

Land and water management at the urban edge: an introduction

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Abstract — Water management is one of the key issues of the sustainable development of urbanization. Periurban catchment are characterized by their rapid land use changes, important migration and financial flows, the range of possible activities and the specific hydrologic functions they provide for the city. These transformations result in increased pressures in water availability and quality. This paper introduces a framework that points out management key nodes: land market processes, the place and role of agriculture in an urbanizing catchment, the development of water and sanitation infrastructure, institutional arrangements to articulate land and water management are key issues to understand the specificities of water management in periurban catchment. These different issues will be illustrated by the thematic contributions of this report which are based on case study of the Metropolitan Region of São Paulo (Brasil), and the Valley area of Tiquipaya in the Cochabamba Metropolitan area (Bolivia)

1 - Introduction

Water management, which relates to the problems of access and use of natural renewable resources, is one of the key issues of a sustainable urbanization (Malsimovic and Tejada-Guibert, 2001). In developing countries, urban expansion in a context of social inequalities dramatically affects water resources in terms of quality (with problems of physical, chemical, biological pollution, etc.) and quantity (depletion of water resources) (Niemiczynowicz, 1996). This raises the issue of supplying potable water to a growing number of consumers, in a context of limited financial resources to be distributed between investment effort and the maintenance of existing network. This is the case of the cities of South America which already hosts 70 % of the population. The investment necessary to supply basic services to the periurban area in this continent was estimated to 6,2 billions USD (Nigam, 1995).

New water policies based on the paradigm of integrated water resource management, i.e., territorial - and often participative - management of water at catchment level, is being discussed and implemented all over the world. These policies emphasize the role of negotiations, either to solve conflicts or for long term strategic resources planning. Can these policies be applied and implemented in the rapidly changing, altered and densely inhabited periurban catchment? How to support negotiation processes in such context? To contribute to answer this question, it is first necessary to understand the specificities of water management in periurban catchment. This paper aims to present some of the key nodes of water management in this type of catchment that will be more precisely studied in the different contributions of this report.

2 - The characteristics of periurban areas

In the interfaces that are periurban areas, domestic water uses compete with other demands such as irrigation or environmental and recreational use. This competition is all the more exacerbated, that it is often combined with a competition for access to land. The cities fringe supports the urban expansion processes, which lead to very diversified forms of land occupation. In many developing countries, this periurban area also concentrates most of the poverty.

While there is still no consensus on the definition of peri-urban interface, it can be characterized by: (i) a "patchwork structure" in terms of functions, values, strategies of occupation of the territory, or appropriation and transformation of natural resources; (ii) a dynamic pattern with a wide range of

transformation and flows (people, goods, income, capital, resources such as water, energy, and building materials); (iii) the new economic opportunities it provides to peri-urban dwellers such as land speculation, or informal activities linked to mineral extraction of raw material for urbanization, etc. (Allen *et al.*, 1999).

Peri-urban interface also provides specific hydrological functions to a city — a catchment area and space for drinking water reservoirs — and supports groundwater recharge zones and absorbs rain water. Its dynamics thus affect the hydrological processes of large areas through the alteration of the natural hydrological network, the expansion of the impermeable surface, and the pollution of surface and subterranean aquifers through industrial activities and inadequate sanitation/wastewater management (Dourojeanni and Jouralev, 1999). Thus, urban expansion in these areas is often associated with the growth of shanty towns with inadequate sanitation arrangements, and enhanced pollution runoff, encroachment of urban expansion over agricultural land (Burke and Beltran, s.d). These processes directly affect the water quality of drinking water reservoirs and aquifers (Baykal *et al.*, 2000). In many metropolitan centres, these tensions are already leading to water use restrictions or open conflicts, as in Sao Paulo (Brazil) (Braga, 2000) or in Bolivia.

3 - Water management in the periurban areas: a complex issue.

