

Town Planning - 20/3/72

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WATER RESOURCES : AUROVILLE

The Township will require an estimated $3\frac{1}{2}$ to 4 million gallons a day when complete, excluding requirements in the surrounding Green Belt and Agricultural zones.

Supply

Geological information available at present suggests that this requirement can not be met from within the Auroville area.

This is also the view of the U.N.D.P. Groundwater Development Team to Tamil Nadu, after five years' work on the coastal belt of Tamil Nadu, although they did not visit the actual site. Three possible sources are available, given below in ascending order of cost:

- (i) Groundwater from south of the River Jingee, and pipeline to Auroville (12 miles).
- (ii) Reclamation of Kalivelli Lagoon to the north, and surface storage of water in a part of it - the other part could be brought under cultivation. Pipeline to Auroville ($6\frac{1}{2}$ miles).
- (iii) Desalinization of sea-water.

In all cases, water would not be available for the Green Belt and Agricultural zones.

As a result Para _____, the water supply for Auroville has to be considered in two parts:

- (a) Township
- (b) Green Belt/Agricultural zones

The Township supply has been dealt with in _____ where the most feasible solution is given under _____. There is a proven ground water reserve in an Eocene aquifer, which, at 3 miles north of Cuddalore is about 500 ft. thick and has a transmissability of 120,000 gal/day/ft.

The Green Belt

Preliminary hydrogeological and soil surveys show that, generally speaking, the soils formed on the Tertiary deposits between the Township and the coast are poor and the water table very deep (30 ft.-130 ft.), but that the soils to the west of the Township developed on Cretaceous deposits are better and have a shallow water table (10 ft.-25 ft.). The permeability of the Cretaceous deposits is generally small: 30 ft. deep open wells may be used for small irrigation purposes, and bore-wells give medium yields from depths of around 300 ft.-500 ft. (say yields in the region of 8,000-12,000 galls/hour. This region also has many tanks which store the monsoon run-off for irrigation and which at the same time feed the ground-water table for a few months after the monsoon season.

It is thus recommended that the Agricultural Zone of Auroville be confined mainly to the west of the Township on the several soil types formed on Cretaceous deposits.

For the zone east of the Township, and lying between the Township and the coast, a "Soil and Water Conservation Project" has been Drawn up, based on preliminary studies, and given in the report below.

SOIL & WATER CONSERVATION PROJECT

Introduction

The Auroville area is situated on the Pondicherry Plateau, a small elevated plateau some 50 metres above sea level. The Plateau is composed of Pliocene deposits up to about 100m. thick, underlain by a thick Cretaceous succession of limestones, sandstones and marls. These overlie the crystalline basement at a depth of 400-800m.

The area is very dry. The monsoon rains occur mainly in heavy downpours which are mostly lost to the sea through the gullies,

causing severe sheet erosion on the way. Boreholes to depths of 130m. have not found any aquifers, and these boreholes produce only a little water. Geological investigations do not indicate the possibility of good equifers at greater depth, which, even if they do exist, probably could not be tapped extensively due to poor recharge. Nevertheless it is essential to bore one deep borehole for exploratory purposes, and it is expected that a very limited number of deep boreholes could be employed. However, it is expected that the water supplies for the township of Auroville will have to be brought from outside the immediate area, and such water would not be available for irrigation purposes.

Proposal

It is therefore proposed to initiate a programme of water conservation; to retain the monsoon waters, preventing them from running off and to store them underground instead. This would create a near-surface water table able to support forest growth and limited cultivation by irrigation. Preventing run-off would automatically stop soil erosion, and forest growth would gradually improve the soils and at the same time moderate the climate beneficially.

Very large areas of Tamil Nadu State have similar geological conditions, and as 93% of the total surface water available to the State is already utilised, development of ground water resources is the only alternative. The results of such a project would have important implications for about 30,000 sq. Km. of Tamil Nadu.

Project

A Project has been drawn up in outline for the Auroville area, covering about 230 hectares of Trials. The work essentially consists of ensuring that the monsoon infiltrates through the surface strata by levelling, bunding, providing check dams and other remedial works in the gully areas and planting forest and other suitable vegetative cover. The cost of equipment and of

executing these Trials, including the Scientific investigations, establishing a Forest Nursery etc. is estimated to be Rs.20 lacs (20,00,000/-) over four to five years.

Work undertaken

Initial studies have shown that such a proposal is feasible. The surface strata are as follows, generally throughout the whole area:

The surface bed up to 5m. thick is a sandy clay, lateritic in composition, with a poor sandy loam developed on the surface. In many places there is no development of soil at all, as it is immediately washed away in the monsoon in the absence of proper conservation work or vegetative cover. On tilled, but uncultivated, land, the infiltration rate on saturated ground has been measured at 16 cm./24 hrs.

