PESTICIDE USE, RISK PERCEPTION AND HYBRID KNOWLEDGE: A CASE STUDY FROM SOUTHERN BRAZIL

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INTRODUCTION

Although the issue of pesticide use has received less international media attention in recent years, it is clear that there is still a world-wide overuse of synthetic pesticides, caused by farmers applying them as a pre-emptive measure, or without considering recommended doses or synergetic effects (Barrow l995; Pretty 1995)[2]. To achieve the desired effect and to avoid risks, the pesticide industry and scientists argue that the appropriate pesticide should be applied in correct amounts, at the right time, and with appropriate precautions in terms of storage, preparation and application, and the cleaning of equipment (Sweet et al. 1990).

There is a scientific consensus that the effects of an inappropriate use of pesticides can seriously affect human health and the environment (Hayes and Laws, 1991). According to estimates by the World Health Organization and United Nations Environment Programme, pesticide poisoning injures 1.5 million agricultural workers a year. At least 20,000 workers die from exposure to pesticides every year, most of them in developing countries. Chemically polluted run-off from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems, and created growing "dead zones" in the ocean (World Bank 2004)

But why are problems of contamination so frequent and why are pesticide residues in food and water resources so frequently found? (Ward 1993, 1995). Beck (l992) suggests an answer to these questions: the recommended use of pesticides is a social fiction. Moreover, there are no objective or agreed parameters of safety in relation to pesticides, because of the infinite number of possible combinations of pesticides in the human body, including those of farmers who are directly exposed to them, or consumers who ingest them in food and water.

The criteria for the safe and effective use of pesticides established through research in laboratories tend to be far-removed from the farmer's everyday decisions and practices in both industrialized and less industrialized countries. In addition, the recommended levels of pesticide use does not allow for the complex social factors that influence their actual use (Wynne 1996).

These complex variables involved in the use of pesticides by farmers do not eliminate the need to understand their reasons for their overuse, or the adoption of unsafe practices. To address these issues, two main positions can be identified. One is based in the presupposition that farmers lack the correct or sufficient information about health and environmental risks, as well the capacity to undertake a rational calculation of input costs. It is argued that with more expert advice, knowledge, and management orientation, pesticide applications could be lowered. The emphasis here is on the ignorance of farmers versus the knowledge of experts, and the need to diffuse more information about adequate farming practices (a classic example of such diffusion-adoption studies is Rogers 1981).

The other argument focuses on farmers as victims of economic constraints, pressure by salespeople or the operation of a 'technological treadmill', which leave them no significant room for manoeuvre. From this perspective, this situation could be changed through economic incentives and the adoption of new technologies which are environmental friendly. The farmer is presented as eager to change the model of production, and open to be training in holistic agriculture such as agroecology (Altieri 1989, 1990).

These arguments and the related strategies present serious limits to understanding farmer's practices, and consequently to the formulation of more effective proposals for sustainable agriculture (either through the use of fewer external inputs or an orientation towards organic production). From these perspectives, farmers are not considered as knowledgeable agents, with their own reasons for behaving as they do, and with their own perception of the risks relating to pesticide use. Within a macro-structural context, marked by natural and socio-economic pressures, constraints and opportunities, the implementation of pesticide technology by farmers involves a special cognitive dynamic, a learning-by-doing process, which involves conflicts and negotiations between it and the knowledge of the technical experts, whether these are extension agents or agrochemical industry sales representatives (Lowe et al. 1997).

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[2] For a definition of pesticides, see FAO (2003).

The central focus of this article is on the analysis of farmers' knowledge and their perceptions of risk as they exist in the dynamics of legitimisation of pesticide use. Instead of working with the dichotomy between traditional/local and expert knowledge, I will argue that farmer's knowledge has a heterogeneous character, as part of processes of transformation, invention and re-appropriation of other knowledge, in a situation of permanent flux.

