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Well Inventory in the Nilaveli - Kuchchaveli Area

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Preface

Water constitutes the basic resource for life. The water resources of the north eastern coastal aquifer are predominantly used for irrigation and domestic purposes. The ever increasing extraction of water poses a threat to the aquifer and ultimately to the livelihood of communities living along the north eastern coast of Sri Lanka. No reliable longer-term data are available for the quantity and use of water generated by the north eastern coastal aquifer nor for the possible change of the water quality. Intensive irrigation and a comparatively dense habitat may result in an over extraction of water and a deterioration of the water quality over time. Since IFSP is has a focus on improving the conditions for nutrition and health of the local communities the availability of water of good quality for human consumption and sufficient water for cultivation has become an important issue.

IFSP-GTZ has initiated a combined survey¹ aiming at

- Establishing a monitoring of the quality and quantity of water of the north eastern coastal aquifer and arriving at conclusions for better water management and possible health threats
- Inventorying all agro-wells and common wells
- Estimating the safe yield of the aquifer and establishing a water balance.

The inventory of wells was a part of the comprehensive survey to determine the quality, quantity and use of the underground water resources in the Nilaveli-Kuchchaveli area, north of Trincomalee town. The survey was implemented with the collaboration of the Water Resources Board, Colombo, from April to October 2001.

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¹ IFSP Technical Paper 16, Water Quality Monitoring in the Coastal Area of Trincomalee District. Results of Phase I July 2000 - July 2001, Authors: C.R. Panabokke, S.R.K. Pathirana, Trincomalee & Colombo, May 2002

IFSP Technical Paper 17, Well Inventory in the Nilaveli-Kuchchaveli Area, Author: K. Nadarajah, Trincomalee, May 2002

IFSP Technical Paper 18, North Eastern Coastal Sand Aquifer in Trincomalee District, Authors: K. A. W. Kodituwakku, S.R.K. Pathirana, Trincomalee. Colombo, May 2002

IFSP Technical Paper 8, Monitoring of Agro-wells in the Sandy Regosol Area between Nilaveli and Kuchchaveli. First Seasonal Results, Authors: C.R. Panabokke, K.A.W. Kodituwaku, S.R.K. Pathirana, Trincomalee & Colombo, February 2001

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2	Agro-ecological map
3	Average monthly rainfall
4	Soil map

Abbreviations

D.S. Division	Divisional Secretariat Division
G.S. Division	Grama Sevaka Division
Agro	Agricultural
TDM	Top dressing mixture
MOP	Muriate of Potash

1. Introduction

The sandy Regosol soil of the coastal plain, flat terrain from Nilaveli to Kuchchaveli, North of Trincomalee town is subject to very intensive cultivation of onions and other secondary field crops. The crops are irrigated by pumping water from wells for about eight hours daily during the cultivation season. The total extent of the land covered under this survey is around 1,600 ha. The high income generated through the short-term onion crop has attracted more and more people to start cultivation. More and more new wells have been constructed and area under onion cultivation is expanding rapidly on account of shrub lands and coconut plantations.

It is obvious that the excessive use of the ground water resources and the application of considerable amounts of organic and chemical fertilisers will lead to a deterioration of the quality and quantity of water. The availability and use of water for agricultural and domestic purposes will be affected, particularly during periods of drought.

2. Objective of the well inventory study

In the recent past in the Kalpitiya Peninsula west of Puttalam very intensive cultivation of onions under similar soil and environmental conditions as found in the Nilaveli-Kuchchaveli area was done. Onion cultivation was very successful and profitable at the beginning, however, after some time the quality and quantity of the water was affected due to both over extraction of ground water and the usage of excessive amounts of fertiliser and pesticides. Such a condition need neither be the same nor be repeated in the Nilaveli-Kuchchaveli area. At present adequate information is not available for the intensity of onion cultivation, the number of common wells and agro-wells, the age categories of the wells, other field crops cultivated, the agricultural and irrigation practices in the area, the application of fertiliser and pesticides. So far no surveys were conducted for the quality and quantity of the ground water table in the area. In the absence of such information no reliable decisions could be made for the present and future behaviour and use of the ground water resources.

