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An Appraisal of Centralized Waste Water Treatment Plant with Respect to Leh Town

Konchok Dolma, Madhuri S. Rishi, Renu Lata

Department of Environment Studies, Panjab University, Chandigarh - 160014, India

Abstract: ***With Leh town bagging the mega drinking water and sanitation project, is taking its first step towards waste water treatment after the changed sanitation practice from dry to wet. The aim of this paper is to highlight the need for an alternative decentralized waste water treatment along with the ongoing centralized system except certain areas which are not feasible geologically. Also in order to create awareness among community members regarding their role in waste water treatment and not depending on the authorities fully. For increasing the sustainability aspect, diversification of the existing system, especially in the midst of so much skepticism about centralized one in cold climatic conditions.***

Keywords: Centralized System, Waste Water, Awareness, Community, Alternative

1. Introduction

Ladakh from time immemorial has been a sustainable society whether in terms of food production or waste disposal, following the age old system of farming techniques and dry sanitation practice [1]. The advent of modernization and urban migration of youth due to globalization has been regarded as a drawback for the traditional culture [2]. The town of Leh (Fig.1.) is a bustling area especially during the few summer months generally from May-August and is the seat of the district semi-autonomous government since 2005 along with the Deputy Commissioner office which is located in the heart of the town. So a significant rural to urban migration [3], along with migrant labourers due to pull factors of summer construction boom is witnessed and finally tourist arrivals, mainly in summer times [4]. This town hosts such a wide variety of floating population, for a few months which prompted the authorities to act fast on solving the issues of water supply augmentation along with construction of a sewerage system as it was absent in the area and were major concerns with the rise in population influx especially propelled by tourism sector directly or indirectly. Leh district have come a long way from 527 tourists, since 1974 to more than the population of district of 1, 79, 491 in 2011 (Fig.2.). In general, to maintain good quality water, scheme/water point construction should follow proper planning complemented by design treatments such as pit latrines [5]. Soak pits consisting of simple pit of $1m^3$ should be between 1.5m and 4m deep but as a rule of thumb never less than 2m above groundwater table. It should be located at a safe distance from drinking water source (ideally more than 30m) [6].

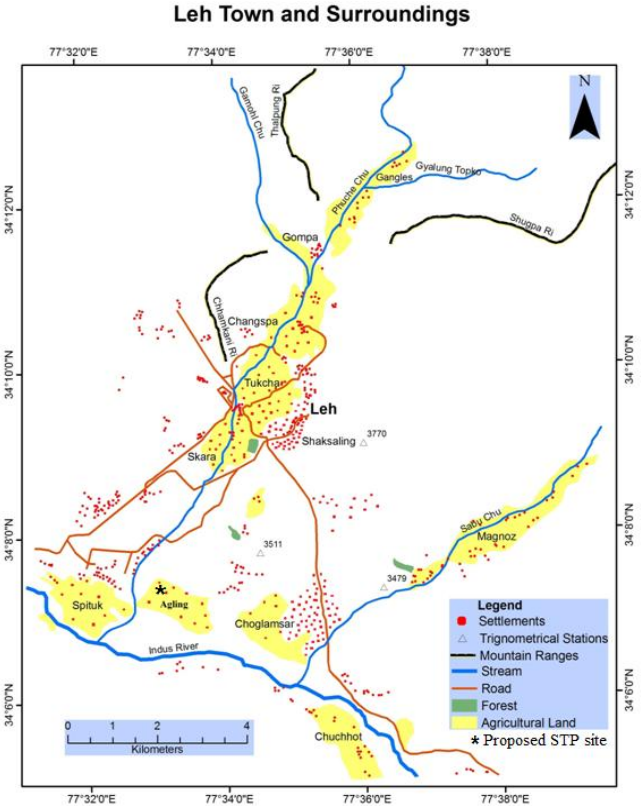
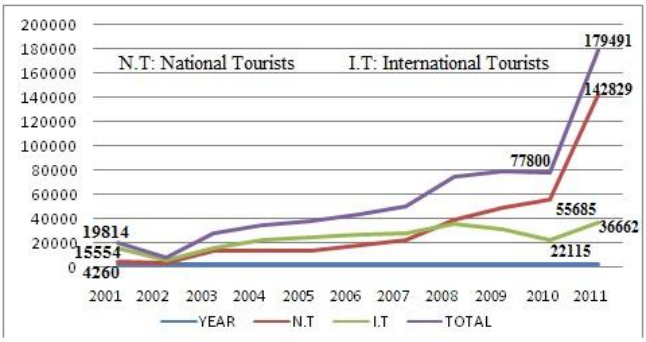