In order to discuss alternatives to those approaches, I analyse a case study in a rural area in Southern Brazil, where for almost thirty years, there has occurred a widespread intensive and inappropriate use of pesticides in horticultural production. Current farmers' knowledge can be conceptualised as a mixture of past and present experiences, resulting from the interaction with expert knowledge, and finally revealing a "cognitive dependency" on pesticides. Although the original data was collected over ten years ago, nevertheless it remains relevant because it presents an extreme case in the spectrum of differing pesticide practices. To this extent, it enhances our understanding of the dynamics of pesticide use and assists in the more effective formulation of participatory strategies for sustainable development. Importantly, this study also allows for a discussion of how to avoid any idealization of local or traditional knowledge. To frame the research theoretically, I integrate the contributions from the actor-oriented theory of rural development, especially the key concept of local knowledge (Long l992; van der Ploeg l993a) as complex, reflexive, dynamic, fragmentary, experimental and innovative. The contrasts with technical knowledge are revealed in the way that problems are articulated and in the factors selected as relevant. This implies that there is no simple opposition between lay and expert knowledge, with the former being irrational or uninformed, and the other rational and scientific. We are dealing with different types of rationalities, without idealizing either one as superior to the other. This critically-informed perspective stands in contrast to studies on rural development that are more oriented to a "rescue" of traditional knowledge.

The characterization of complex and heterogeneous local knowledge converges with constructivist and cultural theories about perception of risk associated with modern technology. These theories emphasize that there is no final definition of those risks provided by scientific explanations, but a plurality of definitions, resulting from different rationalities and assumptions, including lay knowledge (Hannigan 1995; Wynne 1996). It is necessary then to appraise risk as socially selected and defined, and thus capable of being perceived differently by social actors (Adam l995). Also central to this approach are the contributions by Beck (1992, 1999) and Giddens (l990, 1991), which bring risk issues to the centre of contemporary social theory, and from this centrality establish a critical analysis of the limits of science and technology and its relationship with lay knowledge (Guivant, 1998).

EXPERTS AND LAY KNOWLEDGE

According to Beck (l992) no one is an "expert" when it comes to assessing risks with consequences that are global, evade perception, and are difficult to avoid once identified.. However, we should be careful not to idealize lay knowledge or, as in the case of this article, local farmer's knowledge, as better or more appropriate than technical expertise. This is a common problem both in the literature on sustainable agriculture and on recent risk theory.

I would like initially to consider the issue of sustainable agriculture. Among the main criticisms of the linear, top-down diffusion of innovations strategies characteristic of modern agriculture, is its ignorance of local knowledge, and its privileging of expert knowledge. One reaction to this tendency to put the farmers' knowledge last has been to propose recuperation and vindication of farmers' local knowledge as a key factor in establishing participatory models of sustainable agriculture (Chambers 1983, 1994; Bebbington 1994). From the point of view of agroecology, farmers' traditional knowledge contains the seeds for a better use of natural resources. The problem is that expert and local/traditional knowledge are presupposed to be homogeneous totalities, without significant internal differences or conflicts (Altieri 1990).

Murdoch and Clark (l994), discussing the concept of sustainable development in its epistemological and political dimensions, questioned how sectors of the environmental movement express a reductionistic and mechanicistic image of science. According to them, the search for alternatives to this type of science led some environmentalists to a valorization of traditional or local knowledge as a base for the diffusion of sustainable agricultural practices. This led to a reification of this knowledge, putting it in a 'black box', and far removed from any problematization. The consequence of this reification is to reduce sustainable knowledge to a confrontation between right and wrong, without assuming the values behind this affirmation (Murdoch and Clark l994: 118).

An interesting alternative proposed by Murdoch and Clark (1994) involves the analysis of the ways in which both types of knowledges are constructed. By appealing to actor-network theory (for example, the work of Callon l986, and Latour l994), the relations between scientific and lay knowledge are characterized as subtle, dichotomized, without assuming any superiority but with interdependency, a hybridation or fusion. But Murdoch and Clark (1994) concentrate their analyses on opening the black box of expert knowledge, without paying enough attention to the hybrid character of the local one.

Long's actor-oriented approach (1992) contributes to the opening of this other black box, which I refer to as hybrid local knowledge, which is fragmentary, partial and provisional in nature. Knowledge of this kind emerges as a result of accommodations in situations of interface among different actors' worlds, where power relations are involved (Long and Ploeg, l994, 83).

