Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina

Andrés H. Arias\textsuperscript{1,2}, Natalia S. Buzzi\textsuperscript{1,2}, Marcelo T. Pereira\textsuperscript{1} and Jorge E. Marcovecchio\textsuperscript{1,2}

\textsuperscript{1}Universidad Nacional del Sur, \textsuperscript{2}Instituto Argentino de Oceanografía, CCT-CONICET, Bahía Blanca
Argentina

1. Introduction

Recent water quality inventories show that agricultural non-point source pollution (NPS) is the leading source of water quality impacts to surveyed rivers and lakes, and also a major contributor to groundwater contamination and wetlands degradation (Blankenberg et al. 2006; Haarstad and Braskerud 2005; Bergstrom 2004; Thiere and Schulz 2004; Schreiber et al. 2001; Huber et al. 2000; Luo and Zhang 2010). Pest management is one of the main scopes of pesticides usage, because more than 45% of annual food production is lost due to pest infestation. In particular, at tropical climates this is enhanced due to prevailing high temperature and humidity. However, the sporadic use has been leading to significant consequences not only to public health but also to food quality resulting in an impact load on the environment and hence the development of pest resistance (Giupponi and Rosato 1999; Luo and Zhang 2010).

Through overuse, misuse and losses due to the inappropriate application of pesticides there is considerable waste contributing to the environmental burden (Li et al. 2006; Giupponi and Rosato 1999; Hu et al. 2010; Marco and Kishimba 2007; Luo and Zhang 2010). It is well known that most of the applied pesticides are subject to many transport and conversion processes. Thus, they do not remain at their target site but often enter aquatic environments via soil percolation, air drift or surface run-off, affecting abundance and diversity of non-target species, producing complex effects on the ecosystems and, altering trophic interactions (Islam and Tanaka, 2004). Pesticides overuse also destroys the healthy pool of bio-control agents that normally co-exist with the vegetation. Simultaneously, some soil biological functions such as the bioavailability of nutrients and organic matter decomposition could also be altered (Hendrix 1996; Guo et al. 2009). For instance, the herbicides can influence soil microbial biomass carbon (MBC) and metabolic quotient (qCO), variables directly related to soil quality (Reis et al. 2009). In addition, agrochemical application on soybean shoots affects the activity of soil microorganisms in the plant rhizosphere (Reis et al. 2009).

The bulk of pesticides worldwide used is herbicides and there is almost no knowledge of their impact on potential non-target plant species, especially rare or endemic species.
(McLaughlin and Mineau 1995). For example, granular insecticides such as carbofuran are very efficient at killing a large proportion of the songbird population breeding on the edge of fields where they are applied (De Silva et al. 2010; Tataruch et al. 1998). These compounds affect the whole ecosystem by entering into the food chain and polluting the soil, air, ground and surface water. As an immediate consequence, humans are exposed to pesticides found in the media. These come to human contact by different routes of exposure such as inhalation, ingestion and dermal contact. As is widely stated, recent and chronic pesticides residues are being detected in child blood, human adipose tissue and breast milk (Perez-Maldonado et al. 2010; Waliszewski et al. 2010; Waliszewski et al. 2009; Wang et al. 2009; Lopez-Espinosa et al. 2008; Ntow et al. 2008). These exposures could ultimately result in acute and chronic health problems, increasing the incidence of cancer, chronic kidney diseases, suppression of the immune system, sterility among males and females, endocrine disorders, neurological and behavioral disorders, especially among children, have been attributed to chronic pesticide poisoning (Gbaruko et al. 2009; Lin et al. 2009; Casabe et al. 2007; Bila and Dezotti 2007; Aronson et al. 2010; Panegyres et al. 2010; Rull et al. 2009; Silva and Gammon 2009).

As an agricultural country, Argentina was estimated from 26 to 30 million ha of farmland using pesticides in the period 2005-2008. It is stated that during pesticides application, up to 30-50% of the applied amount can be lost to the air. Assuming an average dose of a 4.3 kg.hm-1, the amount of pesticides used range between 112 to 129 million Kg with losses to the environment ranging from 33.6 to 64.5 million Kg per year (this means a minimum of about 1 Kg of pesticide in the environment per habitant). In addition, this estimate is not considering that the number of treatments has increased in the last decade, with 66% of the cropped area using two or more herbicide types, and 80% using two or more insecticides during treatment.

To sum up, the existing evidence arguments in favour of revising and restructuring the national agriculture policy and monitoring programs. As a first step, this chapter will discuss some elements of the Argentinean agricultural practices and policies, and then it will focus in reviewing pesticides’ occurrence in the environment.

2. Country and agricultural practices

The Argentinean Republic is a country with a total area of 3.761.274 Km², including 964.000 Km² of islands and Antarctic lands. Its population was of 36.260.130 inhabitants in 2001 (the year of the last census), with an average density of 13 inhab/km². Despite this, 46% of the population is located around the country’s capital city, Buenos Aires. Argentina reaches up to 89.9% of urban population. 77% of housing has access to drinking water through the national network and 59% of people have social medical insurance. The % of literacy is up to 97.8% (older than ten years) and about 34% complete a secondary education (12 years). The last census also showed 14.3% of homes below the line of poverty (Health Ministry, Argentina, 2003).

The combination of adequate temperatures, soil richness and rainfalls provides, as a consequence, top quality lands for agricultural use. The permanent population growth causes an increase on natural resources pressure that conduces to an overexploitation of them. By 2002, the country counted with 332.057 agricultural exploitations (AE), including an area of about 172.105.798 Ha. The major area was sowed with cereal and oilseeds. AE’s population reached up to 1.447.365, mainly constituted of workers.
About the pesticides regulation in Argentina, the government implemented the Rotterdam Convention by the year 2000. The Convention regulates the import and export of certain hazardous chemicals and pesticides. It is based on the fundamental principle of Prior Informed Consent (PIC), meaning that under the Convention, a chemical listed in the Convention may only be exported with the importer's prior consent. The Convention establishes a procedure to disseminate the decisions taken by the importing countries, thus implementing the PIC principle in the international trade in chemicals. It contains provisions requesting detailed information on the chemicals so that these decisions may be taken once data are available on the properties and the incidence of these products in particular on human health and the environment.

By the date of this convention, Argentina already had several pesticide regulations' laws. As a result, the Rotterdam Convention did not prohibit additional pesticides. The present existing regulation for pesticides in Argentina is summarized in Table 1.

Statistics reveals that the pesticide’s usage is well regulated by different government offices, upon the destination by which they are registered in the National Phytosanitary Pesticides’ Registry. In general, the province legislations agree with the national directives, however there are a few provinces and cities which run their own and independent registry. This reflects a kind of incoherence in the current legislation.

About pesticide’s toxicological information, there are 21 Toxicological Assistance Centers in Argentina, offering several information services pointed to prevention, diagnosis and poisoning treatments. Since 1999, it was established a unique Registry of Toxicological Statistics, established in agreement with the INTOX Project of the International Programme Chemical Safety of the United Nations.

3. Country economy and probable agriculture evolution

The agriculture participation in the Gross Domestic Product (GDP) for 2002 was about 6 %. Inside this contribution area, the agriculture was the highest contributor (63%), followed by stockbreeding (31%). The sector’s evolution estimation is of continuous growth (in magnitude of sowed surface and crops), about 16% by the end of 2010 and 9% by 2016. The estimated production for 2010 reaches 100 millions of Tons, and is expected to grow up to 150 millions in five years. These projections define a strong agriculture sector, which represents country wealth but also an environment threat.

