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Upgrading Wastewater Treatment Plants Based on Reuse Demand, Technical and Environmental Policies (A Case Study)

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Abstract

Reclamation and reuse programs are an indispensable part of integrated water resource management, particularly in arid and semi arid regions. Yet, the feasibility of sustainable application not only is relied on design, operation and maintenance of wastewater treatment plants, but also could be influenced by the economical and environmental aspects of reuse demands. This study is aimed to illustrate different policies applicable for upgrading wastewater treatment plants with emphasize on nutrients management in the reclaimed water. For this purpose, 6 domestic wastewater treatment plants in Tehran were analyzed and discussed based on effluent characteristics and reuse demands. As a result, it was recommended that in a framework of demand based policy, and due to economical, practical and environmental limitations, Shahrake Ghods and Mahallati wastewater treatment plants should be upgraded with flexible operated tertiary units. To compare and select the most appropriate unit, the value function was defined and the attached growth based method was determined as a solution. Subsequently, to ensure the environmental protection, the implementation of floating plants treating surface waters, in association with assignment of dynamic trading discharge permit market in reuse program were suggested. Consequently, it was implied that all these solutions would simply be achieved through integrated water and wastewater management.

Keywords: Wastewater treatment plant, reclamation and reuse, irrigation demand, Tehran

Introduction

In order to meet the growing demands for water, the arid and semi arid regions have been turning into integrated water reuse programs (Pedrero et al. 2010; Ray et al. 2010). This approach can be offered as a promising solution reducing the water stress (Molinos-Senante et al. 2011). It can be due to this fact that the adverse effects of population growth, development of urbanization and food or industrial demands for water can be partially fulfilled through wastewater reclamation and reuse. The population growth would cause more reclaimed water in quantity which can be safely used in agriculture to meet the crop yield, or applied as a source for open spaces irrigation and recreational purposes. Recently, through system dynamics simulation method, it was implied that wastewater reuse can dynamically make the increasing stress balanced on water resources (Davies and Simonovic 2011). In a

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glance, the total quantity of urban and rural treated wastewater (termed as reclaimed water) has been estimated about 3600 and 700 MCM/Year, respectively (IRI Guideline 2010).

Substitution of conventional water resources with reclaimed water can be carried out through different types of applications. In urban areas, the irrigation of landscapes and public parks, commercial activities like vehicle and window washing, dust control and fire protection can be nominated as feasible alternatives (Hranova 2010). Besides, industrial activities would be privileged by reuse in cooling towers, boilers, or reducing process water demand. Agriculture would mostly be addressed because the demand is dramatically high and the required quality is much well-matched (USEPA 2004). It was verified that the reclaimed water would increase the crop yield and agricultural profits (Agrafioti and Diamadopoulos 2012). The other applications can be introduced as recreational and aesthetic aspects, artificial groundwater recharge, and stream augmentation (USEPA 2004).

However wastewater reclamation is justified as a water resource, the quality would be a challenge for safe reuse. It may fundamentally have influence on appropriate application selection while can bring conflicts among stakeholders of treated wastewater (Axelrad and Feinerman 2009; Ray et al. 2010). For example, high loads of nitrogen and phosphorus in a secondary treated wastewater is beneficial for irrigation and agricultural purposes while should be totally reduced for surface and groundwater recharge. In contrary, the salinity or suspended solids are more unfavourable for the former (Al Khamisi et al. 2013). Besides, economical, technical and environmental issues are required to be considered. For instance, the existence of public parks located topographically down the hill, the irrigation demand, and distance to wastewater treatment plants may affect the policy selection, total economy and sustainability of wastewater reuse (Abdolghafoorian et al. 2011). Accordingly, some recent studies are focused on finding the most suitable unit process or reuse application by decision making systems (Anane et al. 2012; Hidalgo et al. 2007; Sa-nguanduan and Nititvattananon 2011).

