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Harnessing unexploited water resources – hydrogeology of springs in the midland regions – a case study from India

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ABSTRACT

The paper describes a case study on spring development in a typical midland region of the Thiruvananthapuram District in Kerala, India. Field investigations show that there are eleven perennial springs, which can be developed as drinking water supply schemes. These springs are 'contact' springs formed at laterite–sandstone, laterite–khondalite, and laterite–coastal alluvium. One of the springs developed between the contact of laterite and khondalite in the midland area is presented in this paper. The summer discharge of the spring is 28,800 l/day and benefits 100 local people. The paper also brings out a comparison between bored well and spring water supply scheme in this midland area.

INTRODUCTION

The hilly watersheds of the Thiruvananthapuram midland region of Kerala in southwestern India generally show a paradoxical situation with respect to the use of water resources as they experience scarcity during summer. Undulated terrain, complex hydrogeology, harsh climatic conditions, and growing population are possible causes for water shortage. This poses difficulties during summer for getting drinking water in that area. The unexploited water resources existing in the midland region of the Thiruvananthapuram area are described in this paper. These resources can be exploited by storing water in tanks and using when required. Development of water resources through this 'spring technology' is found more feasible than constructing bored wells. An inventory of springs existing in the study area as well as one of the springs developed is described below.

HYDROGEOLOGY

The midland region of Thiruvananthapuram has Recent coastal alluvium underlain by laterite of Pleistocene age. It is underlain by either sandstone (Warkalli Formation) of Miocene age or khondalites (garnetiferous sillimanite gneiss) of Precambrian age (Basak and Nazimuddin 1983). Fig. 1 is the geological map of the study area.

The groundwater occurs in the study area under unconfined condition in coastal alluvium, laterites, and sandstones. Open wells and bored wells are the main sources of drinking water in the midland region. The study area has an elevation ranging from 7.6 to 76 m above mean sea level (Fig. 1). Though the midland area receives 1500 to 1900 mm of rainfall, most of the water is lost in the form of runoff and subsurface outflow, resulting in depletion of groundwater table and drying up of most wells. The bored wells in this region are also a failure when compared to the cost of construction and yield. Table 1 gives the rainfall pattern of the area for the last 50 years (Basak and Nazimuddin 1983).

TYPES OF SPRING

A spring is defined as concentrated discharge of groundwater flow issuing at the surface as current of flowing water. This forms another source of drinking water in the hilly midland regions of Thiruvananthapuram. These are frequently found on hill slopes and in the valley. Field studies of springs in the Thiruvananthapuram midland region reveal that these are 'contact springs' of perennial nature. Fig. 2 gives the location of 11 springs in the area. The springs are formed at the contact of (1) coastal alluvium–sandstone, (2) laterite–sandstone, and (3) laterite–khondalite. Fig. 3 is a simplified sectional model of the hydrogeological conditions of the above springs.

Table 1: Seasonal rainfall and rainy days in the midland-Thiruvananthapuram (Nazimuddin 1999)

Thiruvananthapuram midland		Zone I	Zone II	Zone III
Seasonal rainfall in mm.	(Pr.M)	329	381	348
	(M)	619	977	730
	(PM)	532	547	672
Rainy days	(Pr.M)	17	18	19
	(M)	18	45	29
	(Pr.M)	19	39	27
Total rainfall in mm		1457	1600	1900

Zone I - Southern midland-area between Parassala and Vellayani
Zone II - Northern midland-area between Korani and Pallikkal
Zone III - Central midland - area between Korani and Vellayani
Pr.M - Pre-monsoon season; M - Monsoon season
PM - Post-monsoon season