3.1 Evolution of the pesticides’ market

Pesticide use has increased dramatically over the last four decades to an estimated 2.59 x 109 kg of active ingredient used globally during1995 (Golfinopoulos et al. 2003). The gradual change in Argentina towards modern and intensive agricultural activities has led to an increase in the use of pesticides (Figure 1). Between the years 1994 and 2002 there was a 130% increase in the consumption of phytosanitary products, from 80 to almost 180 million liters (Miglioranza et al. 2003a). The physical volume commercialized during the present decade was about three times from the 90’s, with a drastic increase in consumables for Glyphosate (N-(phosphonomethyl) glycine), a broad-spectrum systemic herbicide used to kill weeds, especially perennials, in particular for soybean cultivation by direct sowing.

In Argentina, the major pesticide class is Herbicides (commonly known as a weedkillers; substances used to kill unwanted plants). During 2006, 71% of the pesticides’ market was
Table 1. Restricted Pesticides in Argentina (adapted from information provided by the Health Ministry of Argentina, García et al., 2003).
Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina

Fig. 1. Evolution of the Argentinean pesticides market (data from the Argentinean House of Agricultural and Livestock Health and Fertilizers)

Fig. 2. Distribution of the Argentinean pesticides market for the year 2006 (data from the Argentinean House of Agricultural and Livestock Health and Fertilizers)

4. Factors affecting the application of pesticides

The technology used for their application is a critical factor when considering waste of pesticides and unnecessary environmental contamination. The design of nozzles is one of
the major variables that could save up to 70% of pesticides compared to usual farmer’s practice (Mathews, 1998). Although the Argentinean pesticide spraying systems do not use droplet size < 200 um -avoiding much of the airborne drifting-, pesticide application management usually relies on farmers personal decisions, with scarce regulatory control. Farmers and sprayers equipment operators still have wrong notion that high volumes, high pressure and high doses being perceived as the most appropriate ways for pesticide application (Abilash & Singh, 2009). In the pest’s chemical control, the traditional method use nozzles of high volume rates, which require great volume of water to reach to the dripping point. Nozzles are normally not replaced and are even enlarged on purpose to achieve higher flow rates. The distribution patterns under these conditions are uneven; leaving sections with no pesticide coverage and others receiving overdoses (Mathews, 1998).

The common factors which alter pesticides efficiency, in particular in non industrialized producers are:

- Nozzles’ poor calibration. Usually the equipment is inappropriate or obsolete.
- Inappropriate tractor speed which is reflected in unsatisfactory turbine’s air volumes and pulverized water.
- Late or inadequate fruit pruning which facilitates infestation (in fruit production).
- Inadequate choice of the treatment opportunity time. This reflects ignorance of the pest’s biology.
- Poor weather conditions: weather plays a major factor in affecting timing decisions; these conditions also play a significant role in the occurrence of spray drift. This is a major concern because it diverts the pesticide from the intended target, reduces efficacy, and deposits pesticide where it is not needed or wanted. The factors influencing spray drift contamination are: operating pressure, nozzle, type, orientation, orifice size, wind speed, wind direction, temperature, relative humidity and atmospheric stability. When a pesticide drifts, it may cause both environmental and economic damage through injury to susceptible vegetation, harm to wildlife, deposition of illegal residues on crops, and contamination of water supplies.
- Inadequate choice of the pesticide product in order to the target pest or absence of new pesticides application after precipitations events

Advanced producers are less affected by the abovementioned factors. Many of them use control techniques based on sanitary, environmental and economic criteria; in e.g., the sexual confusion of the Carpocapsa pest technique. These producers have integrative corporations that include many steps of the production process or are close-related to export agents. These conditions put them in the center of the commercial scenario, in a way that pesticides control and regulations must be thoroughly observed.

However, recent projections of several agriculture and livestock trend researchers for one of the most important agriculture regions (Alto Valle, Argentina, Huerga & San Juan, 2004) point that about 5% of crops are performed under “organic” practices (no pesticides usage), 10% under EUREGAP25 practices (=EURE Good Agricultural Practics), 45% under direct responsibility of the exporting corporation -with own protocols- and 40% with no particular system.

5. Potential risks of inappropriate pesticides’ usage

There are at least three potentially dangerous items to consider about pest control:
1. Farm worker and rural population intoxications
Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina

2. Food contamination
3. Environment and natural resources contamination.

At present, it is feasible to avoid these negative effects of pest controlling by regulation, control, education and technological assistance of the producer, executed by both, particular producers and government agents. However, in Argentina, this is hardly achieved and serious risk situations for producers, farms and food consumers are widely observed. Problems are well identified, so as well solutions, then, key questions arise: Why solutions are not applied? Who should be the main funding agent for these secure practices?

The last Agriculture and livestock census in 2002 showed that only 40% of farms were doing pest monitoring and only 10% accurately protecting their workers (Table 2). A key factor for the inclusion of good agricultural practices is the socioeconomic condition of the farm. For example, in the Alto Valle is clearly observed the two scenarios: worked land and abandoned scrubland. The last one usually belongs to low socioeconomic producers stroked by the 2002 crisis. Scrublands are then normal pest reservoirs, which diminish the results of the pest control efforts. A second commonly found scenario is traditionally hand-worked farms, which result inappropriate for pesticides’ modern application techniques (Huerga & San Juan, 2004). As a result, the low socioeconomic condition of many farms affects the whole group of producers, including the ones who adopted good agricultural practices (GAPs).

Table 2. Good Agricultural Practices (GAPs) adoption for pest control

| Provinces and cities | Farms (N) | Area (ha) | Use agronomic chemicals according to pre-harvest intervals | Assessment of the balance status between pests and beneficials | Adopt organic control practices | Pragmatically integrated pest management (IPM) | Application by specially trained and knowledgeable personnel | Empty containers management |
|----------------------|-----------|-----------|----------------------------------------------------------|-------------------------------------------------------------|--------------------------------|-----------------------------------------------|----------------------------------------------------------|-----------------------------|
| Buenos Aires         | 402       | 70,560    | 63,305                                                  | 5                                                           | 1,2                           | 129                                           | 32,1                                      | 8                           | 2,2                          | 18                            | 5,5                           | 18                            | 4,5                          | 119                           | 28,1                         |
| Corrientes           | 2,077     | 633,714   | 588                                                     | 28,3                                                        | 553                                          | 26,6                                      | 44                                        | 2,7                          | 37                           | 12,6                         | 61                            | 30,8                         | 104                           | 17,8                         |
| La Pampa             | 1,391     | 95,263    | 362                                                     | 25,5                                                        | 372                                          | 26,2                                      | 8                                         | 0,6                          | 205                          | 14,4                         | 506                           | 42,7                         | 417                           | 29,4                         |
| San Juan             | 1,060     | 323,216   | 234                                                     | 24,9                                                        | 251                                          | 27,9                                      | 32                                        | 2,0                          | 251                          | 16,0                         | 200                           | 12,2                         | 260                           | 16,4                         |
| Río Negro            | 727       | 45,971    | 34                                                      | 22,8                                                        | 35                                           | 23,5                                      | 8                                         | 0,6                          | 205                          | 14,4                         | 206                           | 42,2                         | 417                           | 29,4                         |
| Tucumán              | 1,644     | 82,364    | 54                                                      | 3,3                                                        | 458                                          | 27,9                                      | 32                                        | 2,0                          | 253                          | 16,0                         | 200                           | 12,2                         | 260                           | 16,4                         |
| Jujuy                | 1,346     | 61,457    | 34                                                      | 23,8                                                        | 372                                          | 26,2                                      | 8                                         | 0,6                          | 205                          | 14,4                         | 506                           | 42,7                         | 417                           | 29,4                         |
| Formosa              | 900       | 33,758    | 164                                                     | 24,9                                                        | 13,6                                         | 9                                         | 1,4                                       | 57                           | 8,6                          | 28,3                         | 42,9                         | 400                           | 60,6                         |                |
| La Rioja             | 150       | 9,230     | 31                                                      | 18,5                                                        | 17                                           | 10,7                                      | 2                                         | 1,1                          | 1,9                          | 29                           | 18,2                         | 31                            | 19,5                         |                |

