The Kerala Ground Water Act in Relation to Regional Hydrogeological Conditions of the State

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Abstract: The Kerala Ground Water Act recognizes ground water as a valuable resource to be used for the benefit of all sections of society. Seasonal rainfall, limited subsurface storage space and low water retention in laterite make ground water a rather scarce commodity in the state. The main features of the Ground Water Act are discussed in this paper. One of the primary requirements for groundwater management is availability of data on existing wells. The provisions in the Act may lead to the creation of a partial database on wells. A detailed well census is required for a proper assessment of the status of groundwater resources in the state. Large regional variations in availability and use of ground water call for different management approaches in different areas. Application of the same rule may have different consequences in different places. Hence it is necessary to appreciate the spirit behind the Act while implementing it. Case studies of a few panchayats are given to illustrate the point. While different interpretations of groundwater rights are possible, the Kerala Act seems to uphold the principle of reasonable use. The need for groundwater pricing leading to more efficient use of the resource is stressed.

INTRODUCTION

Legislation on ground water was enacted in the state for the purpose of regulation and control of groundwater extraction and use and to provide for conservation of this vital natural resource. It reflects an awareness and affirmation of the fact that ground water is a critical renewable resource and hence its use has to be limited to the quantity that can be safely extracted without causing mining of the resource and associated environmental and social problems. As a result, the Kerala Ground Water (Control and Regulation) Act, 2002 came into effect on 16th of December, 2003. The Rules required for implementing the Act were formed on 16th of March, 2004. The Act is implemented by a body called the State Ground Water Authority, which was constituted on 15th of January, 2004. The Authority consists of the following 13 members: nine members nominated by Government, three Secretaries to Government and the Director of State Groundwater Department.

Need for regulation of groundwater use arises when the quantum of resource used approaches or exceeds the quantity available in an area. Thus, availability and present use are the prime factors

which influence groundwater legislation. Hence a brief description of climatic and hydrogeological features controlling groundwater availability in the state and the present status of groundwater resources is given first in this paper.

GROUNDWATER AVAILABILITY

Eighty eight percent of Kerala state forms a hard rock terrain consisting of crystalline rocks (Gneisses, Charnockite and Khondalite) overlain by a weathered zone, mostly laterite (Fig. 1). The weathered zone has limited thickness, generally around ten metres, and high porosity and permeability. In areas where the laterite has a large thickness, such as 15 to 30 metres, the lower portion of this zone is a clay with very little permeability. The crystalline rocks underlying the weathered zone are massive or slightly fractured in most places, zones of intensive fracturing being limited in occurrence. The topography in the midlands and highlands (forming the major part of the state) is undulating to rugged, which results in steep gradients of groundwater flow. Thus the geomorphologic features of

