Using Treated Domestic Wastewater for Urban Agriculture and Green Areas; The case of Lima

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Scarcity of water is one of the main problems in Lima, and there is increasing competition for the use of water, for human consumption, agriculture, industry, and green areas. The use of alternative sources is urgently required.

The city of Lima (1) has a surface area of 2,794 km² and a population of 7,765,151, with a population growth rate of 2.1 percent annually, and a poverty rate of 46.8 percent (INEI, 2002, 2005 and 2006). Migration from the provinces to the capital of people looking for new livelihood opportunities is high. This growth generates increasing demand for water. However, Lima is a desert city with almost no annual precipitation (around 25 mm per year). The main sources of water for the city are surface water (the Rimac, Chillon and Lurin rivers, which contribute a total of 39.1 m³/s) and underground water filtrations (from the Rimac, Lurin and Chillon Rivers, which contribute 8.3 m³/s).

There is some wastewater treatment, but this is relatively limited: 1.6 m³/s only, representing 9.2 percent of the total (SEDAPAL, 2006). As a result, most wastewater (90.8 percent) is discharged into surface water and eventually to the Pacific Ocean, without any treatment, causing contamination of the surface water and of agricultural products. It should be noted that of the wastewater that is treated 54.4 percent is dumped into the sea, which is a waste of a scarce resource. There is a legislative vacuum at the national level with respect to treatment and use of wastewater for productive and recreational purposes, which complicates sustainable management of wastewater. It is in this context that SWITCH Lima operates.

There is a need to search for alternative sources of water, such as the use of treated wastewater
Photo: IPES

SWITCH LIMA

The SWITCH Lima demonstration project is entitled "Treatment and use of wastewater for urban and periurban agriculture and green areas". SWITCH Lima is being implemented by IPES – Promotion of Sustainable Development (Peru) and by the Ministry of Housing, Construction and Sanitation. The main objective of the project is to formulate policy guidelines for the promotion of integrated treatment and reuse systems for urban and periurban agriculture and green areas. The SWITCH Lima Learning Alliance facilitates up-scaling of the research results achieved, and allows the participating stakeholders to discuss and validate these findings with the aim of formulating policy guidelines and building capacities at the same time. An important part of the demonstration is the pilot project "Optimising water management to combat urban poverty: Developing productive and recreational areas through the use of treated wastewater", which seeks to improve food security and community participation of the poor population in the district of Villa El Salvador and generate complementary household income. Once validated, the experience will be used as example for replication in other zones of the country in collaboration with the Ministry of Housing, Construction and Sanitation.

Cases of wastewater use

As part of the SWITCH project, 37 cases involving the use of household wastewater from various secondary sources were identified. They include productive activities like agriculture, aquaculture and the development and/or maintenance of green areas of the

city. They also include activities for which untreated wastewater is used. Seventeen of these are located in the southern area of Lima, where the availability of water is low compared to other parts of the city. The cases are located in periurban (54 percent) as well as intra-urban areas (46 percent). The 37 cases identified cover a total surface area of 985 hectares, and use a flow volume of approximately 1,478 l/s of wastewater, of which 716 l/s is used without treatment and 762 l/s is treated. The majority of the wastewater (almost 80 percent) is used small and medium-sized areas (up to 20 hectares), 11 percent of which are smaller than 1 hectare.

Wastewater is used for a variety of purposes. 44 percent of the cases involve productive activities (agriculture and aquaculture). These activities represent 77 percent of the total area irrigated with treated wastewater, and are predominantly located in periurban areas. Another 56 percent of the cases involve the reuse of treated water for recreational activities like green areas, sports fields and public parks, which make up just 23 percent of the total irrigated area and are located primarily in the city. 34 of the cases involve the use of wastewater that has been treated in some way. The three cases of untreated use represent 40 percent of the total area irrigated with wastewater in Lima. The technologies used for treating wastewater have been grouped into five types: stabilisation ponds (29 percent), aerated lagoons (29 percent), activated sludge (24 percent), artificial wetlands (12 percent), and percolated filters (6 percent).

Action research

The SWITCH research team selected 19 of these 37 cases for a study of their institutional, social, technical, economic and environmental dimensions. Within this selected group, a significant variety of crops are produced, including fruits, vegetables, aromatic herbs, etc. Eight of these cases involve a total of 314 farmers who use wastewater to irrigate 653 hectares of farmland. The main crops are vegetables, which encompass 60 percent of the total productive land area. The largest area is in San Agustin, where 445 hectares of irrigated vegetables are grown using untreated wastewater. Among the most important crops are celery (Apium

Meeting with Ms Ricardina Cardenas, Director of the Office of the Environment of the Ministry of Housing, Construction and Sanitation

One of the responsibilities of the Ministry of Housing, Construction and Sanitation of Peru (MVCS) is the treatment of wastewater. The Ministry is implementing a National Urban Agriculture Programme which seeks to facilitate reuse of treated wastewater. As part of the SWITCH Lima Project, IPES and the MVCS are collaborating in action research towards the formulation of policy guidelines for the promotion of productive (urban and periurban agriculture) and recreational (irrigation of green areas) use of treated wastewater.

Ms Cardenas: The Ministry, through its Office of the Environment (OMA), promotes urban agriculture, in order to improve the quality of life of low-income residents, especially in peripheral urban areas, through training and support in income-generating activities. In addition, we are promoting the creation of sustainable green areas using treated wastewater. (...)

