Appraisal of social and cultural factors affecting wastewater reuse in the West Bank

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Abstract: The reuse of treated wastewater offers opportunities to reduce the demand for scarce potable water resources. Importantly, social acceptance poses a barrier to the effective use of this resource should the concept not be comprehensively presented. This research highlights the potential for reuse of wastewater, identifies the areas of concern and examines the most important factors that affect wastewater reuse in the West Bank, Palestine. The most important factors considered are social, religious, economic, health, political, freshwater scarcity and institutional framework. It is found that traditions have negative effect on the acceptance of wastewater reuse. The psychological factor is negatively affecting the opinion of the community. Public awareness is weak and the information provided is not sufficient. The research will contribute to the improvement of the environment and sustainable development of the West Bank and proposes guidelines for a strategic plan for wastewater reuse.

Keywords: wastewater reuse; social acceptance; psychological factor; statistical evaluation; West Bank; Palestine.

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1 Introduction

Wastewater is a resource that can be applied for productive uses in agriculture, industry, flushing, washing and other activities. Wastewater reuse can deliver positive benefits to the farming community, society and the municipalities. However, it also causes negative effects on humans and ecological systems.

Wastewater reuse has different driving forces (Bahri, 1999). It is a supplemental water supply in water-scarce regions and can be a viable alternative to the disposal of treated effluents in rivers and coastal waters in regions with a humid climate. A careful assessment of the public acceptance and of the extent of potential health risks involved in wastewater reuse is necessary. The extent of risks should be weighed against urgency and derived benefits of the reuse in order to make a sound decision (Shahalam and Mansour, 1989).

Within the semiarid environment of Palestine, the reuse of wastewater offers opportunities to reduce the demand for the scarce potable water resources. The benefits of such additional supplies are augmented by a reduction in the disposal of raw wastewater to sensitive wadies and streams. These opportunities may be particularly relevant at the urban level, especially during dry summers.

The benefits of wastewater reuse are offset by scientific concerns pertaining to issues of human health, bioaccumulation impacts and groundwater pollution. The social acceptance issues may pose a barrier to the effective use of this resource should the concept not be comprehensively presented. Therefore, the development of sustainable water reuse schemes should include an understanding of the social and cultural aspects of wastewater reuse. The psychological factor is essential for initiating, implementing and sustaining a long-term wastewater reuse programme. Public acceptance and the willingness to implement wastewater reuse are highly connected with water scarcity.

This research highlights the potential for reuse of wastewater, identifies the areas of concern and examines the reuse in urban agriculture and other ecosystems and sectors in the West Bank. This is done by performing a public survey, which examines the public awareness, ideas, concerns and other related issues.

1.1 Wastewater and reuse practices in the West Bank

Only 70% of the rural population in the West Bank are served with piped drinking water. This service is generally deficient with an average per capita water consumption of less than 50 l/c/d and substantial unmet demand (Palestinian Economic Council for Development and Reconstruction (PECDAR), 2001). As a result and because the water supply is limited, the search for new sources of water is essential. Currently, only 20% of the West Bank is part of a sewerage system; all rural and suburban areas rely on onsite cess and percolating pits. These pits constitute a threat to freshwater and contaminate the soil and groundwater. Their sewage is usually pumped out into the nearest wadi or body of water.

Table 1 gives the percentages of served inhabitants and the status of the wastewater treatment systems in the major cities of the West Bank. The table has been prepared using recent information and the information in Shaheen (2003), Nashashibi (1995) and PECDAR (1994).

Table 1 Wastewater treatment systems and status in the main cities of the West Bank

City	*Wastewater collected (%)*	*Treatment system*	*Treatment efficiency*	*Status and notes*
Jenin	65	Aerated lagoons	10%	New system is under study
Nablus	90	Trickling filter	N/A	Under study. Raw sewage is flowing into the wadies
Tulkarem	60	Anaerobic ponds	65%	Recently rehabilitated
Bethlehem	80	Under study	N/A	Raw sewage is pumped into the wadies
Hebron	80	– Anaerobic ponds	10%	– Old system
		– Activated sludge and trickling filter	N/A	– A new system is under construction.
Ramallah	80	Aerated lagoons	20%	New system is under study
Al Bireh	90	Extended aerated and trickling filter	90–95%	Constructed and operated recently (2000–2002)
Salfeet	80	Extended aerated lagoons	N/A	Under construction. The system has two phases and sludge holding tanks

In many locations in the West Bank, untreated wastewater has traditionally been reused without supplementary treatment and without any precautions against health risks. Most of these schemes use the untreated flowing wastewater for irrigation of unrestricted agriculture (vegetables, fruits and salad crops). These practices have been frequently condemned and rejected, but still exist.