Table 2. Good Agricultural Practices for Pest Control. Data from the Agriculture and Livestock breeding National Census (2002), adapted from the Agriculture Zonal Study, Huerga & San Juan, 2004.

Farm worker, rural population intoxications and pesticide food contamination are away of the scope of this chapter. However these risks are close linked to the environment pollution. There are two major pathways for pesticides reaching the environment:
1. Accidental spills, as punctual sources, generally registered in farm lands but can also occur away from rural environments (acute incidents, generally characterized as point source pollutions).
2. Continuous spills in lower concentrations due to pesticides applications to sowed land etc (chronic releases to the environment, generally characterized as non-point source pollution).

The following section deals with scientifically documented occurrence of pesticides in environmental compartments of Argentina, as a result of the abovementioned sources.

6. Pesticides reaching Argentinean environments

6.1 Water

Most of the Earth’s living resources are found in specific geographical locations such as the global coastal environment and the catchment basins of large river systems. Furthermore, more than 3 billion people live in close proximity to these regions and are dependent upon it for either part or much of their food supply and industrial raw materials (Moore et al. 2004). The consequence of this situation is that much of the industrial, domestic and agricultural wastes are ultimately transported into aquatic environments, generating ecosystem changes and habitat destruction. These environments are of the greatest biological and economic significance and are quite likely to impact on human life’s quality. In Argentina, the POPs environmental monitoring data is usually related to densely populated areas along the major rivers such as the Río de la Plata, Paraná and Reconquista. The bulk of this information relates to freshwater environments, in detriment of coastal marine areas, which have historically received less attention. There is a general lack of large-scale regional water monitoring programs in the country. Further, only potentially contaminated ecosystems are usually monitored. Scarce multidisciplinary approaches considering simultaneous evaluation of a number of factors and processes are found in the country; in fact, the historic freshwater quality monitoring has been developed on water chemistry and bacteriology, with measurements of only the main variables required for the determination of quality indexes (Salibián, 2006).

6.1.1 De la Plata River

_De la Plata_ river is an international river (Buenos Aires province), which is part of the second largest hydro geographic system of South America, after the Amazon, and the fifth largest in the world. It covers an area of about 38,800 km² and drain a 3,170,000 km² basin. It is situated on the East coast of the country, delimited by Argentina and Uruguay. The tidal river is used for commercial fishing, angling, shipping to and from several mayor ports, recreation and tourism, especially along the sandy north shore. The waters of the river are a depository for many raw wastes and effluents from industries, cites and towns, and from the disposal of dredging spoils. Extensive chemical and physical pressures occur on this river, the same as other estuarial systems surrounded by cities and industries (Kurucz et al. 1998). In 1991, Janiot et al. observed the presence of six chlorinated pesticides (alpha, gamma and delta hexachlorociclohexane (HCH), heptachlor-epoxide, p,p’DDE and p,p’DDD) in sixteen water samples (water and suspended material) from the South shore and along a transect in the outer boundary of the river. Levels were higher near the coast, indicating the HCHs as the most frequent isomers. As levels decreased with increasing shoreline’s distance, the observed distribution supported the hypothesis of a dilution effect in the river as a whole. More recent studies at the South coastal shoreline, showed that high concentrations of chlorinated pesticides (Mirex, Lindane (γHCH), Diel DIN, Aldrin, etc.; 6,8-80 ng/L) in the water column were limited to the mix areas of discharge and tributaries.
Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina (FREPLATA. 2004). A similar behavior was previously observed in the discharge area of Río Santiago River (a highly industrialized -8 km long- tributary of De La Plata River); however, this spot was influenced by the discharge of other tributary, which receives chronic inputs from one of the major petrochemical complexes of the area. Relatively high organochlorine levels were also detected at coastal sampling stations from La Plata Harbor. The release of hydrophobic organochlorines from sediments disturbed by dredging and ship transit could have contributed to the high values of this place. As well as Janiot et al., this study pointed γHCH as dominant in the dissolved phase which was widely detected, in concentrations ranging between 0.9 and 61 ng/L (Colombo et al., 1990). In the same work, an hexachloro component of technical Chlordane was also detected at several stations in relatively high levels (0.4-28 ng/L). On the contrary, other chlorinated pesticides showed lower levels or were under the detection limit at several stations.

Geographically moving to the south, at the outer zone of de la Plata River’s Estuary is located the Samborombón Bay and the maritime front (Atlantic Ocean). The available information at these sites showed that, unless some punctual exceptions, pesticides in the water column were moderate to low (1.8±2.7 ng/L), away from the maximum limits suggested for the protection of the biota. Again, γHCH was the most frequent compound; however it was under the guide value in all cases (FREPLATA. 2004).

More than the 97% of the total water in De La Plata River comes from Paraná and Uruguay rivers. 2004 monitoring surveys showed that the contribution of organochlorinated and organophosphorous pesticides, PCBs and PAHs from these rivers were of little significance, as their concentrations in water were under the detection limits of the used techniques. Only PCBs were detected in a station near Paraná de las Palmas (46 ng/L, FREPLATA. 2004). In general, chlorinated pesticides occurred at very low concentration in water samples collected along the Uruguay River. As in De La Plata River, HCH isomers were the most commonly detected compounds, with concentrations ranging from the detection limits to 10 ng/L. Heptachlor, Heptachlor-epoxide, Aldrin, Dieldrin, p-p’DDE and p-p’DDT were occasionally encountered while o-p’DDE, p-p’DDD, o-p’DDD and o-p’DDT were never detected (Janiot et al. 1994).

In the lower Paraná River’s Delta the concentrations of chlorinated pesticides in water were low and similar between sites (3.9±5.1 ng/L), as informed by Cataldo et al. in 2001. In this survey, γHCH accounted for 45-63% of total chlorinated pesticides, reflecting the relatively high water solubility of this chemical (7 ppm). Pollutant concentrations followed a clear geographic pattern with the highest values in the densely populated area of the Reconquista and Luján Rivers, lower levels in the San Antonio, and lowest loadings in the remote Paraná de las Palmas River. This gradient adequately matched the pattern of mortality rates of the mollusk Corbicula fluminea, which were highest in the Reconquista-Luján Rivers (40 ± 93%) and lowest (and not significantly different from the control) in the Paraná River (3.3 ± 23%).