The well inventory survey and the related studies will contribute to provide insight into the present use of the ground water and will allow decision makers to plan for an optimal water use regime.

3. Environment

3.1 Location

The survey area is located north of Trincomalee town, from Nilaveli to Kuchchaveli, between the 13th and 36th kilometre along the Trincomalee-Pulmoddai road in the Northern and Eastern Provinces of Sri Lanka. The latitudes are between 8° 40' and 8° 51' N and the longitudes between 81° 05' and 81° 12' E (location map, Annex 1).

3.2 Climate

The Trincomalee district including the survey area is situated in the dry zone of Sri Lanka. It receives the major rainfall from the north east monsoon from December to February and from inter-monsoonal conventional rains from October to November and again for a short period from March to April. The survey area falls within the agro ecological sub-class of dry lowland DLI (C) as shown in Anne 2. The average monthly and the annual rainfall is presented in Annex 3.

3.3 Physiography

The survey area falls within the major physiographic unit of the coastal plain, flat terrain. The formation of this physiographic unit is due to the process of marine deposition and sedimentation under the influence of past oceanic action and sea currents. The coastal line comprises of recent (young) beaches formed in elongated strips along the coastline. The special feature of this landscape is the presence of the underlying Gyben-Herzberg lens of fresh water (aquifer) and also the presence of underlying porous shell beds and former coral formation.

3.4 Land use

The survey area has been under onion cultivation for over a decade. Earlier coconut plantations constituted the major land use. Most of the farmers do two crops of onion cultivation during January to March and again May to July. However, recently up to four onion crops are being cultivated in areas with sufficient water availability throughout the year. The lands remain fallow for the rest of the period of the year. Few farmers grow a green manure crop.

There are a number of locations with home gardens and semi-commercial horticulture holdings, consisting mainly of coconut, mango, banana, lime and a variety of market vegetables as well as tobacco. Few neglected coconut estates are left, and many of them are encroached.

3.5 Soils

The soil identified is the sandy Regosols. There is also a very small stretch of soils consisting of an association of the great soil groups of Reddish Brown Earths, low Humic Gley Soils, Solodized Solonetz and Regosols, which are intercepting the area. In these areas no cultivation is done and no wells are found. The vegetation consists mainly of scrubs and medium sized trees (soil map Annex 4). These soils, which are located outside the survey area are not described here.

3.6 Sandy Regosols

The soil group of Regosols is deep, well to excessively drained, and has pale yellowish brown colours. There is no soil profile development. The soils are of a single grained structure and are very porous. The moisture retention capacity is poor due to the sandy nature of the soils. However when compared with the soils of

Kalpitiya which is 100 percent sand, the soils here at Nilaveli-Kuchchaveli area have more body and a little more clay.

4. Inventory procedure

In the absence of updated detailed maps the topographic map of 1:50,000 prepared in 1985 was enlarged to approximately 1:6,250 to be used as a base map. Field visits to the sites of the wells were done and the wells were then located and marked in the maps. The field information could be classified into five main categories:

- Location details
- Technical details of the wells
- Geology and hydro-geological details
- Agricultural activities
- Irrigation activities etc.

The locations of all 2,060 wells surveyed are annexed from north to south for the areas of Kuchchaveli, Kumpurupiddi, Irrakandi and Valaiuthu, Gopalapuram, Nolaveli North and Nilaveli South (location maps of well inventory, maps 2 to 7)¹.

4.1 Location details

The locations of the wells were marked in the base map giving a reference number to each well. The D.S. Divisional and the G.S. Division were recorded with the name of the village. Wherever possible, the name and address of the owner and also the land ownership details were identified. The topographic sheet in which the wells are located was noted. The coordinates of the wells were identified.

4.2 Technical details

The technical details were related to the construction date of the wells. The wells were classified into three categories:

- less than 5 years old
- between 5 and 10 years old
- over 10 years old.

The reasons for the new construction of wells were examined.

The wells were also classified according to the usage, namely

- Agro-wells
- Domestic wells
- Abandoned wells.

¹ Different spellings for village names result from differences in translation from Tamil/Sinhala to English.

The reasons for abandoned wells and newly constructed wells were also checked. The other details are related to the depth, water level and diameter of the wells. The electrical conductivity of the well water was recorded.