As far as water management is concerned, two issues are particularly important in a periurban and urban context: (1) flood management (2) Providing adequate water supply and sanitation in the expanding fringe of the cities. We have chosen to focus on the second point, and the first point has not been dealt with in this project. Providing water and adequate sanitation in periurban catchment raises various questions: How to provide safe water for a growing number of consumers, who often are not able to pay the costs related to the investment needed? How to deal with the other competing demand in the same time? How to control the degradation of water quality? How to articulate land and water management at catchment level?

Water management in the peri-urban interface is a complex issue which combines ecological, technical and social aspects that can be represented in the figure 1. Four mains functions are connected: (1) water resources availability, which depends on geographical, topographical, meteorological and geological conditions of the basin ; (2) water supply organisation - In term of institutional arrangement and related technology (network and treatment plants) - water supply management and structure to collect, store, eventually treat and distribute water. (3) Water uses characterised by very diversified demands in term of quantity and quality of water, depending on the different types of consuming sectors and type of users. Their demand are evolving in time and space depending on socio-economic factors (4) Water uses are closely articulated with land uses and occupation in the basin (5) water drainage organisation, management and structure in the basin, in order to collect, drain, and treat effluents. Water drainage organization and management directly affects, though runoff and release, the quality of the water resources as well as the question of flooding.

4 - Some key nodes in land and water management in periurban catchment

Documenting these different processes in the context of periurban catchment is challenging. In these impacted and inhabited territories, scientists are confronted to sparse data or dispersed data and sites, and discrepancies between information sources. In the same time, policy makers are looking for generalized rules or regulation and rapid policy answers (Wolosoff, 2002).

We propose to focus on the mechanisms that control the evolution of water quality and water availability, which are: (1) the evolution of land use and occupation submitted to demographic growth, spatial vector of expansion and land market processes thus more economic forces (2) The strategy of development of infrastructure, especially sanitation infrastructure (3) evolution of farming activities and rural types of activities in the area. A fourth key node relies in the institutional arrangement to manage land and water, how they are being articulated and the place of users and stakeholders in this management.