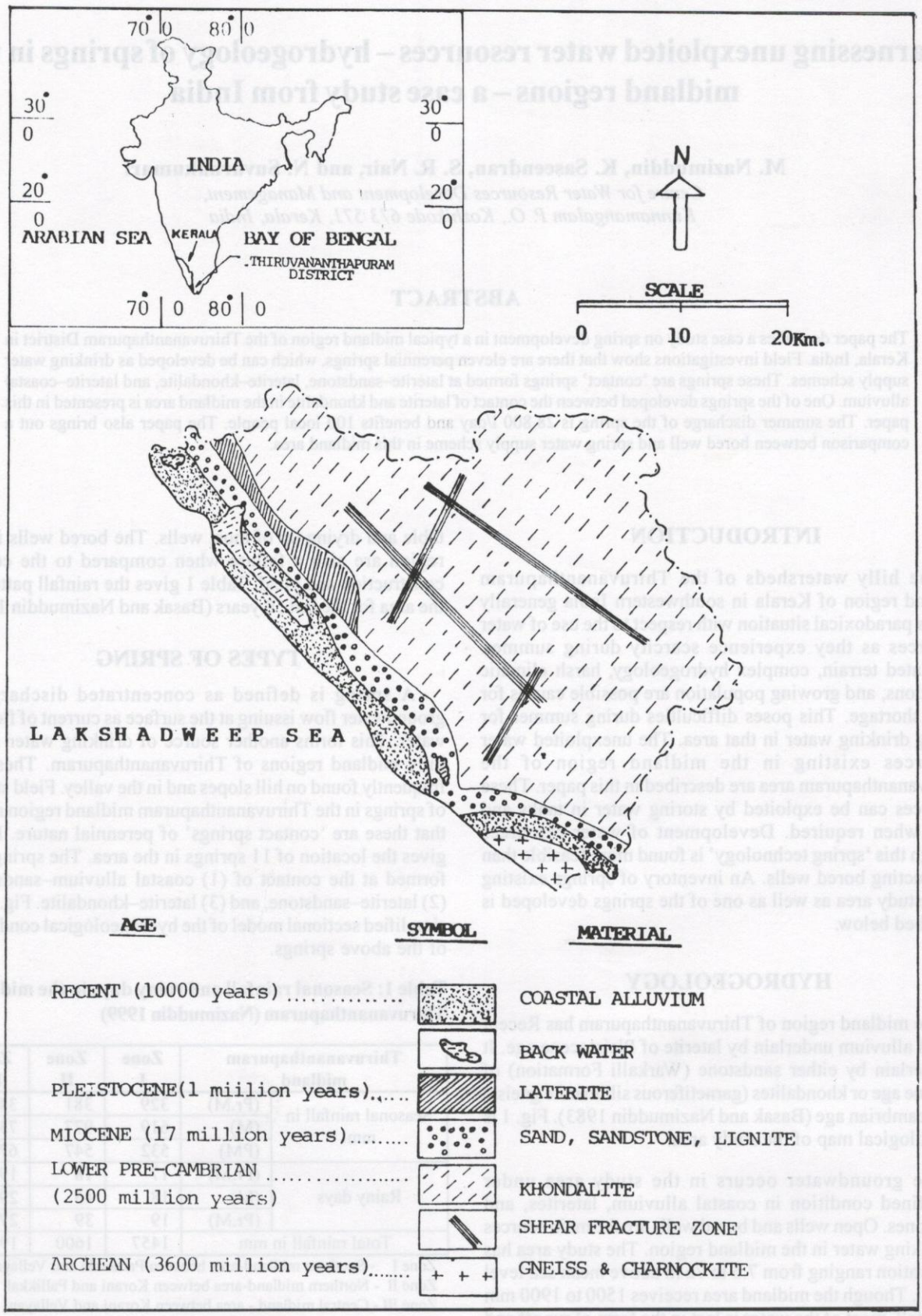

Fig. 1: Surface geological features of the Thiruvananthapuram District