From this perspective, I consider that the hybridization of knowledge, emerging in situations of interface (between farmers and experts), can assume different forms within a broad range of possibilities. Hybrid local knowledge can assume a traditional character, related to a pre-modern agriculture, and also more complex formulations, that can involve adaptations of expert knowledge typical of modern agriculture through local experiences. Included within this can be perverse types of local knowledge, which are not consistent with proposals for sustainable agriculture. The identification and recognition of such knowledge is a pre-requisite for a better understanding of the possibilities and limits of sustainable agriculture, as this case of hybrid local perverse knowledge demonstrates.

PESTICIDES IN EVERYDAY LIFE

The field research for this study was carried out between l989-l992 in the district of Santo Amaro da Imperatriz, in the green belt of Greater Florianópolis (Santa Catarina), Brazil. The study area is characterized by an intensive use of pesticides (fungicides, insecticides and herbicides) in horticultural production, on family farms located along the margins of the Cubatão River and its tributaries. Since the end of the 1980s and beginning of the 1990s, the region was at the centre of an environmental debate related to the level of pesticide contamination of the river. The Santa Catarina State Water and Sanitation Company (CASAN) utilized the Cubatão River as a complementary source of drinking water for the urban population of Great Florianópolis (numbering approximately 500,000 people).

The process of agricultural modernization in the region began in the late 1960s, and involved an increased diversification into vegetable production. A particular set of conditions favoured this type of production: scarcity of land in combination with excess labour supply, appropriate climate and soil type, proximity to an urban market and a reasonable road network. Currently, subsistence farming has been nearly completely abandoned and food consumption is dependent on purchases in supermarkets and local shops. As a consequence of increased incomes, particularly from tomato crops, consumption patterns in some areas have approached middle-class urban standards in recent years.

Horticultural production demands a heavy use of chemical inputs, because of the high incidence of pests and diseases. Although strict legislation regarding pesticide use has been introduced in Brazil, it is poorly implemented and enforced. Products that by law require a licensed company to be responsible for purchase and application are frequently sold without any professional supervision. Farmers can find at the local chemical stores already-signed, blank prescriptions which allow them to buy any type of pesticide, without legal control, mainly because of the few officials available to enforce the law.

The data on pesticide residues in food is very limited. It was only in 2003 that the National Agency for Sanitary Control (ANVISA) issued two research studies about this problem. Among other things, the data showed that in a sample of 1,278 lettuces, bananas, carrots, apples, tomatoes and strawberries in four states, 81.2 percent were contaminated with pesticide residues. Serious irregularities were found among 233 samples of that group, with 94 revealing pesticides residues in excess of allowable doses, and 74 revealing the presence of pesticides which were not registered for use (ANVISA 2003).

In the farming area under study, pesticides are usually sprayed in a preventive manner, although this is not recommended, and farmers tend to spray a mixture of different formulas in a single application. The application of such "cocktails" is conducted in periods during which the residual effect of the previous application of the same pesticide is still active, without considering the rest period required, thus increasing the risks of residues being consumed. A common practice in the area is the regular application of pesticides every four days, as the minimal frequency. Other agricultural practices that lead to excessive use include: sprayer

pressure nozzles that are not adjusted, remaining in the same position for different applications and causing the application of greater doses than necessary; application at times of high evaporation or on windy days; application of pesticides not appropriate for the pests and diseases that are to be combated; and the use of the wrong volume of mixture to the unit of area to be sprayed.

The farmers with more cultivated land - above 5,000 tomato plants for example - normally use a sprayer with a constant pressure pump and a 100m spraying hose, linked to a mini-tractor. Farmers with less area to cultivate usually spray manually with a backpack sprayer, with non-constant pressure. A motorized backpack is very rare in the area due to its cost. For both systems it is recommended that farmers use protective equipment - gloves, boots, hats, coats and masks, but few do[3]. Most of the available equipment is not suitable for the high temperatures which are usual in the area for a great part of the year, although some of this equipment - gloves, hats, long pants and long-sleeve shirts – could be utilized in spite of weather conditions. Other practices not recommended but observed among those interviewed include eating, drinking and smoking during application, spraying against the wind and the preparation of pesticide mixtures with bare hands. In relation to environmental pollution, the watercourses are considered the most accessible places to dump pesticide containers and plastic bottles and to wash spraying equipment. The rivers could also be polluted by contaminated soil washed out by rain or irrigation.