Figure 1: Location Map of the Study Area



(Source: Statistical Handbook, 2010-11) [7]

Figure 2: Tourist Arrivals in Leh District from (2001-2011)

In order to prevent further degradation of water source and to augment the existing water supply volume in Leh town, work began on 'Drinking water and Sewerage project' in 2013 and time frame for the project completion is 3 years till 2016 [8]. This project is building a centralized waste water treatment system in Leh town which aims to 'close the loop' which means giving back the water and nutrients into the ecosystem. In general economies of scale would surely favour centralization except in the case of an area with a range of significantly different heights above sea level that would make decentralization more suitable [9]. The WPD (Water Pump Distance) measure the vertical and horizontal distance that freshwater has to be actively pumped before it is available to the end users. So, in Leh town, WPD is 3000m less in the decentralized system than in centralized system so, it can be a first indication of energy consumption and efficiency of the system which can be applied to centralized waste water treatment system also [10].

2. Literature Review

Review of literature elaborates the ongoing debate between feasibility and sustainability of centralized or decentralized waste water treatment in international and national perspectives.

Balkema et al, 2002 [11] after doing a detailed literature survey on centralization or decentralization of waste water treatment, states that, although several researchers name decisive indicators but none of them gives a clear analysis of the tradeoffs made. As there is still limited insight as to which system are more sustainable in different situations.

Libralato et al., 2012 [9] stated that the adoption of inappropriate technology in waste water treatment field, when failure to take into consideration local conditions of the targeted community results in project failure. This is blamed on the lack of technical knowhow and financial resources. In case of Ladakh region, a small hydroelectric plant in Stakna, has already witnessed such situation in the project not meeting its expectations. The silting aspect from nearby areas, lacking in vegetation was not taken into consideration during the ex-ante phase and the project is a complete failure now after years and years of up gradation also.

As per a report by Centre for Science and Environment (CSE), 2010 [12] proposing decentralization in Shimla, states that the initial sewerage established in 1880 meant for 16000 people was successful for 100 years but in recent times, even after the 2005 augmentation of adding 6 more STPs, is not meeting the increasing required capacity for treating waste water. The reasons are wide like failure of pumping facilities, sewage lines not connected , so it is widely recognized to lay that for areas that are already not connected to centralized sewerage system, it is more viable to look at alternative and decentralized approach.

Narain, 2002 [13] while describing the merits of decentralization says that a block of houses or a colony can have its own sewage treatment plant and compared to centralized systems, far less water is used. As water do not have to be transported very far and less transportation cost with onsite treatment.

3. Need and Significance of the Study

The pressure on existing water resources and risk of water pollution by sewage disposal through soak pits and septic tanks is immense due to absence of a sewage treatment system as per the 30m rule which is not being followed in the town [10]. While the international debate over centralization/decentralization dichotomy it is not possible to accept or refuse one of them a priori and needs to proceed on a case-by-case basis [9]. Especially in the developing world the impediments and challenges of waste water management are more which can be overcome by proper policy implementation. A comprehensive site evaluation for technology selection in the receiving environment is crucial in deciding the type of system to be applied [14]. With Leh adopting a centralized waste water treatment system there is lot of skepticism among locals about its successful outcome mainly because of the cold and harsh climatic conditions of the region [8]. It has been observed that economies of scale would surely favour centralization, except in the case of an area with a range of significantly different heights above sea level that would make the latter more suitable [9]. The relief map more or less shows a decreasing elevation from north to south in general except some breaks in the form of hills when the height rises abruptly (Fig.3.). The aim of this paper is to assess the journey of sewerage project from inception stage and derive possible outcomes, since the project is still in construction phase.