All these perspectives can be assumed as sustained unless the reuse application is varied in time. There are some facilities designed and operated with the primary criteria of reclamation and reuse for irrigation. Therefore, they are not equipped with the tertiary unit process. If the land application changes through the time and irrigation demand decreases, the effluent having nutrients would probably be discharged to the surface and groundwater nearby. As a consequence, secondary problems like eutrophication can be expected (Devi Prasad and Siddaraju 2012). Besides, even in short periods, this shortcoming is noticeable. Annually, the demand for irrigation changes dynamically as a result of irrigation pattern, crop yield, and environmental conditions (Ning et al. 2007). It means that the demand of water and nutrients are typically high in spring and summer while would be decreased or even stopped in winter. If the wastewater treatment plant is designed to feed the farmlands thoroughly, and due to continuous working state of the facility, a question would be remained unanswered that how is it possible to remove the excess nutrients from the effluent?

Since nutrients are valuable for irrigation of public parks, open spaces and particularly farmlands, it should be managed properly. This can dramatically reduce the construction, operating and maintenance costs of the wastewater treatment plants. Also, farmlands and parks would not be dependent on application of chemical nutritious fertilizers. As a result, the irrigation costs can be reduced as well (Molinos-Senante et al. 2011; Murray and Ray 2010).

Currently, most of domestic wastewater treatment plants in Iran were constructed regarding to conventional design criteria (Razeghi et al. 2013). In detail, they were typically aimed to achieve the national standard limits of main pollution indices, including biochemical and chemical oxidation demand (BOD and COD). Accordingly, there is a lack of tertiary treatment unit and reuse criteria are forcefully assigned for irrigation of public parks or farmlands. These would definitely emphasize on this fact that upgrading constructed treatment plants are indispensable and the demands and sustainability of reclamation and reuse programs should be considered as well. The purpose of this study is to assess the feasibility of using different novel policies, including demand, technical and environmental management based approaches, to find either the most appropriate reclamation strategy or upgrading wastewater treatment plants in Tehran.

Materials and Methods

Case study

Tehran, as the capital city of Iran, has about more than 10 million residents located on down skirts of Alborz Mountains. The water is mainly supplied by surface waters (Jajrood and Karaj Rivers) and groundwater resources. The wastewater collection system can partially convey the sewage to the 9 wastewater treatment plants while is going to be expanded to the whole city area. These municipal wastewater treatment plants are termed as Ekbatan, Gheitarieh, Mahallati, Sahebgharanieh, Shahrake Ghods, Zargandeh, Shush, Dowlat Abad, and the South wastewater treatment plant.

Table 1. Average quality of the effluent of wastewater treatment plants (2011-2013)

Parameter	Ekbatan	Gheitarieh	Mahallati	Sahebgharanieh	Shahrake Ghods	Zargandeh
BOD (mg/L)	6 ± 2.5	9 ± 4.4	11 ± 6	15 ± 3.2	11 ± 6.4	10 ± 5.1
TSS (mg/L)	12 ± 6	23 ± 7.2	25 ± 12.3	28 ± 8.7	12 ± 2.5	19 ± 7.6
TDS (mg/L)	442 ± 39	401 ± 74	421 ± 45	396 ± 58	471 ± 42	437 ± 38
TN (mg/L)	21 ± 4.6	51 ± 26.4	45 ± 12	42 ± 20.2	39 ± 8	51 ± 23.7
TP (mg/L)	3.2 ± 1.2	3.8 ± 2.1	4.5 ± 2.7	3.4 ± 1.1	3.1 ± 0.5	3.6 ± 0.8

The first 6 facilities are located in the northern and dense populated part of the city with average high life duration. The whole systems, except Ekbatan, were designed and operated based on conventional activated sludge or extended aeration method having no tertiary treatment units. Therefore, they are required to be optimized or upgraded. Yet, the secondary treated wastewater is currently allocated for parks irrigation and surface water discharge.