4.3 Geological and hydrogeological details

This information is related to the geology of the underlying strata in general, and the water level behaviour during the dry and wet seasons and as well as the taste of the water. The geology of the entire survey area is the semi-recent coastal sand deposits over a coral basement.

4.4 Agricultural activities

The information gathered for the agricultural activities are based on the intensity of the cultivation of certain crops and the prevailing agricultural practices. The type of fertilisers and pesticides as well as the prescribed quantity and frequency of usage was recorded. This information served to assess the possible impact on the quality of the water, thereby considering the comparatively rapid leaching condition of the soils

4.5 Irrigation activities

Information for irrigation activities included details of the pumps used, the pumping duration and frequency of irrigation during the dry and wet season and the water levels before and after pumping. The recuperation time of the water levels too was recorded during both the dry and the wet season. This information served to estimate the impact of water use for irrigation purposes.

5. Inventory details

5.1 Introduction

The agricultural involvement of the communities in the Nilaveli-Kuchchaveli area differs from location to location for many reasons. In some locations/villages the main occupation is fishing and cultivation is done only during the rainy season (Kuchchaveli North). In other locations/villages the lands are fragmented among family members. Each family has its own house and well and there is little or no land for cultivation (Irakkandi). In some places due to the prevailing uncertain and unstable conditions people have abandoned their land. Few families are have returned and started cultivation.

To arrive at precise results the well inventory was carried out at the G.S. Divisions of:

- Kuchchaveli
- Kumpurupiddi
- Irakkandi
- Valaiuthu
- Gopalapuram

- Nilaveli

Since the Irakkandi G.S. Division is predominantly a settlement area with mainly domestic wells it was included in the survey for the Valaiuthu G.S. Division. The break down of the extent of the survey area is given in table 1. The inventory was carried out during the period April to October 2001. Though it was planned and budgeted with the assumption that there were about 500 wells, as the survey progressed, it was found that there were very much more. The total number is close to 2,000. About one thousand wells were surveyed in detail and the balance was studied in less detail due to time constraint.

<i>G.S. DIVISION</i>	<i>LAND AREA (ha)</i>
Kuchchaveli	238
Kumpurupiddy	252
Irakkandy and Valaiuthu	546
Gopalapuram	243
Nilaveli	305
<i>Total</i>	<i>1,584</i>

Table 1: Survey area

5.2 Details of the wells

A total of 2,060 wells were surveyed. They were classified according to different categories based on purpose (e.g. domestic, irrigation) usage and time/date of construction.

5.2.1 Categories of wells according to usage

The wells were classified into three categories according to usage (table 2):

- agricultural wells
- domestic wells
- abandoned wells.

<i>Area G.S. Division</i>	<i>Wells Surveyed</i>	<i>Agricultural wells</i>	<i>Domestic Wells</i>	<i>Abandoned Wells</i>
Kuchchaveli Villages	161	42	96	23
Abandoned villages	40	0	0	40
Kumpurupiddy	325	226	40	59
Irakkandy and Valaiuthu	432	132	258	42
Gopalapuram	353	158	162	33
Nilaveli	749	372	372	05
<i>Total</i>	<i>2,060</i>	<i>930</i>	<i>928</i>	<i>202</i>

Table 2: Categories of wells according to usage.

The distribution of the different categories of wells is shown in the maps (scale of approx. 1: 6,250). In the Nilaveli and Kumpurupiddy G.S. Divisions a high density of agro-wells was found. In contrast, Gopalapuram and Valaiuthu G.S. Divisions showed a rather medium density. An even lower intensity was identified in the Irakkandy and Kuchchaveli G.S. Divisions, where a comparatively high density of domestic wells are located, due to the high population density. The Gopalapuram and Nilaveli G.S. Divisions share a medium density of wells of both categories, whereas in the Kumpurupiddy and Valaiuthu G.S. Divisions a rather low density was recorded. In the Kuchchaveli and Kumpurupiddy G.S. Divisions a moderate number of abandoned wells were identified. In all other areas the number of abandoned wells are relatively low. The density of the different categories of well per km² is given in table 3.

