

SPATIAL, TECHNOLOGICAL AND SOCIAL ASPECTS OF WASTEWATER TREATMENT IN PUDUCHERRY REGION, INDIA

Franz Fardin*^{&***}, Annick Hollé**^{*}, Emmanuèle Gautier***^{*} and Jacques Haury****^{*}

*Social Sciences department, French Institute of Pondicherry (Umifre 21 – CNRS/MAEE), 10 Saint Louis Street, B.P.33, Pondicherry, 605001, India (E-mails: *franz.fardin@voila.fr*; *franz.fardin@ifpindia.org*)

**Laboratory of Social Dynamics and Spatial Recomposition (CNRS/UMR 7533), Geography Department, University Paris 8, 2 rue de la Liberté, 93526, Saint-Denis Cedex, France (E-mail: *annick.holle@free.fr*)

***Geography Department, University Paris 8 and Laboratory of Physical Geography (CNRS/UMR 8591), 1 place Aristide Briand, 92195, Meudon Cedex, France (E-mail: *Emmanuele.Gautier@cnrs-bellevue.fr*)

****Laboratory of Ecology and Phytosanitary Sciences, Agrocampus Rennes, 65 rue de Saint Briec, 35000, Rennes, France (E-mail: *jacques.haury@agrocampus-ouest.fr*)

ABSTRACT

Both centralized and decentralized wastewater treatment plants (WWTPs) are used in Puducherry region. Whereas centralized plants treat urban domestic and industrial wastewaters, decentralized WWTPs are used in rural areas. Technological choices are linked to biophysical and social characteristics, and to the stakeholders and decision makers' knowledge about WWTPs technological diversity. Efficiency of eco-WWTP mainly depends on operation and management (O&M), thus on socio-technical aspects. Because of technical and financial costs, and lack of human resources, as well as some physical parameters (mainly climatic), centralized WWTP do not treat the whole inflows. Some of the decentralized WWTPs have the same dysfunctional situation. Riverine people usually participate to the O&M. So that WWTP functioning is constant, socio-technical studies of O&M are a key-aspect which must be taken into account before implementation.

KEY WORDS

constructed wetlands (CWs); decentralization; geography; India; socio-technical choices

INTRODUCTION

Despite the Millennium Development Goals, many Indian communities are not connected yet to a wastewater treatment network. 40% of the Indian population has improved sanitation (WHO & UNICEF, 2010: 43). In Puducherry region, southeastern India, local initiatives are rising to bridge the gap of rural wastewater management, while the urban area is being connected to sewage network and wastewater treatment plant (WWTP). Thus, Puducherry urban area is expecting to be fully linked to a WWTP in 2015, while Auroville is already connected. Decentralization seems to be a good alternative for rural areas, adapted to the biophysical and socio-cultural local context, a key-factor for endogenous development. Thus, this paper will focus on centralized and decentralized WWTPs in northern Puducherry region, in order to determine benefits and disadvantages of these various techniques, according to the local socio-technical features. Social science views have to be considered, since "development agencies should take people's priorities, values and visions of wellbeing into account to ensure the credibility and legitimacy of development" (Copestake, 2007).

METHODS

This study is based on applied geography, where basic researches become a tool for action and applied research. Applied geography focuses on researches which are "useful", that means which give answers and/or solutions to economic, social or environmental problems (Pacione, 1999). We have chosen to use qualitative method, comparing to some quantitative data, because "qualitative methods, which used strategically can both enrich and improve the accuracy of quantitative data" (Camfield *et al*, 2009: 23). Thus, ethnographical (Leroi-Gourhan 1945; Mauss, 1967) and socio-anthropological methods (Olivier de Sardan, 1995) appeared to be the most useful for that kind of fieldwork. These participative methods involve spending a long time on the fieldwork, in order to share as much as possible everyday life with the targeted population, and so understand the local dynamics. Surveys have been realized in English or in Tamil, via a local translator. Ethnobotanical method has also been used, even if it does not appear that much in that paper. This approach allows determining knowledge and know-how on plants, as well as the frequency of utilization (Reyes-García *et al*, 2007). Here, we study the values and the utilizations of WWTPs (considered as artificial wetlands) and their plant resources. "Values are also central to the evaluation and selection of possible remedial strategies, including comparative analysis of the benefits and disadvantages of different approaches for different people and places [...] the impossibility of objective value-free research is now axiomatic" (Pacione, 1999: 8). Thus, this study focuses on the benefits and disbenefits of centralized and decentralized WWTPs in south-east India, from social and environmental views. Indeed, society and environments are closely linked in an interrelation: change in one involving a change in the other one, in diachronical way.