Face-to-face interviews with open and closed questions were applied to a non-probabilistic sample of operators of 48 small- and medium-sized family-run enterprises, of about 10 to 25 hectares, all devoted to vegetable crops, principally tomatoes and potatoes, sold at the local and national markets (Guivant 1992; 1997; 2000). The open questions focused on the importance of agricultural practices, which allowed for a qualitative analysis. The research also involved interviews with other key informants (agronomists, doctors employed at the Regional Hospital, agricultural supplies sales agents and representatives of the local banks). The interviews were directed at men, because pesticide use is a totally masculine activity (on some occasions other members of the family were present, but gender differences were not considered in this study). All of the interviewees were owners of their land, or at least a part of the land they worked.

THE SOCIAL CONSTRUCTION OF KNOWLEDGE

The farmers interviewed tended to oppose their knowledge to that of the experts or technicians (both salesmen and extension agents) because they considered their knowledge to be more appropriate to the everyday needs of the crops. Farmers showed a significant level of confidence in their ability to handle chemical inputs. For example, reading labels was seen as something that was not very difficult, although many of the farmers had attended no more than 3 years of school and labels were presented in small letters and used technical terms. The farmers openly rejected being considered ignorant and inferior, and came to develop a stereotyped image of the technicians, as they imagined the technicians did of them.

For their part, the technicians working in the area found it very difficult to influence farmers to use lower doses and less toxic pesticides. They came to learn that farmers found it preferable to eliminate all of the emergent pests, while neglecting the simple practices that could avoid infestation. The salesmen also complained about the farmers, who seemed to demand more toxic pesticides (in noting this, it is not my intention to suggest that salesmen are neutral actors, but to expose the tensions involved in the relationship with the farmers).

In the interface situations, we found what Long (1992) referred to as a "battlefield of knowledge", where farmers could find a social advantage in the unregulated use of pesticides which they considered to be better, and in this way reinforcing their identity as social agents, with competence, against the negative image they considered technicians have about them.

This criterion was supported by some basic beliefs, which were frequently referred to by farmers in order to legitimise their use of pesticides:

1) *It is preferable to eliminate all of the emergent pests*. "The idea is not to let the insect get in," explains one of the farmers interviewed. This type of belief stimulated the lack of differentiation in relation to the types of insects that could appear in a crop. It also led to pesticides being used for any situation, without the farmers developing a sharp observation of the level of infestation and without implementing practices that could prevent infestation.

[3]In spite of the fact that farmers tend to overuse pesticides, very limited data exists about cases of poisoning among farmers and consumers. Some authors consider that nearly 2/3 of the farmers have suffered acute intoxication from pesticides (Bull and Hatway l986; Dinham l993).

2) *The more intensive the dose of pesticide applied, the better it is for the crop*. The farmers affirmed that if they were applying too much, this would always be good. The possible application of a dose above that recommended in the instructions was, collectively, not considered a problem or as something irrational. On the contrary, the problem would emerge if the application was below recommended levels. The belief that "the more the better" was reinforced by what the farmers considered to be certain practical "evidence." Even when applying higher doses of pesticides than recommended, the farmers might lose many tomatoes which were thrown out because they did not have the cosmetic appearance required for sale, and because there was no local practice of re-using such tomatoes in an industrial process or for domestic use. Without any economic incentives from the governments to reduce pesticide-use, the majority of farmers concluded that if they used less pesticide, they would lose even more tomatoes and suffer significant economic damage. However, the most important evidence in support of their practices was their ability to obtain satisfactory profits. The purchasing power that they maintained was the most convincing evidence that what they were doing was right. When the results were not as expected, this was considered as something normal in agricultural production, and an experience to be learned from.

3) *There are no alternatives to the way in which the pesticides are utilized*. The farmers interviewed arrived at what they considered a optimal level of use of chemical inputs. This can be summed up in the idea that the form in which the pesticides were applied is "the way". This belief represents a kind of "chemical fatalism", which one farmer summed up in the following manner: "Every plant has to have a remedy," meaning that one could not leave any crop without an application of pesticides, if one intended to produce. Given the pragmatic goal of obtaining high yield, it was deduced that whatever act was consistent with this goal must be pursued. There was no space within the farmers vision for the possibility of overspending because to save costs with pesticides was seen to increase economic uncertainty.

