved salts and hydrogen sulphides.

With nearly 1,000 mm. of annual rainfall, an effective strategy combining rational exploitation of the renewable part of the water resources combined with measures to increase use efficiency can be evolved.

This study will provide necessary information for analysing future scenarios that will be essential for developing a sustainable water management strategy. It will also provide necessary inputs for designing future settlement and development patterns in consonance with water availability.

To manage water resources effectively, an internal mechanism for monitoring and control will be needed. This study will aim at training a team in Auroville to monitor the water resources and the usage pattern on a regular basis. This will help to further increase the awareness level in the Community and develop organisational knowledge to take up pre-emptive action whenever needed to deal with future changes.

V. METHODOLOGY

This study will be based on scientific and social surveys. Data will be computerised and a geographical reference established with the existing Geographic Information System (GIS). This allows for a detailed analysis and a databank will be generated for future references.

This study will cover:

1. Bascline study of both surface and ground water resources

This involves:

a. Study of surface water systems

The existing surface water structures will be analysed to understand the surface water system. This study will include estimation of:

i. Catchment area, storage capacity and inflows into different reservoirs and other hydrological parameters.

ii. Groundwater recharge from these structures.

iii. Retention period and evaporation losses from reservoirs.

iv. Feasibility of using surface water during monsoon and post-monsoon period.

v. Effect of existing vegetative and other engineering measures on water system.

b. Mapping of large and minor aquifers and estimation of their properties and their variations

This part will be based on existing data and exploration during the study. More emphasis will be given to detailed mapping of shallow aquifers up to the base of the Tertiary aquifers and smaller aquifers inside them (mainly because of lower water quality in Cretaceous aquifers). A few deep vertical electric soundings to understand Cretaceous aquifers will also be done. This study will utilise data from:

i. Existing lithologs and electrical logging of existing wells.

ii. Vertical electrical sounding and profiling.

iii. Aquifer properties by well tests, slug tests and rock sample studies.

Approximately 250 shallow electrical soundings (up to 200 m. depth), 25 deep electrical soundings (500 m.+) and 20 electrical profiles will be carried out. Around 20 pump tests and slug tests in all possible tubewells will be carried out. Around 100 rock and soil samples from various sedimentary formations will be tested for porosity and permeability.

c. Estimation of ground water draft and its use

Estimation of ground water draft will be done by 100% survey of existing wells within Auroville and immediate neighbourhood (within 3 km radius of Matrimandir. In addition, around 5% sample study of wells in villages within 5 km radius will be done.

d. Estimation of ground water balance

Ground water balance study will be done using rainfall infiltration and water table fluctuation methods using mostly primary data gathered from the earlier parts of the study. It will include study of:

i. Annual rainfall and micro-catchment runoff.

ii. Recharge into aquifers.

iii. Outflow (especially towards the coast)

e. Assessment of changes in ground water situation based on available records

f. Water quality studies

Water quality from various sources in three seasons will be studied. This will be done at Auroville's laboratory. Basic chemical parameters and bacteriological analysis will be done. Samples that reveal high coliform or toxic elements (heavy metals) will be analysed in detail. Wherever possible, the sources of contaminants will be identified.

2. To evaluate current management practices and suggest methods for their optimisation

This part will be based mainly on the survey of the various users, user groups and assessment of various water supply systems in Auroville and neighbouring villages. It will cover studies on:

a. Different water supply systems and the usage pattern among various sections of Auroville and the rural population.

b. Water conservation measures carried out so far and their effectiveness in improving recharge into aquifers based on available data.

c. Feasibility of reduction in usage of water through increasing usage efficiency.

d. Economically viable options to reduce water usage in irrigation.

At least three likely scenarios of development and their consequences on water needs and water availability will be analysed. Possible options for water conservation in each scenario will be worked out. Investment costs for developing the water system to meet additional needs in each case will also be estimated.

3. Establishing a monitoring system to optimise water use in Auroville

This would include:

a. Developing protocols for recording well levels, current usage and necessary chemical and biological analysis parameters.

b. Training a team to carry out the above as a routine activity.

c. Recommending institutional mechanisms for water education, monitoring and management.

VI. TIME FRAME

This study shall be done in two stages covering a total of 6 months. The first stage will cover 4 months (with 2 months of pre-monsoon and 2 months of monsoon period). The second stage of two months will cover post-monsoon period. This will be necessary to understand the ground and surface water systems in necessary detail.

VII. TEAM COMPOSITION

The team will consist of hydrogeologists, civil engineers and socio-economists. This work will be taken up by a team of senior and junior professionals, which will be aided by field assistants, who will be trained in data collection and analysis. The team will be led by Mr. G.K. Bhat of TARU for Development, who will be the consultants for this project.

The Auroville co-ordinators for the project will be Mr. Jürgen Pütz, Angad Vohra, Mr. Jan Imhoff and Dr. Rauf Ali.

VIII. OUTPUTS

1. Reports

a. Surface water conditions in Auroville and impacts of interventions.

b. Hydrogeology of Auroville area and neighbourhood.

c. Current water usage pattern in and around Auroville and scope for optimisation.

d. Water needs under different development scenarios and possible impacts on ground water systems.

e. Design for water monitoring and a water management unit.