6.1.2 Reconquista River

The Reconquista River is a typical lowland watercourse located at the Buenos Aires Province. More than 3 million people (10% of the population of the country) are settled on its basin. It is located in a temperate subtropical region, crossing what is known as the Pampa Region, sedimentary, flat in topography, with a total surface of 167,000 Ha and 50 km in length. It flows into the Luján River. For over a century, complex mixtures of domestic, agricultural, industrial solids and liquid wastes (mostly untreated) have been dumped in the river, which has thus become a typical example of the adverse impact of
human activities on the health of aquatic environments (Salibián, 2006). For instance, Rovedatti et al. indicated that over 60 samples analyzed 35% presented organochlorine pesticides in a concentration greater than 0.1µg/L (2001). On the opposite, in the same study organophosphates were found in no case, possibly due to their low persistence because of their short half-lives in aquatic environments. Some of the detected compounds were DDT and its metabolite DDE, γ-Chlordane, Heptachlor and HCH isomers. They did not find temporal or spatial trends and there was not a relationship between the time of samplings and the fumigation season for farming purposes. At all locations, pesticides levels were found to be between 40 and 400 times higher than the legal limits established for protection of aquatic life. Recently, new studies demonstrated the effects of poor water quality and environmental deterioration on biomarkers of native fishes species, however in that paper, organochlorine compounds were not found in the water samples (de la Torre, 2007). This fact could be explained due to the low water solubility of organo-halogenated compounds, however, it was clearly documented the occurrence of the “hit and run” effect: although the xenobiotic is not present, it is possible to measure its effects in biota.

### 6.1.3 Pergamino-Arrecifes system

Soybean production in Argentina has increased over the last decade, currently with 10,000,000 hectares of sowed land. A total of 95% of this area corresponds to a transgenic variety of glyphosate tolerant soybean, which is cultivated by direct sowing (Pengue, 2005). Recent monitoring surveys showed that the levels of glyphosate in water, from a transgenic soybean cultivation area located near to tributaries streams of the Pergamino-Arrecifes system in the north of the province of Buenos Aires, ranged from 0.10 to 0.70 mg/L (Peruzzo et al. 2008). The authors concluded that temporal variation of glyphosate levels depended directly on the time of application and the rain events. This emerges as a documented example of pesticides reaching the environment as a consequence of inappropriate agriculture practices. There is scarce available information about pesticides pollution for other regions of Argentina. In the Central and Midwest region of the country (i.e.; San Juan and San Luis provinces), on account of the intense agricultural activity near the rivers that drain the region, the presence of high pesticides’ concentrations is likely to occur. In 2003, Baudino et al. performed a survey at San Juan and after analyzing the overall mean value for the concentration of OCs in water sources, only βHCH (6.556 µg/L) and Dieldrin (5.354 µg/L) were above the maximum permissible value recommended by international organizations (E. C. Council Directive 1980). The authors concluded that the San Juan River basin was the most contaminated area, possibly due to the higher population density, larger cultivated area and industrial complexes.

In San Luis province, water samples coming from agricultural-livestock areas principally indicated an homogeneous distribution of the pesticides found in the area with a clear predominance of HCH isomers and DDT analogs over chlorodines. A prevalence of 4, 4-DDE was observed, suggesting old DDT inputs. Further, this was corroborated by local farmers (Luco et al. 1992), as DDT was a common pesticide in the past.

At the South region of the country (i.e.; Río Negro province), organochlorinated and organophosphorous pesticides have also been detected. Monitoring stations located at Negro River basin’s origin, confluence of Limay and Neuquén Rivers, detected the presence of α-HCH, γ-HCH and Parathion, but in non toxic concentrations for aquatic biota. DDT and metabolites have also been detected but in much less quantity (Natale et al., 1995). Added to this, near this region, ground water samples from fruit production farms belonging to the
Valley of Neuquen River frequently showed organophosphorus pesticides levels that exceeded the acute toxicity risk ratios for aquatic life protection (Loewy et al. 2003). It was found that some pesticides, as Azinphos methyl, had a high detection frequency - 66% of the samples- with concentrations varying from non detectable to 48.9 ppb. Dimethoate, Metidathion and Phosmet were also detected but in less frequency and values. Finally, these authors found that pesticides in ground water samples followed seasonal variations and temporal trends.

6.2 Sediments
Regional POP information for sediments is also dominated by chlorinated pesticides. Overall, as observed for waters, sediment data indicates a complex situation in densely populated areas affected by urban-industrial inputs. The applied pesticides can be transported through surface runoff, leaching, and vapor phase and generally, estuarine and marine sediments are the temporary or long-term ultimate sinks for most of OCs. Consequently, these sediments act later as secondary sources of these substances reaching the ocean and biota. The most frequently reported POPs are DDTs, HCHs, PCBs, and heptachlors, however, concentrations show a large variability.

The FREPLATA 2004 program showed the occurrence of pesticides in sediments from the discharge of De la Plata River basin. The organochlorines’ levels were around 1.9±3.84 ng/g. In the middle and external area of the river, the concentration was under the detection limit of the method. Contrarily, on the South coast of this river, the values of toxic compounds were higher than the levels suggested for the protection of aquatic biota. It was found that pesticide levels diminished by distance from coast line and from tributaries discharge’s sites. Similarly, littoral affluents between De La Plata River and Necocnea City showed concentrations of 3.1±6.5 ng/g, with maximum values of 12-31 ng/g in Atalaya and Mar del Plata harbor. In general Chlordane, DDT and its derivates predominated among OCs. In 2001, pesticides monitoring in the Reconquista and Luján Rivers showed levels around 2.8±3.9 ng/g, being the trans-Chlordane the most abundant (Cataldo el a., 2001). As previously shown in sediments sampled from De la Plata River (Colombo et al., 1990), the abundance of DDD and DDE, relative to the parent compound, indicated that DDT was being readily metabolized in the sediments.

As expected by anthropogenic pressure, the highest loadings of pollutants occurred in areas located closer to the urbanized area, decreasing toward the more remote sites. The same behavior -as abovementioned for water- was observed in Corbicula fluminea mortality. As expected for hydrophobic substances, all sediment samples were enriched in organic contaminants relative to water, then, in agreement with their highest pollution levels the strongest toxicity responses were obtained with them (Cataldo et al., 2001).

In relation with organophosphorus pesticides, levels of Glyphosate in sediment and soils from a transgenic soybean cultivation area located near to tributaries streams of the Pergamino-Arrecifes system in the north of the Buenos Aires’ province were between 0.5 and 5.0 mg/Kg (Peruzzo et al. 2008).
Results from two creeks of the Southeast Argentina region showed similar total OCs concentrations in sediments, in the range from 6 to 25 ng/g (dry wt.), being below the sediment quality criteria demanded for wildlife protection. ΣEndosulfans, ΣDDT’s and ΣChlordanes were the main OCs’ group, with Endosulfan sulfate being the most frequent and abundant compound. The predominance of metabolites with respect to parent
compounds suggested a contamination mainly by runoff from aged and weathered agricultural soils (Miglioranza et al. 2004). The latter shows another clue about pesticides inputs to the environment due to inappropriate application practices.