In Table 1, the average values of typical parameters of effluent of 6 wastewater treatment plants are demonstrated. Based on these data obtained from the official laboratory of Ekbatan for two years (2011-2013), it can be concluded that the effluent quality is more challenging on nutrients concentrations. The BOD and total suspended solids (TSS) values are noticeably acceptable by standards while nutrients would certainly deteriorate surface or groundwater quality. This can be a threat for Tehran and Varamin plains downstream of the surface waters (Kerachian et al. 2010). Since in the northern part of Tehran, no farmlands are available, public parks can be a well alternative for integrated reclamation programs. However, the demands of public parks depend on area and dominated species, in association with the location and elevation. These were previously determined based on Tehran municipality report published by Abdolghafoorian et al. (2011).

Methodology

Using demand based strategy to determine the sustainable approach on wastewater reuse should take effect under integrated water and wastewater management considering environmental, economical and technical issues simultaneously. In order to define the most appropriate policy, three strategies of demand based, technical based, and environmental management based methods were testified through a case study. For this purpose, the flow chart demonstrated in Figure 1 was followed for decision making similar to the plan suggested by Razeghi et al. (2013). It should be noticed that in this management strategy it was assumed that the health considerations and disinfection units perfectly follow standard limits.

To adjust the technical strategy for a flexible operating and reuse method, the process layout shown in Figure 2 was recommended as a development of previous recommendations (Badalians Gholikandi and Khosravi 2010). Also, to find out which unit processes can well be matched to the strategy with the highest economical, operational and technical value, in association with the lowest risks, the value function was recommended shown as Equation 1 (WEF 2004).

In this assessment and based on the recommended scheme, the risk is totally related to the operating and maintenance of the system. As the effluent quality is more equalized (reliability), the unit process is able to be more easily operated (workability), having wide range of operation (vulnerability), is more easily returned in line after start-up or failures (replicability) and have less sensitivity to the environmental conditions (i.e. temperature, pH, and total solids), consequently, it can be expected that the total operational risk would be reduced. The total risk value is calculated by average values of parameters mentioned above.