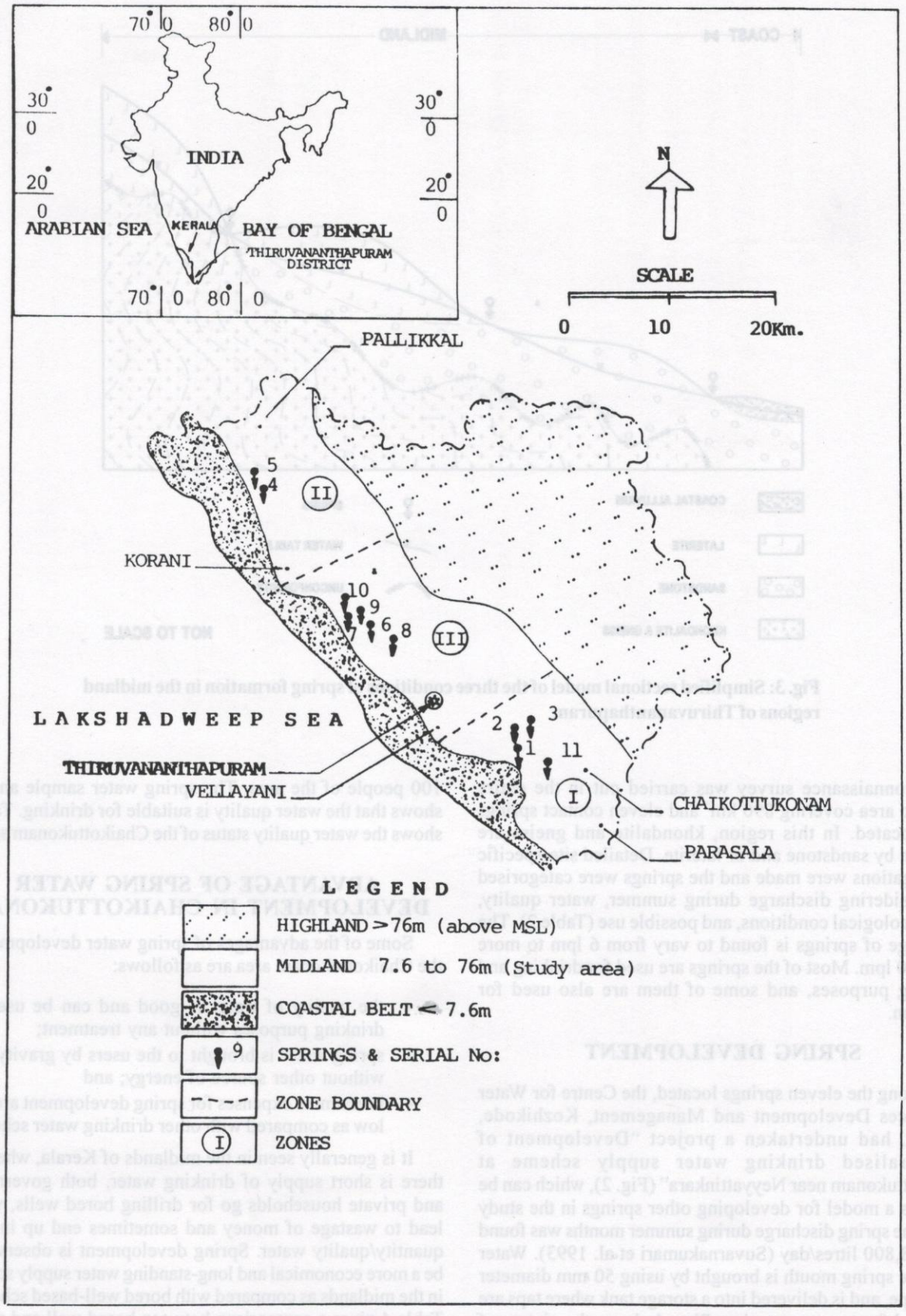

Fig. 2: The midland belt of Thiruvananthapuram (after Nazimuddin 1999)

