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STUDIES ON DEVELOPMENT OF SURANGAMS AS A NON CONVENTIONAL WATER RESOURCE IN THE KANHANGAD BLOCK PANCHAYAT, KASARAGOD DISTRICT, KERALA

(Final Report)

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EXECUTIVE SUMMARY

The project proposal entitled as " Studies on development of surangam as a non-conventional water resource in Kanhangad Block Panchayat, Kasaragod district, Kerala" has been funded by KRPLLD/CDS with a total budget outlay of Rs. 2.2 lakhs for a period of 18 months. The specific objectives of the project consists of documentation of all the existing surangams in the Kanhangad Block Panchayat, evaluation of their hydrogeological status, estimation of water resources potential and water quality, sustainability of surangams in terms of change in land use, socio- economic analysis among surangam holders, ownership pattern of surangams, cost benefit analysis , technology of construction of surangams and the scope of community based surangams on priority basis in the area.

The physical survey on the variations of surangams is often difficult due to inaccessibility and poor approach ways to the sites and unfavourable nature of the terrain. . Still, best efforts have been taken to visit the surangams individually with the help of local guides except those lie within the wells/ponds. Relevant information on various physical and socio-economic aspects was collected through a separately prepared survey format. The following aspects like shape variation, type of surangams, growth rate, status of water availability, use pattern, physical status, lithological set up, water quality, discharge characteristics and effect of land use change etc. were examined. Surangams are very successful in laterite area.

There are 472 surangams identified in 35 wards of five gramapanchayats of Kanhangad Block Panchayat. The maximum number of surangams is found to exist in the Kodom-Beloor panchayat. Though rectangular, circular and irregular shapes of surangams are existing in the area, the former type is common. One dug in the hillslope are more frequent than inwell type. The locations of surangams are being mostly done by following unscientific methods, which resulted in a fairly high amount of failure rates. In many instances surangams are found to be draining the aquifers and regulation of the yield of water from surangams may be thought off. Water quality is generally found to be good.

Limiting the utilization of surangam water for drinking purposes alone for community requirement has to be explored. The large scale lowering of regional groundwater table is a deathblow for this traditional water harvesting structure and the problem to a large extent can be solved by adopting stringent soil/water conservation measures. The changes in landuse profusely influence the yield of water from surangam. By providing trained construction workers in every panchayat and adoption of scientific methods for locating surangam along with the help of geobotanical indicators would reduce the failure rate considerably. Financial assistance from banks and institutional support shall promote the general development of surangams in the area. There is a need of conducting awareness programmes on water management on a sustainable basis and the present system of flooding the agricultural land with copious water has to be controlled and reduced to a greater extent. Development of new surangams is beyond the scope in the area and proper maintenance of existing surangam is to be given importance.

1.0 INTRODUCTION

The project proposal entitled as "Studies on development of surangams as a non – conventional water resource in the Kanhangad Block Panchayat, Kasaragod district, Kerala" has been sanctioned by KRPLLD/CDS vides No. KRPLLD/TRM/KILA/99 dated 12th August 1999. A Memorandum of Agreement (95/99) has been made between the Programme Co-ordinator and the 'Subscriber' i.e. Dr. Kamalakshan Kokkal and the Executive Director, CWRDM as 'Obligor'. The total budget outlay of the project is Rs. 2.2 lakhs with a duration of 18 months.

1.1 Review of work

A very few studies have been conducted on surangams of Kerala. The first scientific report published by CWRDM[1] has documented about 600 surangams existing in the Kasaragod district and their utilization for agricultural and domestic purposes. Another important work on surangams has been reported by Central Ground Water Board[2] published in 2001, which basically gives a picture on draining of groundwater from surangams and their controlling measures. Studies have been conducted by CWRDM, CGWB etc. on certain groundwater problems in different parts of Kasaragod district.

1.2 Objectives

The specific objectives are

- To have a systematic records of all the existing surangams in the Kanhangad Block Panchayat
- Evaluation of hydrogeological status of surangams in the area
- Estimation of water resources potential and water quality in the area
- Sustainability of surangams in terms of change in land use

- Explore the ways and means to improve the status of all the surangams as a sources of drinking water and for irrigation purposes
- Socio- economic analysis among surangam holders
- Organization of beneficiary association and ensuring their active participation in the maintenance and utilization of surangams as major source of water.
- Ownership pattern of surangams, its utilization for drinking water and irrigation, its cost for development and maintenance.
- The technology of construction of surangams.
- Reasons for diminishing surangams.
- Possibility for development of surangams by the panchayat.