$$Value\ Index\ (V) = \frac{Efficiency}{Risk + Costs} \tag{1}$$

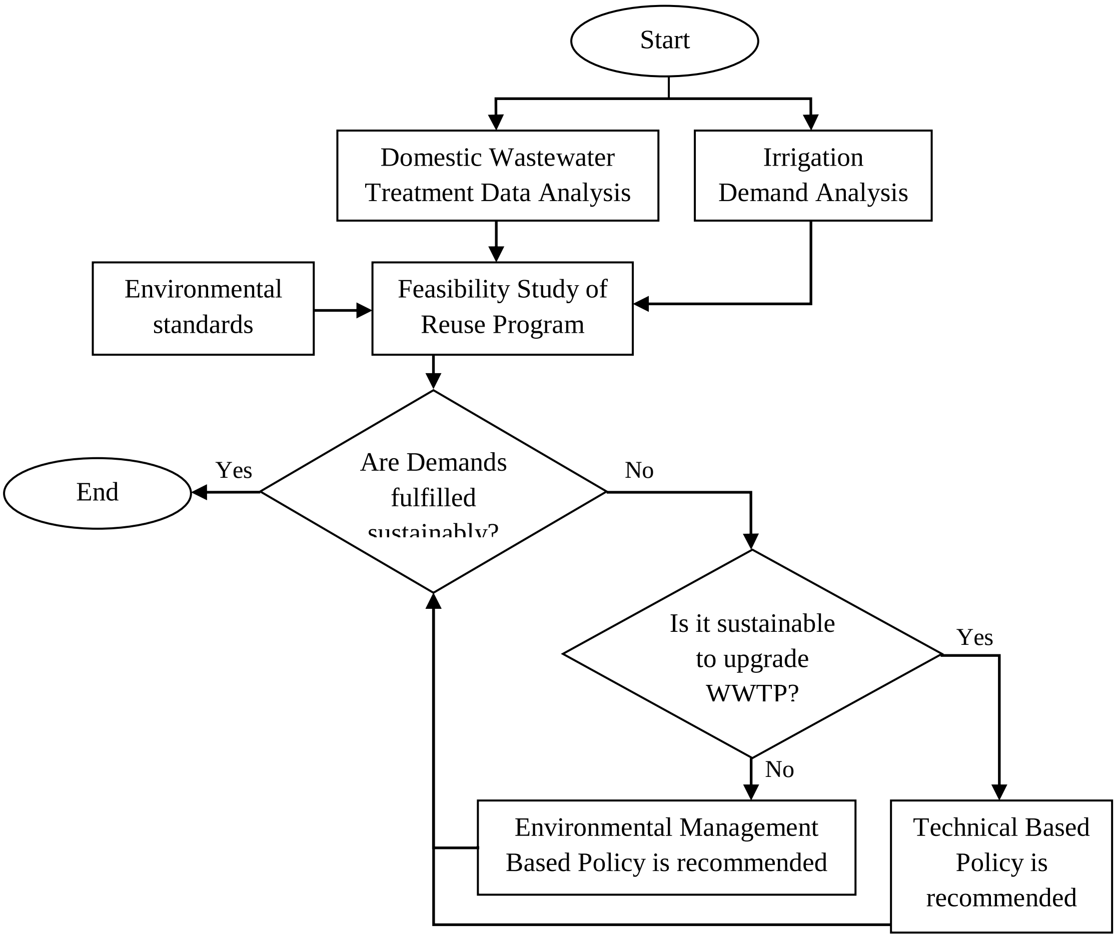

Figure 1. Decision making flow chart on upgrading wastewater treatment plants (WWTPs) based on reuse program

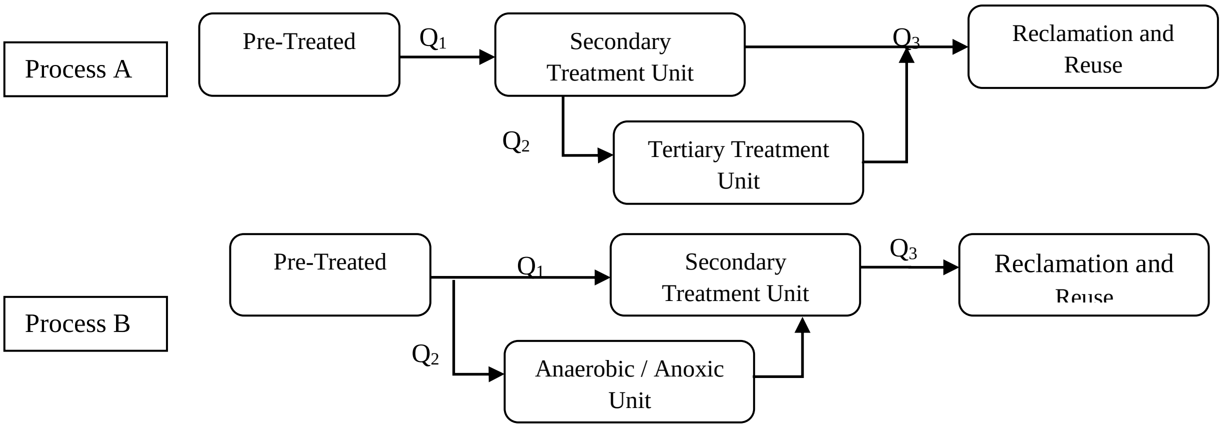

Figure 2. Schematic flow diagram of flexible treatment plant, Application of attached growth, MBR and Phytoremediation techniques (Process A), Application of biological suspended reactors having anaerobic and anoxic processes in sequence (Process B).

Results and Discussions

Demand based policy

Based on feasibility studies, it can be described that the treated wastewater can be used for public park irrigation while cannot certainly be discharged to the surface and groundwater. Therefore, integrated management of reclaimed water and upgrading recommendations for treatment plants are dependent on irrigation potentials located nearby.

As illustrated in Table 2, two treatment plants (Sahebgharanieh and Shahrake Ghods) are located in vicinity of public parks while the others should find potential demands in distant and preferably lower lands to reduce operating and maintenance costs (i.e. pumps and pipes). Accordingly, two treatment plants of Mahallati and Zargandeh can possibly discharge the effluent to the parks termed as Lavizan and Taleghani, respectively. But, the average total suspended solids (TSS) values of the former can possibly cause long term maintenance problems for reuse distribution system, particularly in distant. However, the sedimentation within pipelines may be neglected as a matter of high elevations differences. Therefore, it is implied that the quality parameters such as total solids (TSS and TDS) can have influence on the sustainability of reclamation and reuse programs.