The Al-Bireh treatment plant has considered a reuse system although it has not yet been installed. As a first step, the treated effluent is planned to be discharged to a nearby agricultural area and ultimately utilised for restricted irrigation. Restricted and unrestricted agriculture have been defined by Shelef (1991). The excess sludge arising from biological wastewater treatment would be delivered to the farmers as a hygienic product in dry and granular form.

The objective of this research was to figure out and explore the opinions of the society in Palestine, especially in the West Bank through different levels and layers, regarding wastewater treatment and reuse, in addition to examining the potential purposes for the reuse. The research aimed also to explore the attitudes, preferences and perceptions of a decision to acquire and reuse treated wastewater in the West Bank. Determining the impacts of the social, economic, religious and political factors on this decision will contribute to the improvement of environment and sustainable development of the West Bank.

2 Research methodology

This research is not to argue for or against the option of wastewater reuse, but is to explore the opinions of the society in the West Bank against wastewater treatment and reuse. The exploration concentrates on the social aspects and figures out to what extent the social habits; culture, heritage, mentality, attitudes and religious understandings affect the attitude towards wastewater reuse.

The research covered the interested and affected individuals, farmers, households, experts, organisations, agencies and several governmental entities. The characteristics of the inhabitants as well as the level of education and the position of the individuals by whom the questionnaires were answered have been considered. Four target group categories have been defined; these are farmers, public, experts and institutions.

Out of the 731 distributed questionnaires, 644 were collected and 609 respondents were considered and analysed using statistical tools and SPSS 11.5 version. The random sample was distributed amongst different cities and villages of the 11 districts of the West Bank (Figure 1). Table 2 gives the distribution and percentages of the respondents amongst the 11 districts grouped into five sets. The respondents consisted of 187 (30.7%) public, 168 (27.5%) farmers, 127 (20.9%) experts in relevant subjects and 127 (20.9%) working in civil institutions. About 10% of the respondents were females.

The questionnaires were divided into different sections; general information, agriculture, public health, religion and social, economy and feasibility, environment, political, technical, public awareness and participation, water resources and wastewater treatment and reuse. The following are the most common subjects that the four types of the questionnaires covered:

- *General information*: this section contains information about the district, type of location (city, village, camp or housing complex), gender, age, marital state, religion, information about the work, education level, residency and accommodation, information about water consumption, method of water supply, method of wastewater collection, methods of solid waste collection, income, information about the family and family size.
- *Family and public health status*: this section contains questions about the Diarrhoea cases within the family, Amoebiasis and Ascariasis cases, in addition to questions about water quality, water shortage and its effect on health.
- *Religion and social aspects*: this section asked about Islam as the main religion in the West Bank. It contains questions which were used as means to measure the adherence of the individual to the religion and social customs and traditions.

- *Economic and financial aspects*: the questions of this section were used as means to determine whether the water prices are considered burden. This section also finds out whether the society is willing to participate financially in the development of water and wastewater sectors.
- *Public awareness*: this section discusses the growing awareness of water resource scarcity in Palestine, the competition of water resources, the negative impact of contaminated water on human health, the environment demand and the development of adequate strategies in water management.
- *Public and social participation*: this explores the willingness activation of the individuals and local communities to participate in the development of a water resources management system and the willingness to privatise the water and wastewater sector.
- *Political aspects*: it discuses the political situation in the West Bank and its effect on the acceptance of people, particularly the experts and institutions.
- *Agriculture and wastewater reuse*: this section addresses types of crops and irrigation resources and the main factors that adversely affect agricultural. It also discusses the types of wastewater reuse, particularly in agricultural sector.

