ENVIRONMENTAL IMPACT ASSESSMENT AND PESTICIDE CONTAMINATION ABATEMENT

Evaluación del impacto ambiental y disminuición de la contaminación por agroquímicos

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key words: pesticides, environmental impact assessment, agriculture, animal raising, intensive farming.

Palabras clave: plaguicidas, evaluación de impactos ambientales, agropecuaria, agricultura intensiva.

ABSTRACT

Pesticide residue contamination of the environment and foodstuffs is ubiquitous worldwide. The scientific information on pesticide contamination in the region known as the South Cone of South America points out to a steady drop in residue levels following the ban on organochlorinated compounds. However, reports on people and animal intoxication, produce contamination, and accidental environmental pollution are not fully absent. With the growth of the regional market fostered by the free trade agreement (Mercosur), pesticide use is expanding markedly. Considerable effort is being devoted within the region to cooperatively (inter-countries) assess the risks imposed by pesticides on agriculture and livestock production, as well as on human and environmental health, in order to warrant good standing in the world's marketplace. Environmental impact assessment procedures are proposed to help both the assessment and report, and the selection of management practices for the abatement of pesticide contamination in the region. A growing predisposition of producers toward best production practices, and of consumers seeking healthy food, may appropriately ensure societal environmental stewardship.

RESUMO

A contaminação do ambiente e de alimentos por resíduos de pesticidas é uma realidade mundial. A informação científica sobre contaminação por pesticidas no Cone Sul indica uma clara tendência decrescente desde a exclusão dos organoclorados do mercado. Entretanto, notícias sobre intoxicação animal e humana, contaminação de produtos, e poluição ambiental acidental não são completamente ausentes. Com o crescimento dos mercados incentivado pelo Mercosul, o uso de pesticidas vem se expandindo dramaticamente em todos os países da região. Esforço considerável vem sendo despendido na região para avaliar cooperativamente entre os países os problemas potenciais dos pesticidas nos produtos agropecuários, bem como na saúde humana e ambiental, com vistas a assegurar uma boa posição no mercado mundial. Procedimentos de avaliação de impactos ambientais são propostos, tanto para a condução e notificação dessas avaliações, quanto para a seleção de alternativas de manejo para a diminuição da contaminação na região. A crescente predisposição dos produtores para aplicação de práticas ótimas, e dos consumidores para

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exigência de melhores produtos, tende a favorecer a responsabilidade social para com o ambiente.

PESTICIDES AND ENVIRONMENTAL CONTAMINATION

An extensive review on pesticide contamination in the South Cone was recently published (Rodrigues, 1997). Pesticide residues are present in all environmental compartments of the globe, even the most remote areas. Traces of DDT, HCB, aldrin, heptachlor, among others, can be detected in the atmosphere over the South Atlantic and Antarctic Oceans (Weber & Montone, 1990), in samples of soil, water, ice and snow from Antarctica (Tanabe *et al.*, 1983), and in the high altitudes of the Chilean Andes (Ciudad & Moyano, 1988). The contamination extends to groundwaters tapped for human consumption (Lara & Barreto, 1972), and in treated waters of city supplies (Caceres *et al.*, 1981) even if at levels considered safe.

Environmental contamination by organochlorinated compounds may have the immediate consequence of building up residues in organisms, thus interfering negatively with livestock production. This is so because these compounds are lipophilic and tend to accumulate through the food chain. As an example, even though contamination of the water in reservoirs studied in São Paulo state was not significant, total organochlorine residue content in fish fat reached up to 20 ppb, which although lower than levels observed elsewhere, and considered acceptable according to current standards, indicates the existence of a cumulative effect (Celeste & Caceres, 1988).