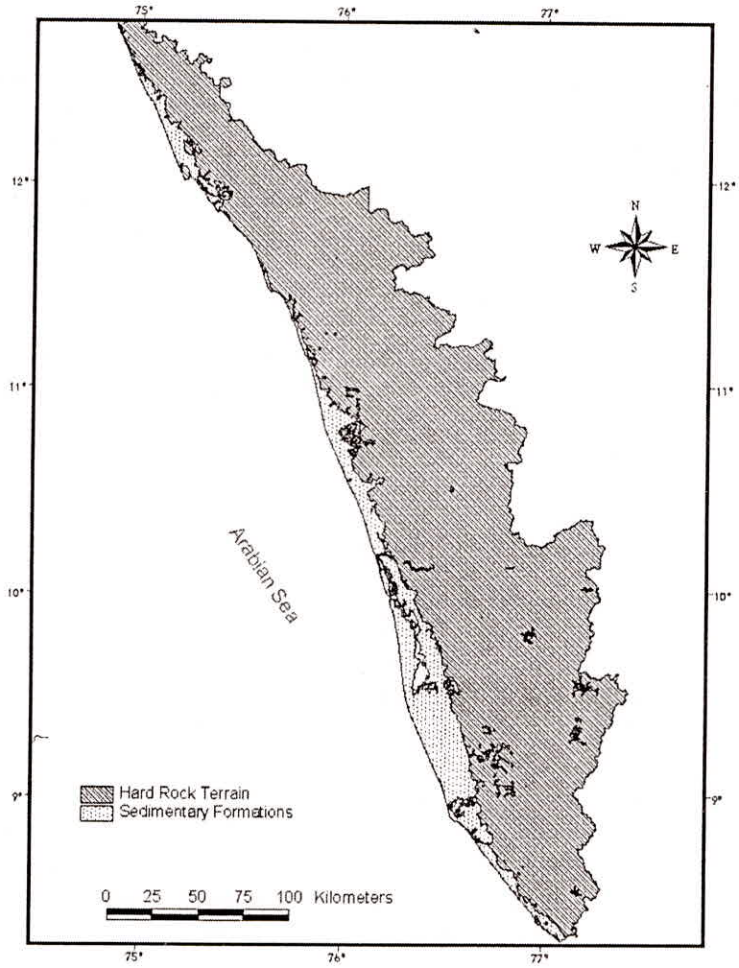

Fig. 1. Major hydrogeological subdivisions of Kerala.

the state are not favourable for occurrence of significant resources of ground water. Subsurface storage space for water is limited and flow of subsurface water to rivers and the sea is rapid. The coastal zone contains sedimentary aquifers in the southern part of the state. However, the quality of ground water is poor in many places here. Since these aquifers trend as linear patches parallel to the sea coast, possibility of salinewater intrusion exists and this limits the potential. Similarly, the network of saline backwaters in the coastal area makes ground water brackish in many areas adjacent to it.

The state has a tropical monsoon climate with an average annual rainfall of 3000 mm. About eighty five per cent of this rainfall occurs in six months of monsoon rains. The major part of monsoon rainfall is again concentrated in a short period of two months. The highly seasonal pattern of rainfall is unfavourable for groundwater recharge and retention of water in the subsurface. Thus the geological, topographical and climatic factors of the state do not support occurrence of major groundwater reservoirs. The limited resources available have to be used judiciously, fixing priorities for use wherever necessary. It is necessary to consider this fact while preparing a plan for groundwater development and management for the state.

The Groundwater Estimation Committee did a study on the groundwater resources of the state in 2004 (Central Ground Water Board, 2005). The annual groundwater availability was estimated as 6229 MCM. The total annual groundwater draft is 2920 MCM, which is 46.8% of available resources. It comprises 1821 MCM used for irrigation and 1099 MCM for domestic and industrial needs. Five blocks were classified as over-exploited, fifteen as critical and thirty as semi-critical. Based on this the Government, on the recommendation of the Kerala Groundwater Authority, declared the five over-exploited blocks as "notified areas" under the Kerala Ground Water Act. The balance groundwater potential of the state is not uniformly distributed.

SALIENT FEATURES OF THE ACT

There are three main features in the Act: (1) declaration of certain areas as notified areas with a view to control further groundwater development in the area, (2) registration of groundwater users in all parts of the State and (3) protection of public drinking water sources.

1. Notification of Areas

Areas where regulation of extraction or use of ground water is required can be notified under the Act. Notification is done by the Government on the recommendation of the Authority. In notified areas, the Authority's permit is required for constructing a new well. Open wells for domestic purpose and wells constructed by Government are exempted from this requirement. Permit is also required for energising an existing well. However, permit for energisation of existing wells is not necessary if the motor horsepower of the pump to be installed is 1.5 or less in the case of open wells and 3 or less in the case of bore wells and tube wells. The Act also requires all owners of existing wells in a notified area, except owners of open wells used for domestic purpose, to register with the Authority. The Authority can refuse to grant permits or registration certificates if investigation by the hydrogeologist indicates a need to do so in public interest.

Discussion: All farmers, including small and marginal farmers, are brought within the ambit of the Act in Notified areas. This is essential in a state like Kerala where land holdings are small (average land holding of a farmer is 0.27 ha as per Farm Guide, 2006). In fact, willing participation of such

small–scale groundwater users is crucial for the success of groundwater management efforts in a region having a large population and limited groundwater resources. In the case of bore wells, new domestic wells also require permit. This is again justifiable in over-exploited areas with high density of population. Some parts of Kasaragod block in northern Kerala located near the sea and areas near tidal rivers are examples. Here extraction of ground water through closely-spaced bore wells (mostly for domestic purpose) could lead to inflow of saline or brackish water. In some densely populated coastal panchayats like Kadalundy, the groundwater development, though restricted to domestic needs only, has given rise to disputes and court cases. Registration of all existing wells is essential for creating a data base for resource management.