Figure 1 The West Bank Districts

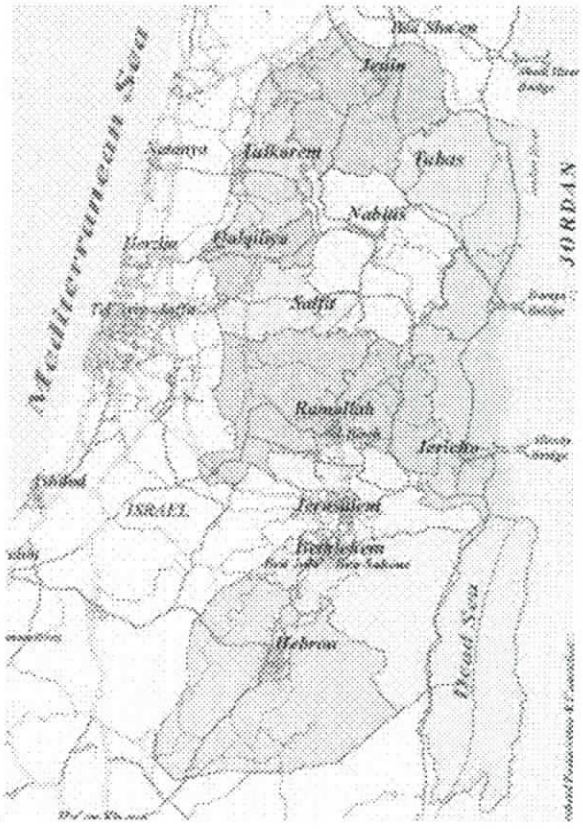

Table 2 Distribution and percentages of respondents amongst the West Bank Districts

District	*Public*	*Farmers*	*Experts*	*Institutions*	*Total*
Hebron and Bethlehem	28(15.0%)	30(17.9%)	40(31.7%)	22(17.5%)	120(19.8%)
Jerusalem, Ramallah and Jericho	35(18.7%)	25(14.9%)	32(25.4%)	57(45.2%)	149(24.6%)
Nablus and Salfeet	65(34.8%)	44(26.2%)	33(26.2%)	33(26.2%)	175(28.8%)
Tulkarem and Qalqilia	29(15.5%)	37(22.0%)	5(4.0%)	5(4.0%)	76(12.5%)
Jenin and Tubas	30(16.0%)	32(19.0%)	16(12.7%)	9(7.1%)	87(14.3%)
	187	168	126*	126*	607

*One of the respondents did not indicate the location and the district.

3 Results and discussion

3.1 Social aspects

A relationship was found between the social traditions and customs and the acceptance or non-acceptance of wastewater reuse. In general, most of the people agreed that the social traditions and customs practiced in the West Bank do not accept the reuse of the treated wastewater. This was the opinion of 69.6% of the farmers and 66.7% of the public. However, 70.5% and 78.5% of the farmers and the public respectively said that they are to utilise treated wastewater for any purpose, except for drinking, during drought seasons.

Cross tabs were constructed between some social indicators (living locations, respondents' ages, income, level of education and gender) and the non-acceptance of reuse. The results are as follow:

- 81.4% of respondents who live in cities consider that reuse is rejected by traditions and customs. The percentages are 59.8% in villages, 75% in camps and 44.4% among housing complexes. A *t*-test was conducted and the correlation is not significant; $r = 0.214$ and $t = -7.578$. One-way ANOVA test was conducted; $f = 5.345$ and Sig. = 0.002. The higher acceptance of the wastewater reuse in the villages is due to lack of water.
- 67.7% of respondents aging between 20 and 30 years consider that traditions and customs reject wastewater reuse. These percentages are 60.4% for 30–40, 65.6% for 40–50 and 73.9% for older than 50 years. The *t*-test resulted non-significant correlation; $r = -0.035$ and $t = -3.647$. For one way ANOVA test, $f = 0.179$ and Sig. = 0.911.
- 66.9% of the male respondents and 60.4% of the females consider that reuse is rejected by traditions and customs. The correlation is not significant; $r = -0.066$ and $t = -12.753$. For ANOVA test, $f = 0.968$ and Sig. = 0.382.
- 63.15% of the graduated respondents consider that reuse is rejected. For undergraduate respondents the percentage is 69.6%, while it is 80.95% for those who did not complete the school. The *t*-test resulted non-significant correlation; $r = -0.215$ and $t = -9.004$. The results of the ANOVA are $f = 4.316$ and Sig. = 0.015. Less rejection percentages are amongst the educated.