Pesticides applied to crops are destined to contaminate soils. Residues bound to soil particles may be slowly released through leaching, volatilization, and absorption, resulting in the contamination of waters, the atmosphere, and plants and their consumers. Meat contamination due to sanitary practices and consumption by livestock of organochlorine-treated pastures have been studied since the early 1970s (Lara *et al.*, 1971). Extensive monitoring conducted at that time pointed to an uneasy picture (Nishikawa *et al.*, 1982; Yokomizo, 1979) - 17% of beef samples were contaminated above acceptable levels (Carvalho *et al.*, 1980). Temporal trends, on the other hand, indicate that in the early 1980s residue levels began to decrease sharply, surpassing acceptable levels in just 3.2% of 2,959 beef samples analyzed in 1984 (Carvalho *et al.*, 1984) and none in the 1984-87 period (Rauber & Hennigen, 1988).

The decreasing tendency in organochlorine residue content was confirmed in evaluations of poultry meat in the 1988-91 period. Although a large proportion of samples showed traces of several compounds, the levels never exceeded tolerance limits (Barretto *et al.*, 1992). In another study (Delazari *et al.*, 1991), the highest residue levels detected in poultry flesh remained between one tenth and one hundredth of the maximum allowed, reflecting positively in the quality of eggs (Marcus *et al.*, 1989).

Legal restrictions and regulations on pesticide use in Argentina began as a result of trade constraints imposed by the USA because of organochlorine residue content in meat during the 1960s (Cuerpo & Pizzi, 1983). As a consequence, and following the temporal trend observed throughout the region, recent monitoring programs of residues in meat and derivatives produced in Argentina showed only 0.7% of samples with residue levels above 50% of the acceptable levels established by North American legislation (Cuerpo, 1990).

These studies suggest that organochlorine contamination results essentially from residues in pasture lands. Contamination of pastures ends up causing residue in milk and milk products. As early as 1971, organochlorine residues were detected in milk sold in São Paulo city (Almeida & Barretto, 1971). In a follow-up study in 1979 contamination levels had decreased (Lara *et al.*, 1980), a trend that persisted in later evaluations (Lara *et al.*, 1985), and in 1984 no samples collected in three cities of São Paulo State exceeded acceptable limits

(Yokomizo *et al.*, 1984). A similar trend seems to have occurred in Argentina, where assessments are more recent. Milk (Maitre *et al.*, 1994) and butter (Lenardon *et al.*, 1994) samples were evaluated for organochlorine residues and even though residues were present in most samples, the FAO/WHO limits were violated only sporadically.

These studies on pesticide contamination in the region point out to a steady drop in residue levels following the ban on organochlorinated compounds. With the growth of the regional market fostered by the Mercosur, pesticide use is expanding markedly. In Argentina, for instance, approximately 100 thousand tons have been applied annually, a quantity that doubled since 1990 (Annone, 1998). Considerable effort is being devoted within the region to cooperatively (inter-countries) assess the risks imposed by pesticides on agricultural and livestock products, as well as on human and environmental health, in order to warrant good standing in the world's marketplace (Rodrigues, 1998b).

PESTICIDE CONTAMINATION ABATEMENT

Dr. David Pimentel from Cornell University states that before synthetic pesticides were introduced to common agricultural management, crop losses to insects averaged 7%. Since those days, and despite a tremendous increase in pesticide use, crop losses increased to 13%. He expectedly inquires – how the devil could this happen? (Pimentel, 1998). The answer is straightforward: pesticide usage favored simpler production systems, without crop rotation or association, and lacking plant-animal integration. The sustainability of such a system is very weak. Dr. Pimentel argues that pesticides cause public health losses of 1 billion dollars, and environmental degradation worth 8 billion dollars annually in the US. Proposing a suite of alternative technologies, he contends that it would be possible to reduce pesticide use in the US by 50% on about 40 crops, without any yield impairment, keeping the same cosmetic standards for produce, and even though at a cost of 1 billion dollars, it would bring three billion dollars in savings to the country's farmers (Pimentel, 1998).

Such pesticide reduction programs have been implemented in Sweden, Denmark, and the Netherlands (Hurst *et al.*, 1992), and their approved success attest to the possibilities of implementing similar programs in our region. As a matter of fact, propositions of sustainable agricultural production systems abound in our literature. Given the recent improvements attained in agriculture and livestock production practices observed in the region, result of the summoned efforts of farmers and ranchers to successfully partake in the Mercosur, the best choice of sustainable management practices should encompass these two activities. Hence, agriculture-livestock production integration has been proposed as the principal opportunity both to increase profits and improve natural resources exploitation, bettering the sustainability of the rural sector in the region. Through the application of environmental impact assessments it is possible to delineate the best choice of techniques and management practices that will bring about this sustainable development.

