



# Pesticides in Esteros del Ibera (AR): evaluation of impacts and proposal of guidelines for water quality protection

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## Abstract

This work is within the framework of a project where the overall objective is to create the methodology for a sustainable management of an important wetland in Argentina, “Esteros del Ibera”. Rice culture has been identified as the main anthropogenic activity, being necessary to evaluate the impacts of pesticides used in rice culture on the aquatic ecosystem. The purpose of this paper is to evaluate the impacts of pesticides used in rice culture through the use of a Mackay’s model, to identify the potentially more contaminated environmental compartments, and identify their toxicological and physicochemical properties. Based on the results of the model, water samples were collected and two insecticides (endosulfan and carbofuran) were analysed using the solid-phase microextraction (SPME) extraction technique with detection by gas chromatography with mass spectrometry (GC–MS). To create a decision tool based on monitorization results, pesticide guidelines for water quality (drinking and for aquatic life protection) were calculated and compared with the available international regulations for pesticides; conservative guidelines are recommended. The results of pesticides analysis were compared with these guidelines; some results exceeded the international guidelines (mainly the values for protection of aquatic life) in particular those from samples taken close to the discharge points and due to the presence of the more toxic insecticide endosulfan; however, the impact of pesticides on most waters of the lagoon Ibera seems not yet to be very significant, but monitoring of impacts and careful use of pesticides, specially insecticides, should be observed in the future.

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## 1. Introduction

Wetlands are areas where water covers the soil, or is present inside or near the surface of the soil during all year or for significant periods of the year (US-

EPA, 2000a). The almost continuous presence of water creates conditions to support aquatic and terrestrial living species. The combination of water, high levels of nutrients, and primary productivity is ideal for the development of organisms that form the base of the food web and feed many species of fish, amphibians, shellfish, and insects. Many species of birds and mammals rely on wetlands for food, water and shelter, especially during migration and breeding. Indeed, an interna-

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tional agreement to protect wetlands of international importance (the Ramsar Convention on Wetlands) was developed because some species of migratory birds are completely dependent on certain wetlands and would become extinct if those wetlands were destroyed (Barbier et al., 1997). Besides providing biological habitat, wetlands play a vital role in water quality management because they have important filtering capabilities to retain excess nutrients and some pollutants.

Losing or degrading wetlands can lead to serious consequences, such as increased flooding, extinction of species, and decline in water quality.

Some wetlands are situated near agriculture lands. These activities take advantage of wetland rich resources, like irrigation water but, on the other hand, they can be affected by the over use of chemical products, such as fertilizers and/or pesticides, necessary for the success of intensive agriculture.

The need to avoid the risk to the environmental due to the use of such chemicals has been the base of the regulations to control their use, such as of pesticides in developed countries. There has been an increased awareness and concern from the public and regulatory authorities regarding the potential of pesticides to contaminate air, soil and water sources. This pressure has resulted in the evolution of different assessment methods in order to quantify the fate and effects of such products in environment and human health (Eadsforth and Woodbridge, 1995).

In this study the assessment of the impact of agricultural rice practices, particularly pesticides, on aquatic environment has been made integrating modelling,

field and laboratory work. The results obtained with this type of approach are normally used to introduce changes in the traditional agricultural practices in order to achieve a better quality of the aquatic environment, required in a sustainable agriculture.

## 2. Pesticides and rice production in the Esteros del Ibera region

The studied site is a large wetland area (13,000 km<sup>2</sup>) in north eastern Argentina (Fig. 1), the “Esteros del Ibera”, a complex ecosystem which includes many lagoons (Ibera, Galarza, Luna, etc.) inhabited by wild animals such as alligators, monkeys, swamp deers, etc., Rice, usually considered as one of the main crops in terms of pesticide consumption, occupies the more relevant position in agriculture activity of “Esteros”. In recent years the need to increase crop yields has led to the adoption of more intensive production systems with a consequent raise in pesticides use. Therefore, rice production can affect the quality of aquatic communities of Ibera lagoons, since water containing pesticides from these crops are discharged, through drainage channels or directly, into water bodies. The fate and impact of these products into the surrounding ecosystems are, in most cases, unknown. In this case, the contamination can affect not only the water ecosystem but also the drinking water, since the local population uses water from the lagoons in the public supply system, after a treatment not suitable for pesticide removal.



Fig. 1. Study site localisation.

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