4. Methodology

For assessing the state of water quality in the advent of sewage treatment plant still in construction phase, a total of 10 groundwater samples were collected from different locations in Leh town which spans an area of 1893 hectares/18.93 km^2 and water quality analysis was undertaken during 2013-14 using standard procedures to assess drinking water quality of the town. The samples were collected in the month of July (tourist season) and January (non tourist season), 2013-14.

Prior to sample collection, all the plastic bottles were thoroughly washed and sun-dried and before sample collection the plastic bottles were rinsed twice with the water sample to be collected. The bottles were then labeled and the co-ordinates of the sampling sites were duly noted (Table.1.). Parameters like Temperature, pH, and EC were analyzed on the spot using potable water and soil analysis kit. For the analysis of other parameters, the bottles were taken to the laboratory and stored at 4^oC and further analysis completed as per standard procedures. Water samples were analyzed in the geochemical laboratory of the Department of Geology and Water Resources Department, Chandigarh according to the standard methodology given by American Public Health Association (2012) [15], Trivedy and Goel (1986) and Central Pollution Control Board, New Delhi (2001) [16]. For map making survey of India toposheet no. 52F/12 was used for digitization in the (Global Information System)

GIS software, ArcGIS and Global Positioning System (GPS) device was used for identifying sampling location. Semi-structured interviews were also undertaken among some stakeholders, particularly groundwater scientists, soil experts and direct beneficiaries from this project, mainly hotel owners of the town.