ENVIRONMENTAL IMPACT ASSESSMENT IN AGRICULTURE

Environmental impact assessments (EIA) are an appropriate set of analytical tools designed to evaluate the best choice of technologies, management practices, and development projects and programs, as regarded to their potential effects on every aspect of the environment: 1. the health, safety, and well-being of the affected populations, 2. the social and economic activities, 3. the biota, 4. the sanitary and aesthetic conditions of the landscape, 5. the quality of natural resources (Secretaria do Meio Ambiente de São Paulo., 1992).

EIAs can help both the assessment and report, and the selection of management practices for the abatement of pesticide contamination in the agriculture-livestock production in the South Cone. This means that following an EIA, the most appropriate array of technologies, products, and practices are made available to producers, and the EIA report may suffice to register and communicate, or even to advertise to clients, this selection of best management practices, enabling these clients to find the products that match their requirements.

Comprised by over a hundred specific methods, EIA procedures may be bundled into six main approaches: 1. *ad hoc* methods, 2. checklists, 3. overlay mapping, 4. networks, 5. systems diagrams, and 6. simulation modeling (Bisset, 1987; Bolea, 1980; PADC, 1983; Pinheiro, 1990; Rodrigues, 1998a; SURHEMA-GTZ., 1992). An adequate approach for listing all intervening factors, selecting best management practices, and comparing alternative production systems is represented by scaling checklists (Rodrigues, 1998a).

An EIA scaling checklist constructed for conventional and integrated agriculture-livestock production is presented in Table 1. Conventional agriculture is represented by grain production under prevalent management practices, rain-fed mono-cropping, prescribed chemical pest control, and winter fallow. Conventional livestock production is represented by extensive grazing on cultivated grass pasture. Integrated agriculture-livestock production is represented by the main system under development in most parts of the South Cone: no-till legume summer crop sown on chemically controlled grass pasture, followed by small grain green manure sown in early spring and grass sown on the legume or small grain crop straw, and cattle grazing rotationally among pasture parcels (Salton, 1996; Terra & Prechac, 1997; Terra *et al.*, 1997).

The values attributed to each factor relating to the management systems considered are derived by the author from experimental results and reports on comparative performance of the systems in field demonstration units, (Salton, 1996; Terra & Prechac, 1997; Terra *et al.*, 1997; Thomas, 1995). The system considered to present a baseline impact for a given factor has an assigned value of zero, and the compared systems receive a positive or negative value (as percent decimal) according to expected effect extent. However subjective and unpretentious, this approach renders adequate simplicity to the evaluation. A more accurate analysis may be performed for specific situations, involving a team of experts and precise field data.

Table 1. Environmental impact assessment scaling checklist for conventional and integrated agriculture-livestock production system.

