Smart City – Good Practice

**Waste, Water, Land Use**

# Wastewater reuse for urban agriculture and green spaces

**Lima, Perú**

POCACITO
european post-carbon cities of tomorrow

## Lima's reuse of treated wastewater for a multifunctional city park

**Lima faces multiple challenges such as a growing urban population, limited and polluted water supply and unsanitary housing. Positioned in an area of limited precipitation, the city is dependent on underground and surface water delivered from the Andes Mountains by rivers [8]. These rivers are heavily polluted and are seasonally variable, and will be subjected to climate change in the future. Given the water scarcity and underdeveloped wastewater treatment, Lima had collaborated with stakeholders to impact national legislation on wastewater reuse and to establish a demonstration project: using treated wastewater for a multifunctional city Eco-Park. This legislation allowing for wastewater reuse for irrigation of urban green spaces has opened the way for further applications with multiple benefits [7].**

## Country/ City Profile


| | Country | | City | |
|---|---|---|---|---|
| | Population (2014) | 30.77 million [1] | Population (2014) | 9.7 million (city) [2]<br>10.674 million (metropolitan) [4] |
| | Land area (km²) | 1.285 million | Land area (km²) | 2,672(city)<br>2,819 (metropolitan) |
| | GDP per capita (2014, current international $, at purchasing power parity) | 12,069 [15] | GDP per capita (2014, US$, at purchasing power parity) | n/a (city)<br>16,530 (metropolitan) [4] |
| | Region | South America | Region | Coastal (12°2'S, 77°1'W) |

| City's physical geography | | |
|---|---|---|
| | Location | ✓ In the central pacific coast of Perú, placed in the valleys of the Chillon, Rimac and Lurin Rivers, overlooking the Pacific Ocean<br>✓ Positioned in a barren, unvegetated and flat desert of grayish-yellow sands in the Peruvian coastal plain<br>✓ The city slopes from the shores of the Pacific Ocean into the Andes mountainous region, reaching an altitude of 500m [5] |
| | Climate | ✓ Located in the tropics and influenced by the cool offshore Humboldt Current, which creates a temperate climate with high humidity [5]<br>✓ Average annual precipitation reaches 9 mm, average maximum temperature of 28°C (January) and the average minimum temperature of 19°(June) [6] |

## Initiating context

The city of Lima is the main financial and administrative center in Perú, making it subject to intense urbanization. The metropolitan area is expected to reach 9.7 million inhabitants in 2015, concentrating almost 1/3 of the country's population, and the city is expected to grow to 16 million inhabitants by 2050. Annual rainfall is scarce (around 9mm) [6], reason for which city water supply is from surface, underground sources and glaciers from the Andes mountains. The available water is used 75% for human consumption, 22% for agriculture in urban areas and 3% for green spaces and industrial activities [10]. The city's rivers are overexploited, being used both as a source of water and means of waste disposal. The average consumption of water per inhabitant is 150 liter per day, varying from 50 to 250 liters per capita per day [8]. The urban drinking water network is in poor condition, measuring 36% losses from leakage during distribution [7].

Even though wastewater reuse for agriculture is a known practice, the lack of formal recognition makes the use of wastewater for productive purposes poorly regulated in developing countries. The role of urban agriculture and its contribution to sustainable city development is fundamental for urban environmental management, food security, poverty alleviation and climate change adaptation [7]. In 2008 in Lima there were 12,680 ha of peri-urban area under irrigation [12], 94% of the crops being irrigated with raw sewage or with polluted river water and only 3% being irrigated with treated wastewater [10]. Regarding the city's green spaces, in 2008, less than 15% (210 ha) of the parks and gardens were using treated wastewater, while over 1,200 ha consume polluted river water or drinking water [9, 12].

### Project description

In 2006, an EU-funded research partnership called SWITCH[1] approached these issues and focused on scaling up the reuse of wastewater in green productive areas. With the involvement of various stakeholders from national and local administrations, the project resulted in demonstrating how water could be safely reused for multiple purposes and also highlighted the importance of national policy guidelines that promote safe re-use of wastewater [9].