<i>Area G.S. Division</i>	<i>Agro-wells</i>	<i>Domestic wells</i>	<i>Abandoned wells</i>
Kuchchaveli North (54 ha)	50	164	102
Kuchchaveli South (184 ha)	10	8	30
Kumpurupiddy	90	15	23
Irakkandy (64 ha)	14	300	10
Valaiuthu (48ha)	29	13	7
Gopalapuram (243 ha)	62	65	12
Nilaveli (305 ha)	129	124	2
<i>Total</i>	<i>384</i>	<i>689</i>	<i>186</i>

Table 3. Density of the different categories of well per km²

Abandoned Wells

Properties and wells were abandoned mainly due to the conflict. In a few cases the owners have gone abroad for employment. In other cases the poor quality of the water was the reason for abandoning the wells.

Domestic Wells

The domestic wells are located mainly in the densely populated areas such as Kuchchaveli North and Irakkandy. The lands are fragmented among family members and each member has a small extent of land, a house and a well. There is very little or no land for cultivation in such places.

5.2.2 Categories of wells according to period of construction

The wells were categorised according to the period of construction. The summary is given for the G.S. Divisions in table 4. Many new wells were recorded in the GS Divisions of Nilaveli, Irakkandy and Valaiuthu. New wells are common in the DS Divisions of Gopalapuram, Kumpurupiddy and Kuchchaveli. More than 70% of all wells are older than 10 years, however, even during difficult times people constructed new wells (19% of total).

Area G.S. Division	No. of Wells	< 5 years	5 to 10 years	> 10 years
Kuchchaveli	201	22	02	177
Kumpurupiddy	325	32	6	287
Irakkandy and Valaiuthu	432	107	50	275
Gopalapuram	353	70	38	245
Nilaveli	749	159	98	492
<i>Total</i>	<i>2,060</i>	<i>390</i>	<i>194</i>	<i>1,476</i>

Table 4: Wells according to the period of construction

5.2.3 Construction of New wells

The reasons for the construction of new wells are:

- Land is a limiting factor; holdings are fragmented among family members and there is a need to have a well for each family. This is mainly observed in the villages.
- The expansion of agricultural lands especially for onion cultivation requires an ever increasing demand for water for irrigation; the construction of agro-wells are the consequence. Nearly 100 new agro-wells were excavated within the last five years in the Valaiuthu G.S. Division. Most of them are of large sizes with a diameter of around 4.0m on an average, whereas older wells have average diameter of 2.5m. Water extraction from larger wells would be significantly higher.
- The fear of 'missing the onion boom' is an observed fact along the coast². With families returning and land use becoming more specific, it is expected that more and more common wells and agro-wells will be established, which may lead to serious damages of the coastal aquifer.

5.3 Electrical conductivity of the water

The test for electrical conductivity of the well water indicated that the water is within the normal range except for a few locations closer to the sea, and lagoon. Most of the wells show results between 500us/cm to 1000 us/cm. For a few wells EC values up to 500us/cm and even above 2,000us/cm. were recorded. This water is unfit for human consumption.

5.4 Depth and water levels of the wells

The depths of most of the wells is between three to six metres. After the rainy season the water level of most of the wells reaches the ground level, except in certain elevated areas where the water level is few meters below the ground level. During the dry period from May to August the water column is between two and four metres high. Wells with such a good water capacity never get dried-up. In the driest months of August to September they have at least one to two metres of water column.

² IFSP Working Paper 42, Missing the Onion Boom, Authors: D. Dharshinie, T. Fläming, B. Korf, C. Schenk, Trincomalee, February 2002

IFSP-CATAD Project 2001, Conflict – Threat of Opportunity? Land Use and Coping Strategies of War-affected Communities in Trincomalee, Sri Lanka, Author: CATAD-IFSP Team, Berlin/Trincomalee, December 2001

5.5 Cultivation details

The area has generally been under intensive cultivation of onions for over a decade except in the dense settlement village areas. Most of the farmers raise two crops of onion cultivation per year during January to March and from May to July. Some farmers cultivate one crop from October to December during the rainy season. Farmers are making use of the rain water with supplementary irrigation (Kuchchaveli North, this area is not subject to flooding during the wet season). Few farmers are doing three onion cultivations per year, however, recently an intensification has been observed and three to four cultivations are practised.