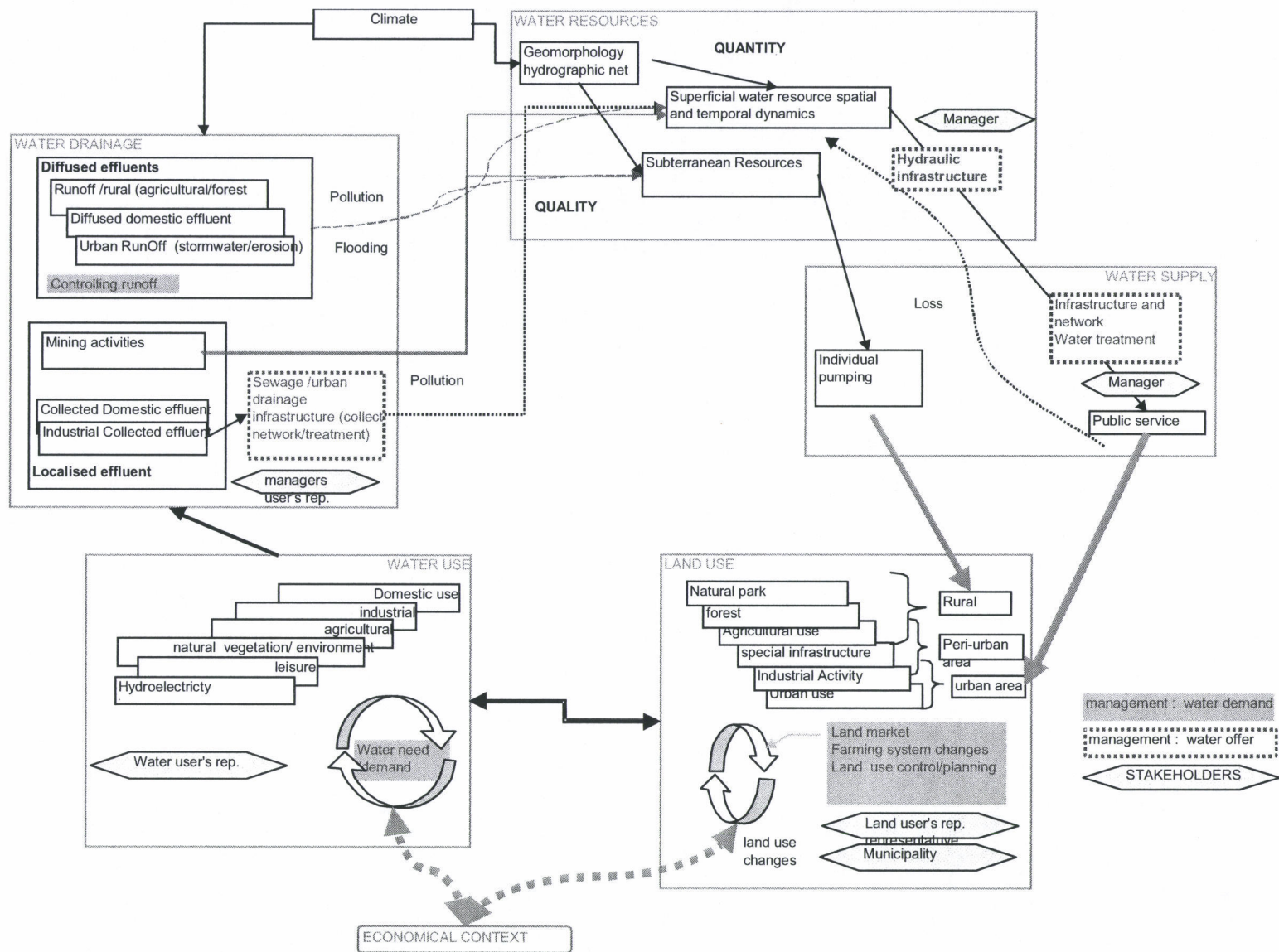


Figure 1 : representation of land and water management in peri urban catchment

4.1 - Land market processes

Land use and occupation in this type of catchment relies on a "patchwork" pattern that ranges from urban infrastructure to strictly rural and agricultural uses. But it follows a dynamic pattern and land-use changes are resulting from different processes: conversion from non-urban (rural and/or natural cover) to urban activities; and development of special infrastructure, due to appropriation of land and changes in property rights (Maxwell *et al.*, 1998). In many cases of the developing world, the access to land by low-income groups is mainly possible through illegal channels. They tend to occupy low-value land, generally environmentally unsuitable (highly sensitive to risks such as earth slides on hill slopes or pollution impact in marsh lands, etc.) and vulnerable to floods and other hazards (Baroos and Linden, 1990); (Douglass, 1992). Land-use changes at the urban edge are thus linked to a combination of diverse land tenure and market mechanisms that range from speculation to illegal occupation. It raises various questions such as (1) how does land tenure, land market evolve in rural area submitted to urban pressure and how does it affect water demand in term of quantity and quality? (2) How does land speculation affect the evolution of land uses and related water uses? (3) What are the impact of water and land regulation on land tenure and land market? (4) What land planning mechanism is being used and how is it articulated with water planning?

4.2 - Infrastructure development

Various pollution sources are responsible for the degradation of water pollution in periurban catchment: localised pollution (especially industrial and garbage deposit pollution), non-point pollution from "urban" origin, domestic effluents, as well as non-point pollution from rural and remaining agricultural activities. Various studies have underlined the importance of non-point sources pollution associated with the development of illegal settlements: they were responsible for microbiological/nutrient pollution, litter and sediment transportation, or habitat destruction in South Africa (Pegram *et al.*, 1999). While it is difficult to control diffused pollution, it is possible to reduce domestic and industrial effluents by collecting and treating them. It supposes the development of adequate sanitation infrastructure. But their development for illegal settlements is often limited by land tenure statute, rapid growth and socio-economical factors. Thus, network developers have difficulties to keep trace and pace with the rapidly expanding auto-build settlements, which are likely not to follow urbanistic pattern permitting network extension. In that case, infrastructure development requires heavy urbanistic intervention, which can include re-urbanization and expropriation. Irregular occupation makes difficult identification of ownership when needed (expropriation), or hinders legal public intervention as intervention might be seen as an implicit recognition of title ownership, and thus interference into a legal dispute. It can also be associated with practical difficulties such as the identification of responsibilities, for example for maintenance. The socio-economic capacities of households might limit network connection and tariffs payment and thus network maintenance and adequate functioning.