### Implementation process

The project partners defined as their main objectives the creation of a set of guidelines that would form a foundation to cover regulatory gaps in the legislation. It would also set a national and municipal agenda for the improved management of treated wastewater for productive use in urban areas and the improvement of recycling water resources [14]. Locally-based evidence was generated for the development of the policy guidelines. The project identified 37 cases involving the use of household wastewater for productive activities like agriculture (37% of the cases), aquaculture and the development and maintenance of green areas of the city (51% of the cases), including activites for which untreated wastewater was used. After this inventory was made, research needs were identified (the weaknesses in using treated wastewater) and research areas were covered by local case studies [8].

The inventory also created a typology of wastewater reuse and urban agricultural experiences, which was built on: the location (urban/peri-urban), type of activity – productive (agriculture/forestry) or recreation (green areas/golf courses) – and treatment technology (aerated lagoons, constructed wetlands, activated sludge, stabilization ponds etc.). The typology ultimately lead to a framework of analysis to assess the case studies [8].

<table>
<tr><th colspan="3">Projects implementation details</th></tr>
<tr><td>Financing</td><td colspan="2">Funded by the Directorate General for Research of the European Union over the period 2006-2011, with a budget exceeding €20m [9].</td></tr>
<tr><td>Objectives [7]</td><td colspan="2">✓ Raise awareness on the potential reuse of wastewater<br>✓ Develop national policy guidelines that promote the use of treated wastewater through research and demonstration<br>✓ Strengthen the capacity of local government to design adequate systems</td></tr>
<tr><td>Involved partners</td><td colspan="2">✓ IPES – Promocion del Desarrollo Sostenible<br>✓ Office of Environment of the Ministry of Housing, Construction and Sanitation (Perú)<br>✓ ETC Foundation (The Netherlands)</td></tr>
<tr><td>Two Learning Alliances (groups of stakeholders in which public institutions and private organizations and civil society are represented) were formed [7, 12]:</td><td>National learning alliance<br>✓ Focused more on the formulation of policies and guidelines<br>✓ Integrated sectoral governmental origanizations linked directly or indirectly to the formualtion and approval of policy guidelines</td><td>Local learning alliance<br>✓ Focused more on the implementation of the national guidelines and the corresponding policy<br>✓ Integrated local stakeholders (local government, private sector, research institutions etc.) with experience in using treated wastewater for irrigation</td></tr>
<tr><td>Demonstration activities to motivate stakeholder involvement [8]</td><td colspan="2">✓ A demonstrative project was planned and implemented in order to validate the proposed policy guidelines and to institute an experience that could operate as a research and demonstration site.<br>✓ The design of a multifunctional Eco-Productive Park was done through a participatory approach, involving the community and local authorities, architects and local organizations. The park has four areas: recreation (for children, chess table), production (growing ornamental bushes to sell to the city for its parks), sports and a tertiary treatment pond for wastewater.<br>✓ The Eco-Park demonstration project intended to present decentralized reuse of treated wastewater on 2 ha of productive and multifunctional green areas by combining social functions with economic and environmental functions.</td></tr>
<tr><td>Main phases of project development [7]</td><td colspan="2">✓ Research and demonstrations (based on the local learning alliance)<br>✓ Development of  recognized policy guidelines (based on the national learning alliance)<br>✓ Capacity building for the people involved in the process</td></tr>
</table>

[1] SWITCH was a major research partnership funded by the European Commission with a budget exceeding €20 million over the period 2006 to 2011. It involved an implementing consortium of 33 partners from 15 countries. SWITCH involved innovation in the area of sustainable urban water management often also referred to as integrated urban water management (IUWM) [9]