Since there is no feasible demand for the effluent of Ekbatan and Gheitarieh, they should be upgraded and supplied with tertiary units, respectively. This approach cannot be achieved for the latter because it is totally limited to the residential areas. Also, the demand of Taleghani Park is less than supply values of Zargandeh treatment plant. Thus, the remaining amounts of effluents should be appropriately managed to prohibit environmental problems. Accordingly, and based on decision making flow chart shown in figure 1, some policies and recommendations are submitted in order to the numbers allocated to each facility mentioned in Table 2.

1. For Ekbatan treatment plant, the tertiary treatment unit focusing on phosphorus removal is recommended to be upgraded, because the ratio of TP to TN is relatively high. Then, the effluents can be discharged safely to the surface waters nearby. It should be noticed that A^2O process, oxidation ditch or attached growth systems can well be matched for this facility (USEPA 2007).

2. For Gheitarieh treatment plant, since there are some limitations (i.e. available land) for the facility to construct new settlements, and there is no considerable irrigation demand nearby, it is recommended that the effluent be discharged to the wastewater collection

systems. Then, it is possible to be fully treated in the tertiary treatment unit of South wastewater treatment plant exists in outskirts of Tehran. However, this would increase wastewater collection systems construction and operating costs considerably. Another option is that the effluent be used by the municipality for parks in higher elevations with tankers intermittently. It is obvious that this solution is applicable for a short period. Since, other technical policies cannot be sustainably used, it is recommended that the reuse policy be determined and managed through environmental management based approaches. This would be discussed further in the paper.

Table 2. Overall specifications of wastewater treatment plants with feasible reuse applications and policy recommendations

WWTP	Ekbatan	Gheitarieh	Mahallati	Sahebgharanieh	Shahrake Ghods	Zargandeh
Elevation (m) *	1224	1562	1731	1678	1419	1472
Annual Flow Rate (MCM)	6.4	1.2	2.9	0.3	5.5	2.2
Feasibility of irrigation	Yes	Yes	Yes	Yes	Yes	Yes
Feasibility of surface water discharge	No	No	No	No	No	No
Feasibility of Irrigation with direct pipelines	Yes	No	No	No	Yes	No
Public parks available nearby	No	No	No	Yes	Yes	No
Public parks exist in lower lands in distant	No	No	Yes	No	Yes	Yes
Name of Park	-	-	Lavizan (West side)	Niavaran	Pardisan	Taleghani
Average Park Elevation *	-	-	1600	1650	1400	1400
Approximate Park Distance	-	-	3.5 km	<1 km	<0.2 km	1.8
Annual irrigation flow rate required (MCM) *	-	-	7.8	0.4	5.7	1
Surface Water Nearby	Yes	Yes	Yes	No	Yes	Yes
Feasibility of Upgrading WWTPs	Yes	No	Yes	No	Yes	No
Demand based Policy Recommended	1	2	3	4	5	6

* From Abdolghafoorian et al. (2011)

3. Because of the distance, and in order to reduce the construction costs, it is recommended that the effluent of Mahallati wastewater treatment plant be transported by distribution system and stored in tanks for irrigation. Otherwise, tertiary treatment units with high performance can be applied prior of being discharged to the surface water nearby (termed as Darabad). The recommended processes as tertiary treatments are denitrification

filters, attached growth based reactors, or chemical sedimentation. Other options based on sequencing anaerobic, anoxic and aerobic processes (i.e. MLE, Bardenpho, or UCT) cannot be used as a matter of odor emission in residential areas (USEPA 2007). Thus, due to the feasibility of upgrading, the reuse can be managed through technical based policy.

4. Because of the clogging possibility of pipelines, the distance, low flow rate and elevation differences, it is recommended that the treated wastewater of Sahebgharanieh to be used for irrigation using portable tankers. If the dynamic demand of irrigation is considered, environmental management based approaches should be considered.