Pesticides are applied to the degree that they are judged necessary to guarantee the investment, with the criteria for the quantities to be used determined in practice, in the various situations confronted. Practically all decisions about the use of pesticides, such as doses, mixtures, which brands to buy, etc., are customary, routine decisions, rather than situation-specific procedures, that occupy what Ilbery (1985) calls the "grey area," located between programmed and un-programmed decisions. Once the decision to plant some crops that are highly vulnerable to several pests is made, the costs of pesticides are seen as inevitable, and part of open planning. Given that the pesticides are part of this daily routine, a constant re-evaluation of what to do, how to do it and what brands to use can mean a loss of time, and an increase of uncertainty, which is exactly what farmers seek to reduce with the use of these inputs.

Farmers are unanimous in accepting one main positive difference between agriculture in the past and the present: that greater control over nature - climatic fluctuations, ecosystemic factors and depleted soil - is made possible by the use of pesticides and chemical fertilizers, with less time at work in the fields. Within the guidelines for maximizing production, a central criterion in the choice of innovations is to "not waste time." Pesticides do not disappoint the farmers in this respect. To repeat, from the farmers' perspective there is no such thing as "overspending," because saving pesticide costs is synonymous to increasing economic risks.

Some procedures are common in the social construction of local knowledge. One of these is "accumulation," which makes possible the formation of knowledge through a process of trial and error. One farmer described it in this way: "One who studied, learns by studying. One who didn't study learns the hard way." The farmers justified the frequency of weekly and daily applications in much the same way. A standard became established at the level of local knowledge which achieved what the farmers determined to be the best possible results. In this regard, the distance between what was recommended by the agronomists and the effective practices of the farmers is very significant. It is difficult to find farmers applying just one product on the areas of most intensive production, and they justified this practice as labour saving. A second rule observed is that of "association." For example, the practices concerning pest and disease control in tomato plants can be extended to other crops. The same process of transference occurs between the knowledge that the farmers have about the use of fungicides, to the use of insecticides and vice versa. Another rule that fundamentally influenced the diffusion of knowledge acquired in combination with the other two procedures is that of "imitation", which is observed especially in the use of pesticides. For one farmer, "everything is copied from one thing to the other." The results are not always recognized as effective, but this does not stop the practice being widely followed. Other knowledge spread by imitation is the association of the effects of an insecticide used by veterinarians for mites, to the combat of a tomato pest. There is no formal study or technical advice concerning such use, but one farmer decided to experiment and other farmers evaluated the result as positive (for another type of experimentation, see Ploeg 1993b).

PERCEPTION OF HEALTH RISKS

The tensions between farmers and experts also permeate perceptions of risk. Farmers were asked if they had information on how pesticides should be used, and the dangers involved. The answers can be grouped as follows:

1) *The technical recommendations that the farmers claim to be acquainted with and which are being respected*. The interviewees claim not to disregard the rest period between pesticide applications, although most of them claim that "other" farmers do disregard such recommendations. This practice is emphatically considered as socially irresponsible, which shows that farmers know that pesticide applications should be done in a less intensive way because of the risks to the health of the consumers. Around 20 percent of farmers indicated that they were concerned about the effect on their production of measures for stricter control on the quality of the water from the river, following public debate on this issue. These issues are important because they relate to what the farmers know about risks - the information they have - and what they considered themselves at least obliged to mention in their interviews, even though their actual practices and beliefs might be far removed from this discourse.

2) *The technical recommendations that farmers claim to be acquainted with and which they know are being neglected*. Examples of this include the disposal of used plastic and glass pesticide containers in the river, failure to vary spraying according to the weather conditions, and a failure to use safety equipment. It is at this level that a significant tension emerges between the knowledge of the technicians and that of the farmers, in terms of understanding the rational and safe use of pesticides (this issue is considered in more detail below).

3) *The technical recommendations with which farmers are demonstrably not acquainted.* These include the dangers from dermal penetration of pesticides, the need for regular control and adjustment of spraying equipment, and knowledge of any alternative practice that could allow a reduction in pesticide use.