## The project approach used [11]

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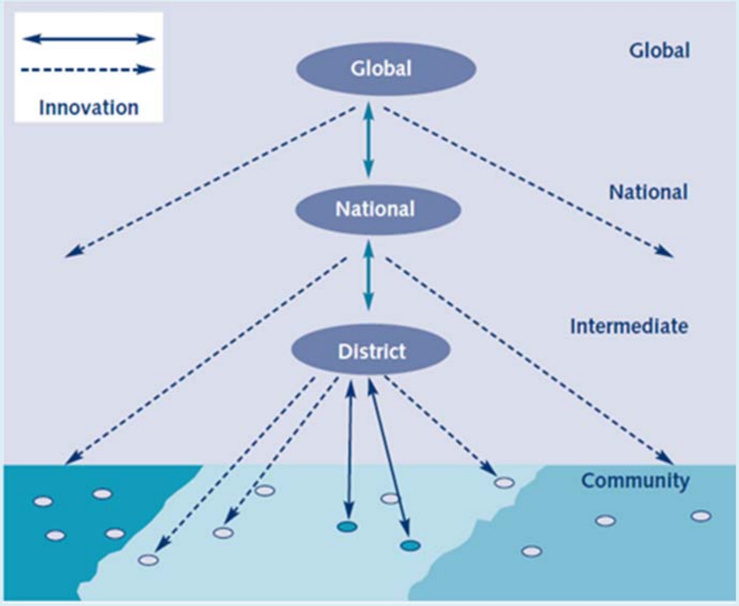
| **The Learning Alliance (LA) method** | ✓ A learning alliance is defined as a series of connected multi-stakeholder platforms at different institutional levels (local, district, national etc.), involved in innovation in an area of common interest, and its scaling up<br>✓ LAs focus on innovation and scaling up, and the fact that they are platforms of multiple stakeholders at multiple levels<br>✓ The aim of a LA is to develop locally appropriate innovations and scale up the principles, and building capacity for innovation and scaling up |
| **Methodology** | ✓ Stakeholder mobilization,<br>✓ Action research,<br>✓ Process monitoring and documentation,<br>✓ Dissemination and sharing<br>✓ Strong process facilitation: the approach was applied in a flexible way, according to local needs and contexts |
| **Capacity development for innovation and scaling up** | ✓ Individual level (skills, knowledge, motivation, experience of individuals)<br>✓ Organizational level (structures, processes, procedures, mechanisms of organizations)<br>✓ Institutional level (policies, regulations, financial arrangements and institutional arrangements) |
| **Expected outcomes** | ✓ The institutionalization of innovation<br>✓ Adaptation of innovation and replication to new contexts<br>Intermediate results:<br>✓ Effective and locally relevant innovations<br>✓ Scaling up the principles of innovations<br>✓ Strengthening capacity for innovation and scaling up |




**Conceptual diagram of a learning alliance, ©IRC 2007, Source: [11]**

### Results

Current national legislation in Perú prohibited the use of wastewater on crops and food, but the SWITCH initiative focused on treated wastewater reuse on parks, gardens and ornamental horticulture [7]. The project has contributed to research and knowledge in use in Lima and provided the foundation for the creation of the Ministry of Environment in Perú (2008), the National Water Authority (2009) [13], and a national Law on Water Resources (2009) [8]. Further development of a legislation framework is needed that will enable wider use and income generation by linking opportunities for the local community and private sector [12].

## Project benefits [7]

| | | | |
|---|---|---|---|
| **Direct benefits** | ✓ The initiative resulted in the construction of a wastewater treatment facility and a multifunctional urban park<br>✓ The project liberated more clean water for citizen use by reclaiming wastewater for irrigation<br>✓ The use of knowledge and experience to expand the use of wastewater treatment<br>✓ Reuse technologies in other areas | **Objectives achieved** | ✓ Better general understanding of available water treatment and reuse practices<br>✓ The creation of a stakeholder platform, which contributed to the development of legislation for the use of treated wastewater and which will also help future initiatives<br>✓ The development of an innovative framework of analysis and decision making |

### Lessons learned

The Wastewater reuse project has contributed to the scientific basis for sustainable water management by creating a better understanding of available treatment and reuse practices. It has also provided an innovative framework of analysis and facilitated a greater understanding of the potential use of these practices [8]. Successful implementation of the reuse of treated wastewater project in Lima depended on the engagement of the right stakeholders and on the commitment of the organizations involved. Moreover, the learning alliance approach was important since it increased the flexibility of the project, making communication and cooperation between stakeholders easier and it also ensured their involvement at the right level of intervention and competence [7].

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