5. The effluent of Shahrake Ghods facility can directly be used to irrigate Pardisan Park using pipelines and storage tanks. Meanwhile, the technical based policy can be used to submit environmental management policies.

6. In Zargandeh, the reuse application would be challenged by different types of factors. First, due to the distance exists; the distribution network is required which may increase the construction and operating costs. Second, the demand is less than the supply values. Therefore, the remaining has to be discharged to the surface water or wastewater collection systems. Both would cause a risk in integrated water and wastewater management. It should be noted that this facility cannot utilize extra settlements as tertiary treatment unit. Also, the facility would not be able to be upgraded by even in situ techniques. Therefore, it is recommended that the remaining effluent which is not reused, be discharged to the surface water nearby, as Gheitarieh, to be managed by environmental based policies.

However, all facilities are located in Tehran treating domestic wastewater, and in addition, the demand is specified for public parks irrigation, different policies have to be marked for integrated reuse program; Because, different factors including economy, environment, operation and efficiency have affected the decision making procedure.

Technical based policy

In order to have a sustainable approach for wastewater treatment and reuse, a solution can be achieved by technical approaches. As mentioned in previous studies, the municipal wastewater treatment plants should be designed and operated in a way that are efficient, reliable, economical, and with low vulnerability and environmental risks (Jamshidi and Niksokhan 2013). It means that the facilities should be able to remove contaminants perfectly (efficient) with low quality variation in effluent during the operation (reliable). Furthermore, it should be designed robustly not only against hydraulic and organic shock loads (vulnerability) but also to reduce the total costs and environmental risks through reclamation programs (Jamshidi and Niksokhan 2013). These factors were similarly used to assess the unit processes and reuse possibility by Kalbar et al. (2012). Although, the flexibility of unit processes is required to be added (Badalians Gholikandi and Khosravi 2010).

Secondary treated wastewater is well endorsed by farmers due to this fact that it would reduce the labour and fertilizer costs and increase the crop yield (Murray and Ray 2010; Tsadilas and Vakalis 2003). Meanwhile, in some periods (about 3 to 6 months), the demand for farms or public parks irrigation would be reduced dramatically. In this condition, as there is no demand, wastewater could only be discharged to the water resources nearby. Thus, the unit processes should be designed and operated as flexible systems to treat nutrients in an average 4 months while are recommended to be standby or operated in the lowest flow rate for about 8 months annually. This is only simple in the theory. Because, the biological unit processes like MLE, A^2O, Bardenpho (4 and 5 stages), UCT-MBR and Oxidation Ditch are totally dependent on continuous wastewater influent (Tchobanoglous et al. 2003). Otherwise, the living biomass and activated sludge would be deteriorated and intermittent start-up should take effect constantly (Gerardi 2002). This would severely increase the operational costs, environmental risks and vulnerability of facilities. In addition, it should be noticed that each unit process cannot be operated in a wide range of influent quantity. For example, if an activated sludge is designed to be operated in 10 hours hydraulic retention time, it can hardly be expected to be efficient in 18 or 4 hours HRTs. Thus, based on operational capability, a reliable range of flow rate should be defined as design criteria (Tchobanoglous et al. 2003).

The decision making is typically identified as a rational approach using multiple criteria analysis for addressing objectives to find the most appropriate solution. For this purpose, the options may be scored or ranked using different techniques. The more complicated options and criteria, the more it takes to be analyzed. Therefore, to facilitate comparing and selection of different unit processes, and simultaneously, considering a comprehensive scope, some index functions can be introduced (Hajkowicz and Collins 2007). This study recommends that a unified index should be defined including all aspects having influence on upgrading and reuse. This can be determined through the value index function shown in equation 1. There, it is expected that the comparing of unit processes would be more sustained.