Moving toward the south, the Southwest coastal area of Buenos Aires province presented total OCs levels from non-detectable to 166.5 ng/g (d.w.) (Menone et al. 2001; Arias et al. 2010). In example, in terms of average concentration, the major pesticides detected in sediments from Bahía Blanca Estuary were Mirex > Heptachlor-epoxide > Metoxychlor > δ-HCH > Endosulfan I > α-HCH > Heptachlor > DDE > DDD (Arias et al. 2010). Macroinvertebrate bioturbation affects the fate and partitioning of sediment-bound contaminants in sediment profiles, pore water and the water column. These factors increase the rate of important physicochemical processes that occur at the sediment-water interface such as diffusion, desorption, degradation, and resuspension of organic and inorganic compounds (Ciarelli et al. 2000). The burrowing crab, Neohelice granulata, is a bioturbator widely distributed in SW Atlantic estuaries. These crabs inhabit almost all the zones of the intertidal, the soft bare sediment flats and the lower salt marsh zones (Iribarne et al. 1997). Crab beds act as sinks for OC pesticides in SW Atlantic coastal environments. Sediments from these sites from the northeastern of the country exhibited total OC pesticide concentrations in the order of other Argentinian coastal environments (Menone et al. 2000; Menone et al. 2004). β- and γ-isomers of Hexachlorocyclohexane, γ-Chlordane, Dieldrin and p,p-DDE were the dominant OC pesticides detected in all sediment samples, while Aldrin, Metoxichlor and p,p'-DDD were below the detection limits (Menone et al. 2006).

6.3 Soils
Extensive agricultural practices can cause soils’ degradation by means of hydric and wind erosion, structure deterioration, salinization, fertility diminution and desertification. Moreover, soils are natural sinks for persistent and lipophilic compounds that strongly adsorb to organic carbon and remain relatively immobile in this reservoir. Pollutants enter the soil either by deposition from air, drift or by washing-off from plant surface during rainfall or irrigation. The proportion of applied pesticide reaching the target pest has been found to be less than 0.3%, thus leaving over 99% elsewhere in the environment (Pimentel 1995). POP monitoring in soils is also limited within the region. There are no regional monitoring programs, and most data refer to agricultural areas.

Agricultural soils in the Southeastern region of Argentina could be an important source (if not the major) for OC pesticides. In 2003, the highest values for OCs (656.1 ng/g d.w.) were found in the most superficial layers of soil, even though at sites which have never received direct OCs application (Miglioranza et al., 2003). At sowing lands, OCs levels were of 30.19 ng/g dry wt in the surface horizon. The pattern of OCs distribution was similar at all sampled soils, with DDT and metabolites > HCHs > Heptachlor > Chlordanes. In this work the authors concluded that volatilization could have been one of the major causes of pesticide loss from the sowing target area, due to inappropriate management practices (Miglioranza et al. 2003b).

In the same geographical area, other researchers found that total OCs levels in soil from conventional farm were greater than those from organic farm, but with the same distribution pattern - DDT and derivatives as the major compounds- (Gonzalez et al. 2005). In 2005 Andrade et al. studied the concentrations of organochlorine and organophosphorus pesticides in soils from the South of Buenos Aires province. Results showed that the
horticulture dedicated soils contained higher pesticide levels than the wheat, soybean and sunflower dedicated ones. This fact probably reflected the differences in soil management according to the different crops. The studied soils contained DDT and their metabolites, Heptachlor-epoxide, Dieldrin, Endrin, Lindane, Malathion and Parathion. In the same study the authors concluded that the soil pesticide accumulation was principally due to the age and persistence in the application of these products (Andrade et al. 2005).

Concentrations of OCs in the Patagonia region are of importance on account of their massive past and/or present use in fruits and vegetable production. Recent studies showed that levels in Río Negro Valley reached up to 492 ng/g and 3.43 ng/g for DDTs and Endosulphanes, respectively (Mitton et al., 2010). The authors found that in different vegetables and fruit plants of this region, OCs were more abundant in the roots than in the aerial parts. In this way, they demonstrated the translocation of toxic compounds from the soils and the capacity of plants for bioaccumulating highly hydrophobic compounds.

6.4 Air
POP monitoring in air as well as studies about volatilization of persistent pollutant from the sowed land are scarce in Argentina. Stronger efforts have to be made in this research discipline in order to test the volatilization/air drift and atmospheric transport from other matrices.

6.5 Biota
Available data on POPs in Argentina for both aquatic and terrestrial animals is poor when comparing to other regions of the world. Among this information, aquatic organisms are by far the most studied organisms; in special bivalves and fish are the preferred ones. In Argentina, the most comprehensive program of POP monitoring in coastal organisms was the global Mussel Watch (Farrington and Tripp 1995). In this monitoring, the highest levels of POPs were obtained in mussels from the coastal Hudson City (southern Buenos Aires province). On the one hand, among the reported POPs, PCBs dominated, followed by Chlordanes and DDTs. On the other hand, in 2006, Endosulfan sulfate, Chlordanes, HCH isomers and DDT compounds dominated in tissues and ingested food of fish (Cynoscion guatucupa), from Bahía Blanca Estuary (Lanfranchi et al., 2006). These authors also identified α-Chlordane, Heptachlor and p,p´-DDE as the major bioaccumulated and biomagnified OCs. Recent studies in birds from the arid-semiarid Midwest region of Argentina showed the presence of several OCs in fat tissue [ΣHCH range: ND to 3168.41 ng/g fat, ΣCHL range: ND to 4961.66 ng/g fat, ΣALD range: 287.07 to 9161.70 ng/g fat, ΣDDT range: 1068.98 to 6479.84 ng/g fat] with the exception of p,p´-DDT. Total OCs concentration in all bird species ranged from 2684.91 to 19231.91 ng/g fat (Cid et al. 2007). This point to an immediate threat, since in a previous study, Gil et al. indicated concentration of pesticides under the detection limit of the method at Patagonia coasts, corresponding the higher value for p,p´-DDE. In the same study, the concentration in mammals did not exceed 0.1 mg/L (Gil et al., 1997).

7. Conclusions
About the regulatory point of view, Argentina’s government implemented the Rotterdam Convention by the year 2000. Despite this, by the date of this convention, Argentina already had several pesticide regulations’ laws. This reflects a strong national regulatory framework, however, there are a few provinces and cities which run their own and independent registry
and regulations. This reflects a kind of incoherence in the current legislation. Added to this, some of the more severely regulated pesticides have been identified as main compounds in the illegal trade-market (Pentachlorophenol, Parathion, DDTs, HCHs and Daminozide) and in environmental samples.

About Good Agricultural Practices’s adoption, although many steps have been taken, Argentina still has a long way to cover. As a matter of fact, recent projections of several agriculture and livestock trend researchers for one of the most industrialized agriculture regions showed up to 40% of the producers with no particular system of Agricultural practices.

According to the environmental point of view, the most relevant problems with pesticides arise from the improper use, disposal, and maintenance of the available stock. The discharge of untreated effluents throughout the whole region is recognized as a major input pathway of POPs into the environment. There is enough scientific information to conclude that pesticides are extensively reaching the environment, with levels in some compartments exceeding the permitted values to protect wildlife. These levels include several already banned pesticides.

It came clear that POP’s survey, inventory and monitoring are still poorly developed in the country. Argentina lacks of routine monitoring programs and most of the available data were generated by punctual studies in urbanized areas. The bulk of the information corresponded to aquatic animals, waters and sediments, with scarce information regarding soils and atmosphere. Finally, it is recommended the consideration of the actual relevance of atmospheric transport of pesticides, since they were usually identified in pristine regions or geographically distant areas from the pesticides application points.