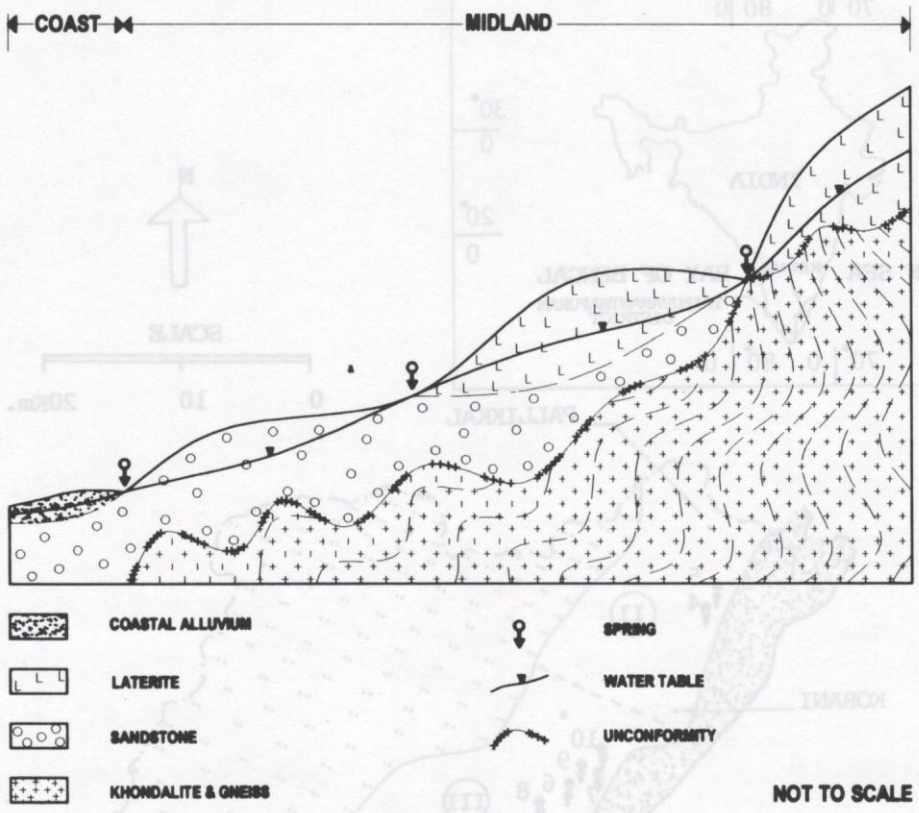

Fig. 3: Simplified sectional model of the three conditions of spring formation in the midland regions of Thiruvananthapuram

Reconnaissance survey was carried out in the entire midland area covering 890 km^2 and eleven contact springs were located. In this region, khondalite and gneiss are overlain by sandstone and/or laterite. Detailed site-specific investigations were made and the springs were categorised by considering discharge during summer, water quality, hydrogeological conditions, and possible use (Table 2). The discharge of springs is found to vary from 6 lpm to more than 100 lpm. Most of the springs are used for drinking and washing purposes, and some of them are also used for irrigation.

SPRING DEVELOPMENT

Among the eleven springs located, the Centre for Water Resources Development and Management, Kozhikode, Kerala, had undertaken a project "Development of decentralised drinking water supply scheme at Chaikottukonam near Neyyattinkara" (Fig. 2), which can be taken as a model for developing other springs in the study area. The spring discharge during summer months was found to be 28,800 litres/day (Suvarnakumari et al. 1993). Water from the spring mouth is brought by using 50 mm diameter PVC pipe, and is delivered into a storage tank where taps are provided for water extraction. Plate 1 shows the picture of the developed spring at Chaikottukonam. It benefits about 100 people of the area. The spring water sample analysis shows that the water quality is suitable for drinking. Table 3 shows the water quality status of the Chaikottukonam spring.

ADVANTAGE OF SPRING WATER DEVELOPMENT IN CHAIKOTTUKONAM

Some of the advantages of spring water development in the Chaikottukonam area are as follows:

- the quality of water is good and can be used for drinking purposes without any treatment;
- spring water is brought to the users by gravity flow without other source of energy; and
- investment expenses for spring development are very low as compared with other drinking water schemes.

It is generally seen in the midlands of Kerala, wherever there is short supply of drinking water, both government and private households go for drilling bored wells, which lead to wastage of money and sometimes end up in poor quantity/quality water. Spring development is observed to be a more economical and long-standing water supply scheme in the midlands as compared with bored well-based schemes. Table 4 gives a comparison between bored well and spring water supply schemes.