This bed is underlain by a clay bound sand up to 12m. thick. It has a measured Porosity from 22% to 28% and a measured Permeability of about 5 galls/day/ft.². (approx. 0.2 darcy). This bed is underlain by a stiff fissured clay. Thus, if the monsoon waters are made to infiltrate through the top bed, they will be retained in the clay-bound sand as the underlying clay is practically impermeable. The permeability of this clay-bound sand is too low for it to be called an aquifer, and although this has the disadvantage that it could not easily be pumped back to the surface, it has the advantage that the ground-water will flow very slowly down the hill to the sea, and will be lost only very slowly. It is proposed that about 80% of the area under conservation in the total Plan (2,300 hectares) would be under Forest, and the remaining 20% would be cultivated, irrigation being from open wells - these areas being selected where the storage strata lie nearer the surface.

Observations in some deep gullies where the clay-bound sands outcrop have shown water seepage and small flows continuing for over two months after the last rain, giving confirmation to these proposals.

Forest Plantation Trials were started in 1971, when 35,000 seedlings were planted out. Survival rates after two months varied from 95% in areas having soil and where seedlings were watered to 40% in totally eroded areas where seedlings were not watered. However, if the surviving seedlings are not watered during the 1972 hot season (about twice a month minimum, for 3 months), few can be expected to survive. After the first year, the hardiest trees usually do not require watering. For this purpose, either bullock drawn or tractor trailer water tankers are essential.

A forest Nursery has been started where a windmill pump is being installed for Nursery irrigation. A proposed 6,00,000 seedlings are being reared in preparation for planting out during the 1972 monsoon. About a dozen varieties are being grown, the largest number being Casuarina equisetifolia and Hybrid Eucalyptus.

Immediate needs for preliminary work

Until funds become available to start the Project in full, the work is limited to scientific studies and the collection of basic scientific data, and Forest Plantation with minor remedial works. Since it takes several years to establish Forest Cover and for its effects to be measured, it is very necessary to make a start with this work now. Also, although not as effective as the more costly measures proposed for the Project Trials, plantation in itself is expected to reduce soil erosion and increase infiltration.

For the work in hand, immediate needs are listed:

Semi-temporary Field Office/Lab./Overnight accommodation	...	Rs.20,000
35 h.p. Tractor	...	35,000
5 Ton Tipping Trailer	...	13,000
5 Ton Water Tanks	...	6,000
Implements, one set	...	12,000
350 metre deep Exploratory Borehole: tests and Completion, afterwards to be used for supplying water for infiltration and groundwater movement tests and for Forest Nursery	...	94,000

Check Dams. Minor dams for gully reclamation, but mainly for measuring run-off so that infiltration can be estimated. This is necessary data. Three dams:	...	Rs. 18,000
Miscellaneous equipment for Forest Nursery, including tools and irrigation installations, etc.	...	15,000
	TOTAL:	Rs.2,13,000

NOTE: The Government of India permits the import of Agricultural Machinery without payment of duty. It would be very helpful if a Tractor having hydraulic take-off and a back-hoe digger could be imported, as this is not available in India, and would be of great value for Plantation work. Also, a vehicle, deisel driven, such as a Mercedes 'Unimog' would be very valuable for Forest Work.

Basically, this project aims at conserving the monsoon waters, by preventing their rapid run-off into the sea, as happens now, and which at the same time causes such serious soil erosion that there is little soil development to speak of, and large gullies up to 30 ft. deep are found in places. Run-off is to be prevented by terracing the gentler slopes and by afforestation; the best known cover to induce infiltration. Water will then be collected underground in a near surface water table, which will itself support forest growth - making the cycle self-generating once started. It is recommended that this whole zone of about 2,500 hectares be about 80% afforested, with small areas of cultivation here and there, comprising 15% to 20% of the area. These areas may be selected where the newly established water-table may be tapped by open wells for irrigation.

This project will provide at the same time the most suitable and pleasing environment for the Township - a true Green Belt, which will result in beneficial climatic moderations.

P A R T 2

M I N E R A L R E S O U R C E S

Limestone

It is reported that reserves of about one million tons of Cretaceous limestone may contain 42% to 50% CaO. This subject is covered in the Section on Industries.

Brick making

Suitable clay for bricks is not found within the Auroville area or its vicinity. On the Gingee River Flood-plain, where small kilns have long existed, it is reported that sufficient reserves of about 1.6 million tons are found that would justify a small semi-mechanised plant for grade 'A' bricks (See report by Geological Survey of India).

Building materials

Gravel bearing deposits exist to the west of Promesae, partly on present Government lands and partly on Auroville lands. The gravel is being worked and sold to Auroville and elsewhere by Pondicherry business men. Since this is a basic building material and will be needed in a very large quantity throughout the construction period of Auroville, it has been proposed that Auroville should start a gravel pit. Preliminary surveys show that two possible sites exist on land already belonging to Auroville where this work could conveniently be started. The reserves have yet to be estimated. The price of this material has just been increased on the local market.