2. Registration of Groundwater Users

A groundwater user is defined as a person using ground water from a dug well with pump of horsepower greater than 1.5 or a bore well/tube well with pump of horsepower greater than three. Owners of domestic wells are also included in this category if the horsepower is above the specified limits. All users in the state have to register with the Authority. Only about 4000 applications for registration have been received till now.

Discussion: The distribution of land holdings in Kerala, as per the 1995-96 Agriculture Census (Farm Guide, 2006), is given in Table 1. According to this, marginal farmers, with an average land holding size of 0.15 ha, hold 94 per cent of the total number of operational holdings and 53 per cent of the total area of the holdings. In Kerala, the land owned by marginal farmers is mostly garden land having coconut palms, plantains, etc. Further, use of ground water for paddy cultivation is rare in the state. Pumps of 1.5 HP (in the case of dug wells) and 3 HP (in the case of bore wells) are sufficient for

Table 1. Operational holdings

		Kerala			*India*	
		As per 1995-96 Agri. Census			*As per 1995-96 Agri. Census*	
Sl. No.	*Class and size of holdings*	*No. of operational holdings (lakhs)*	*Average size of holdings (area in ha.)*	*Area (lakhs ha.)*	*No. of operational holdings (lakhs)*	*Average size of holdings (area in ha.)*
1	Marginal (<1 ha)	59.18	0.15	9.12 (53.24)	711.79	0.40
2	Small (1-2 ha)	2.62	1.34	3.50 (20.46)	216.43	1.42
3	Semi medium (2-4 ha)	0.96	2.54	2.44 (14.20)	142.61	2.73
4	Medium (4-10 ha)	0.20	5.20	1.04 (6.08)	70.92	5.84
5	Large (> 10 ha)	0.03	34.74	1.02 (6.02)	14.04	17.21
	Total	62.99	0.27	17.12 (100.00)	1.41	

Source: India's Agricultural Sector, CMIE February 2004. (Figures in brackets are percentage to total)

irrigating the garden lands of marginal farmers. As per the Act, the owners of these wells are not classified as groundwater users and hence are not registered with the Authority. Thus registration of groundwater users under the Act may not provide sufficient data for estimation of groundwater draft for irrigation in the state.

3. Protection of Public Drinking Water Sources

As per the Act, the Authority's permission is required for constructing a new well within 30 metres of a drinking water source from where water is pumped for public purpose. This rule is not applicable to any well for a drinking water scheme implemented by Government or local bodies or to a dug well meant for domestic purpose.

Discussion: Though the prescribed limit of 30 metres seems to be rather low, it is probably applicable in some of the coastal areas in the southern parts of the state which have thick sedimentary formations. Here the deeper confined sandstones overlain by clay beds and the shallow sandy formations at the surface may form more or less separate aquifers in many places. Thus a deep tube well and a shallow well such as a large diameter open well or a filter point well may be feasible at the same place. Similarly, the spacing may be reasonable in some highly potential valleys with permeable lateritic valley fills in the hard rock areas. However, studies of the hard rock fracture aquifer in the midlands have shown interference effects between bore wells separated by distances of 500 metres. Drying up of dug wells due to pumping from bore wells has also been observed. Great care is required in applying the provisions of the Act in such places.

Definition of well: By definition given in the Act, the term "well" does not include wells constructed by government agencies. Hence these agencies can drill wells in notified areas or near existing water supply sources without obtaining permit from the Authority. This may cause problems of well interference if a particular agency is constrained to ignore scientific considerations while deciding the location for a new well.

REGIONAL VARIATIONS IN GROUNDWATER AVAILABILITY AND PATTERN OF USE

The three physiographic divisions of the state, i.e., the coastal area, midlands and highlands, have differences in availability and use of ground water. The Palakkad Gap, which is a broad pass in the Western Ghat hill ranges, is a fourth physiographic division with good groundwater resources. The status of groundwater resources in three panchayats, one each in the Gap, the midlands and coastal area (Fig. 2), is reviewed here in the light of the provisions contained in the Groundwater Act.

Vadakarapathy Panchayat

This is at the eastern boundary of the plains of the Palakkad Gap and is adjacent to Tamil Nadu. It is a crystalline rock terrain with gneissic rocks and a moderately thick weathered zone of about 10 metres. Physiographic conditions here are different from the rest of the state, and are similar to the plains of Tamil Nadu. Here majority of dug wells are dry for about six months in a year, and the area depends on bore wells for its water supply, both for drinking and irrigation. This is one of the few places in Kerala where ground water is used on a large scale for irrigation. Average annual rainfall is 1215 mm. Streams present are seasonal.