3.2 Economic aspects

The economic situation of the farmers has an obvious effect on their decision regarding the wastewater reuse. The driving force for them is to provide irrigation water at lower prices. It was found that 67.5% of the farmers get a monthly income less than NIS 2000 and 38.3% get less than NIS 1000, which is the poverty level.

About 72.5% of the farmers and 74.2% of the public considered the water bill a heavy burden on their budget, 44% of the farmers and 50% of the public considered the water prices as reasonable prices, while about 44% considered it not reasonable. However, 76% and 81.2% of the farmers and the public respectively agreed to pay additional fees in order to improve water and wastewater networks and facilities.

On the other hand, 62% of the farmers will accept reuse the wastewater if it is provided at lower prices; the percentage for the public was about 64.6%. The rest said that the municipality and the water authority must support and lower the water prices. About 64.1% of the farmers and 65.9% of the public accepted the reuse if this will provide them with additional water quantities. The farmers have expressed less interest in the recreational purposes; only 54.5% of the farmers will accept the reuse of the treated wastewater for recreational areas. They said that the wastewater reuse should be utilised to supplement water shortages in the essential purposes such as agriculture, washing and other ecosystems. Of the public 65.4% voted in favour of the recreational area.

3.3 Religious and cultural aspects

Islam is the religion of the majority in the West Bank. Given the emphasis that Islam, like other religions, places on cleanliness, there is also a persistent notion that wastewater is against Islam. In 1978, the Council of Leading Islamic Scholars of Saudi Arabia issued a special 'Fatwa' to regulate the rules of treated effluents for different uses. Wastewater reuse was made permissible for all purposes provided that wastewater was treated to the required level of purity for its intended use and did not result in any adverse public health effect (Farouki, 1999). Despite this rule, 64.7% of the farmers and 60% of the public in the West Bank, think that treated wastewater will be still considered unclean from the Islam point of view. On the other hand, only 16.2% of the farmers and 11.7% of the public believe that the treated wastewater is considered clean if it is treated to the required level of purity, while 18.6% and 28.3% of them respectively said, they do not know what the Islam opinion is.

About 71.1% of the farmers and 74.2% of the public said that their reference in the wastewater reuse will abide by any decision issued by the official religious authorities. This indicates that the rule that was issued in 1978 is neither realised by the farmers nor by the public. Even those who declared that Islam considers the treated wastewater unclean, do not know the actual judgement on the subject. About 17.5% of the farmers and 12.1% of the public refused to engage religions.

Religions have an obvious effect on the opinion of the farmers and the public. Most of the respondents said that in order to find acceptable solutions, the technical experts must work closely and cooperate with the religious references. It is obvious that the respondents seem to be prejudiced against wastewater reuse. The public should be aware and informed about the religion judgement.

3.4 Health aspects

In rural areas and most refugee camps, only 37.5% of the Palestinians are connected to a sewage system. The wastewater is discharged into percolating pits or septic tanks. These tanks are emptied by vacuum trucks and disposed into the wadies. This practice causes environmental hazards to the underground aquifers.

About 12.5% of the farmers and 27% of the public said that one or more of their family members suffer from consecutive diarrhoea symptoms. About 23.2% of the farmers and 27.0% of the public declared that one or more suffered from Amoebiasis and Ascariasis symptoms. While 22.3% of the farmers and 24.0% of the public stated that raw wastewater is being utilised for irrigation. In addition, 25.5% of the farmers and 33.7% of the public declared that they sometimes eat vegetables irrigated with raw wastewater. These percentages indicate that most of the Amoebiasis and Ascariasis cases are from using raw wastewater in irrigation.

In Nablus, 30.8% of the farmers and 40.7% of the public declared that raw wastewater is used in irrigation and that 33.3% of the farmers and 45.5% of the public suffer from Amoebiasis and Ascariasis. In both Tulkarem and Qalqilia, 30.6% of the farmers use raw wastewater to irrigate their crops and 32.4% suffer from Amoebiasis and Ascariasis. Other districts have reported much less percentages.

3.5 Political aspects

Most of the respondent farmers and public in the West Bank were pessimistic about the water future in the West Bank. Only 36.1% of the farmers and 38.5% of the public were either optimistic or fairly optimistic. Many of the respondents argued that "as far as the land is under occupation, the water will never be ours". The respondents are thinking of new water resources to compensate for the natural resources as 83.1% of the farmers and 77.3% of the public considered wastewater an important future water resource.