5.6 Fertiliser usage

The commonly used fertilisers for onion cultivation are:

- Cow dung
- N-P-K 04:30:12 as a basal application
- TDM (top dressing mixture) of N-P-K of 30:00:20
- Green seas (Multigrow)
- Organic protein fertiliser enzymatic digestion of fish by-products, containing major nutrients of N- P- K 03:1:0.5
- Sulphate of Ammonia N 21%
- MOP, (Muriate of Potash)

For each season two lorry loads of cow dung and 50 kg of N-P-K 04:30:12 are applied per acre with an additional top dressing mixture for land preparation. Thereafter two dosages of TDM of N-P-K 30:00:20 are applied in 20 days intervals. MOP is used for the bulb enlargement.

Some farmers, instead of applying two dosages of TDM, apply one dosage of Sulphate of Ammonia N 21% and one dosage of TDM. This is practised only during the wet season. During the dry season Sulphate of Ammonia is not used. For the healthy growth of the plants the green seas (Multigrow) too are used.

5.7 Usage of pesticides

The commonly used pesticides are:

- “Decis” (Deltamethrin 258/lit), Pyrethroid insecticide, or
- Calcron (Insecticide), with
- Topsin – M 70 (Thiophanate methyl 70%) Fungicide, or
- Dithane M-45 (Fungicide)

The type of insecticide and fungicide used and the frequency of application depend on the actual need. The cultivators identify the problem and accordingly the applications are done, generally at least three times and up to five times per cropping season. The commonly used pesticide is the “DECIS”. Pesticides commonly applied get rapidly deactivated according to research findings and it appears to be affirmed that they have no serious effect on the quality of water.

5.8 Irrigation practices

Irrigation for the onion cultivation is done by pumping water from the wells using mostly 2" centrifugal pumps. The average pumping rate is 300 litres per minute. Pumping is done for approximately 8 hours on a daily basis. The furrowed basin irrigation system is used for the onion cultivation. The water requirement during the January to March cropping season is more than adequate. Water levels go down only by about one to two meters and recuperate to the original level in about three to four hours time. No change in the taste of the water tested was found.

Water requirements for the second cropping season from May to July can adequately provided by most of the agro-wells. However, in some wells the water level reaches almost the bottom Here, the water requirement is somewhat inadequate to irrigate the full extent. During the dry season the recuperation time to the original water level after irrigation varies from six to above ten hours.

The third onion cultivation is practised only by few farmers in the elevated areas. It is not done in the lower areas due to the flooding hazard. For most of the wells the availability of water is inadequate to irrigate the crops for a third season.

5.9 Land ownership

Most people posses deeds of ownership for their land. Some families hold permits and Jayaboomi land titles. However, very few owner farmers are engaged in cultivation. Most of the holdings are leased out on short-term basis, usually for one year for onion cultivation. There is a considerable extent of abandoned lands especially in the Kuchchaveli and Kumpurupiddy G.S. Divisions. Some of the owners are livings elsewhere and the existence of others is unknown.³