8. References

Abhilash, P.C. & Singh, N. (2009). Pesticide use and application: An Indian scenario. Journal of Hazardous Materials. 165, 1-12, 0304-3894.

Andrade, M.; Covelo, E. & Alonso Vega, M. (2005). Influencia del manejo agrícola intensivo en la contaminación del suelo, In Revista Pilquen. Sección Agronomía, Pozzo Ardizzi, M. Cristina (Ed.), pp17, Año VII, N° 7, Centro Universitario Regional Zona Atlántica (CURZA) de la Universidad Nacional del Comahue, ISSN 1851-2852.

Arias, A.; Pereyra, M. & Marcovecchio J. (2010). Environ Multi-year monitoring of estuarine sediments as ultimate sink for DDT, HCH, and other organochlorinated pesticides in Argentina. Environmental Monitoring and Assessment, DOI 10.1007/s10661-010-1315-9.

Aronson, K J; Wilson, J W L; Hamel, M; Diarsvitri, W; Fan, W L; Woolcott, C; Heaton, J P W; Nickel, J C; Macneily, A, & Morales, A. (2010). Plasma organochlorine levels and prostate cancer risk. Journal of Exposure Science and Environmental Epidemiology, 20, 5, 434-445, 1559-0631.

Baudino, O.; Suero, E.; Augusto, M.; Gimenez, M. & Flores, N. (2003). Monitoring organochlorine pesticides in surface and ground water in San Juan Argentina. Journal of the Chilean Chemical Society, 48, 2, 7-12, ISSN 0167-6369 (print version); ISSN 1573-2959 (electronic version)
Bergstrom, L F. (2004). Symposium 2 part 2: Food production for a growing world population - The impact of food production on soils and groundwater resources. *Journal of Food Science, 69*, 9, R181-R184, 0022-1147.

Bila, D M & Dezotti, M. (2007). Endocrine disrupters in the environment: Part 1 - Effects and consequences. *Quimica Nova, 30*, 3, 651-666, 0100-4042.

Blankenberg, A G B; Braskerud, B, & Haarstad, K. (2006). Pesticide retention in two small constructed wetlands: treating non-point source pollution from agriculture runoff. *International Journal of Environmental Analytical Chemistry, 86*, 3-4, 225-231, 0306-7319.

Casabe, N; Piola, L; Fuchs, J; Oneto, M L; Pamparato, L; Basack, S; Gimenez, R; Massaro, R; Papa, J C, & Kesten, E. (2007). Ecotoxicological assessment of the effects of glyphosate and chlorpyrifos in an Argentine soya field. *Journal of Soils and Sediments, 7*, 4, 232-239, 1439-0108.

Cataldo, D.; Colombo, J.; Boltovskoy, D.; Bilos, C. & Landoni, P. (2001). Environmental toxicity assessment in the Paraná river delta (Argentina): simultaneous evaluation of selected pollutants and mortality rates of *Corbicula fluminea* (Bivalvia) early juveniles. *Environmental Pollution*, 112, 3, 379-389, ISSN 0269-7491.

Ciarelli, S.; Kater, B. & van Straalen, N. (2000). Influence of bioturbation by the anphipod *Corophium volutator* on fluoranthene uptake in the marine polychaete *Nereis virens*. *Environmental Toxicology and Chemistry, 19*, 2, 1575-1581, ISSN 0730-7268.

Cid, F.; Antón, R.; Caviedes-Vidal, E. (2007). Organochlorine pesticide contamination in three bird species of the Embalse La Florida water reservoir in the semiarid midwest of Argentina. *Science of the Total Environment, 385*, 1-3, 86–96, ISSN 0048-9697.

Colombo, J.; Khall, M.; Arnac, M.; Horth, A. & Catoggio, J. (1990). Distribution of Chlorinated Pesticides and Individual Polychlorinated Biphenyls in Biotic and Abiotic Compartments of the Río de La Plata, Argentina. *Environmental Science & Technology, 24*, 4, 498-505, ISSN 0013-936X.

de la Torre, F.; Salibián, A. & Ferrari, L. (2007). Assessment of the pollution impact on biomarkers of effect of a freshwater fish. *Chemosphere, 68*, 8, 1582–1590, ISSN 0045-6535.

De Silva, P M C S; Pathiratne, A, & van Gestel, C A M. (2010). Toxicity of chlorpyrifos, carbofuran, mancozeb and their formulations to the tropical earthworm *Perionyx excavatus*. *Applied Soil Ecology, 44*, 1, 56-60, 0929-1393.

Farrington, F. & Tripp, B. (1995). International Mussel Watch Project. Initial Implementation Phase. Final Report. NOAA Technical Memorandum NOS ORCA 95, 63 p and 5 append..

FREPLATA. (2004). “Análisis Diagnóstico Transfronterizo del Río de la Plata y su Frente Maritimo”. Documento Técnico. Proyecto Protección Ambiental del Río de la Plata y su Frente Maritimo, p301, Proyecto PNUD/GEF/RLA/99/G31.

García, S.I.; Bovi-Mitre, G., Moreno I., Eiman Grossi, M., Digón, A., de Titto, E. (2003). Regional Workshop on Pesticides Toxicology and Data Collection Protocols.
Argentina Health Ministry, Sanitary Program Secretariat, Buenos Aires, Argentina.

Gbaruko, B C; Ogwo, E I; Igwe, J C, & Yu, H T. (2009). Organophosphate induced chronic neurotoxicity: Health, environmental and risk exposure issues in developing nations of the world. *African Journal of Biotechnology*, 8, 20, 5137-5141, 1684-5315.

Gil, M.; Harvey, M.; Beldoméncio, H.; Garcia, S.; Commendatore, M.; Gandini, P.; Frere, E.; Yorio, P.; Crespo, E. & Esteves, J. (1997). Contaminación por metales y plaguicidas organoclorados en organismos marinos de la zona costera patagónica. *Informes Técnicos del Plan de Manejo Integrado de la Zona Costera Patagónica (Puerto Madryn, Argentina)*, 32, 1-28.

Giupponi, C & Rosato, P. (1999). Agricultural land use changes and water quality: A case study in the watershed of the Lagoon of Venice. *Water Science and Technology*, 39, 3, 135-148, 0273-1223.

Golfinopoulos, S.; Nikolaou, A.; Kostopoulou, M.; Xilourgidis, N.; Vagi, M. & Lekkas, D. (2003). Organochlorine pesticides in the surface waters of Northern Greece. *Chemosphere*, 50, 4, 507-516, ISSN 0045-6535.

Gonzalez, M.; Miglioranza, K.; Aizpún de Moreno, J. & Moreno, V. (2005). Evaluation of conventionally and organically produced vegetables for high lipophilic organochlorine pesticide (OCP) residues. *Food and Chemical Toxicology*, 43, 2, 261-269, ISSN 0278-6915.

Guo, H; Chen, G F; Lv, Z P; Zhao, H, & Yang, H. (2009). Alteration of microbial properties and community structure in soils exposed to napropamide. *Journal of Environmental Sciences-China*, 21, 4, 494-502, 1001-0742.

Haarstad, K & Braskerud, B C. (2005). Pesticide retention in the watershed and in a small constructed wetland treating diffuse pollution. *Water Science and Technology*, 51, 3-4, 143-150, 0273-1223.

Hendrix, P F. (1996). Nearctic earthworm fauna in the southern USA: Biodiversity and effects on ecosystem processes. *Biodiversity and Conservation*, 5, 2, 223-234, 0960-3115.