1.3 Methodology

As a first step, an overview of the study area was obtained through G.T.S. maps. There are two G.T.S maps numbered 48 P/3, 48 P/7 with a scale of 1: 50,000 covering the whole Kanhangad Block Panchayat were analysed for its topographical and geological features. A number of field trips to all Grama panchayat were undertaken during this period. Preliminary information on the location of existing surangams was obtained from the offices of Hydrogeologist of the district, panchayat and village offices and by contacting ration shops, local people, watershed committee etc. The physical verifications of the surangams are often difficult due to inaccessibility and poor approach ways to the sites. Even though, best efforts have been taken to visit the surangams individually with the help of local guides except those lie within the wells/ponds. Relevant information on various physical and socio-economic aspects were collected through a separately prepared survey format .The data collected from the field have been processed which constitute the basis for the evaluation of surangams in the study area. About 26 surangams were selected for periodic discharge measurements and 12 surangams for water quality analysis. Separate survey performa has been prepared for documentation survey among people engaged in surangam construction. Five soil samples have been collected from caved surangams for analysing the geotechnical properties of soil for the purpose of assessing the stability of surangams.

The following aspects of Surangams were investigated during the study

- Shape variation
- Type of surangams
- Growth rate of surangams
- Status of water availability
- Use pattern
- Physical status
- Lithological set up
- Discharge characteristics
- Landuse change

1.4 Location

The study area lies between latitudes 12^{o} 13' and 12^{o} 35' N and longitude 74^{o} 54' and 75^{o} 27' E encompassing a total geographical area of 534 sq.km. (Fig. 1) with a population of 2,36,705 (1991 census). There are eight panchayat, namely Udma, Pallikkara, Pullur – Periya, Ajanur, Madikai, Kodom- Beloor, Panathadi and Balal in the Kanhangad Block Panchayat. There are 95 Grama panchayat wards exist in the Kanhangad Block Panchayat. Among the eight panchayat , Udma, Pallikkara and Ajanur constitute the coastal part, while Pullur – Periya and Madikai panchayat in the mid land regions. The Kodom-Beloor and Panathadi grama panchayat constitute high land regions of the study area. The land use, agricultural practices, crops, soil types, types of drinking water sources and extraction structures and even the socio- economic set up by a large are controlled by this physical location in the above less distinct longitudinal divisions in the area. The area is characterized by rugged topography with small steeply sloping hillocks separated by deep cut valleys (Plate-1)

Plate- 1 General topography of the study area

1.5 Accessibility

The area is well connected by a network of roads and railway line, which lies almost parallel to the coast. The NH 17 that runs from Nileshwar to Kasaragod passes through the area. The state highway from Nileshwar to Kasaragod via Bekal and Udma provides accessibility to three coastal panchayat of the study area. The road from Mavungal to Panathoor and one from Nileshwar to Vellarikkundu and Konnakad together provides good accessibility to the eastern part of the study area.

1.6 General status of the water resources

The area receives an average annual rainfall of about 3500 mm of which 75% receives during the SouthWest monsoon and balance during North East monsoon. The area as mentioned above is longitudinally divided into three regions in which 6228 hectare coastal land and 14324 hectares midland and highland constitute 32926 hectares. The important rivers flowing through the block panchayat area consist of Pazhaswini, Chittari and Nileshwar River. They are all originating from the Western Ghat portion, which flows through the area and joins with the Arabian Sea. Besides a number of streams, thodus,

ponds, springs, wells and a large number of surangams have been constructed for domestic and agricultural purposes. Most of the wells are of open dug type with a depth of 10-15 m. In the midland and high land regions the wells are become deeper and dry during summer periods. Recently a number of bore wells are constructed with a maximum depth of 100m from the surface. The Chittari Kayal with an aerial extent of 1.08 sq. km. However, a number of areas especially in the mid land and highland parts in the Block Panchayat experience acute water shortage even for drinking purpose during summer period.

