Chapter 14
Guarani Aquifer System Transboundary Management

Luciana Cordeiro de Souza Fernandes
UNICAMP, Brazil

ABSTRACT

This chapter presents the Guarani Aquifer System (GAS), its location and its characteristics, and discusses its management, since it is located in four countries, Argentina, Brazil, Paraguay, and Uruguay. The GAS is a transboundary aquifer, which goes beyond political boundaries, watersheds, and hydrogeological provinces. After briefly highlighting the technical aspects of the GAS, an overview of the groundwater management legislation of each country will be offered, with emphasis on Brazil. International Environmental Law and international treaties and agreements involving this territory will also be discussed, to present the characteristics of the Guarani Aquifer Agreement formulated by these four MERCOSUR countries, which, although not in force, provides for the protection of this environmental good. Finally, it is proposed to create an urban environmental planning tool to protect the GAS recharge areas, innovating the legal system to unite environmental law with urban law in search for GAS protection. This special environmental zoning tool will be called ZEA.

INTRODUCTION

Fresh water, a vital element found in nature in three physical states: solid, liquid and gaseous. In its liquid state, it is contained in surface and groundwater reservoirs as rivers, streams, lakes and in the so-called aquifers.

DOI: 10.4018/978-1-7998-2513-5.ch014

Within the aquifers, groundwater is considered invisible, because it is found within the subsoil, collected in its fissures, pores and fractures of rocks, in other words, distant from human vision and susceptible to exploitation. Within these groundwater reservoirs the water which is found was stored millions, thousands, hundreds, dozens of years or including months within the subsoil, depending on the soil formation in the geological history of the planet. This water made up the water cycle once the evaporated water from the surface condensed and turns back to its liquid state infiltrating within the soil recharging the aquifers. In this process the groundwater and surface water, it is interdependent, teaches Rebouças, A. C. (2002)

Hirata, R.; Suhogusoff, A.V.; Marcellini, S.S.; Villar, P.C., Marcellini, L. (2019, p. 4) date and note that groundwater is critical for the global water safety, because within the aquifers a 97% of fresh liquid water of the planet can be found, which makes it the largest fresh water reservoir of humanity.

According to estimations of the UNESCO, the worlds aquifers which participate more actively within the mechanism of renovation of the worlds water, store close to 10,3M km^3 of the total volume of the planets water (34,6M km^3) and its contribution to the river flow is 13.000 km^3 per year-1. At the same time, the total water demand, human and industrial consumption and land irrigation within the year 2000 were estimated between 4.000 and 5.000 km^3 per year-1. The Phi/UNESCO 2003 estimates that between 600 and 700 km^3 per year-1 are extracted from the wells to supply the 50% of the world's freshwater consumption, 40% of the industrial demands and 20% for agriculture of land irrigation. Generally, the lack of constructive and operative quality of large part of wells, favors the idea of that the use is unreliable as a generator for water production (SOUZA, 2009).

Meanwhile, recent studies by Hirata, R.; Suhogusoff, A.V.; Marcellini, S.S.; Villar, P.C., Marcellini, L. (2019, p. 8), claim that the estimated overall groundwater collection of the world, exceeds since 2010 1.000.000 Mm^3, which places it in a key position with a higher level of abstraction on the ground. Groundwater plays a fundamental role in several countries, being present within the populations water supply, irrigation and industry.

These data justify the necessity of adopting preventive tools which promote management of the quality of its water through an adequate land planning. All at once, the surface is the key element for this protection, declares Souza (2009).

Due to the importance of aquifers within the global water supply, the focus of this study will be the known Guarani Aquifer System.