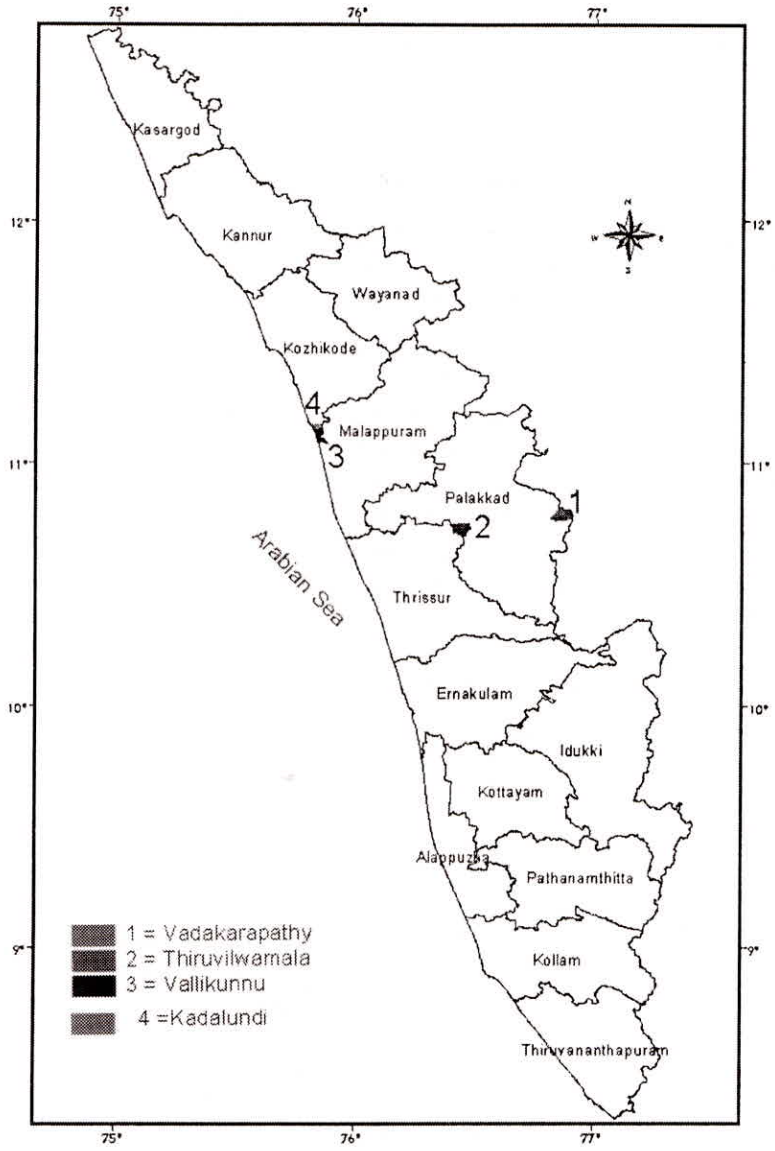

Fig. 2. Locations of study areas.

The panchayat has an area of 49.51 sq. km and a population of 25,717 (519 persons/sq.km), with 5995 households. A detailed well census was done here with the help of the local Kudumbashree unit. Out of the total number of 1950 wells in the area, 1593 are irrigation wells (32 per sq. km). Gross annual groundwater draft for all purposes was estimated as 10.88 MCM, out of which irrigation accounts for about 95 per cent (0.219 MCM per sq.km). Draft due to industries is less than one per cent of the total draft. Groundwater availability is only 6.3 MCM. The stage of development is 172 per cent, indicating over-exploitation. Observation wells show falling long term water level trends.

The area falls in Chittur block, which has been declared as "notified area" under the Act. Hence permit is required for new wells here. The question of how long permits can be issued in an over-developed area is a relevant management issue in this panchayat.

The Act contains a provision for registration of groundwater users, which is based on the horsepower of pumps installed in wells. Data on horsepower collected from this panchayat reveals that 968 out of 999 dug well pumps and 388 out of 473 bore well pumps fall above the cut off limits of 1.5 HP and 3 HP respectively. In such areas the Act would be effective in obtaining a reasonably correct picture of groundwater draft from registration data. 562 applications for registration have been received from this panchayat till now.