1.6.1 Hydrometeorology

Hydrometeorological studies were carried out by using the data collected from existing stations in the study area.

a) **Rainfall**

Daily rainfall data of the area were collected during the period January 1998 to July 2000. The monthly rainfall data during 1998 to 2000 (Table 1), mean monthly rainfall during 1998 – 2000(Table 2) and number of rainy days during 1998 - 2000 (Table 3) are given. In the coastal parts at Pallikkara area the total annual rainfall during 1999 was found to be 2721.1 mm. The South-West monsoon contribution during the June- September period was found to be 2135.4 mm, which is 78.5 % of the total annual rainfall and the contribution from the North-East monsoon was 21.5 %. In the Ambalathara meteorological station of the midland region, the total annual rainfall recorded during 1999 was found to be 3879.5 mm of which the contribution from the South- West monsoon accounts for 73.9%. The North- East monsoon contribution accounts for 11.3 %. In the high land area at Panathadi the total annual rainfall during 1999 was found to be 4314.9 mm. The South-West monsoon contribution has found to be 66.9 % and during North-East monsoon 17.9%. The maximum rainfall occurs during July in the Pallikkara and Ambalathara area while it occurs maximum during June in the Panathadi area. The mean monthly rainfall during 1999-2000 in the Pallikkara, Ambalathara and Panathadi was respectively found to be 3189.7 mm, 4058.1 mm and 4191.7 mm (Fig. 2). The number of rainy days during 1998-2000 was found to be maximum during the month of June except in July 1999 at

Panathadi. The seasonal rainfall for the different hydrometeorological stations for the period 1998–2000 (Table 4) is given.

Table 4. Seasonal rainfall (mm) for the period 1998-2000

Season	Year	Panathadi	Ambalathara	Pallikkara
Pre-Monsoon	1998	NR	NR	NR
	1999	656.1	573.8	NR
	2000	375.2	501.6	494.1
	Mean	515.7	537.7	494.1
Monsoon	1998	NR	3417.4	NR
	1999	2887.2	2848.2	2135.2
	2000	NR	NR	NR
	Mean	2887.2	3132.8	2135.2
Post-Monsoon	1998	356.0	783.0	NR
	1999	877.4	462.0	611.3
	2000	NR	NR	NR
	Mean	616.7	622.5	611.3

NR- data not recorded.

It is observed that the rainfall during different seasons was lowest in the Pallikkara while the highest seasonal rainfall was recorded at Ambalathara (Fig. 3). On an average in the Panathadi area the mean seasonal rainfall was found to be 12.8% during pre-monsoon, 71.8 % during South-West monsoon and 15.4% of the mean annual rainfall during post-monsoon period. In the Ambalathara stations these values are respectively found to be 12.5 %, 72.9% and 14.6 % during the pre-monsoon, monsoon and post-monsoon periods. In the Pallikkara stations the seasonal rainfall contribution during the pre-monsoon, monsoon and post-monsoon periods are respectively found to be15.2 %, 65.8%, 19% of the total annual rainfall. The maximum one day rainfall during the period 1998-2000 at Panathadi ,Ambalathara and Pallikkara are given (Table 5).

Table 5. Maximum one day rainfall during 1998-2000

Station	Year	Rainfall in mm	Date
Panathadi	1998	290	13/11/1998
	1999	90	17/07/1999
	2000	96.2	08/06/2000
Ambalathara	1998	130	24/06/1998
	1999	214.8	18/07/1999
	2000	168.8	27/05/2000
Pallikkara	1998	NR	--
	1999	214.9	18/07/1999
	2000	NR	--

NR- Data not recorded

b) **Evaporation**

The evaporation data are given in Tables 6 and 7. The maximum evaporation 213 mm occurred during the month of March 2000 at Panathadi. The evaporation was recorded its maximum at Panathadi followed by Ambalathara and Pallikkara. In all the three stations the evaporation was maximum in the month of March. The evaporation was lowest during the month of August. On a seasonal basis pre-monsoon evaporation also followed the same trend as that of monthly evaporation in which maximum evaporation occurred at Panathadi.

c) **Drainage**

Drainage basin analysis provides information regarding the development of the drainage, the texture it acquires, the pattern it exhibits and the drainage systems giving the erosional history of the basin. Southern tributaries of Chandragiri River, Bekal hole, Chittari hole and Monachi hole mainly drain the area. The entire drainage network spread over twelve medium watersheds in the study area is traced out and a contour map (Fig.4) showing the different watersheds and a drainage map (Fig .5) have been prepared from the topographical map 48 P/3, 48 P/7 with a scale of 1:50,000. A lineament map also has been

prepared (Fig. 6) using the toposheets and areal photographs. The drainage pattern is sub-dendritic to trellis in the eastern part of the area and dentritic towards western part of the study area.