Polished stone

Stone suitable for polishing for use as flooring and facing is available in the hinterland not far from Auroville. Charnokite, a dark almost black rock, takes a very good polish and is very durable. This rock would be very suitable for floors not open to the sun. Gneiss occurs as a white or very light rock with about 20% wavy dark or black banding, and takes a good polish. Although

less durable than the former, it is still a durable rock and would be suitable for interior or exterior facing, where it would appear similar to a decorative banded marble

High-strength concrete is better constructed with crushed charno-kite than with pebbles, so that the wastage from cutting blocks for polishing and from cutting to size, etc., would be used also. Such a quarry would, therefore, serve a double purpose.

P A R T 3

A GENERAL REPORT

Groundwater ~~XXXXXXXXXX~~ areas: Map

The surface deposits of Auroville are up to about 200 ft. of Tertiary red sandy clays and clay bound sands. This series is underlain unconformably by Cretaceous limestones, calcareous sandstones and marls. Ground-water is available from the Cretaceous sandstones, but only in limited quantity due to their low permeability. Lack of data and poor records of bore-hole logs prevent and general information about location of these aquifers to be given. The deposits are in any case not thought to be extensive in any direction, but lenticular. Further south, the lower horizons of the Cretaceous basin contain gypsum, and water from such horizons is brackish. The Cretaceous series lie unconformably on Archaean crystalline rocks at an unknown depth which would not yield ground water.

Major soil groups: Map

About eight major soil groups have been identified in the field, but lack of facilities, assistance, transportation and equipment have not made it possible to map them.

Soil erosion: Map

Severe sheet erosion is widespread on the eastern slopes, and less severe but present on the western slopes which are gentler. It has been controlled to a large extent further west, where terracing has been practised and reasonably good agricultural conditions prevail as a result.

Localised but severe gully erosion is found on the eastern slopes, which would also interfere with proposed remedial work under the "Soil and Water Conservation Project" which, therefore, calls for gully reclamation work.

WATER RESOURCES PLAN

Watershed management

The Soil and Water Conservation Project is a comprehensive scheme of Watershed Management and Development for the eastern slopes, resulting in

- o ground water storage
- o reduction of soil erosion
- o improvement of soil
- o afforestation
- o water supply for minor irrigation.

Flood management

This applies to river works: no river passes through the Auroville area. In the case that Kaliveli Lagoon reclamation is initiated, this subject would apply there.

Navigation

Large ships are able to approach close to the shore with safety except during the cyclone season. However, there is an extremely strong foreshore movement of sand, northwards for about 8 months and southwards for about 4 months during the monsoon, during which a greater quantity is moved than during the northward flow, resulting in a continuous build-up at the southern end of the Cauvery Delta. If the foreshore is breached anywhere, for example, by a river, the gap is immediately plugged by this lateral movement of beach sand as soon as the river-flood flow is over, and rivers having a large enough flow to keep open a mouth, invariably have a bar. For these reasons the construction of a harbour would present many difficulties. Apart from this factor, a good harbour site could possibly be found at the southern end of Kaliveli Lagoon, where it is separated from the sea by a relatively narrow stretch of land. The whole harbour site would have to be excavated. It is proposed to have an airport in this general area, and there may be many reasons favouring location of a medium sized Port there also.

Hydro-electric power

No possibility.

Irrigation

Dealt with under Part of this report.

Pollution drainage

Due to the general scarcity of water, the domestic waste water from the Township should be treated and used for agricultural or industrial purposes.

The industrial sector of the Township is located on the western, i.e., inland, slopes, and it is essential that contaminated industrial wastes are not discharged into the inland drainage system or into the ground water. The inland drainage system empties into Kaliveli tank, where, due to the relatively small turnover of water, contaminated water would accumulate, seriously interfering with any reclamation of Kaliveli Lagoon at a later date. In addition to this, Kaliveli is at present a Wildlife Sanctuary, (mainly wildfowl) and any possibility of industrial contamination must be avoided. The alternative to development of Kaliveli Lagoon as indicated above, is its proper development as Wildlife Sanctuary/Recreation area, and its freedom from pollution must be preserved.

Either Auroville only permits the establishment of industries in this zone which do not produce contaminated wastes, or a discharge pipe would have to be provided from the industrial sector to the sea, which would be costly inasmuch as it would require much excavation where it passes through high ground between the zone and the coast.

Recreation

This has been dealt with under Paras except for use of the sea. It may be noted here that expanses of fresh water are a health hazard in the climate of southern India, due to rapid growth of algae which becomes a breeding ground for infectious bacteria and viruses.

Fish & wild life

This has been dealt with under Paras except for use of the sea.

Sheet erosion control

The Soil and Water Conservation Project for the eastern slopes calls for terracing, bunding and afforestation to prevent or reduce sheet erosion.

Salinity

Over-pumping of ground water supplies, particularly along the coastal belt, will result in intrusion of sea water into the ground water. Deep aquifers are much less likely to be affected as the vertical permeability is probably almost negligible in comparison to the horizontal permeability.

Insect control

Stationary water provides a breeding ground for mosquitoes. To a large extent, Auroville is free from mosquitoes, and the creation of breeding grounds will inevitably change this desirable situation.