2. Training of a core team for water monitoring

IX. BUDGET

Item	Unit	Cost / unit	Number of units	Total (Rs.)
Senior professionals	man-months	15,000	12	1,80,000
Junior professionals	man-months	8,000	18	1,44,000
Field assistants	man-months	2,500	36	90,000
Field expenses				40,000
Equipment rent				50,000
Water quality and soil/rock sample analysis		500	100	50,000
Xerox and stationary				30,000
External consultancy	man-months	20,000	3	60,000
Local travel				50,000
Outstation travel		5,000	10	50,000
Computer rent	months	5,000	6	30,000
10% overhead and contingencies				77,400
Accommodation, board and lodging for 6 people, 6 months / Rs. 200 per day				2,16,000
Rent of office space	months	5,000	6	30,000
Total				**10,97,400**

X. OTHER REQUIREMENTS (not budgeted)

The following items are to be provided by Auroville:

1. Topographic map of the area on 1:4000 or 1:8000 scale with contour interval of 1m. with an accuracy of at least 30 cm. in Z direction and less than 2 m. in XY directions.

2. Satellite data

   2 season (April - June and November - December) of 1987 and 1995 period. (SPOT MLA if available or IRS LISS II) on 512 x 512 (x 3 bands LISS II) / (x 4 bands SPOT MLA) on 1.2 MB diskettes.

   1024 x 1024 for SPOT PLA on 1.2 MB diskettes. Alternatively if LISS III data is available by then, it is preferable.

   (Total costs of data are around Rs. 10,000.)

3. A set of equipment for long term monitoring

   a. Digital water conductivity meter.

   b. Digital thermometer (0 - 60 or 20 - 100 degree Celsius range with 0.1 degree accuracy).

   c. Basic water analysis kit for chemical and bacteriological analysis.

   d. A 486 PC with math co-processor and colour deskjet printer and plotter.

   e. A submersible pump set and generator set (7.5 HP) and required accessories.

   f. A portable generator set with at least 1000 VA capacity.

APPENDIX

RAINFALL

The advancing South-west summer monsoon which is the main dependable monsoon for most of India, occurs only spasmodically in Tamil Nadu, and brings relatively moderate rain. The retreating North-East winter monsoon is the main one for the region but not really dependable.

The area is classified as tropical dissymmetric because tropical implies regular rainfall patterns in the summer and the winter. But here they are irregular and unequal, thus dissymmetric.

Yearly rainfall:

Maximum (from 1972 to 1983)	1,898 mm (in 1978)
Average (from 1911 to 1968)	1,266 mm
Average (from 1968 to 1988)	1,259 mm
Minimum (from 1972 to 1983)	729 mm (in 1980)

Seasonal average rainfall (1968 - 1988):

Winter	(January - February)	42 mm 3%
Hot weather	(March - May)	61 mm 5%
SW monsoon	(June - September)	351 mm 27%
NE monsoon	(October - December)	805 mm 65%

Monthly rainfall in mm recorded in the Auroville area during the years 1990 - 1994, and average monthly rainfall in mm from 1968 - 1988:

Year	**90 - 91**	**91 - 92**	**92 - 93**	**93 - 94**	**94 - 95**	**68 - 88**
April	0	0	0	0	2	7
May	0	0	0	11	5	33
June	20	144	27	132	46	35
July	0	29	48	40	110	80
August	210	141	40	181	143	133
September	155	173	153	200	39	123
October	470	196	167	252	239	153
November	205	283	445	375	459	367
December	75	0	77	398	79	185
January	20	0	0	0	—	22
February	0	0	0	67	—	20
March	0	0	0	0	—	21
Total	**1155**	**966**	**957**	**1656**	**1122**	**1179**

Note: Average number of rainy days per year: 52

Maximum recorded rain intensity:
390 mm in 24 hours (November 1978)
10 days of non-stop rain (November 1986)

SUMMARY

In the last 25 years Auroville has set an example as to how, with the means of afforestation, soil and water conservation work an almost barren region can be transformed into a fertile 'Green Belt' with large sectors of forest and a high diversity of vegetation, that is replicable in any other part of India.

The township of Auroville is the centre of this 'Green-Belt'.
In planing and developing this township, which is projected to accommodate 50,000 residents the availability of water has to be studied in detail. Growing water demand along with the building of new settlements and industries already has increased ground water usage considerably. Water shortages in some parts of Auroville have been reported indicating a decline of the water table and intensive irrigation in surrounding areas has led to saltwater intrusion near the coast, which is irreversible.

With nearly 1,000 mm of annual rainfall, that could replenish the Ground water aquifers a basis for an effective strategy is provided.

In February 1995 the Development Group in a joint venture with the Working Committee set up a Water Board. The objective is to carry out detailed studies of the water resources, increase the awareness of people and develop strategies to meet the current and future water demand of Auroville.

In the first 6 month all wells were mapped and monitored. A survey of the five Villages of the area was commissioned to study water consumption habits and data from other sources was collected and computerised. This recurring costs are met by the Development Group.

At this stage it is necessary to carry out a hydro-geological survey of the area. The survey is budgeted at Rs 11 lakh and will start in October 1995 and be completed by September 1996.
The aim is to provide a detailed analysis of the condition of the aquifers and to train a local team to continuously monitor the surface and underground waterflow.