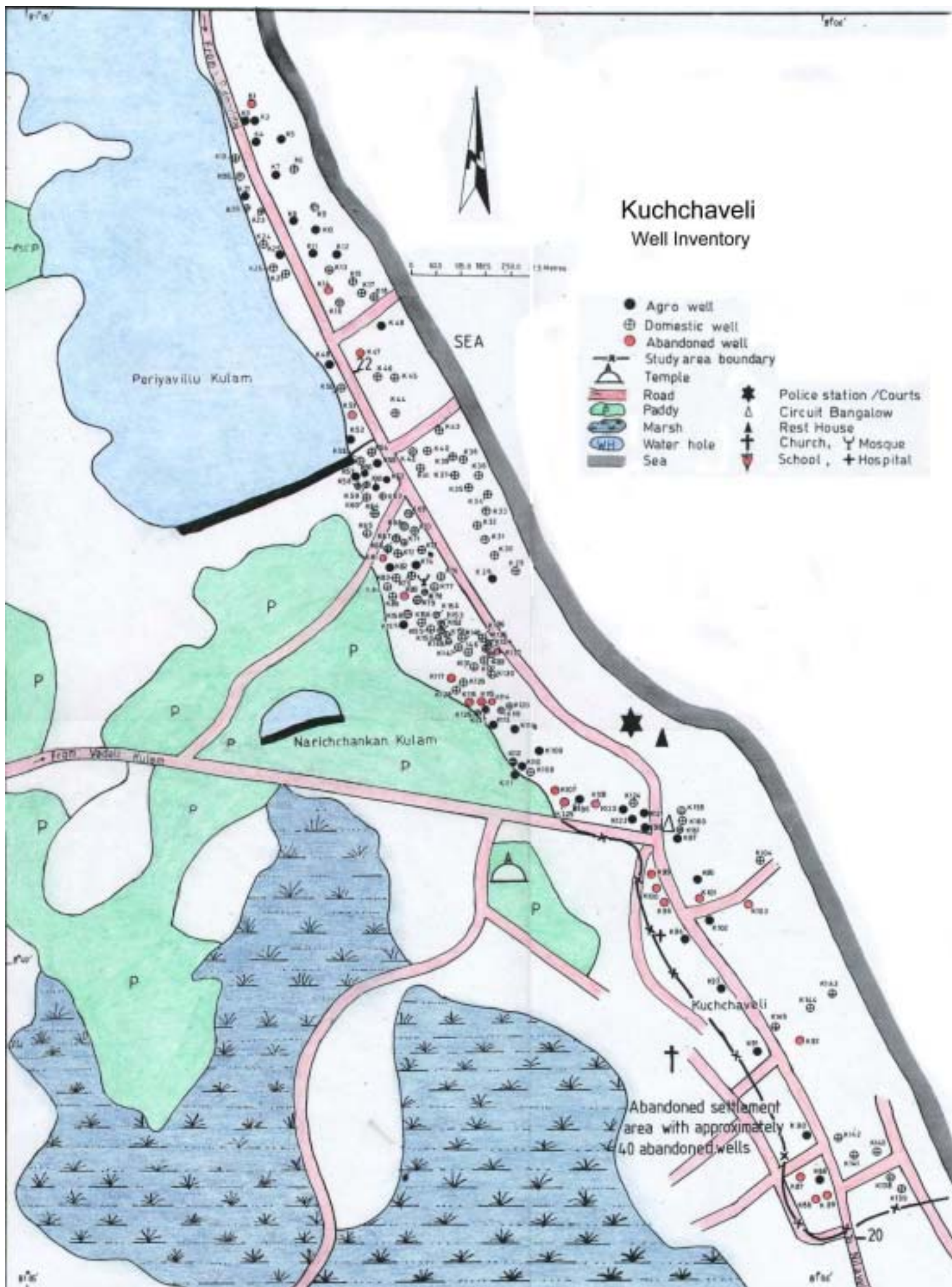
6. CONCLUSIONS

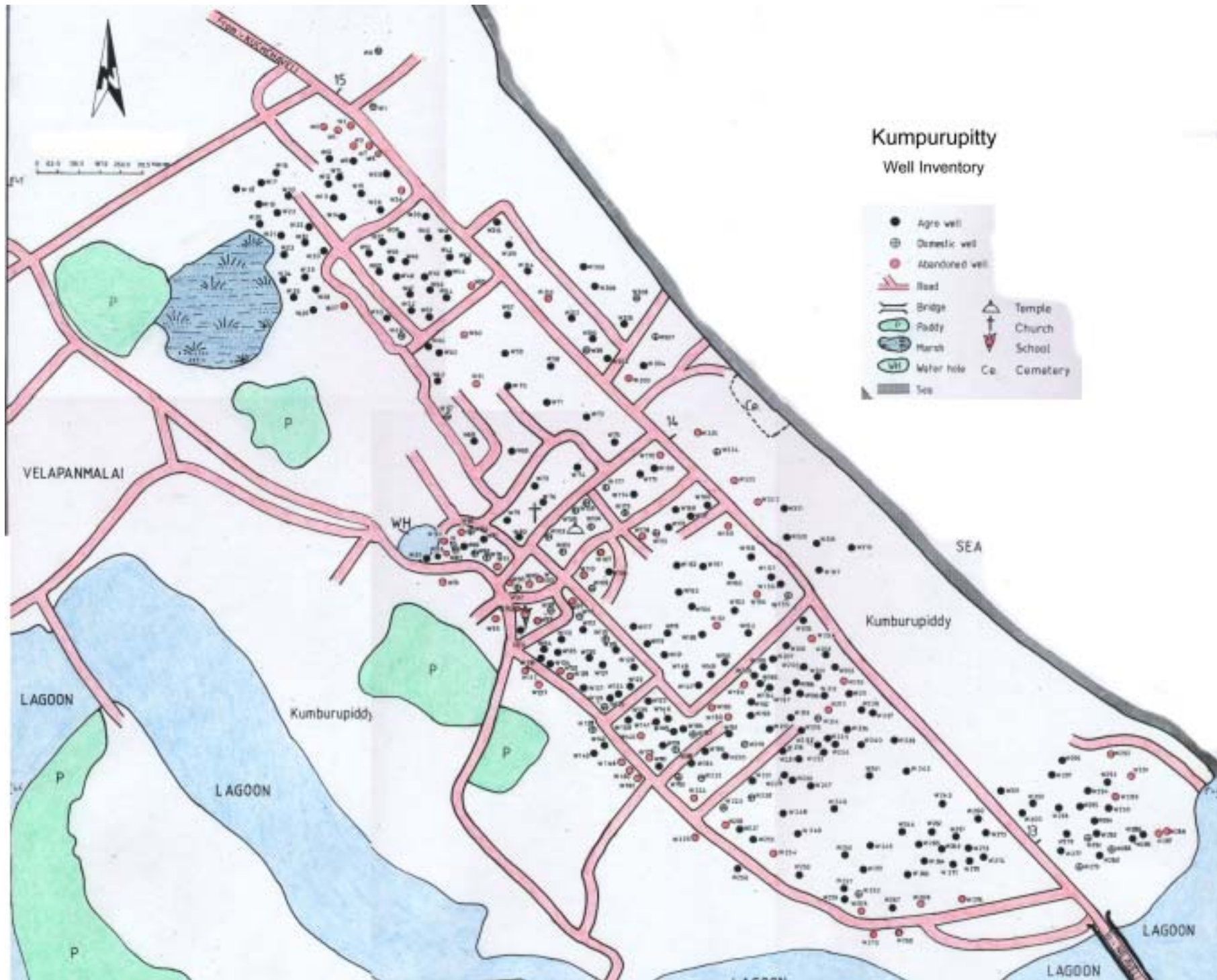
- The development of the onion cultivation its expansion and the construction of additional agro-wells need to be closely monitored. Strict control and licensing of wells are recommended.
- Environmental protective measures have to be introduced as soon as possible on a larger scale: e.g.
 - Construction of toilets near domestic wells have to be prevented
 - Construction of sheds for poultry, cattle and goats etc. near domestic wells should be stopped
 - Excavated new wells should have protective side walls
- The intensive cultivation of onions, thereby extracting considerable quantities of groundwater, using high amounts of fertiliser and applying pesticides requires a

