AQUASSISTANCE

Monasteries of Sera Jhe and Sera Mhe

Mission report

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SUMMARY

FOREWORD

Our mission in March 2004 follows those of 2000 and 2002 which aimed at boosting the water supply of the kitchens of the Sera Jhe Temple. The 2000 and 2002 missions proved to be unsuccessful due to a non-productive boring in 2002. Nevertheless, the 2002 mission provided a lot of useful information regarding water supply (numerous borings, storage issues, electricity problems, etc.) and emphasized the issues of wastewater and domestic waste treatment.

It had then been decided to tackle this problem by studying the reasons for this shortage and by trying to stop the problem by making new state-of-the-art borings. An additional solution may be to restore the existing system by defining the wastewater treatment project, specifically the location of the treatment plant (lagoons), the collection network and the creation of a waste policy.

This report will discuss the following issues:

- Drinking water supply.
- Wastewater collection and treatment.
- Domestic waste policy.

The above issues were discussed with the following people who are in charge at the Temples:

- For Sera Jhe:
  - Geshe Thupten Moulam, secretary of the Temple until the end of 2004.
  - Geshe Thupten Seunam, secretary of the Sera Jhe Health Care Committee, in charge of the hospital, the water and the domestic waste.
- For Sera Mhe:
  - Geshe Karma Lobsang, secretary of the Health Care Committee of the Temple.

All our contacts were facilitated by the presence of Philippe Arribet with Monk Lobsang Tsultrime on the day of our arrival. Using the equipment left by Okinh, Philippe now continues our work to define the wastewater treatment system to be built by performing the topographic survey of Sera with the help of the American doctor, Daniel Rikleen, from the Sera Mhe hospital.

For the wastewater treatment and domestic waste parts of this report, a global solution for Sera is perfectly logical. Solutions for wastewater treatment can include connection of the houses, of the gutters or the main sewers for both Temples and the possible use of the land contemplated by Sera Mhe for the lagoon. Regarding drinking water, we must take into account not only the various existing networks which are connected to each Temple, but also the fact that for Sera Mhe, all houses in the "village center" are not connected (currently consisting of taps in the street) as well as the scattered new buildings. In this respect, Geshe Thupten Moulam has proposed that for the new houses, the cost of the boring be given to the Temple which will take care of the water supply by extending its network.

Our proposals, described in detail in each Section, were approved by both institutions before our departure from Sera. We are currently awaiting the estimates for the work, which will be available once both institutions have completed the local tendering procedure.

PART ONE
Drinking water supply

I. Introduction

Since 1959, 135,000 Tibetans have been forced to leave their country. 80,000 of them live in camps in India, and the remainder are scattered in various communities. Two Colleges of 5,000 monks have established monasteries in the southern part of India at BYLAKUPPE, in the State of KARNATAKA. They are called the Colleges of Sera Jhe and Sera Mhe.

The first mission of Aquassistance took place in October 2000 upon the request of the Sera Jhe College which was facing a lack of drinking water, primarily for their kitchens. This exploratory mission led to the realisation of a need for a boring in March 2002, a job which was found to be unproductive and was thus abandoned.

It was then decided to tackle this problem by studying the reasons for the water shortage and trying to put an end to the shortage by either making new state-of-the-art borings or by restoring the existing system. This was the purpose of the mission which took place from March 5 to 14, 2004.

II. Geological and hydrogeological context

The subsoil of the land occupied by the two Colleges is located on Precambrian (most probably Algonkian) metamorphic soil which is mainly formed of gneisses. On the rock exposures we have been able to study at the bottom of a watercourse we have seen, in some places, rocks of a gneissic appearance with clear bands of quartz and feldspath, which have a granular texture and dark bands of biotite that look like migmatites.

Above the gneisses, alteration has enhanced the formation of large blocks capped by the most recent alteration phase, i.e. clay soils covering almost the entire geographic area at stake. This overburden usually ranges from 3 to 5 meters.

Regarding tectonics, this area seems to have collapsed and is surrounded with faults that have favoured the formation of a series of secondary fractures, thus giving the rock a fissure porosity which may sometimes be high, especially perpendicular to the combination of such irregularities.