Thiruvilwamala Panchayat

This panchayat is in the midlands. It is also a crystalline rock terrain with gneisses and charnockite. Here the weathered zone consists of laterite, which has an average thickness of 6.7 metres. The phreatic aquifer has low potential, but does not totally dry up in summer as in Vadakarapathy. Topography is undulating and the area is bordered by Bharathapuzha, the largest river of Kerala. Groundwater use for irrigation is limited, and is mainly for garden crops like coconut and plantain. However it is the main source of domestic water supply. Annual rainfall in the area is about 2300 mm. The panchayat has an area of 35 sq.km and a population of 26,626 (761 persons/sq.km), with 5929 households.

A census limited to irrigation wells was done in this panchayat with the help of an NGO named AVARD. The total number of irrigation wells is only 260 (seven per sq. km), and these are mostly used for irrigating small patches of garden crops. Gross annual groundwater draft for all purposes was estimated as 1.45 MCM, out of which irrigation accounts for 54 per cent (0.02 MCM per sq.km). Industrial draft is negligible. Groundwater availability (by rainfall infiltration factor method) is estimated as 4.71 MCM. However, the water table fluctuation method indicates a resource of 1.8 MCM only and a stage of development of 81 per cent. The area does not come under the "notified" category.

Out of the total of 260 irrigation wells in the panchayat, 163 are dug wells, 46 are ponds and 51 are bore wells. Only seven bore wells fall above the cut off limit of 3 HP for registration as groundwater

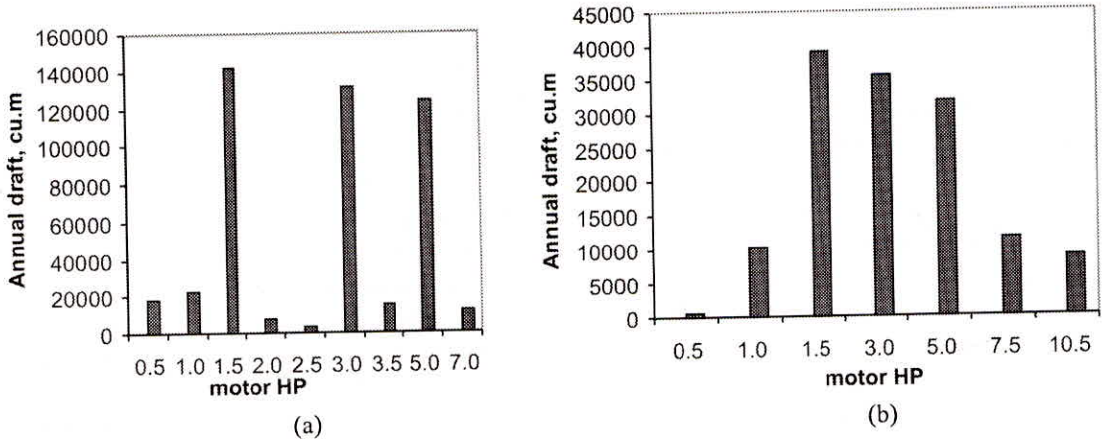

Fig. 3. (a) Annual GW draft from dug wells with pumps of different HP.
(b) Annual GW draft from bore wells with pumps of different HP.

user in non-notified area. Among the remaining 209 structures, 71 fall above the cut off limit of 1.5 HP for dug wells. Figures 3 (a) and 3(b) show the annual groundwater draft due to pumps of different horse power. In the case of dug wells, irrigation draft of about 0.182 MCM (38% of total draft from dug wells) is on account of wells with pumps of 1.5 HP and less. Similarly, a draft of 85,706 cubic metre (62% of total draft from bore wells) is due to wells with pumps of 3 HP or less. The registration data will not include these wells. Hence a well census is required in such areas for correct groundwater estimation.

Vallikunnu Panchayat

This is a coastal panchayat with low lands having sand and clay formations and hillocks of laterite underlain by crystalline rocks. The clay covered depressions or mud flats have groundwater of marginal to poor quality, which severely limits the groundwater potential of the area. The sandy and laterite patches have low to moderate groundwater potential. Irrigation is practically absent and industrial development is negligible. Domestic water requirements are met by ground water. Annual rainfall is about 2800 mm. The panchayat covers an area of 25 sq.km, and has a population of 43,123 (1725 persons/sq.km), with 8029 households.