In developing periurban area, basic services access is not only a technical (type of infrastructure and maintenance) and economical (tariff structure, level, collection) issue but also an organisational and social one, which involves various actors such as heterogeneous local dwellers health authority, municipal authority, water firms (Jaglin, 2001). In front of these different interests, notions driving infrastructure development such as equity of service access, sustainability or quality of service or water resource may have different significance that need to be discussed and collectively validated.

4.3 - Role and place of agriculture and rural activities in urbanizing catchment

As a transitional zone, periurban areas combine land cover of rural and agricultural type with more specific urban area. These leads to a traditional dual focus of the institutions, which have difficulties to integrate either each others specificities and to address the links between rural and urban activities (Mattingly, 1999). This is all the more difficult than the definition of "urban" or "rural" land uses remains ambiguous in this kind of environment.

4.4 - Institutional management of land and water

The traditional approaches to deal with land and water management, based on the implementation of specific legislation and rules have proved to be inefficient in dealing with these conflicts and might locally have negative effects (Bareto, 1998). It is all the more difficult that the institutional setting generally combines a dual management system: land and water management and organization focused for rural area and institutional organization more related to urban activity. This dual setting is often combined with various institutional reforms: decentralization processes (in the management of cities

and natural resources) or reorganization of water management at territorial level (at catchment level or other area level), or participation of civil society (Dourojeanni and Jouralev, 1999). This raises various questions: What are the adequate management scale and territorial unit ? How is land and water management articulated at the different scale? Are there mechanisms to facilitate this articulation? What is the role of concertation and negotiation within in the institutions? To what extend are stakeholders involved in the management processes? How are the institutions functioning?

5 - Different types of conflicts

The multiplicity of land and water users, the rapid evolution of uses facilitates the development of complex conflicts of various origins. Among others, new project development related to land (urbanization project, transportation project, infrastructure project) and / or water (new water or sanitation infrastructure, new storage capacity or flood control project with conflict related to the resources themselves), institutional arrangement of the new project, multiple uses of the resources and the land (competition between agricultural water uses and periurban), implementation of new policies and legislation (conflicting arrangement), uncertainties of evolution of resources ownership and jurisdiction in a context of urbanization, procedural uncertainty on the functioning of management institution (such as representatives or agenda) are example of issue that can lead to conflict and tensions at the periurban interface. As dealing with populated area, these conflicts can be amplified by the political and social significance ...

6 - Two cases study: The spring catchment in the metropolitan catchment of Sao Paulo (Brasil) and the valley area of Tiquipaya, Cochabamba (Bolivia).

The document presents the results of various studied developed to illustrate and clarify the links between the different themes, in two very different periurban areas:

(1) The upstream catchment of the Metropolitan Region of Sao Paulo, more specifically the Cabeceiras-Tietê and Guarapiranga catchment which are respectively responsible for 15 % and 30 % of the water supply of the 18 millions inhabitants of the agglomeration. The catchments have a respective superficies of 1690 km² and 905 km². Part of their territory is protected by a specific legislation aiming to control the urbanization, but they are both affected by the development of precarious settlements that directly impact the quality of their superficial water resources. In the same time the demand of an growing population is increasing the competition with other uses such as agriculture.

(2) The valley area of Tiquipaya, part of the Metropolitan of Cochabamba in Bolivia, is an area of 67 km², situated in the Valley of Cochabamba (2500 m). This rapidly urbanizing periurban area was once one the most productive agriculture area of the Valley.

The first presentation of each part will detail the historical processes, legislation and institutional arrangements to manage land and water in the area studied. The different elements will then be presented. The framework developed in each catchment will be then presented.

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