Table 2: Details of springs in the midland regions of Thiruvananthapuram, Kerala, India (Nazimuddin 1999)

S. N.	Location	Zone	Reduced level (m)	Discharge during summer (lpm)	Use	Water quality	Hydrogeology
1	Karimbuvilakuzhi	I	40	6	D,W	P	LS
2	Kanjirampara	I	45	12	D, W and I	P	LS
3	Ayakonam	I	45	14	I	P	LK
4	Utukuzhi	II	50	540	DW	P	LK
5	Muttapalam	II	50	20	D	P	LK
6	Thiruvallur	III	95	95	D,W	P	AS
7	Karakode	III	20	20	D,W	P	AS
8	Karyavattam	III	40	16	D,W	P	LK
9	Sripatham	III	20	16	W,I	P	LS
10	Anathazchira	III	25	20	D	P	LS
11	Chaikotukonam	I	20	20	D,W	P	LK

D- Drinking; W- washing; I- irrigation; P- potable; LS- laterite-sandstone; LK- laterite khondalite; AS- alluvium sandstone

Table 3: Water quality status of the developed spring at Chaikottukonam (Suvarnakumari et al. 1993)

Parameters	Chaikottukonam (Thiruvananthapuram)
pH	6.90
Electrical conductivity (μS/cm)	75.90
Total dissolved solids (ppm)	48.58
Total hardness (ppm as $CaCO_3$)	16.00
Sulphate (ppm)	trace
Chloride (ppm)	14.00
Fluoride (ppm)	0.11
Nitrate (ppm)	trace
Calcium (ppm)	3.20
Magnesium (ppm)	1.94
Iron (ppm)	trace

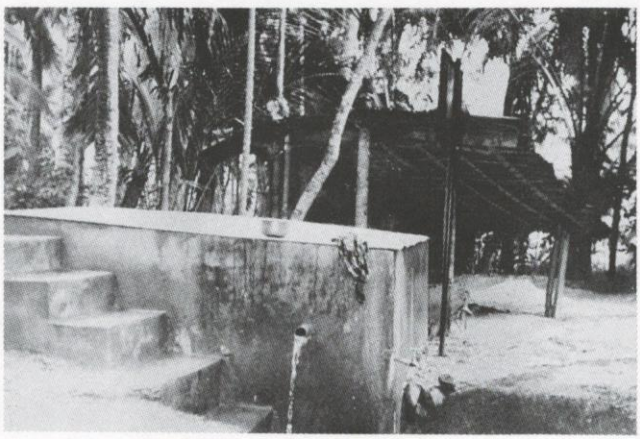

Plate 1: Spring developed by CWRDM at Chaikottukonam

Table 4: Comparison between bored well and spring water supply schemes

Drinking water schemes through springs	Drinking water supply schemes through bore wells/bore wells fitted with hand pumps
(a) Total cost of schemes vary between Rs. 18,000 and Rs. 26,000	(a) The total cost of bore well scheme through hand pumps cost Rs 30,000. The cost increases on drilling depth and casing pipe etc.
(b) Safe and good clean quality of drinking water	(b) Local people do not use the bore well during monsoon season, leading to the break down and increase in iron content
(c) Annual maintenance minimum	(c) Annual maintenance cost will be more
(d) Gravity flow, pumps not needed	(d) Yields of the wells are found poor. During summer months the water level goes beyond pump setting. Hence most of the bore wells, there is no water during summer resulting in pump disorder.
(e) No caving problems	(e) High discharge bore well based water Supply Scheme costs more than Rs. 50,000. Occasional cavings are noticed which become detrimental to the bore well life.
(f) Storage tank can be cleaned at any time and cost effective	(f) Bore well servicing is more time consuming and expensive

CONCLUSIONS

The study shows that the spring water is found to be safe and good in the midland regions of Kerala. Similar to that of Chaikottukonam, many other water supply schemes are needed for future development of water resources in other highland and midland areas of Kerala. These schemes may also be the demonstration models for other developing countries.

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REFERENCES

Nazimuddin, M., 1999, Groundwater Assessment and Development in the rural midland Region of Thiruvananthapuram, District, Kerala, C. W. R. D. M. Publication (GW/R.324/98), pp. 27–31.

Suvarnakumari, N., Nazimuddin, M., and George, C., 1993, Spring based Community Drinking Water Supply Scheme in Kerala Calling Publication from Department of Public Relation, Govt. of Kerala, v. 13(5), 31 p.

Basak, P. and Nazimuddin, M., 1983, Groundwater in the Coastal Belt: Trivandrum District, C.W.R.D.M. Publication (GW/R-67/83), pp. 8–17.