Bore wells are rare due to the possibility of encountering brackish water at depth. There are about 4611 dug wells (183 per sq.km), almost all being domestic wells. Groundwater development is less than 50 per cent, but water quality problems limit the scope for any large scale development. The area does not come under the "notified" category though ground water is a critical resource here. Majority of wells here have pumps of 1.5 HP or less, and need not be registered under the Act. Thus the provisions in the Act do not lead to creation of a good database on wells or an estimation of groundwater draft in such areas. This is applicable to most panchayats in the coastal region. Detailed well census is required here.

GROUNDWATER RIGHTS

The issue of groundwater rights is very complicated. In the United States four doctrines of groundwater use law have evolved over time. The first law is based on the English Rule which recognizes ground water as a property right, ie, a land owner has total rights over the water under his land. The Reasonable Use Rule allows a property owner to use water under his land as long as the use is reasonable in comparison to the water needs of his neighbours. The Correlative Rights Rule apportions groundwater resources of an area on the basis of the amount of land owned by each person. The Appropriation Rule gives rights to the first users in an area, i.e., new comers in an area have little or no rights to water. Advances in groundwater science over the years have resulted in a shift from viewing ground water as private property to recognizing it as a valuable public resource.

The Kerala Groundwater Act recognizes ground water as a valuable resource to be used equitably for the benefit of all sections of society. It appears to uphold the principle of reasonable use of ground water by all concerned. Any other approach would probably be unscientific and impractical in a land as densely populated as Kerala. This is reflected in the provision in the Act which allows the Authority to include conditions or restrictions on groundwater use in permits and registration certificates. The conditions are prescribed on the basis of an examination of the following hydrogeological factors:

1. Purpose for which water is used
2. Existing users of the locality

3. Availability of ground water
4. Quality of ground water
5. Well spacing and well density in the area and the possibility of well interference
6. Rate of recharge
7. Chances for groundwater pollution
8. Long term water level trend

Drinking Water Issues

People in the rural areas of the state depend mostly on ground water for meeting their domestic needs. This has created problems in some coastal panchayats, where a high density of population and low groundwater potential has made existing domestic users raise objections to proposed new community drinking water supply schemes. Kadalundi panchayat in Kozhikode district is an example (Fig. 2). The area comprises laterite hillocks having good quality ground water surrounded by large tracts of low lands or mud flats with water of poor or marginal quality (Fig. 4). The rivers bordering the area are tidal and have brackish water. There are practically no industries here and irrigation use is negligible. Bore wells are not feasible even on hillocks since the fracture aquifers become saline with pumping. But the phreatic laterite aquifer on the hillocks supports about thirty community water supply wells and scores of individually owned wells which provide water for the population of 40,450 (3852 persons/sq.km.) in the panchayat. The area is in a critical state with regard to ground water. New dug well–based schemes near valleys have sometimes depleted levels in wells on higher ground. Some people have even filed court cases to stop new drinking water schemes. Places like Kadalundi are a challenge to any groundwater manager.