The infiltration water occupies these fissures when they are open. The volumes of water and the flow rates vary according to the number of fissures.

III. Analysis of the current situation

When they first settled there, the monks only used surface waters. They made use of the water coming from the two watercourses which were running along the geographic area occupied by the two Universities.

The poor quality of these waters, particularly in regards to bacteriology, quickly induced the appearance or the intensification of a series of water-related diseases. As a result, the Sera Jhe Health Care Committee (SJHCC) was set up in 1989 with the objective of improving the health and hygiene situation. Then, for the same reasons, the Sera Social Service (SSS) was established at Sera Mhe.

These Committees succeeded in improving the existing hygiene problems by performing a number of borings in order to allow access to the water contained by the fissures in the gneisses. The monks used the local method of boring which consists of calling upon a borer who chooses the location and then completes the boring. He is helped by a geophysicist and a dowser.

All borings were performed using compressed air with a 6 ¼ inch diameter down the hole drill. The overall depth ranges from 120 to 180 feet. The hole is not cased, except between 0 and 10 feet (fore shaft).

The entire job was carried out without taking into consideration good engineering practices which are absolutely indispensable for such work. For example, the geophysical part was completed with injection pipes that were too short. The investigation depth ranges from 10 to 30 meters, which is a depth that is clearly not sufficient.

The boring was carried out in 1 to 1 1/2 days, with no flow rate test. The person drilling merely measured the instantaneous flow rate of drainage during the drilling phase, a method which does not allow for a check of the perennity of the drainage, nor the determination of the operating flow rate.

It is for this very reason that some borings may no longer be used due to the absence of flow rate, and others which had been identified by the driller as originally being at a large flow rate may actually today only be used with a low flow rate. For example, it was stated that the boring located at the entrance of the Sera Mhe Hospital, in the gardens, initially had an artesian discharge greater than 40-m3/h, whereas today, the pump is drained at 3-m3/h!!

This flow rate decrease, sometimes at a total stop, may have several causes which cannot be identified due to the method used for drilling and the lack of testing. This situation could be due to a bad boring location (closed or clogged fissures), to excessively high head losses with respect to the flow rate extracted, or to chemical clogging.

In conclusion, we can say that as of today it is impossible to know the true capacity of each of the numerous existing borings. There is currently no information regarding the static and dynamic levels, the head losses or the critical flow rate.

1. The collective structures of Sera Jhe:

The Sera Jhe Health Care Committee is currently facing two problems:

- the supply of drinking water needed for the population, i.e. approximately 3,000 inhabitants, plus the customers of two restaurants and one hotel.
- the control and treatment of tuberculosis. Additionally, this Committee has a department specialized in Tibetan medicine.

• Storage structures:

The SJHCC has at its disposal the following for use in supplying its population with water:

- two 100-m3 tanks, one old and one nearly finished.
- one 50-m3 tank in bad condition.
- one 40-m3 tank which is not used (and not supplied) next to NGARI KANGTSEN.
- the SJHCC has planned to build a 150-m3 tank (average cost: €20,000) and is currently looking for a financial sponsor.

• Drainage structures:

To supply these tanks, 6 borings are used:

- 2 supply the oldest 100-m3 tank; they are both fitted with a 7.5 HP pump.
- 2 feed the same 100-m3 tank and the 50-m3 tank, thanks to a valve. Each boring is fitted with a 10 HP pump.
- 2 supply the new 100-m3 tank and are each fitted with a 7.5 HP pump. One of the borings is located next to the tank, but the other is quite far off.

2. The collective structures of Sera Mhe:

• Storage structures:

The Sera Mhe Committee has the following tanks at its disposal:

- one 25-m3 tank above the Temple's kitchen. This tank is used to supply the population, a share of which is not connected. The tank feeds four fountains.
- one 5-m3 tank above the library.
- two 5-m3 tanks at the level of the school.
- two 10-m3 tanks above the new Temple.
- the SSS plans to build a 150-m3 tank at the centre of the old town and has claimed to have secured a promise of funding from the Indian government.