1.7 Geology

The study area is a part of the hard rock terrain consists of three distinct hydrogeologic units. In the coastal part of the area consists of sands, alluvium, Tertiary formations and at some places laterite exposures. In the midland area with an elevation range of 7.6 to 76 m from MSL, the predominant type of rock is laterite. In the high land area with an elevation of more than 76 m the rocks are basically crystalline type consists chiefly of gneisses and charnockites with occasional laterite capping. The subsurface geology of the area is shown in Fig. 7.

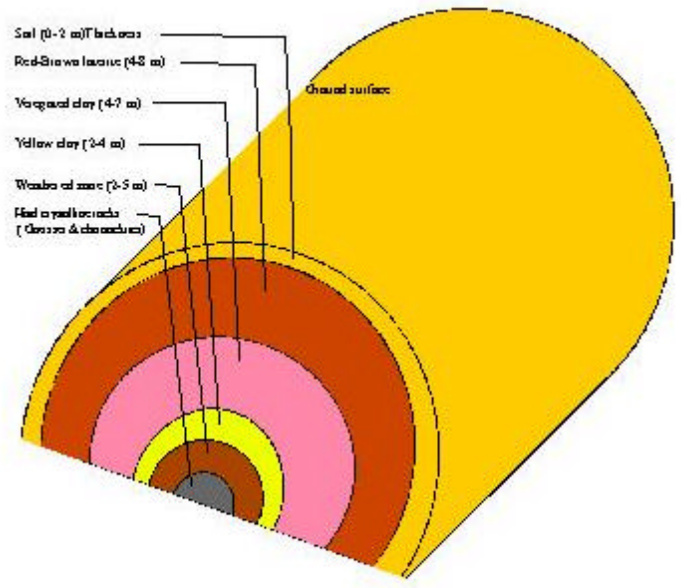

Fig. 7 SUBSURFACE GEOLOGY OF THE STUDY AREA

Fig. 7 SUBSURFACE GEOLOGY OF THE STUDY AREA

1.8 Soil

The soils of the region predominantly fall into three groups, namely, sandy soil in the coastal belt, lateritic soil in the midlands and forest loams in the high ranges (Fig.8). The important soil types are

- Coastal alluvium
- Riverine alluvium
- Hydromorphic soil
- Lateritic soil
- Forest loam
- Onatukara series
- Red loamy soil

2.0 SURANGAMS

The groundwater extraction structures depend on the nature of geological formation. In the coastal belt of the State open dug wells and tube wells are the predominant groundwater extraction structures. In the lateritic midlands, unlined open dug wells and bore wells constitute important extraction structure. In the highlands, the groundwater extraction is done either through bore wells or rectangular shaped open dug wells. In the northern Kerala, especially in the Kasaragod district, a non- conventional type of groundwater extraction structure exists and is locally known as "Surangams" or "Thurangams". It is basically a horizontal tunnel, dug in the hillocks for the purpose of harvesting freshwater, which seeps through the overlying mounds. These structures cut across the prevalent groundwater table in the area. The surangams are usually rectangular in cross section, 50 to 80 cm wide and 0.90 to 1.5 m high and length varies between 3 to 300 m.

Historically speaking, Surangams are similar to 'Qanats' that had their origin in the Middle East and are still in vogue in Syria, Iraq, and Palestine in 700 BC. The technology must have got transferred to Kerala through trade contact with the countries of Middle East. The expertise in such structures had come to India with the Arabic Muslims who got settled in the Malabar Coast at the end of 7^{th}Century[3].