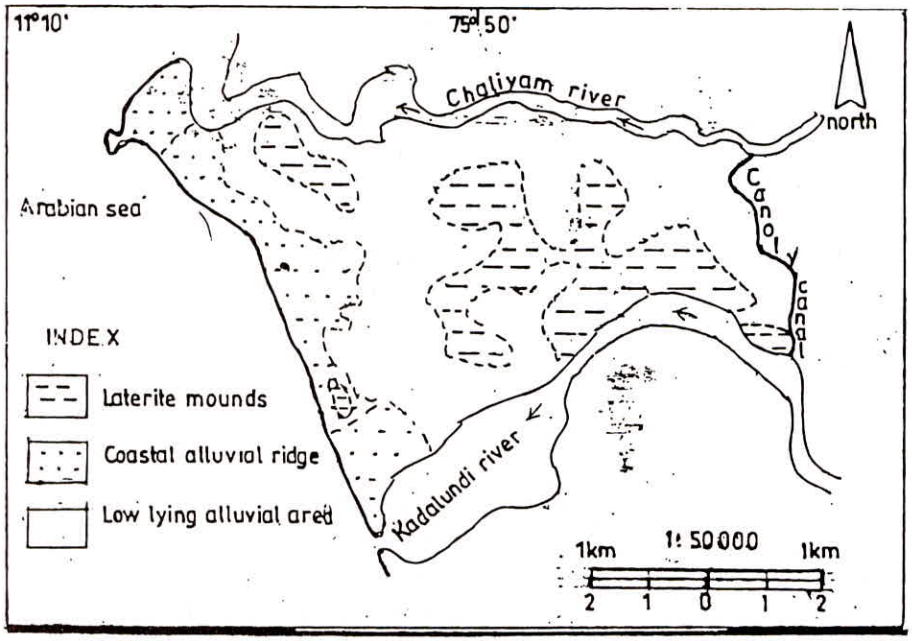

Fig. 4. Hydrogeological map of Kadalundi Panchayat.

GROUNDWATER PRICING

Development of bore well technology has resulted in a rapid increase in groundwater extraction in all parts of the world. In many areas the greater availability of water has led to a shift in agricultural practices. Water intensive crops occupied greater areas in farmlands, with a general rise in agricultural productivity and prosperity. Traditional water management practices were neglected. The uncontrolled use of this new found water source gradually led to over-exploitation of the groundwater resources and fall in groundwater levels. This has caused environmental and management problems in the water sector. Coupled with rise in population, it has given rise to drinking water shortages. Cost of pumping of ground water has increased due to fall in water levels. If this continues unchecked, it can cause excessive production costs and even drying up of aquifers. Eruthempathy and Vadakarapathy panchayats of Palakkad district are classical examples.

In the Eighties irrigation using bore wells started on a large scale in these panchayats. Water intensive crops like sugarcane and coconut replaced earlier crops like groundnut, maize and cotton in many farm lands. Since the bore wells here tap deeper semi-confined fracture aquifers connected to the shallow aquifer, over-exploitation gradually led to drying up of dug wells which provided drinking water to the people. In many areas here the water level in bore wells falls to depths greater than forty metres in summer, making it difficult for people to obtain water from bore wells with hand pumps. As a result the poor and landless have suffered. Now some areas in eastern part of Vadakarapathy are supplied drinking water in tanker lorries during the monsoon season when the rest of the state has an abundance of water.

Pricing of ground water could induce farmers to use water more efficiently. One way to do this would be to raise power costs in areas with groundwater over-exploitation. The revenue generated could be returned to the farmers in the same area in the form of subsidies on water–saving technologies like drip irrigation and schemes for rainwater harvesting. Ultimately there has to be a limit to groundwater extraction and increase in agricultural production.

In coastal panchayats like Kadalundi, shortage of water is experienced even though ground water is used for domestic purpose only. Community–run water supply schemes here charge for the water supplied to households. Collective responsibility in running schemes could make the people and the local-self governments understand the importance of limiting use and conserving water.

The per capita availability of ground water in Kerala is 530 lpd. There are factories, for example soft drink and water bottling units, which extract lakhs of litres of ground water per day. Charging a groundwater cess in such cases would be quite a reasonable and sensible step. Decisions taken on pricing, unpopular as they may be, are important for sustainability of groundwater resources. Delay in this matter may aggravate the problem.

CENTRAL AND STATE LAWS

The Central Ground Water Authority has notified two blocks in Kerala as over-exploited. These blocks are also declared as notified areas under the State Act. CGWA requires all wells, except non-energized dug wells used for domestic purpose and bore wells with hand pumps, to be registered. Under the State Act all wells, except dug wells used for domestic purpose with pumps upto 1.5 HP, have to be registered. The two laws prescribe vastly different application forms. The State Groundwater department, which is expected to complete registration under both Acts, is likely to face the wrath of the citizens.

CONCLUSIONS

Legislation on ground water has a direct impact on the common man. Its success will probably depend on the response and cooperation of the people. An awareness at all levels on the need for groundwater management and sharing of the limited resource is essential for successful implementation of the Act. Excessive withdrawal of ground water to satisfy local demands could eventually lead to drinking water shortages and deterioration in water quality. Measures directed at pricing of ground water could lead to more efficient use of available water. Wide regional variation in groundwater availability and pattern of use indicates a need for different priorities in different areas. The Kerala Ground Water Act is in its infancy and will probably have to change and adapt to circumstances. Experience gained in implementing the Act in the coming years will be crucial. This legislation made by the State Government could go a long way in promoting the welfare of the people of the State, if it is accepted and acted upon in the right spirit.

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(The views expressed in this paper are of the authors only)