Of the farmers, 11.4% and of the public, 13.8% said that we must think first of our water rights, obtain the ultimate quantities of our natural water resources, which are according to their opinion, sufficient for agriculture and other ecosystems, subsequently and only then think about wastewater reuse.

The political factor has two opposite effects. The first is to reject wastewater reuse as a future water resource. Those who rejected consider that the idea is introduced by Israel, in order to divert the Palestinians from their water rights. The others accept wastewater reuse as it can be used as a supplement to the natural water resources.

3.6 Technical aspects

The questionnaires contain questions about water, water quality and quantity, water abundances, as well as water facilities, water services and water networks. About 66.4% of the farmers and 68.4% of the public indicated that the water quantities are not sufficient. About 53.7% of the farmers stated that water shortage is the main reason for not utilising 100% of their lands as they have to buy additional quantities of water in order to irrigate. About 55.7% of the public have to buy additional quantities of water to irrigate their home gardens. Accordingly, 70.4% of the farmers and 73.6% of the public do not have any objection to irrigate their private gardens with treated wastewater.

Although the majority of the respondents considered the wastewater reuse not acceptable from the social, cultural and religious point of view, 83.1% of the farmers and 82.4% of the public believe that treated wastewater can be used for agricultural purposes. The same percentages encouraged the reuse for agricultural and industrial purposes. 80.1% of the farmers and 85.7% of the public believe that wastewater reuse will improve groundwater quality, eliminate the pollution and improve the agricultural sector.

Concerning the type of agriculture, about 60% of the farmers and the public said that the treated wastewater should only be used for restricted irrigation. Only 42.2% of the farmers would accept to buy and eat raw vegetables irrigated with treated wastewater. This percentage is 46.2% among the public. However, 37.3% and 36.3% of the farmers and the public respectively do not think that wastewater can be reused in any type of agriculture.

3.7 Institutional aspects

In Palestine, water distribution networks in the major cities are under the responsibility of the municipalities. The Palestinian Water Authority (PWA) was established in 1995 with the main objective of the development and management of all water resources. As to the Water Law of 2002, the PWA is recognised as the regulator for water. PWA licenses water utilities and organisations.

Although 78.9% of the farmers and 84.1% of the public claimed that the water facilities need rehabilitation and improvement, 57.2% of the farmers and 55.5% of the public said that there is continuous improvement of the water wells and water networks.

The responsibility of wastewater management in the major cities should be within the hands of PWA; this was the opinion of 41.1% of the farmers and 42.5% of the public. Whereas 34.5% of the farmers and 32.0% of the public said that the municipalities should be the responsible entity for wastewater management. About 14.9% of the farmers and 12.2% of the public voted in favour of NGOs, while 9.5% of the farmers and 16.5% of the public voted in favour of international foreign private company. About 8.3% of the farmers and 11.0% of the public prefer a local company, but decided not to buy shares in such a company, claiming that it will make no profit.

Although the majority of the farmers and the public voted for the wastewater management to be under the jurisdiction of the PWA or the municipalities, they encouraged that the Ministry of Health (MoH) and Environment Quality Authority (EQA) should have the authority to audit these entities and to penalise those who breach the rules.

3.8 Guidelines for a strategic plan for wastewater reuse

Most crops in arid and semiarid countries will have to be grown increasingly and eventually solely, with reused wastewater. To help the gradual and coherent introduction of such a policy, the Palestinian National Authority (PNA) will have to adopt an integrated water management approach, facilitate public participation, disseminate existing knowledge, generate new knowledge and monitor and enforce standards. PWA has recognised the importance of wastewater reuse and has listed it as number seven among the nine focal areas of the water sector strategic plan (Palestinian Water Authority (PWA), 2000).