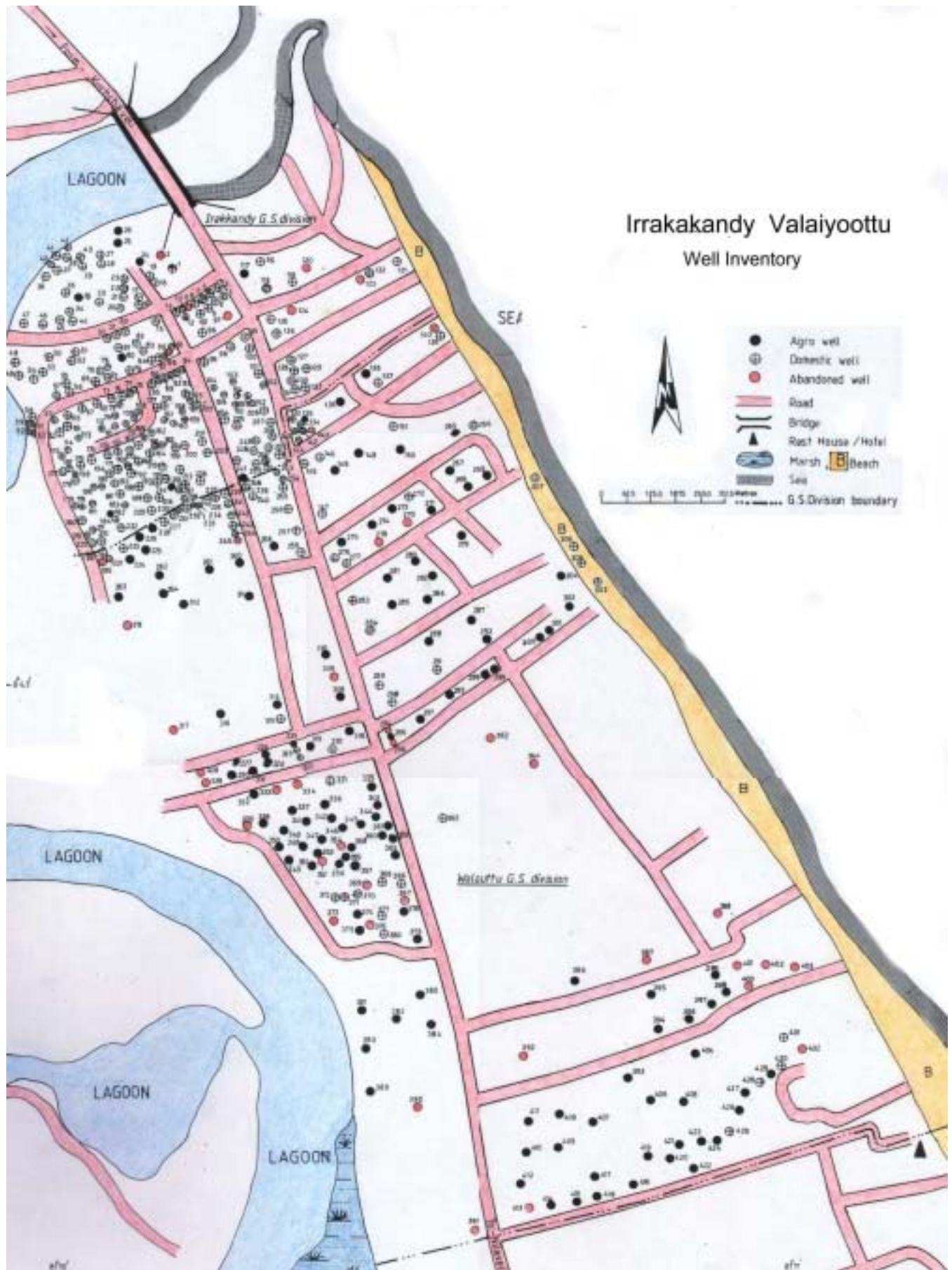
³ Details about land use, ownership etc. were researched during the IFSP-CATAD Project 2001: Conflict – Threat of Opportunity? Land Use and Coping Strategies of War- affected Communities in Trincomalee, Sri Lanka, Author: CATAD-IFSP Team, Berlin/Trincomalee, December 2001

regular monitoring of the water level/water quantity and the water quality. It is recommended that a competent institution is charged with this task (Environment Authority ?).

- In view of the sandy porous characteristic of the soil further investigations should be undertaken for fertiliser and pesticides residues in the soil and ground water (leaching effect, wastage of water).
- The third and fourth onion cropping should be restricted, according to the availability of groundwater. Integrated farming and crop rotation are recommended.
- Due to the high density of agro-wells are high in the Nilaveli and Kumpurupiddy G.S. Division in the ranges of 90 to 125 wells per km²,
 - Exclusive cultivation of onion should be avoided
 - The land use should be changed to a mixed cultivation of coconut, onion and vegetables, which will significantly help to reduce the ground water extraction and minimise the risks for the farmers.
- The competent authorities (Dept. of Lands, D.S.) should undertake a comprehensive land use survey.









Nilaveli North



Nilaveli South