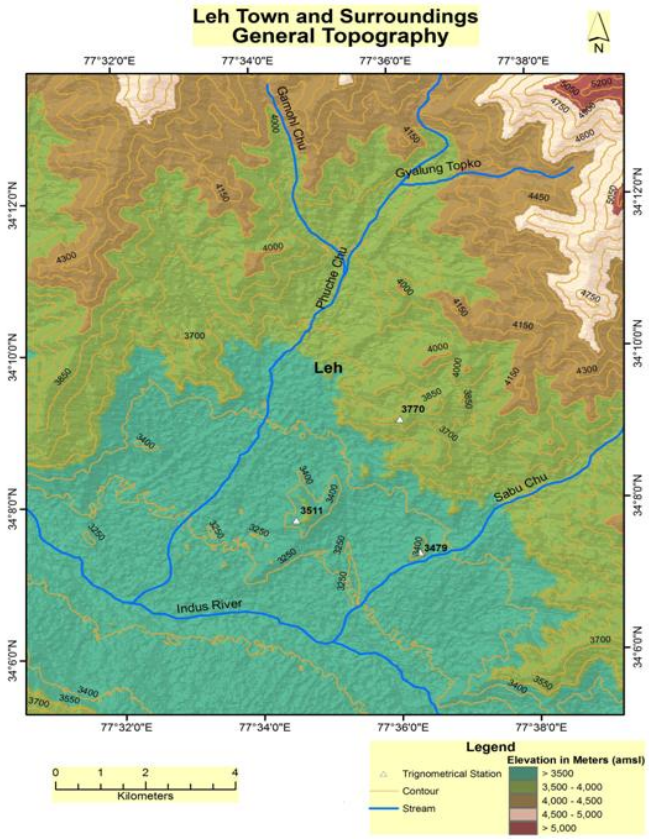


Figure 3: Elevation Map of the Study Area

Table 1: Sampling points and their location

S. No	*Location*	*Latitude*	*Longitude*
1.	Gyalung	$34^0$12’	$77^0$37’
2.	Gangles	$34^0$12’	$77^0$35’
3.	Gompa	$34^0$11’	$77^0$35’
4.	Sankar	$34^0$10’	$77^0$35’
5.	Changspa	$34^0$10’	$77^0$34’
6.	Chubi hand pump	$34^0$09’	$77^0$34’
7.	Housing colony	$34^0$08’	$77^0$35’
8.	Skalzangling	$34^0$08’	$77^0$34’
9.	Spituk west	$34^0$08’	$77^0$30’
10.	Choglamsar zivey tsal	$34^0$06’	$77^0$34’

5. Results and Discussion

Soak pits: This is the present on-site sanitation treatment being followed for black and grey water disposal with the shifting trend of water based flush sanitation practice from the age old dry sanitation prevalent from earlier times. The problem with soak pits in the area is rapid seepage and threat to groundwater as the major soil type is sandy [17]. According to a hotel owner in fort road area of Leh, there is an immense stench, especially fecal during summer times as interviewed by the author.

He further described about the state of soak-pits that when the lid of his hotel’s soak pit was opened for cleaning, there was nothing which means that all water had seeped and as there were no drawdown black and grey water in the pit, we can derive that infiltration rate is quite high in the region except in some areas which lies in hilly and mountainous terrains.

Water Quality: A total of 10 drinking water samples from 10 point sources were collected and analyzed for various parameters during the year 2013 and 2014, in the wake of STP still in development phase and having unplanned soak-pits or not at all in some areas (Table 2).

Table 2: Water Quality Analysis and their Ranges

S. No	Parameter	Methodology	Max. permissible limit for drinking water	Desirable limit for drinking water	Range among the 10 samples analyzed	
					Max	Min
1.	pH	pH meter	No relaxation	6.5-8.5	8	7
2.	EC	Electrical Conductivity meter	0-2000 µS/cm	750 µS/cm	849	223
3.	TDS	TDS Meter.	2000 mg/l	500 mg/l	134	565
4.	TH	EDTA-Titrimetric method	600mg/l	300mg/l	90	178
5.	Cl^-	Argenoto metric method	1000 mg/l	250mg/l	0.3	0.7
6.	Ca^{2+}	EDTA-Titrimetric method	200 mg/l	75 mg/l	11.8	44.4
7.	Mg^{2+}	By Difference	100 mg/l	30 mg/l	2.9	26.3
8.	NO_3^{2-}	Ultraviolet Spectrophotometer method	No relaxation	45mg/l	1.0	5.3
9.	Na^+	Flame photometric method	No guidelines		0.1	31.9
10.	Biological Parameters i)Total Coliform	Most Probable Number Method	<50 MPN/100ml: Class A (Drinking water after disinfection). >5000 MPN/100ml: Below C After disinfection, no drinking.		<2	$2.6x10^5$ Only in Chubi Hand pump

Out of total analyzed water samples 9 samples were well within the permissible limits as per (APHA, 2012) [15], only one sample from Chubi handpump had bacterial contamination due to shallow aquifer being tapped for drinking purposes in July, 2014 but absent during 2013 and Jan, 2014. An interview with a hydrogeologist working in Leh, it was known that Chubi area is most susceptible to groundwater pollution from nearby soak pits which leaches raw sewage because of shallow aquifer. A striking point to be noted was that only in peak summers the bacterial contamination was noted and bacterial presence was absent in peak winters which indicates a direct point pollution source from nearby soak pits mainly due to tourism boom and waste water discharge of summer times.

