



## The first Brazilian municipal initiative of payments for environmental services and its potential for soil conservation



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### ABSTRACT

It has become evident that policies aimed at mitigating the growing water resources and water use conflicts in Brazil are crucial. The municipality of Extrema in Minas Gerais state in Brazil pioneered the first Brazilian municipal PES initiative (Conservador das Águas program), based on the relationship between forests and the benefits they provide. This study aimed to assess soil loss in the Posses sub-basin, where the Conservador das Águas program began. Additionally, we aimed to determine the potential that this PES initiative has for soil conservation, as well as to minimize the soil losses as a function of forest area size and location in order to propose a technical approach for implementing PES. In this sense, considering the prescribed conservation practices, land use situation, and soil cover in the Posses sub-basin, we analyzed the effectiveness of the Conservador das Águas program before and after implementation in relation to reduced soil loss under 36 different land use and soil cover scenarios. We used a geographic information system (GIS) for spatializing and producing different information plans and the Revised Universal Soil Loss Equation (RUSLE) for estimating soil loss. As a result, we found that minimization of soil loss may be obtained by adopting pasture conservation practices. Additionally the expected average soil loss in the Posses sub-basin under conditions of land use and soil cover, before and after implementing the water conservation program was 30.63 and 7.06 Mg ha<sup>-1</sup> year<sup>-1</sup>, respectively.

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### 1. Introduction

Brazil possesses one of the most important water assets in the world; however, the country experiences vast differences among its hydrographic regions. Although Brazil has the largest water reserves in the world, those reserves are not distributed according to the concentration of the population. In addition, the largest portions of these water reserves are not always located where the highest urban concentrations and demands occur, which causes serious problems in maintaining water supply within the country's most populous regions (Zolin et al., 2011).

One of the largest water resource problems in Brazil (and which serves as a good example of water conflict use within the country) involves the hydrographic basins of the Cantareira system and of the upper Tietê, Piracicaba, Capivari, and Jundiaí rivers.

The metropolitan region of São Paulo (MRSP) (approximately 20 million inhabitants) is located in the upper Tietê drainage basin (upper Tietê-DB) and only provides 240 m<sup>3</sup> Person<sup>-1</sup> year<sup>-1</sup> of water to the MRSP (Orellana González et al., 2008), while the minimum necessary to satisfy this population's needs is 2900 m<sup>3</sup> hab<sup>-1</sup> year<sup>-1</sup> according to Watkins (2009). To meet this demand for water, it is necessary to transport water from the drainage basins of the Piracicaba, Capivari, and Jundiaí rivers (PCJ-DB) via the Cantareira system.

To produce approximately 33 m<sup>3</sup> s<sup>-1</sup> of water for the MRSP, the Cantareira system transports water between two drainage basins, importing 31 m<sup>3</sup> s<sup>-1</sup> of water from the PCJ-DB to the upper Tietê-DB. However, transporting the water between the two drainage basins produces major environmental liabilities for the PCJ-DB, and such water transportation creates significant economic, social, and

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environmental impacts for the PCJ-DB (Folegatti et al., 2010). The concerns due to the water transfer from PCJ-DB has led to the campaign “More Water for the Piracicaba River Basin”, which pushes for the reversal of the Cantareira System and the development of projects and policies aimed at reducing the dependence of the MRSP on water derived from the PCJ basins (Orellana González et al., 2011).

Several studies (Sánchez-Román et al., 2009; Orellana González et al., 2008; Folegatti et al., 2010; González, 2011; Zolin et al., 2011) on the water resource problem within the PCJ-DB have aimed to assist decision makers with water resource management policy within these basins.

According to Folegatti et al. (2010), in cases such as the PCJ basins, where there is a physical problem of water availability, mitigation of the availability problem would need to be based on economic, social, and environmental management policies.

In this regard, the Payment for Environmental Service (PES) concept has gained traction and spread worldwide (Mayrand and Paquin, 2004) within the context of sustainable development. The provision of environmental services, such as watershed protection, has a fundamental importance for societies, due to the fact that it has the character of a public good. They benefit mankind at large but tend to be available at no charge, which leads to the unsustainable use of scarce natural resources because existing markets are not able to value them properly. Therefore, PES schemes seek to address this market failure by providing financial incentives and other types of rewards to land users to maintain/improve the provision of valuable environmental services (FAO, 2013), presenting an important approach to cope with water resources conflicts, such as the PCJ-DB and the upper Tietê-DB.