Hu, G C; Luo, X J; Li, F C; Dai, J Y; Guo, J Y; Chen, S J; Hong, C; Mai, B X, & Xu, M Q. (2010). Organochlorine compounds and polycyclic aromatic hydrocarbons in surface sediment from Baiyangdian Lake, North China: Concentrations, sources profiles and potential risk. *Journal of Environmental Sciences-China*, 22, 2, 176-183, 1001-0742.

Huber, A; Bach, M, & Frede, H G. (2000). Pollution of surface waters with pesticides in Germany: modeling non-point source inputs. *Agriculture Ecosystems & Environment*, 80, 3, 191-204, 0167-8809.

Huerga, M. & San Juan, S. (2004). Pests Control in Agriculture, Argentina. World Bank/Investment Center FAO, Buenos Aires, Argentina.

Iribarne, O.; Bortolus, A. & Botto, F. (1997). Between-habitats differences in burrow characteristics and trophic modes in the southwestern Atlantic burrowing crab *Chasmagnathus granulata*. *Marine Ecology Progress Series*, 155, 132-145, ISSN 0171-8630.
Islam, M. & Tanaka, M. (2004). Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. *Marine Pollution Bulletin*, 48, 7-8, 624-649, ISSN 0025-326X.

Janiot, L.; Orlando, A. & Roses, O. (1991). Niveles de plaguicidas clorados en el Río de la Plata. *Acta Farmacéutica Bonaerense*, 10, 1, 15-23, ISSN 0326-2383.

Janiot, L.; Sericano J. & Roses, O. (1994). Chlorinated pesticide occurrence in the Uruguay river (Argentin-Uruguay). *Water, Air and Soil Pollution*, 76, 3-4, 323-331, ISSN 0049-6979.

Kurucz, A.; Masello, A.; Méndez, S.; Cranston, R. & Wells, P. (1998). Calidad ambiental del Río de La Plata. Capítulo 3, 71-86, In *El Río de la Plata, Una revisión ambiental*. Un informe de Antecedentes del Proyecto EcoPlata, Wells, P. & Daborn, G. (Eds.), 256p., Dalhousie University, Halifax, Nova Scotia, Canada.

Lanfranchi, A.; Menone, M.; Miglioranza, K.; Janiot, L.; Aizpun, J. & Moreno, V. (2006). Striped weakfish (*Cynoscion guatucupa*): A biomonitor of organochlorine pesticides in estuarine and near-coastal zones. *Marine Pollution Bulletin*, 52, 1, 74–80, ISSN 0025-326X.

Li, R Q; Dong, M; Peng, H; Zhang, L L; Cui, Q G, & He, W M. (2006). Agricultural expansion in Yunnan Province and its environmental consequences.*Chinese Science Bulletin*, 51, 136-142, 1001-6538.

Lin, A Y C; Huang, S T Y, & Wahlqvist, M L. (2009). Waste management to improve food safety and security for health advancement.*Asia Pacific Journal of Clinical Nutrition*, 18, 4, 538-545, 0964-7058.

Loewy, R.; Carvajal, L.; Novelli, M. & Pechen de D'Angelo, A. (2003). Effect of Pesticide Use in Fruit Production Orchards on Shallow Ground Water. *Journal of Environmental Science and Health*, Part B, 38, 3, 317–325, ISSN (printed version) 0360-1234, ISSN (electronic version) 1532-4109.

Lopez-Espinosa, M J; Lopez-Navarrete, E; Rivas, A; Fernandez, M F; Nogueras, M; Campoy, C; Olea-Serrano, F; Lardelli, P, & Olea, N. (2008). Organochlorine pesticide exposure in children living in southern Spain.*Environmental Research*, 106, 1, 1-6, 0013-9351.

Luco, J.; Aguilar, E.; Silva, P.; Baudino, O. & Gonzalez, D. (1992). Niveles de Pesticidas Organoclorados en Aguas de la Provincia de San Luis (República Argentina). *Acta Farmacéutica. Bonaerense*, 11, 3, 121-8, ISSN 0326-2383.

Luo, Y Z & Zhang, M H. (2010a). Spatially distributed pesticide exposure assessment in the Central Valley, California, USA.*Environmental Pollution*, 158, 5, 1629-1637, 0269-7491.

Luo, Y Z & Zhang, M H. (2010b). Spatially distributed pesticide exposure assessment in the Central Valley, California, USA.*Environmental Pollution*, 158, 5, 1629-1637, 0269-7491.

Marco, J.A.M. & Kishimba, M.A. (2007). Organochlorine pesticides and metabolites in young leaves of Mangifera indica from sites near a point source in Coast region, Tanzania.*Chemosphere*, 68, 5, 832-837, 0045-6535.

Mathews, G.A. (1998). Application Equipment with Particular Reference to Smallscale Operations, UNIDO Report.
McLaughlin, A & Mineau, P. (1995). The impact of agricultural practices on biodiversity. *Agriculture Ecosystems & Environment*, 55, 3, 201-212, 0167-8809.

Menone, M.; Aizpún de Moreno, J.; Moreno, V.; Lanfranchi, A.; Metcalfe, T. & Metcalfe, C. (2001). Organochlorine pesticides and PCBs in a southern Atlantic coastal lagoon watershed, Argentina. *Archives of Environmental Contamination and Toxicology*, 40, 3, 355-362, ISSN 0090-4341 (print version), ISSN 1432-0703 (electronic version).

Menone, M.; Bortolus, A.; Botto, F.; Aizpún de Moreno, J.; Moreno, V.; Iribarne, O.; Metcalfe, T. & Metcalfe, C. (2000). Organochlorine contaminants in a coastal lagoon in Argentina: analysis of sediment, crabs and cordgrass from two different habitats. *Estuaries*, 23, 4, 583-592, ISSN 0160-8347.

Menone, M.; Miglioranza, K.; Botto, F.; Iribarne O.; Aizpún de Moreno, J. & Moreno, V. (2006). Field accumulative behavior of organochlorine pesticides. The role of crabs and sediment characteristics in coastal environments. *Marine Pollution Bulletin*, 52, 12, 1717-1724, ISSN 0025-326X.

Menone, M.; Miglioranza, K.; Iribarne, O.; Aizpún de Moreno, J. & Moreno, V. (2004). The role of burrowing beds and burrows of the SW Atlantic intertidal crab Chasmagnathus granulata in trapping organochlorine pesticides. *Marine Pollution Bulletin*, 48, 3-4, 240-247, ISSN 0025-326X.

Miglioranza, K.; Aizpún de Moreno, J. & Moreno, V. (2003a). Trends in Soil Science: Organochlorine Pesticides in Argentinean Soils. *Journal of Soils & Sediments*, 4, 3, 264-265, ISSN 1439-0108.

Miglioranza, K.; Aizpún de Moreno, J. & Moreno, V. (2003b). Dynamics of organochlorine pesticides in soils from a southeastern region of Argentina. *Environmental Toxicology and Chemistry*, 22, 4, 712-717, ISSN 0730-7268.

Miglioranza, K.; Aizpún de Moreno, J. & Moreno, V. (2004). Land-based sources of marine pollution: organochlorine pesticides in stream systems. *Environmental Science and Pollution Research International*, 11, 4, 227-32, ISSN 0944-1344 (print version) ISSN: 1614-7499 (electronic version).