- **Drainage structures:**
- 2 borings supply the 25-m3 tank.
- 1 boring supplies the school's tank.
- 1 boring supplies the library tank.
- 2 borings supply the new Temple's tanks.

All pumps are 5 HP models.

It seems that it takes one hour for the borings to fill the 25-m3 tank. This would mean a flow rate of slightly more than 10-m3/h per boring.

In addition, we were told that one hour of pump operation was required to fill one of the 10-m3 tanks at the new Temple with a single boring, i.e. a flow rate of 10-m3/h.

- **Water treatment plant:**

The SSS has a small water treatment plant based on the osmosis principle and supplied by two borings. The treated water is stored inside a 10-m3 tank. The cost of osmosis amounts to 700,000 rupees. One litre of treated water is sold at the cost of 1 rupee to the monks of Sera Mhe, 2 rupees to the Sera Jhe monks and 3 rupees to the laymen.

Raw water analysis for both borings and treated water analysis are presented in the appendix. It is interesting to note that although the raw water was free from coliforms, 39 were found in the treated water! The reason for this situation could be a breakdown of the UV treatment unit.

3. Individual supplies:

Several monks have had single-family houses built for them. Others live in multi-story buildings (Kangtsen).

The SJHCCC and the SSS have had difficulties in supplying enough water to the population, therefore the monks have looked for sponsors in order to have running water in their own house or in their building. The water supply technique is always the same, a boring is made and fitted with the appropriate equipment and a 5-m3 tank is placed on the roof.

This leads to the multiplication of drainage structures, which are countless, and their number prevents any control since the volumes of water drawn from the ground water are completely unknown.

All operations are manual, meaning that the tank stops filling when the monk responsible for the water realizes that the tank is full, i.e. when it overflows.

4. <u>Problems related to the current practices:</u>

- The responsibility of the monks who participate in the Committees that are in charge of the water supply is highly diluted by the large number of private facilities which are out of their control.
- The absence of automatic devices in the tanks leads to water losses, the volume of which is unknown but is expected to be quite high.
- The frequent electric power outages raise a major issue for pump operation. Usually, power is available for 2 hours in the evening (from 10 pm to midnight) and for 3 to 4 hours in the morning (from 3 am onwards).
- The low cost of the electricity used to operate the pumps (1 hour = 40 rupees) makes the Committees reluctant to equip their structures with machines that would instead have an operating cost of approximately 60 to 80 rupees per hour according to the pump's power (3 to 4 litres per hour of fuel, costing 20 rupees per litre).
- No control, neither qualitative nor quantitative.
- Impossible to ensure minimum protection for all of the borings. For instance, we have found a boring located just 3 meters away from a set of latrines and a boring right next to a dump for domestic waste.

At this time, the two Committees have a storage capacity of 275-m3 of water to supply the population.

The population currently consists of approximately 5,000 monks. If we add the two projected tanks for Sera Jhe and Sera Mhe and if we eliminate the old 50-m3 tank of Sera Jhe, we reach a storage capacity of 525-m3. This would mean a consumption of water greater than 100 litres/inhabitant/day.

These figures show that the entire population could have an adequate water supply with 100 litres/inhab./day. Once the projected tanks are built, it will be possible, due to the new practices that are described in the following pages, to collectively meet the drinking water needs.

It is also interesting to note that even if only one of the tanks were built, for instance the 150-m3 tank of Sera Jhe to replace the existing 50-m3 tank, there would still be 75 litres/inhabitant/day, a volume that would also be sufficient to meet the needs.

IV. Proposal for the implementation of a rational use and management

To supply the 5,000 monks forming the two Colleges of Sera Jhe and Sera Mhe with drinking water requires the following:

- construction of two tanks totalling 300-m3 and elimination by the SJHCC of the old 50-m3 tank. **The water lines** of all tanks should be perfectly under control. However as of today, the Committees of Sera Jhe and Sera Mhe do not know if the tanks are under control.
- **automation of the tanks** to make sure that the pumps start and stop at the right time, without overflows or oversights.
- **power source:** although the cost is slightly greater than that of electric power, it is absolutely necessary to equip all structures with fuel generators which will make it possible to fill the tanks by operating the pumps at the right time.
- **the network:** identification of the existing network should be carried out so as to check that all the pipe diameters are appropriate and that the network is completely connected (especially at Sera Mhe).
- **selection of the existing borings to be used:**

  a. currently the number of borings is sufficient for the supply of water to more than the entire population. However, it is preferable to select just a few of the borings which would supply at least 50-m3/h, a flow rate that would enable the monks to fill the storage tanks in less than 10 hours.

  b. below is a brief description of the borings we examined with the entrepreneur who made them, plus all the information we were able to gather from the driller and the users. The numbers used are indicated on the drawing in the attached appendix.

  Boring A2: in front of house #51; it has reportedly pumped for a 24 hours period at 30-m3/h. Currently this boring supplies a building hosting 60 people. According to the users, the 5.5-m3 tank is filled in just 20 minutes of pump operation. The flow rate would thus be 16.5-m3/h.

Boring A3: Kopan Khangtsen; according to the driller, it has supplied 50-m3/h over night.

Boring A4: Sera Mhe Hospital; according to the driller the tanks have pumped for a 2 day period at 45-m3/h. According to the users, today it supplies 18-m3/h with a 6 HP pump.

Boring A6: The gardens at Sera Mhe Hospital. The driller has described it as an artesian boring which has supplied 45-m3/h. Today, according to the users, it is only able to supply 3-m3/h (pump drainage).

Boring A14: In front of the staircase of the Sera Jhe Temple. According to the driller, this boring has supplied 30-m3/h in one hour. However, we can not use it due to the nearby presence of a set of latrines. Furthermore, the monk in charge of this structure has told us that 2 hours are required to fill the 2 tanks totalling 10-m3 with the A14 and with the help of another boring located next to a dump which is close to the old school (now a dining hall). As a result we are far from the 30-m3/h announced for the A14.

Boring of the Sera Jhe Temple: This boring supplies a tank with a volume between 25 and 30-m3. According to the monk in charge of this structure, 3 to 4 hours are required to fill this tank, whereas 5 years ago, it took only one hour. It seems that it has lost most of its capacity. Furthermore, we were told that the drainage water was slightly turbid.

This list of borings must be accompanied by all or part of the borings currently used by the two Committees, i.e. 4 borings for the SJHCC and 2 for the SSS.

- **Proposed methodology for possible realization of new borings:**
  - **Location:**

These borings should obviously be made as close as possible to the tank they are supposed to feed and by choosing the areas most affected by tectonics. It might be useful to have support from electrical geophysics, provided that the length of the AB injection line is greater than or equal to 400 metres.

- **Drilling:**

We will propose, as a first phase, to test some of the existing systems. This will include a series of measurements that will be made, one of which will be the present depth of the structure. This will enable us to compare this value with the original depth (if the users or the driller still remember it) and to at least make sure there has not been a major landslide. If this is a problem, the holes will be left uncased (except for the fore shaft which will be cased).

Regarding the holes' diameter, however, the widely adopted value of 6 1/4 inches shall be replaced by a larger diameter, to enable the pump (the dimensions of which will depend on the drainage flow rate) to pass through the holes, but also to make room for a flexible pipe intended to determine the levels during the flow rate tests.

- **Cleaning:**

After the drilling phase, the structure shall be cleaned by air-lift pumping until perfectly clear water is obtained.

- **Flow rate tests:**

Determination of the critical flow rate:

This is done with a submersible pump. The critical flow rate allows for the assessment of the head losses and to determine from that the flow rate that may be drawn.

The operating method will comprise of 4 levels of one hour pumping at 4 different flow rates: 1/6 of the desired operating flow rate, then 1/3, then half and finally twice the flow rate.

After each pumping phase of one hour, the dynamic level will be determined and there will be a one hour pause. This test will thus last seven hours in total. It will determine the critical flow rate which will obviously become the operating flow rate. If the critical flow rate is lower than the desired operating flow rate we will have to adopt this lower value. It should never be pumped at a value greater than this measured limit.