PES are one of the new approaches supporting positive environmental externalities by transferring financial resources from beneficiaries of specific environmental services to those providing those services. In this sense, the Brazilian legislature took a significant and groundbreaking step forward enacting a municipal law that led to a major innovation in strategically preserving water storage areas.

Created by the municipal law No. 2100 on December 21, 2005, Conservador das Águas is the first Brazilian municipal initiative to implement the PES concept based on the relationship between forests and the benefits they provide, such as soil conservation and water quantity and quality (TNC, 2009).

According to the Extrema city hall, the approximate cost for implementing the project’s recommended practices in the Posses

sub-basin is R\$ 1.25 million (approximately 0.6 million dollars). An important characteristic of the water conservation project is that the proprietors that join the project are compensated based on the total property area and not only for the conserved area, as is the case in most PES projects.

It is expected that the practices that will be adopted in the water conservation project will focus on improving water resource quantity and quality and reducing erosion and sedimentation in the drainage sub-basins within the municipality of Extrema, where most of the springs that feed the Cantareira system are located.

More than ever, attempts to promote sustainable development (Zolin 2010) are being made, but PES has only recently been adopted in Brazil. Yet, the impact of innovation on the design, implementation and sustainability of PES has so far hardly been addressed in the current academic literature (FAO, 2013). Thus, considering the fundamental role that Conservador das Águas program plays in the PCJ-DB and the MRSP water conflict, as well as its impact on future PSA initiatives in Brazil, it is paramount that this program be evaluated for its effectiveness in providing environmental services, such as soil conservation. This study aimed to present some of the main conceptual bases of the first Brazilian municipal initiative of PES (Conservador das Águas program) and to evaluate its potential in reducing soil losses. Additionally, we aimed to minimize the soil losses as a function of forest cover size and location in order to propose a technical approach for implementing new PES programs.

## 2. Materials

### 2.1. Describing the study area

The Posses sub-basin is one of seven sub-basins that comprise the Extrema municipality and is located between geographic coordinates from 46°13'24" to 46°15'8"W and from 22°49'46" to 22°53'21"S (UTM zone 23S, coordinates 374,500–371,500 W and 7,468,200–7,474,800 S), Datum SIRGAS 2000. Fig. 1 shows the geographic location of the Posses sub-basin.

The Posses sub-basin covers approximately 1200 ha and has over 100 rural properties sustaining subsistence farming (Calheiros, 2009).

The predominant climate in the Posses sub-basin is Cwb, defined as a hot and humid climate with a dry winter (Calheiros, 2009) and an average annual rainfall between 1600 mm and 1800 mm (CPCJ-DB, 2010).

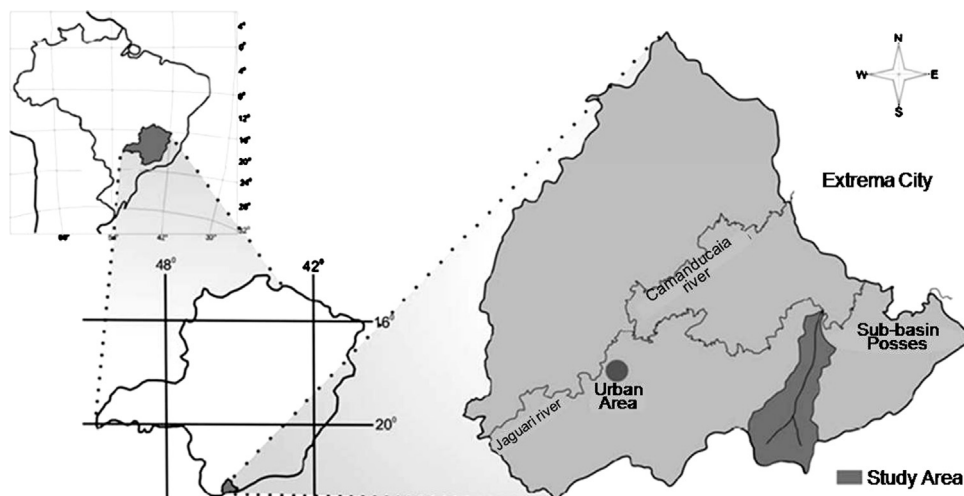


Fig. 1. Geographic location of the Posses sub-basin. Source: adapted from Azevedo (2008).

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