Basically there are two types of surangams, viz. one dug in the hillocks for the purpose of harvesting freshwater which seeps through the lateritic mounds and the weathered residual materials; the second category are those dug horizontally at the bottom of the wells /ponds. There exist a variety of surangams having branched or pinnate types. There are also surangams, which starts from a well and conveys water to the desired points. In a few, water from the surangams is collected in a pond or well, which in turn supplies water through horizontal tunnels to the lower reaches. In some of the surangams, overlying weathered portions are completely stripped down and exposed as narrow valleys or gorges. Even in some cases the starting points of the surangams are deepened and converted to an

open dug well in which even bore wells are also developed. In some of the wells /ponds two or three surangams are also encountered[1].

2.1 Documentation survey and field results

The study has been undertaken to have a systematic record of all the existing surangams in the area by using a pre-prepared survey format (Appendix-I). The documentation has been started in ward wise and essential features like size and dimension of surangams, yield characteristics, land use features, utilization pattern and maintenance and the associated problems are collected. The maximum number of surangams is concentrated in five panchayats namely Kodom-Beloor, Balal, Panathadi, Pallikkara and Madikai. The collected data are being processed and the classification of surangams based on certain criteria is being attempted. [Table 8 (a-e)] and surangam holder's lists are given in Appendix-II.

There are 472 surangams identified in the thirty five wards of five grama panchayats of Kanhangad Block Panchayat. The map of Kanhangad Block Panchayat showing the selected surangams for detailed observations are given in Fig. 9 and Schematic sketch of surangam is represented in Fig.10. A typical surangam in Kanhangad Block Panchayat, entry point(out side view) and inside view of surangam are also shown in Plate2, plate 3& plate 4 respectively.

Plate- 2 Typical surangam in Kanhangad Block Panchayat

Plate-3 Entry point (out side) view of surangam

Plate-4 Inside view of surangam

2.1.1 Shape variation

It is observed that rectangular, circular and irregular shaped surangams are existing in the study area (Fig.11) in which rectangular shaped surangams are commonly seen in the Kanhangad Block Panchayat and are predominant in Kodom- Beloor panchayat.

2.1.2 Type of surangams

There are two types of surangams (Fig.12), one dug in the hill slopes and the other in the wells/ponds for extracting groundwater. The hillocks surangams are predominant in the study area and the extracted groundwater is stored in a tank in the lower reaches of the hillocks for various purposes by gravity flow. In this type, the surangams begins as a trench across the slope of the hill, which gradually transforms into a tunnel. Surangams with branches are also encountered during study. It is found that during excavation of surangams when ever hard rocks like granites, gneisses or charnockites are exposed its course, construction makers divert its courses in order to avoid the obstructions. Moreover in order to increase the yield from surangams people construct sub branches for the main surangams (eg. Esthappan, Kottakandom). In a few, the overall pattern look the form of pinnate, parallel to sub parallel types are existing (Fig.13).

Functionally, a surangam can be used to serve as groundwater harvesting structure and at many instances, it can also act as conduits for the groundwater. In some cases at the end of the surangams people have constructed a well and even a bore well within the well and here they are used surangam as a means of transit of water by the use of ½"pipe to the houses lying lower part of the region. In certain cases dug wells are made at the hill slopes and to bring the water from the wells to the storage tank located at the lower regions, surangams are made within the well one or two meters above the bottom and water from the well is brought to the tank through the surangam by gravity flow due to hydrostatic head and thereby avoiding installation of pumping system. In the monsoon season, same such surangams are used for releasing the excess water collected in the well to the streams in the low-lying areas.

In certain cases, one or two tunnels or surangams are ending at a well or pond, which are primarily used for irrigation purposes (Fig.14). In certain other cases, the tunnels on the up slope side of the dug well derives water which is being stored in the well which in turn transits water to the low lying areas (Fig.15) through different set of tunnels. A complex nature of geology and interaction of water and its flow below the surface of the earth creates big subsurface holes especially in the valley portion of the hilly areas, which act as a natural surangam in such areas. It is locally known as "Maali" which is nothing but formed due to the subsurface flow of groundwater.