From these responses, it is clear that farmers have some information about pesticide risks. So, why they do not conduct safer practices? One answer relates to the lack of trust in the information sources, as noted earlier. Another answer has to do with the risks themselves. For many farmers there is not enough evidence to confirm the existence of risks. They argue that if the risks were "real," these would have already resulted in their own and other farmers' deaths. In other words if a farmer has handled pesticides without any harmful consequences that he could relate to pesticides, he draws the conclusion that they are not hazardous. If nothing has happened to him so far, nothing will ever happen in the future.

Cases of poisoning, dizziness, vomiting, headaches, are not considered harmful, and are symptoms farmers believe they have to put up with. Those symptoms are incorporated as part of "normal" daily conditions. When they occur, the farmer simply waits for them to pass, usually without going to the doctor, because he considers their cause is known. The body is not an object of everyday concern to the farmer, because disease will manifest itself as such only when it prevents him from working in the field. Health is very much appreciated by the farmers, but it is an abstract category that occurs as a natural gift, not necessarily as something that is conquered through care and prevention. Going to the doctor because of pain or illness is usually a last resort, and is not pursued as long as the body can work. If the symptoms last for more than one day, the farmer may go to a doctor and stay in the hospital for a couple of days. The presence of these occasional symptoms is not enough to stop using pesticides. However, it was possible to observe a more frequent use of protective gear among the interviewees who had already been to the hospital and who continued to have a direct contact with pesticides.

Risks are thus ruled out because they are abstract, remote and invisible. Much the same is true of diseases, which can appear in the long run because they tend to evade perception. The possibility of preventing diseases caused by the cumulative use of pesticides is not - and cannot be – considered, because farmers have only a remote idea of such problems. The absence of visible health problems reinforces the farmer's reliance upon his strength and on the idea that pesticides are not as dangerous as they are claimed to be by the technicians. There are even local anecdotes that refer to farmers who try to commit suicide with highly toxic pesticides, yet apparently suffer no serious problems.

Only a limited group of farmers defined the dangers from pesticides as "real" but non-existent if the recommendations were followed. However, risks were restricted to highly toxic pesticides or those that were sold in the past. In general, the farmers tend to evaluate what was said about risks as an exaggeration: "What they [the technicians] say makes it seem like a volcano," said one farmer.

The widespread denial of any serious risk originates in the way farmers deal with pesticides, and can be considered as an adaptive strategy which enables farmers to carry on with their work routine. For the farmers, the adaptation to risks is a fundamental pre-condition to continued production according to a strategy aimed at maximizing results. The dangers are partially known, but thinking about them could interfere negatively in the labour process. In the psychopathology of work, similar attitudes have been observed in other risky jobs. Dejours (1987) for example, has described how workers in civil construction in France do not usually adopt minimum measures of security, even though these are close at hand. In this way, workers neutralize risks in order to allow completion of tasks while diminishing anxiety; in Dejour's words, they adopt a kind of "defensive occupational ideology".

Therefore, denying the risks involved is a necessary and appropriate adaptive strategy. By not following the recommendations for handling pesticides, farmers are, to a certain extent, provoking risks in order to prove their resistance, and to confirm that danger exists only for those who want it or are not strong enough to withstand it. Adaptation to risk is efficient as long as it reproduces itself as a collective process, shared by farmers in the region. Each social actor finds in his neighbour a mirror image confirming his own experience, and it is unusual for them to discuss among themselves accidents or problems related to risks. In other words, following the recommended safety measures would imply an acknowledgment of the danger that is to be neutralized and remind farmers that danger exists, but this would only serve to make tasks more difficult and laden with anxiety.

This minimization of the possibility that something harmful may happen during the daily exposure to risks, is a way of bringing it under control. According to Douglas (l994), this is related to a "sense of subjective immunity", which is expressed as the ability to expose oneself to pesticides without suffering - at least immediately - any harm. Such "resistance" tends to be interpreted as proof of strength and masculinity. As spraying is typically a male job, the way a farmer deals with pesticides has a central role in establishing a masculine identity. "Being a man" requires, in addition to intrinsic resistance to the effects of pesticides, that the farmer is not afraid to face possible risks. Those who use protective equipment are, therefore, subject to facetious remarks from their peers, who regard them as being "womanish," or "not man enough" and are accused of "chickening out."

Notwithstanding the widespread belief that health problems affect just a small number of farmers, how are these cases assessed? I found three non-exclusive types of explanation. One of the most frequent explanations is that the contaminated person (whether seriously ill or not) is responsible for neglecting, abusing and disregarding recommendations. The victim is to be blame for making a mistake. Pesticides themselves are not criticized.