Table 3. The value allocated based on different sub criteria (from 1 to 10 points)

Value Parameter	Sharon/ Anammox	IFAS/ MBBR	Constructed Wetland	Trickling Filter	MBR
Capital Costs	8	6	2	4	10
Land Required	6	4	10	8	2
Power Required	8	5	1	3	10
Technology Required	5	4	1	3	10
Waste Management Required	4	2	1	2	8
Risk of low reliability	5	5	6	8	2
Risk of low workability	8	3	4	4	10
Risk of vulnerability	3	5	9	9	8
Risk of low replicability	6	4	5	8	3
Risk of high sensitivity	5	3	10	8	5

As shown in Table 3, the sub values were determined regarding to each process. Then, the total risk, average costs and the total value index were calculated based on equation 1 (Table 4). Since, the nutrients removal efficiency were not as challenging as operating risks and costs, the latter has been weighted by the factor of 2 in total value index calculation. It can be concluded that upgrading wastewater treatment plants to a recommended form of flexible system can well be suited by the attached growth, MBR, and biological systems in order. Thus, they were nominated as the best alternatives, however, final decision making should be performed regarding to the amount of waste load allocation between the secondary and tertiary units.

Table 4. Total value assessment of each process

Parameter	Sharon/ Anammox	IFAS/ MBBR	Constructed Wetland	Trickling Filter	MBR
Nutrient Removal Efficiency	8	7	6	3	10
Capital & Operating Costs	6.2	3.2	3	4	8
Total Risks	5.4	4	6.8	7.4	5.6
Total Value Index	34	49	31	13	37

Environmental management based policy

Environmental management strategies can be classified into 1) using natural and environmental potentials on pollution control, and 2) an application of management methods including trading discharge permit program. These strategies are founded on controlling environmental contaminants in a wide scale. There, it can be recommended that the ponds, basins or streamlines should be equipped with surface floating treatment systems using phytroremediation method as a hydroponic approach (Haddad and Mizyed 2011). These are floating treatment plants (FTP) reducing nutrients gradually in surface waters having low construction and operating costs with the possibility of distribute application. These techniques were typically recommended when specific plants like *Vetiveria zizanioides* or *Typha latifolia* are included, which are able to increase the aeration potential of the environment and in situ treatment capacity (Boonsong and Chansiri 2008; Chua et al. 2012). For example, it was previously verified that these plants were environmental friendly, non-aggressive, and efficient systems (Akbarzadeh et al. 2013). For instance, it was proved that using FTP vegetated with *Vetiveria zizanioides* along surface water to downstream can reduce the values of total nitrogen and phosphorus to about 35 and 1.5 mg/L (equal to 30% TN and 60% TP removal) and increase the DO level of treated wastewater about 3 mg/L in a day. Also, using these plants can improve surface waters aesthetically. Nevertheless, the remediation performance of the plants and photosynthesis are naturally reduced dramatically in cold climate, especially in winter periods. This climatic condition is unluckily coincided with low demand of reclaimed water for irrigation. Thus, the phytoremediation techniques can hardly respond to the requirements of the study but should not be neglected in nutrients control and integrated water resource management particularly in rural areas.

It was mentioned that using flexible treatment facilities in association with natural remediation can control the nutrients discharged to the surface water, as a matter of reclamation program. However, an achievement in environmental protection and fulfilment of total maximum daily load is still uncertain (Heberling et al. 2010). Therefore, it was recommended that a nutrient management framework be established to balance the excess loads discharges to the surface waters. This can be implemented through trading discharge permit (TDP) program.

Trading discharge permit is primarily established as a market for environmental permits in river systems (Nikoo et al. 2011) which is mostly recommended to be carried out between point and non-point sources controlling nutrients (Ranga Prabodanie et al. 2010; Ribaudo and Gottlieb 2011). This is due to the fact that point sources, such as domestic wastewater treatment plants, would be able much easily and economically to be constructed, operated, and upgraded, while the latter can hardly even collect the drainage to manage the contaminants. Thus, the gap between the marginal costs would motivate and ensure the trading market (Niksokhan et al. 2009).