Mitton, F.; Gonzalez, M. & Miglioranza K. (2010). Dinámica de DDTs y endosulfanes en plantas comestibles cultivadas en suelos de Río Negro, Patagonia. *III Congreso Argentino de la Sociedad de Toxicología y Química Ambiental*, SETAC 2010, p.113, Santa Fe, Argentina.

Moore, M.; Depledge, M.; Readman J. & Leonard D. (2004). An integrated biomarker-based strategy for ecotoxicological evaluation of risk in environmental management. *Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis*, 552, 1-2, 247-268, ISSN 0027-5107.

Natale, O.; Gómez, C.; Vermeulen, J.; Casamiquela, C.; D’Angelo, A.; Loewy, R.; Alcalde, R.; Vernier, B.; Schultz, F. & Cardot, L. (1995). Anexo 2, Estudio de caso: Plaguicidas en el Río Negro, Argentina. In: Manual de Evaluación y Manejo de sustancias tóxicas en aguas superficiales, 5409/C44/40272; CEPIS-OPS-INCYTH.

Ntow, W J; Tagoe, L M; Drechsel, P; Kelderman, P; Gijzen, F J, & Nyarko, E. (2008). Accumulation of persistent organochlorine contaminants in milk and serum of farmers from Ghana. *Environmental Research*, 106, 1, 17-26, 0013-9351.
Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina

Panegyres, P.K.; Gray, V.; Barrett, L., & Perceval, S. (2010). Neurological disorders in a rural Western Australian population. *Internal Medicine Journal*, 40, 3, 209-213, 1444-0903.

Pengue, W. (2005). Transgenic crops in Argentina: the ecological and social debt. *Bulletin of Science, Technology & Society*, 25, 4, 314-32, ISSN 0270-4676 (print version), ISSN 1552-4183 (electronic version).

Perez-Maldonado I.N; Trejo, A; Ruepert, C; Jovel, R D; Mendez, M P; Ferrari, M; Saballos-Sobelvarro, E; Alexander, C; Yanez-Estrada, L; Lopez, D; Henao, S; Pinto, E R, & Diaz-Barriga, F. (2010). Assessment of DDT levels in selected environmental media and biological samples from Mexico and Central America. *Chemosphere*, 78, 10, 1244-1249, 0045-6535.

Peruzzo, P.; Porta, A. & Ronco, A. (2008). Levels of glyphosate in surface waters, sediments and soils associated with direct sowing soybean cultivation in north pamassic region of Argentina. *Environmental Pollution*, 156, 1, 61-66, ISSN 0269-7491.

Pimentel, D. (1995). Amounts of Pesticides reaching target pests: environmental impacts and ethics. *Journal of Agricultural and Environmental Ethics*, 8, 1, 17-29, ISSN 1187-7863 (print version), ISSN 1573-322X (electronic version).

Reis, M R; Silva, A A; Freitas, M A M; Pereira, J L; Costa, M D; Picanco, M C; Ferreira, E A; Belo, A F; Coelho, A T C P, & Silva, G R. (2009). Impact of Glyphosate Associated with Insecticide and Fungicide Application on the Microbial Activity and Potential Phosphate Solubilization in Soil Cultivated with Roundup Ready (R) Soybean. *Planta Daninha*, 27, 4, 729-737, 0100-8358.

Rovedatti, M.; Castañé, P.; Topalián, M. & Salibián, A. (2001). Monitoring of organochlorine and organophosphorus pesticides in the water of the Reconquista river (Buenos Aires, Argentina). *Water Research*, 35, 14, 3457-3461, ISSN 0043-1354.

Rull, R P; Gunier, R; Von Behren, J; Hertz, A; Crouse, V; Buffler, P A, & Reynolds, P. (2009). Residential proximity to agricultural pesticide applications and childhood acute lymphoblastic leukemia. *Environmental Research*, 109, 7, 891-899, 0013-9351.

Salibián, A. (2006). Ecotoxicological Assessment of the Highly Polluted Reconquista River of Argentina. *Reviews of Environmental Contamination & Toxicology*, 185, 35-65, ISSN 0179-5953.

Schreiber, J D; Rebich, R A, & Cooper, C M. (2001). Dynamics of diffuse pollution from US southern watersheds. *Water Research*, 35, 10, 2534-2542, 0043-1354.

Silva, M H & Gammon, D. (2009). An Assessment of the Developmental, Reproductive, and Neurotoxicity of Endosulfan. *Birth Defects Research Part B-Developmental and Reproductive Toxicology*, 86, 1, 1-28, 1542-9733.

Tataruch, F; Steineck, T, & Frey, H. (1998). Carbofuran poisoning in wildlife (birds of prey, songbirds and carnivores) in Austria. *Wiener Tierarztliche Monatsschrift*, 85, 1, 12-17, 0043-535X.

Thiere, G & Schulz, R. (2004). Runoff-related agricultural impact in relation to macroinvertebrate communities of the Lourens River, South Africa. *Water Research*, 38, 13, 3092-3102, 0043-1354.

Waliszewski, S M; Melo-Santiesteban, G; Villalobos-Pietrini, R; Gomez-Arroyo, S; Amador-Munoz, O; Herrero-Mercado, M, & Carvajal, O. (2009). Breast Milk Excretion
Kinetic of beta-HCH, pp'DDE and pp'DDT. *Bulletin of Environmental Contamination and Toxicology*, 83, 6, 869-873, 0007-4861.

Waliszewski, S M; Quintana, R V; Corona, C A; Herrero, M; Sanchez, K; Aguirre, H; Aldave, I A; Arroyo, S G, & Pietrini, R V. (2010). Comparison of Organochlorine Pesticide Levels in Human Adipose Tissue of Inhabitants from Veracruz and Puebla, Mexico. *Archives of Environmental Contamination and Toxicology*, 58, 1, 230-236, 0090-4341.

Wang, R Y; Jain, R B; Wolkin, A F; Rubin, C H, & Needham, L L. (2009). Serum Concentrations of Selected Persistent Organic Pollutants in a Sample of Pregnant Females and Changes in Their Concentrations during Gestation. *Environmental Health Perspectives*, 117, 8, 1244-1249, 0091-6765.
This book provides an overview on a large variety of pesticide-related topics, organized in three sections. The first part is dedicated to the "safer" pesticides derived from natural materials, the design and the optimization of pesticides formulations, and the techniques for pesticides application. The second part is intended to demonstrate the agricultural products, environmental and biota pesticides contamination and the impacts of the pesticides presence on the ecosystems. The third part presents current investigations of the naturally occurring pesticides degradation phenomena, the environmental effects of the break down products, and different approaches to pesticides residues treatment. Written by leading experts in their respective areas, the book is highly recommended to the professionals, interested in pesticides issues.

How to reference
In order to correctly reference this scholarly work, feel free to copy and paste the following:

Andrés H. Arias, Natalia S. Buzzi, Marcelo T. Pereira and Jorge E. Marcovecchio (2011). Pesticides Reaching the Environment as a Consequence of Inappropriate Agricultural Practices in Argentina, Pesticides - Formulations, Effects, Fate, Prof. Margarita Stoytcheva (Ed.), ISBN: 978-953-307-532-7, InTech, Available from: http://www.intechopen.com/books/pesticides-formulations-effects-fate/pesticides-reaching-the-environment-as-a-consequence-of-inappropriate-agricultural-practices-in-arge