RESULTS AND DISCUSSION

Results concern geography, and also socio-anthropology. The main factor of the distinction between centralized and decentralized WWTP is the concentration of the population in urban area, whereas the population is quite scattered in rural area. The other important factor is land: scarcity in urban zone, availability in rural one. Many kinds of technologies have been proved to be efficient to treat wastewaters. Each technique depends on various factors: land, energy, financial costs, technical formation of the workers, environmental and social vulnerabilities.

Centralized..

The northern urban area of Puducherry is equipped with one central treatment plant (75 Millions Liters a Day – MLD –, 100,000 People Equivalent – PE), located on the northern outskirts of the city (peri-urban area). In order to bring wastewater to the WWTP, nine pumping stations have been implemented, because the site is located at an elevation of 50 m above sea mean level (MSL), whereas the rest of Puducherry is around 10–20 m MSL. The area of that WWTP is about 30 hectares (ha), where 1/3 is dedicated to infiltration ponds, and 1/3 to agricultural lands. Two different techniques are used: a UASB (including sludge dry beds)/Duckweed Pond/Fish Pond system, and a lagooning system (oxygenation ponds), each treating 50% of the inflow. When the second system is overloaded, about 50% (so 1/4 of the total) is used to irrigate agricultural lands. The Public Work department (PWD) with the Health

department is in charge of the management of the site. The lack of workers involved a clogging of some ponds, and a mismanagement of the whole site. Official managers do not use any plant resources. The riverine people, composed by permanent tribal population and temporary workers, use some of the local resources, mainly plant resources. These plants are harvested, especially to feed animals. Because it has been proved that harvesting plants of constructed wetlands (CWs) improve the efficiency of such WWTP (Otte & Jacob, 2006: 63), thus we can say that local populations take part in the treatment, since they improve the efficiency of such systems. But, this participation is non-official and illegal, and it is mostly done during week-ends, when persons employed by the local government do not work.

...versus Decentralized

Wastewater management of the rural area, *i.e.* Auroville, is based on decentralized systems (all less than 500 PE, with some of only 4 PE), each site having its own WWTP. 14 of the 55 communities have been visited. All the wastewater treatment systems visited are based on sub-surface flow CWs for the secondary treatment, with other techniques for the first step of the treatment (mostly Imhoff or septic tank). In few sites, there is a tertiary treatment based on lagooning with floating macrophytes (*Spirodela polyrhiza* (L.) Schleiden, and *Pistia stratiotes* L.). Even if the implementation has been done by different structures (BORDA, Kraft & Associates, CSR-Auroville, CDD-Society), the Aurovillian Center for Scientific Research (CSR) is in charge of the management with the inhabitants of each community. In about half of the sites, O&M (mainly macrophytes harvesting) are not practiced, causing a deficiency in the functioning (clogging, high nutrient rate etc.). But in the half where O&M are realized, treatment is effective. In all the sites but one, treated waters are used for the irrigation of the local garden. Plant resources are used for agriculture purposes only in the site where treated waters are not used for irrigation. But O&M are operated by workers, so that the inhabitants know only few things about CWs functioning and attributed potential values.

Decentralized systems (point-source treatment) are often considered as more sustainable than centralized WWTPs (Campbell, 1999), because reclaimed water can be used locally for irrigation and because energy used is less, thus it can be considered as a more economical technique. From sanitarian point of view, they represent a low risk, according to the potential contamination as well as the spatial influence.

In south-east India, traditional wastewater management was based on tank system. In a way, tank system could be seen as a lagooning system, because they work like stabilization ponds system (decanting ponds, oxygenation ponds). Moreover, tank vegetation has the same role as in CWs, (oxygenation, nutrient removal, etc. – Vymazal & Kröpfelová, 2008: 116-120). From a social point of view, local population can be considered as real actors, since they harvest some of wetland plants, collecting them for different kinds of uses (mainly for fodder and construction purposes).

CONCLUSIONS

Thus, about people participation, decentralized WWTPs can be seen as sites where riverine people can participate in the O&M, as well as the implementation, increasing ecological awareness. Because WWTPs produce many kinds of nuisances, centralization of wastewater treatment plant concentrates them, thus they can often be considered as a witness of socio-spatial segregation. Because every locality has its particular characteristics, the choice of technology should be correlated with a global view, taking into account as many factors as possible. Some wastewater treatment ecotechnologies are based on holistic approaches, so they include socio-technical parameters. Indeed, because these technologies need less technical formation than conventional techniques, they can be easily managed by local stakeholders (riverine population, local government etc.).

But, the non-use of the resources created by CWs decreases the potential of durability of the sites. Furthermore, even if decentralized WWTPs can be considered as more sustainable than centralized ones, they need much more space, and a good network, infrastructure, logistic, in order to connect the different stakeholders and actors: it is not possible to have a specialist of CWs management in each decentralized site.

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