In this case and based on the results of demand based and technical based policies, to find how much nutrients should be removed and which facilities can handle the market of permits in environmental management method, the total nitrogen and phosphorus loads discharged to the water bodies in association with reuse volumes were calculated as depicted in Table 5. It should be noticed that however the addressed surface water of the effluents are not the same, all drainage systems would be rallied into Tehran plain downstream (Kerachian et al. 2010). Thus, based on national standards, it was assumed that the maximum total nitrogen (TN) and phosphorus (TP) concentrations allowed to be discharged are 20 mg/L and 6 mg/L, respectively. Therefore, the annual total maximum load of nitrogen and phosphorus can be calculated as 370 tons and 110 tons, respectively while these are currently 665 tons and 64 tons, respectively for 6 wastewater treatment plants. Therefore, nitrogen management should be considered as a high priority.

Table 5. The total nutrients load discharged or reused for wastewater treatment plants

Parameter	Ekbatan	Gheitarieh	Mahallati	Sahebgharanieh	Shahrake Ghods	Zargandeh
Q_{total} (MCM/Y)	6.4	1.2	2.9	0.3	5.5	2.2
Q_{Reuse} (MCM/Y)	-	-	1.7	0.2	3.3	0.6
TN_{total} (Ton/Y)	134.4	61.2	130.5	12.6	214.5	112.2
TN_{Reuse} (Ton/Y)	-	-	76.5	8.4	128.7	30.6
$TN_{discharge}$ (Ton/Y)	134.4	61.2	54	4.2	85.8	81.6
TP_{total} (Ton/Y)	20.5	4.6	13.1	1	17.1	7.9

Since, some open spaces were not necessarily required to be irrigated in whole days; it was assumed that 60% of annual discharge allocated for reuse was attributed for irrigation (7 of 12 months a year). Thus, it can be determined that annually, 244 tons of nitrogen would be reused. This provided 37% reduction of nutrients. Meanwhile, to reduce total nitrogen loads to below 370 ton/year, it was recommended that Shahrake Ghods and Mahallati wastewater treatment plants should be equipped with flexible tertiary treatment units (technical policy), preferably based on attached growth systems, with at least 40% nutrients removal efficiency. Thus, it can be expected that sustainable demand based policy would be achieved. Also, Ekbatan wastewater treatment plant can be addressed to upgrade its tertiary treatment unit. Consequently, they can provide a nutrients permit market for other facilities, i.e. Gheitarieh and Zargandeh in a year.

As a result, it can be summarized that the demand policy would be able to highlight the conflicts exist among stakeholders and the feasibility of reclamation and reuse. Therefore, it should primarily be considered in integrated water and wastewater management. In the second step, the tertiary treatment unit can be selected appropriately and flexibly through technical based policies to manage the nutrients and upgrading conventional systems. Finally, an integrated environmental management for water and wastewater would ensure the safe and fare reuse and nutrients allocation among the stakeholders. These approaches can be introduced simultaneously as robust alternatives for flexible waste load allocation.

Conclusion

Regarding to the results, it can be concluded that policy of upgrading conventional wastewater treatment plants and reclamation programs are totally dependent on feasibility and reuse demands. For this purpose, demand based policies using technical and environmental management approaches should be included. This study implies conclusions as follows:

- In order to obtain a sustainable reclamation and reuse program for treated wastewater, the policies are recommended to be compatible with the demands and stakeholders conditions. Even in similar issues, the reuse allocation may be differed as a matter of variety in stakeholders requirements. Thus, an integrated water and wastewater management should be considered.
- In upgrading wastewater treatment plants, the reuse potential, reclamation program, dynamic demand, technical and practical issues should be considered.
- To either manage nutrients for a better application or protect environment and water bodies, it was recommended that some wastewater treatment plants should be supported by flexible tertiary treatment units.
- To select an appropriate unit as a tertiary treatment or facility upgrading approach, it was recommended that different parameters, including efficiency, operational risks and overall costs should be considered in a comprehensive decision making through value index function.

- Wastewater reuse can provide a potential for environmental management to determine an integrated total maximum daily load, including different conditions required for stakeholders. Also, they could offer a market space for trading discharge permit program to reduce overall construction and operating costs.

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