There is another type of explanation for cases of contamination of farmers who have followed what they consider to be proper recommendations. Contamination is attributed to the individual characteristics of the victim: allergies, "weak blood" and exposure to pesticides since childhood. The problems are not caused by pesticides themselves, but depend on the physical structure of the individual. Blood is referred to as the centre of vital strength and blood diseases are considered to be the main cause of weakness and susceptibility to pesticides. Underlying this is an association between those who are resistant to pesticides and physical strength. Farmers who believe they do not have a weak condition deduce that they can even prepare pesticide mixtures barehanded, without harmful consequences. Such a practice is justified by farmers who not only regard themselves as strong, but who also tend to consider pesticides as weak, inefficient and even falsified in their formulas, compared to chlorinated hydrocarbons, defined as the "true pesticides." These farmers suspect that the representatives of agrochemical companies could be offering them products with expired validity dates, inappropriate mixtures and even inadequate products, in order to make a profit. Farmers are not completely wrong when they claim that some chemical inputs not very efficient, but this depends on the farmer's evaluation of "efficiency" of a pesticide. This is usually based on the assumption that if a product does not kill "everything" it is inefficient and not so dangerous. This possible ineffectiveness of the pesticide is not related to the resistance it could have generated in the pests, as will be analysed below.

The third type of explanation points to the possibility of getting poisoned by chance. A farmer can follow the minimal recommendations that are consensually defined as "precautions," he can even be strong, but he may not, nevertheless, be protected against fate.

For these different reasons, pesticides end up being "absolved" as a source of risk and, consequently, farmers tend to deny they are running risks because risks simply do not exist. Pesticides are part of the daily life of the field and, paradoxically, are converted into a kind of "natural" resource, obvious and unquestionable. The

name used among the farmers to refer to the pesticides is "remedy", which reinforces the image of the pesticides as a resource which is "on their side" in the fight against the farmers' natural "enemies." When referring to pesticides, only a small number of farmers use the term "defences," the official name used by the petrochemical industry, and only a very few use the term "poison."

In summary, the adaptation to risks is socially shared among farmers and can be related to the need to keep a sense of ontological security, which guarantees the continuity of routines and everyday life as it is, and avoids anxieties (Giddens, 1991, 1992). Farmers did not want to talk about cases of contamination, showing in this way also another aspect of the adaptation to risk. According to Douglas (1985), this can be reinforced by a lack of memory regarding past accidents, because what is registered in memory can depend on social pressures. If risk is not collectively registered as significant, cases of contamination can easily be put aside. Another important aspect to guarantee ontological security is trust, in this case trust in pesticides.

MISTRUST OF EXPERT SYSTEMS

The statements of the sales representatives and of the farmers indicate that farmers in general preferred to continue using the commercial formulas already tested, avoiding experimenting with new products There is a double relationship established by farmers with pesticides, as part of what Giddens (l990, 1991) defined as abstract systems on the one hand, and with the technicians with whom the farmers have a direct social relation on the other. This relationship corresponds with the two processes described by Giddens (l990) as characteristic of modernity. The first refers to the plane of the "disembedding" of social systems, through mechanisms that remove social activity from localized contexts, reorganizing social relations over great distances in time and space, in which social commitments have no "connections established in circumstances of copresence" (Giddens, 1990: 80). The second corresponds to the position adopted by the farmers who defend their skills against the technicians, and is situated in the plane of the "reembedding" in which there is a reappropriation or redefinition of the social relations, or of knowledge and know-how, according to certain local conditions of time and place. The two processes do not develop independently. In spite of the tensions in the farmers' relationships with the technical skills of experts, they keep trusting in technology itself and, therefore, the way the "reembedding" takes place does not threaten its continuous implementation

When I asked if pesticides are becoming less effective, the majority of the farmers expressed the view that the problem they have was related to the weak pesticides they were using. They "missed the good old pesticides," such as DDT, which they considered to be much more effective. According to the farmers, the power of these pesticides still represents the symbol of efficiency when compared to the pesticides which are currently on the market. The positive returns which they associated with the more toxic pesticides, is a source of resistance to the adoption of the generally cheaper, less toxic pesticides, with focused and non-systemic effects, which have been on the market in recent years.