The water sector strategic plan has targeted the total annual wastewater quantities available for reuse at 21 MCM in 2005, 33 in 2010 and 92 in 2020. This study proposes four major principles for wastewater and reuse management. The principles are meant to create an enabling environment and to ensure safe reuse of the treated effluent as one tool to combat food and water scarcity. These principles are:

- Wastewater treatment and reuse must form part of an integrated water management strategy with multidisciplinary linkages between different sectors such as environment, health, industry, agriculture and municipal affairs. The main producer of wastewater, the municipalities, must interact with the main user, the agriculture. Urban and rural planning must be integrated so that industries are sited in locations where the effluent will not contaminate water resources. In order to make the reuse feasible, clusters of locations nearby villages, cities and camps can share one treatment plant.
- PNA should facilitate the participation of stakeholders in wastewater treatment and reuse. This should include supporting NGOs which help build institutions at the local level. The study concluded that about 80% of the community is willing to pay additional fees in order to improve water facilities and wastewater treatment plants. About 90% of the community are willing to participate in social services related to water and wastewater. The Palestinian community expressed their willingness to participate in the legal and financial aspects, technical aspects, in addition to management and administration.
- There is a need to disseminate existing knowledge about the danger of raw wastewater, safe reuse guidelines and the position of Islam on wastewater reuses. Knowledge of cost-effective treatment technologies and crop and soil protection is also necessary. The quality of the treated wastewater must be monitored and evaluated to decide on the types of crops to be irrigated.
- To ensure the protection of the public health and environment, PNA presented by MoH and EQA must evaluate, regulate and monitor the quality of the effluent, reuse practices, public health, crop water quality and soil and groundwater quality. PWA has proposed criteria which is similar to the Israeli criteria for unrestricted irrigation. A step-by-step application of the reuse should be adapted to introduce these advanced criteria. A continuous monitoring and evaluation is necessary.

An independent specialised entity is proposed to take the responsibility of the wastewater sector and its activities. This entity should have the experience and sufficient specialised staff. Its responsibility should include reviewing, evaluation and development of any plan for treatment and reuse. PWA should license and regulate this entity.

The questionnaire concluded that PWA is the most capable entity to take the responsibility of the management and administration of the wastewater sector. It also concluded that the municipalities with partial public participation shall directly implement the treatment and reuse projects under their jurisdiction.

3.9 Public awareness and acceptance

The psychological factor is essential for initiating, implementing and sustaining wastewater reuse programmes. In the absence of social support a reuse project may fail. The questionnaire has measured the public awareness towards wastewater reuse. It has

questioned the effect of the mass media on water conservation and wastewater reuse and found that 89.2% of the farmers and 87.9% of the public are affected regarding water conservation and preservation. Only 42.2% of the farmers and the public declared that they get sufficient information about the wastewater, while 50% voted that mass media do not provide that. About 96.4% of the farmers and 98.4% of the public stated that the academic institutions and schools should include subjects about water and environment.

The public must participate in decision-making processes concerning wastewater and reuse management. About 84% and 81.9% of the farmers and the public respectively are of the opinion that public must be considered in any wastewater and reuse scheme.

4 Conclusions

Assessment of the factors that affect the attitude of the Palestinian communities is crucial before implementing any wastewater reuse scheme. This research highlights the potential for reuse of wastewater, identifies the areas of concern and examines the wastewater reuse. It also examines the public awareness, ideas, concerns and other related issues. The results have shown similarities between farmers and the public as one group and the experts and institutions as another group. It is concluded that social traditions and customs highly affect the opinion of the respondents towards the reuse issue.

The psychological factor is the most important factor affecting acceptance of wastewater reuse. The original nature of the effluent will be always reflected in the trend of judgement of society on reuse. In this context, religion must be considered in the assessment of the factors as most of the respondents do not know the actual opinion of religion. It is the responsibility of the PNA to disseminate wastewater reuse, its advantages and potential risks. A cooperation and coordination plan is proposed to be developed between the Ministry of Advertisement and the religious references, in order to disseminate the Islamic point of view regarding reuse. The PNA should make contacts with other Islamic countries in order to develop a vision regarding wastewater reuse.

The governmental organisations should play a role in informing the community about reuse as public awareness is very weak. Officials, NGOs and the mass media must be supported and given enough opportunities in this subject. Public perceptions should be assessed continually to measure public opinion.

In Palestine, the link between the political conflict and the opinion of the public cannot be avoided. The Palestinians want to retrieve their water rights before the development of any artificial and supplementary resource.

Among the other recommendations addressed by the research are: appropriate wastewater treatment technologies; comprehensive management plan; priority criterion for the wastewater treatment and reuse; religious, social, economic and political considerations; human resources development; public health standards; code of practice; institutional arrangements and legislations and institutional restructuring.

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