Centralized waste water treatment why adopted by the authorities: Since 2009, the PHE department of Leh has envisioned this project in collaboration with Tetra-Tech under JNNURM (Jawaharlal Nehru National Urban Renewable Mission) [18]. Through an interview with a soil expert from Leh, it was known that it is impossible to set up the STP (Sewage Treatment Plant)at Skara which is located on the foot of the town that due to people's disposition and influence, as any area nearby a STP is conventionally very smelly. Finally the place being chosen at Agling is understandable as mostly rural migrants and refugees reside here. In spite of the fact that these residents should have a say in this but the authorities finally could procure this land after much deliberation as it is located on the fringes and is a satellite outgrowth of Leh town. Also to set up a cluster of decentralized system requires some space in the midst of residential areas and social convincing for this technology among the locals could take a very long time and in this particular case, the need was dire for setting up a waste water treatment facility as soon as possible.

Topographically also, some places like Leh Old town area and hillock housing areas, below old bus stand are not feasible to set up such plants due to these areas being in mountainous terrain.

Finally, India is a developing country and the standard waste water treatment usually practiced is a centralized STP plant generally monitored by CPCB/SPCB (Central Pollution Control Board/State Pollution Control Board) all over India. Thus the same system is being adopted in Leh town and according to Reach Ladakh paper it is one of the biggest project pegged at 217 crores INR, so highly prestigious if successfully completed, that too at the earnest within the set timeframe.

Pros and Cons of Centralized waste water treatment in Leh valley: *Pro:* General acceptance and adopted by public, as there is assurance of continuum of treatment, that too a third party is doing and the people does not need to worry about sewage [9]. Relatively easier to procure land for setting up the STP as has to be done once rather than squabble several times over many small lands among present housing areas in case of decentralized ones. No special training required to be imparted for the community in management of any such small plants.

Con: While on the contrary this system, especially the lifetime of sewage collection pipes is 50-60 years and has high maintenance cost along with large volume of water for gushing through the pipes in order to prevent scaling, is needed. The major concern is even if the collected sewage does not freezes during winters by following precautions like pipes being laid deep below the ground and cotton wool being used for surface ones while the question is, during the treatment at the plant will it not freeze? Added energy and high end technology is needed along with a continuous electricity supply but many arctic central water

systems above ground have failed because of a missing fuse, pump or heater [19].

This region already comes in the high seismic zone IV and is prone to earthquakes [20]. A high hazard and risk is also there of the centralized system during any disaster which can cause havoc in the region putting all surface and groundwater quality at stake but the area already is at risk of groundwater pollution from not having a proper system for sewage treatment.

Pros and Cons of Decentralized waste water treatment in Leh valley: *Pro:* Lesser in cost due to reduction in collection cost as the process is generally onsite or very small distance from waste collection till treatment. More flexible than centralized system as on site technologies can be developed and distributed in free market easily [21].

Con: Decentralization is hard to introduce due to conditioning factors (social, economic and environmental). Without effective cooperation by the end user, it is not possible to successfully run and manage such a system. This also needs some space even though little and an enclosed or below the ground along with constant heating is required for smooth functioning, under sub-zero conditions. So, densely populated and hilly terrains of Leh Old town and Maney Tselding are not suitable to have such systems as the later area already had a record of flash floods.

6. Conclusion

As massive challenges lie ahead regarding the long term sustainability of a centralized sewage treatment system, there is requirement of diversification in waste-water treatment in Leh town by not depending on this centralized treatment facility solely. One method is promoting the age old traditional sanitation system especially during winters rather than using the wet system as *passive solar technology* had made possible for yearlong functioning of wet sanitation practice in recent times in the region without having freezing pipes. More importantly the region needs to assimilate advanced, cost-effective decentralized systems along with the centralized system in order for tourism promotion and general public cannot be dictated for using dry sanitation only. Alternatives to the flush toilets and sewerage are needed and flush and forget attitude is not working, the faster we realize it, the better [13]. An integrated suite of suitable alternatives would make the sanitation policy more robust.

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Author Profile

Konchok Dolma is a UGC-SRF, pursuing Ph.D from Department of Environment Studies, Panjab University, Chandigarh, India