The Ministry collaborates with SWITCH. specifically in the formulation of policy and operational guidelines on wastewater treatment and reuse in urban and periurban agriculture and greening. OMA is dedicated to the preparation of these policy guidelines,which will formalise treatment, use and reuse and the construction of wastewater treatment plants that are more accessible to the poorer sectors of the population. (...)

Water is essential as a human right. So taking care of this resource is our civic duty. Wastewater is not just "waste" but it is a resource! And with proper treatment, enhanced awareness among citizens and industries, and a legal-regulatory framework, wastewater can be used. (...)

The OMA is working on necessary regulations already, such as a maximum level of emissions from wastewater treatment plants when discharging into receiving bodies, like the ocean, lakes, rivers, etc.; and for the reuse of wastewater in agriculture, green areas, aquaculture and reforestation. (..) Other projects OMA is working on include the level of discharge into the sewer network (a controversial issue we have been working on for almost two years with CONAM, (now with the newly formed Ministry of Environment); regulations for solid waste management; an environmental classification system for projects in this sector; and guidelines for the preparation of environmental impact studies and environmental adjustment programmes for water and sanitation activities. (...)

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graveolens), onions (Allium cepa), wild leek (Allium ampeloprasum), radish (raphanus sativus), tomato (Lycopersicon sculentum) and squash (Cucurbita maxima Duch). Nine cases use wastewater for recreational purposes like green areas, sports fields and public parks. They manage 116 hectares of grass for gardens and another 54 hectares of forests with ornamental trees, like the eucalyptus (Eucalyptus spp.), poncianas (Caesalpinea pulcherrima) and the Peruvian peppertree (Schinus molle). Irrigation techniques vary and include the use of gravity by flooding or furrows, sprinklers, and drip irrigation.

The size of the treatment systems depends on the volume that is being treated, the final quality of the effluent and the technology used. Aerated lagoon plants require the largest amount of space, followed by activated sludge plants and stabilisation ponds.

The quality of the wastewater being treated is monitored in only nine of these cases, which means that currently there is no adequate system of control for reuse activities operating in Lima. The parameters that are monitored are faecal coliforms and the biochemical oxygen demand. Only two plants had effluents with less than 1,000 faecal coliforms per 100 ml, which is the quality required for irrigating parks and sports fields. The rest had higher levels, and, therefore the effluent would only be useful for some crops. In only two cases was the presence of human parasites reported, since this is a variable that is not yet monitored obligatorily. The investment, operational and maintenance costs of the facilities were not well documented, so no conclusions can be drawn from this.

A legal and institutional framework has to be created at the national level

Using the information produced by the research, the SWITCH team in Lima drafted political guidelines to promote treatment and reuse of wastewater for use in urban and periurban agriculture and green spaces. These draft guidelines have a national scope, and will be validated through a series of meetings, workshops and a virtual platform, with different stakeholders like different local and national governmental institutions, universities, private sector and representatives from the civil society that participate in the Learning Alliance. It is expected that this process will be finished in 2008.

Conclusions

There is a need to search for alternative sources of water, such as the potential use of treated wastewater, water extracted from fog, etc., to cater for the high demand of water. Since 92 percent of wastewater currently ends up in the Pacific Ocean, there is a high potential for use (after proper treatment).

Because of the shortage of water, untreated wastewater is already being used for production in the city, and these farming systems have become important sources of food for the city. Treated wastewater is also used but this is still a minimal part of the potential that this resource has. Less than half of the total treated wastewater is used for agricultural or recreational activities. Utilising this potential would require assessment of the quality of the effluent from treatment plants and development of guidelines for its use for different activities.

The use of treated wastewater for agriculture will reduce the stress on the supply of water, since there will be a constant and larger flow of water available. This will result in higher yields, better products and improved access to food in the city, as well as extra income and jobs. Using treated wastewater for green areas and urban forestry will facilitate more public recreational spaces, improve the city's landscape, capture carbon dioxide and other polluting gases, as well as lead to other environmental benefits.

A legal and institutional framework has to be created at the national level that will encourage integrated wastewater treatment and use for productive and recreational purposes. Thus, rather than wasting a valuable resource, a policy should be developed that recognises this waste as a resource. The guidelines elaborated by the SWITCH Lima team will allow the achievement of this objective.

A variety of wastewater treatment technologies are available, which have different investment and operational costs and which are appropriate to the physical characteristics of the city. However, only for some of these technologies, regulatory frameworks are provided by the Peruvian state. These regulations relate to treatment and disposal of wastewater into a receiving body, but do not take into account the option of reuse of the effluent.

For this reason one of the strategic actions identified in the SWITCH studies is the need to update these regulatory frameworks and to seek to include the reuse of wastewater for productive-recreational purposes. In addition it is essential to develop a governmental system that links the different stakeholders and sectors involved, in order to define the different roles and facilitate the implementation and management of Integrated Wastewater Treatment and Reuse Systems.

Finally, the access to information and capacities of these stakeholders need to be improved, so that they are able to implement and manage integrated wastewater treatment and reuse systems. This activity is supported by SWITCH in Lima through the Learning Alliance.

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End notes

1) Throughout this article we refer to the "city of Lima", assuming, for simplification purposes, that it includes Metropolitan Lima, with 43 districts and the constitutional province of Callao, with 6 districts.

References

INEI, 2002
INEI, 2005
INEI, 2006