Performance of the flow rate test

This allows for the check of the ground water supply and the calculation transmissibility. It shall be performed with a constant flow rate, slightly below the critical flow rate, while measuring the variations of the static level.

The level measurements will be made at the precise moments indicated in the tables which will be provided to the person in charge of the testing.

- **Protection of the boring:**

A 5m-radius concrete slab will be built around the boring. This area will be fenced and its access will be restricted to the members of the Department in charge of the borings.

- **Controls:**

Periodically, the flow rates and the levels of the borings should be checked. Regular analysis of the drainage water should be carried out.

This proposal of control and maintenance operations will require the creation and implementation of a new entity employing **permanent**, adequately trained staff.

We are convinced that the implementation of such an entity is as necessary as the previous entities implemented for the tanks and the borings.

V. Conclusion

The mission carried out by Aquassistance from March 5 to 14, 2004 has allowed for the identification of the problems that the two Committees of Sera Jhe and Sera Mhe are facing. The problems are mainly due to a very low storage capacity, the absence of tank automation and the inconvenient use of the electrical power supplied by the Indian company.

It is obvious that the deficiencies identified in the network have influenced a major part of our proposal.

It seems to be essential to give the responsibility of the water supply to one single competent institution formed of permanent staff who would be trained in the operation, control and maintenance of all the facilities.

PART TWO
Wastewater treatment

I. Presentation

The two monastic Universities of Sera (Mhe and Jhe) have received from the Indian government a piece of land (600 hectares) of a triangular shape, located at the top of a hill, with two streams running along the limits and joining at the north of the land. The height above sea level ranges from 800 to 900 metres.

The highest part is occupied by the village and the monasteries over approximately 150 hectares, with a population of 4,500 monks and a water endowment of roughly 60 litres.

The wastewater treatment plant includes fixed pits with overflow and discharge by pipes flowing toward the open air gutters located along the streets, which collect storm water during the monsoon. These gutters follow the streets' slope and discharge into the streams surrounding the site. In terms of the higher part of land, which is relatively flat and is where the temples and new buildings are located, the discharge is carried out by means of concrete main sewers (diameter: 500 or 600 mm). These are again running towards the streams along the lines of the slope.

II. Project

Only an exhaustive topographic survey (in progress thanks to Philippe) will allow for the determination of the sewer network that need to be established in order to supply one or two treatment lagoons. In this respect, it is interesting to note that a German NGO called NORBU LING e V works with Sera Mhe, specifically with their hospital. It has started a map of the Mhe part of Sera (without the topography) and would like to run tests regarding a lagoon-macrophyte system for the hospital's effluents. Moreover, the NGO proposes to co-operate with us.

Currently, a 500 mm main sewer coming from the area of the Temples and the old village is at the location chosen for the first lagoon. We can assess that two thirds (east slope) of the population may be served by this lagoon after connection of the street gutter located next to the Sera Mhe hospital (see map in appendix).

The remaining third (west slope) corresponds to the area of urbanistic development. Only the topographic survey will enable us to define the location of the second lagoon.

III. Treatment lagoon

This will be located north of Sera, close to the Sera Mhe Temple, next to a Eucalyptus grove and below the 500 mm main sewer coming from the village center. The 500 mm main sewer discharges into a gully which is connected to the eastern stream.

The land is owned by Sera Mhe and corn is farmed by Indians on behalf of the Temple. The underlying soil has a high clay content (decomposition of gneisses) and is thus favourable for the set up of a lagoon.

We have planned a 6,000-m^2 lagooning system with 1m of liquid height and three basins connected serially, one standard basin of 3,000-m^2 and two finishing basins of 1,500-m^2. This type of basin is lacking in the existing lagoon of the Nangdroma Temple (located 3km away) but is foreseen for the new lagooning system which is currently being built for this Temple (Golden Temple).

The operating characteristics are as follows: flow-through time of 30 days or 1.7-m^2 per inhabitant considering a connected population of 3,500 monks and a water endowment of 60 litres, i.e. approximately 200 cubic metres per day. These values are in line with those of the Golden Temple.