FACTOR / MANAGEMENT SYSTEM	Conventional agriculture (a)	Conventional Livestock production (b)	Integrated ag-livestock production (c)	Combined Variation
SOIL				
Erosion	-0.30	0	-0.10	0,05
Compaction	-0.20	-0.30	0	0,25
Water loss	-0.20	-0.10	0	0,15
Organic Matter depletion	-0.30	0	0.20	0,35
Nutrient Leaching	-0.20	0	-0.10	0
Run off	-0.20	0	0.20	0,30
GROUNDWATER				
Run off loss	-0.20	0	0.10	0,20
Nitrate load	-0,20	0	-0.30	-0,20
Pesticide load	-0.20	0	-0.40	-0,30
SURFACE WATER				
Nutrient load	-0.30	0	0,10	0,25
Pesticide load	-0.30	0	-0.20	-0,05
Sediment load	-0.30	0	0.20	0,35
INFRASTRUCTURE REQUIREMENTS				
Heavy machinery	-0.30	-0.10	0	0.20
Multi-implement operations	-0.20	-0.10	0	0,15
ENERGY AND INPUT CONSUMPTION				
Fossil fuel	-0.30	0	-0.10	0,05
Fertilizers	-0.30	0	-0.10	0,05
Pesticides	-0.20	0	-0.30	-0.20
LABOR RELATIONSHIPS				
Workforce requirement (shortage)	0	-0.30	0.20	0.35
Workforce seasonality (volatility)	-0.20	0	0	0,10
Worker mobility (migratory flux)	-0.20	0	0	0,10
Livelihood constraints	-0.20	-0.10	0	0,15
ECONOMIC EFFICIENCY				0
Product dependency	-0.10	-0.10	0	0,10
Cash flow seasonality (volatility)	-0.20	-0.10	0	0,15
Profit expenditure for maintenance	-0.20	0	0.10	0.20
SUSTAINABILITY CONSTRAINTS (rates)				
(1-) Abiotic production factors / Biotic production factors	(1-(.55/.45)) = -0.22	(1-(.5/.5)) = 0	(1-(.45/.55)) = 0.18	(c-(a+b/2)) 0,29
(1-) Nonrenewable resources / Renewable resources	(1-(.55/.45)) = -0.22	(1-(.5/.5)) = 0	(1-(.45/.55)) = 0.18	(c-(a+b/2)) 0,29
(1-) Natural resources degradation / Natural resources conservation/recovery	(1-(.55/.45)) = -0.22	(1-(.55/.45)) = -0.22	(1-(.45/.55)) = 0.18	(c-(a+b/2)) 0,40
TOTAL	-5.97	-1.42	0.05	3,74

According to this constructed scenario, conventional agriculture presents the higher comparative negative environmental impact, followed by conventional livestock production. The integration of both systems brings about gains in natural resources conservation, input savings, and social and economic benefits, resulting in a comparative positive impact. Such a simplistic analysis, which could be further elaborated by an interdisciplinary team to better encompass the complexity of the subject, well represents the possibilities of EIA procedures for the evaluation and selection of production systems, and for the communication of effects on the environment. More specifically to pesticide contamination abatement, it is noticeable that efforts toward improving pest management programs for no-till agriculture could greatly reduce the negative impacts of the integrated system, since the main factor resulting in negative impact in this case is related to pesticide load.

INTENSIVE FARMING AND ENVIRONMENTAL STEWARDSHIP

Recognizing the negative impacts caused by agricultural and livestock production systems is the first step toward improving not only the environmental quality, but also to warrant good standing in the opening global marketplace. Two main strategic planning approaches to sustainable environmental management (SEM) have been drawing attention in entrepreneurial circles (especially in industry), and can be well adapted to rural activities, the Responsible Care and Design for the Environment (DFE) (Barnthouse *et al.*, 1998).

Responsible Care is a chemical-industry initiative which centers on assigning who has responsibility for each and every process in the production chain, and establishing performance goals in the fields of the environment, health, safety, distribution, emergency response, and relations with the public.

Design for the Environment (centered on life-cycle assessment) integrates environmental, health, performance, cost, social and legal requirements into the earliest stages of decision making, and throughout the whole physical life-cycle of the product. For farming activities it means balancing by this multi-attribute consideration all production phases, from crop variety and seed selection, to soil fertility management, and natural reserve preservation. DFE tends to allocate most of its considerations on schemes for recycling, which is adequate for agricultural and livestock production systems. Among the potentially useful techniques cited to implement these environmental stewardship approaches (Barnthouse *et al.*, 1998), EIA stands first.

In a world threatened by global warming and cosmic ionizing radiation bombardment due to manmade gases; from which species vanish at an unparalleled rate; and which must feed and clothe a quarter million additional people a day, it must be the commitment of all, and especially of those involved in production, to exercise responsibly the mandate of caring for the earth. A sustainable environmental management paradigm is a good step toward this goal. All, entrepreneurs and society at large, must devote to environmental education, taking into consideration every conceptual and technological framework available to improve their activities, choosing will to change over inertia.

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