This dissatisfaction with the result of pesticides leads farmers to look for stronger pesticides in the black market, because these cannot be obtained in the regular market. The long-term effects of these stronger products on the agro-ecosystem are beyond the perceptive horizon of farmers, who consider only their immediate effects in the control of pests. The farmers do not have enough information on the environmental effects of pesticides, which differs from the situation observed in relation to health effects. Nevertheless, in relation to the information they did have, they still expressed disbelief about the environmental impacts of pesticides.

The main problem seems to lie in the socially constructed cognitive dependence on a pesticide's effectiveness, plus a distrust of the sources of information. Farmers rejected the views of expert advises because the farmers felt that they had been considered as ignorant, and also because the experts did not bear any economic risk. Therefore, farmer's risk perception cannot be characterized simply as a deviance from expert knowledge, to be transformed with the communication of more information. As Renn (1991) observed, the top-down communication of risks, which still permeates the extension agencies in Brazil even when more sustainable practices are being diffused, can be a central source of social distance between lay and expert people which can be hard to overcome.

DISCUSSION AND CONCLUSIONS

Through a case study among family farmers in Southern Brazil, I have discussed how the problems in the use of pesticide did not appear to reflect concepts of economic irrationality, ineffective instrumental strategies, reluctant adoption or lack of information. In the case examined here, farmers legitimise their pesticide practices by reference to two main benefits; firstly, from their point of view, pesticides are inputs that can be controlled in the fields by farmers (in terms of doses, brands, spraying frequency, mixtures, etc.), which emphasises their identity against that of the experts; secondly, pesticides are central tools for controlling the production process, through minimizing economic risks and maximizing production.

Hybridization of farmers' local knowledge in relation to pesticide use takes place in face-to-face situations, especially between farmers and technicians, and between farmers themselves, and can assume a broad spectrum of possibilities. It can include perverse forms of knowledge which are very distant from the parameters of sustainable practices. The recognition of these forms, in which farmers stress the benefits of pesticides while disregarding the health and environmental risks, is a necessary step towards establishing strategies to change the intensive and dangerous use of pesticides. As the case study reveals, a top-down communication of risks is not effective because it implicitly situates farmers as ignorant or passive social actors, without the capacity to choose and take decisions (Guivant, 1998; 2002a; 2002b). That is, farmers are considered as social actors without agency. Risk communication also needs to consider the relationship between farmers and experts, be they salesmen, rural extension agents or the institutions they represent, which make communication difficult because of the past and present tensions and conflicts.

A different approach to communication of risks is central in participatory methodologies for rural sustainable development. And at this point it is possible to establish a connection between some of the recent literature on rural development and that concerened with cultural risk analysis. The cultural framework demonstrates how people's beliefs change very slowly, even when they are confronted with contrary evidence (Slovic, 1995; Douglas, 1994) or when they are dealing with risks of high consequences which are not immediately obvious (Beck, 1991). One important conclusion for participatory methodologies is to start with an understanding of farmer's risk perception, their hybrid local knowledge, and the power and conflicts that are present in the relationship between farmers and experts. For example, it would seem to be necessary to take into consideration the masculine values involved in pesticide use. In this regard, information related with the effects of pesticides on sperm reduction and consequently on sexual reproduction can be more efficient than the communication of the long-term risk of cancer.

But the establishment of different parameters for participation and communication of risk is not an easy task for extension agents or representatives of NGOs working in rural areas. First, they may be resistant to the fact that farmers are not eager to change, that they have their own rationalities, and that the proposals made by external agents are not seen by farmers as obviously better. As Pretty (1995) suggests, sustainability needs to be considered as a ongoing and open learning process, which includes all the social actors involved, and eschews ready-made solutions. This process demands that the experts take a critical perspective in relation to their own values, perceptions and knowledge (Reijntjes et al, l992; Cornwall et al. 1994). Second, development and rural extension institutions need to be permeated by a participatory decision process, open to the formulation of programmes, strategies and goals in collaboration with the farmers. Third, public policies are necessary to stimulate the transition to an agricultural system which relies less on external inputs, and which also monitors more effectively farmer's practices, and enforces the existing laws in relation to pesticide use.

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