Each basin will have a liquid height of 1m and a freeboard of 0.5m. The banks will be covered with grass and their slope will depend upon the soil's resistance and upon the levelling equipment. A by-pass system will allow for isolation, if required, of each basin for a possible scraping. One stoned ramp per basin and driving roads are required. This network of bypasses will also allow for the discharge of the excess flow rates during the monsoon.

We have carried out a topographic survey of the land, which is relatively flat, thanks to the sighting equipment brought by Okinh. The GSM is useless for topography due to its precision of ±10m.

IV. Actions in progress

To finalize the wastewater treatment project, it is necessary to conclude the topographic survey of Sera and to obtain the estimates for the lagoons and the main sewers. The requests for estimates has been forwarded to the Temples which have called requesting tenders, but no answers have yet been received (Philippe will keep us informed).

For the survey, Philippe has started working with Daniel Rikleen, the American doctor of Sera Mhe. However, it is thought that the help of the German NGO would be welcome to speed up the process. It would also help in getting this partner involved in the general project, which includes the drinking water project.

PART THREE
Domestic waste

I. Introduction

Despite an obvious goodwill demonstrated by both Temples:

- collection of waste every day (or even more frequently during religious ceremonies) by two trailers towed by a tractor (one per Temple) and operated by two teams of three monks
- presence of dedicated containers within each Temple and in the area designated to shops and restaurants

The appearance of Sera is similar to what may be seen in developing countries. There is a presence of plastic items (bags and bottles) everywhere in the streets, gutters, fields and fences.

Furthermore, the waste collected is stored in areas that are totally inappropriate. It is stored next to the watercourses in order to have an efficient waste removal by the floods linked to the monsoon, next to sensitive places such as the elementary school of Jhe or the Mhe hospital, or even next to unprotected borings.

The average analysis of the waste gives the following composition:

- Plastics 70%
- Fruit juice packaging 10%
- Putrescible waste 10%
- Rags 4 %
- Paper 3%
- Glass 3%

In India, the water bottlers (Pepsi or Coca Cola) will take collected PET bottles provided that they are compacted and clean. This recovery circuit is managed by the Untouchables who are thus present on dumps. Therefore, part of the waste disappears thanks to the Untouchables who recover PET bottles and paper-cardboard. Additionally, the sacred cows of India eat the few organic residues contained in the waste. Furthermore, in order to minimize the volume of waste, the dumps are set on fire twice a month, thus producing a high atmospheric pollution (school and hospital).

Our idea is to facilitate the work of the Untouchables and increase, as much as is possible, the recovery ratio of bottles by means of a sorted collection.

II. Proposal

- **Awareness raising** campaign to inform the monks that their waste should be placed into dedicated containers and nowhere else.

- **Increasing** the number of containers throughout the town and at the collective dwellings.

- **Sorted collecting** of PET bottles after manually compacting to minimize the volume and for paper-cardboard. Storage inside a fenced area is also suggested to prevent material from flying away and to make it easier for the Untouchables to recover.

- **Creating** a dumping area for the rest of the waste away from the floodable zones and the houses. For example waste can be placed next to the lagooning system and treated in a technical burying center. If the organic waste increases after the plastic collection, it could be possible to do a simple composting in windrows and turning so as to stabilise these residues and re-use them in agriculture.

This "Pilot Action" on Sera could serve as an example for the surrounding villages (both Indian and Tibetan) but requires that the population, starting in the primary schools, be educated on the proper process of waste containment. It is also necessary to have simple and demonstrative posters to educate all of the monks regarding the three key issues of collective life: **Cleanliness, Waste, and Water.**

III. Conclusion

To conclude, here is the strong desire expressed by Okinh:

May we fulfill our mission so that the entire population of Sera be perfectly healthy, that clear and pure water be abundant and full of minerals, that the environment be free from pollution (water, soil, air); and that the beauty of nature be beneficial for everyone and reign magnificently over this holy place.

Appendix

1. Water analysis of Sera Mhe

2. People to contact

3. Maps of the lagoon

- **Location plan of the lagoon**
- **Layout of the lagoon**
- **Sections of the lagoon**

4. Photographs

- **Drinking water**
- **Wastewater treatment**
- **Domestic waste**

5. Map of Sera Mhe