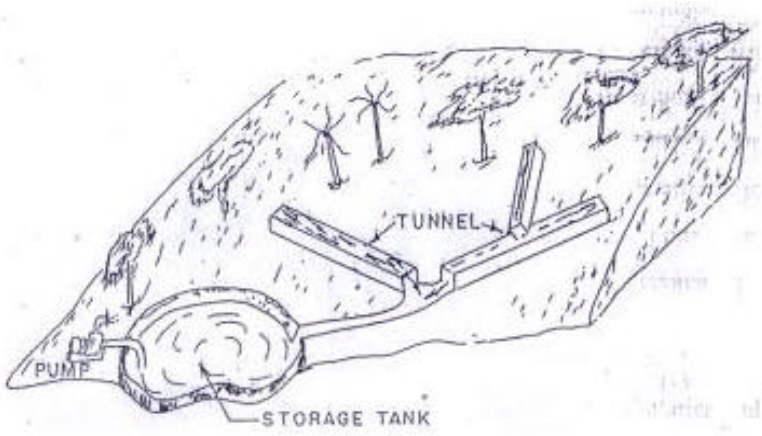

Fig.14 Surangam ending at a dug well

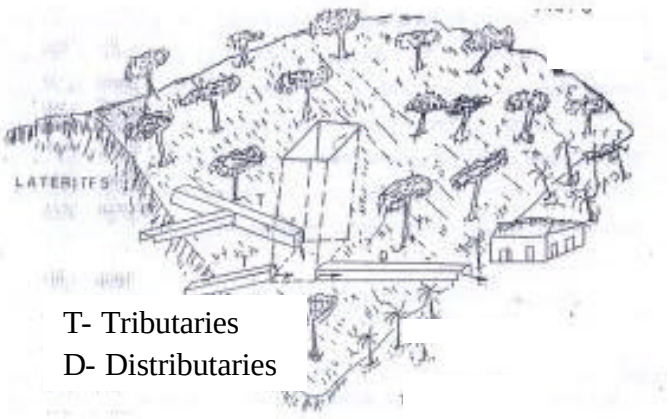

Fig. 15 Surangams act both as extraction structure and supply lines for domestic/ irrigation purposes.

2.1.3 Dimension of surangams

Surangams are usually 50 to 80 cm wide, 0.90 to 1.5m high and length varies from 3 to 300m. In the Kanhangad Block Panchayat, surangams having length more than 20 meters are concentrated mostly in Kodom -Beloor panchayat (Fig. 16).

2.1.4 Growth rate of surangams

From the field investigations it is observed that in the Kanhangad Block Panchayat, only 10 surangams were constructed before 1950. Subsequently 23,44,66, 131 and 158 surangams were constructed during 1951-1960, 1961- 1970, 1971-1980,1981-1990 and 1991-2000 periods respectively (Fig. 17).

2.1.5 Use pattern

In Kanhangad Block Panchayat, 183 surangams are currently being used for domestic purposes especially for drinking. 58 of them are used for irrigation and 8 of them are not used for any needs. 141 of surangams are used for both domestic and irrigation purposes. Out of 432 surangams, 282 surangams are perennial, 116 are seasonal and only rest are existed as dry surangams. Among the perennial surangams majority are concentrated in Kodom–Beloor panchayat. Status of water availability and use pattern of surangam is shown in Figures18&19.

In some places people used surangam water for their domestic purposes only in summer seasons. Some people also made surangam for bringing water from well without pumping. Majority of people used surangam water directly and others made concrete tank with an average dimension of 3.5x2.5x2 m for collecting water for irrigation (Plate-5 & Plate -6). Some surangams have about 4-6m closed channel and nearly 8m open channel for store the water in a mud pond (Plate-7). A few people are used motor for pumping water from pond or tank. Less than 20 percentage surangam owners allow their

neighbours to use surangam water and others not interested to share their water with neighbours.

Plate-5 Storage tank (concrete) used for both domestic & irrigation purposes

Plate-6 Storage tank used for irrigation purposes

Plate-7 Mud pond used as a storage structure for irrigation

2.1.6 Health status of surangam

The stability of surangams depends on the nature of formation where it exists. The field investigation reveals that partially or fully caved, uncaved and partially collapsed surangams are present in the study area (Fig.20). Caving occurs during the rainy season. Action of crabs and other biobs, protection measures are adopted like lining, roofing and providing lateral supports.

2.1.7 Land use pattern

The field investigation shows that surangam waters is used for irrigating crops like areca nut, coconut trees, pepper, plantains and paddy. The original forestland has been used for cultivating crops like cashew, coconut, areca nut and rubber. The change in the land use of the study area is depicted in Table 9.