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Acute pesticide poisonings among small-scale farmers in La Paz county Bolivia

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FOREWORD - ACKNOWLEDGEMENT

This master-thesis is not telling the truth, and beware of those claiming to tell a truth that can never be told. We can only circle around it, such as this thesis is doing, and hopefully it will fit in as a piece of the big picture. Pesticides are partly a religious matter, often black or white. On the one side the industry and many farmers are claiming pesticides to be harmless substances in the right hands and substances without which we can't live and produce sufficient food with the growing demands due to the world's ever increasing population. On the other side, consumers, ecologists and scientists have witnessed "the silent spring", increasing resistance among the pests, human death and suffering due to pesticide poisonings, and are now saying enough is enough, we must find alternatives, we can't go on poisoning the earth, destroying our drinking water and polluting the mother milk of the Inuit's on the North Pole, where pesticides were never sprayed.

Who is right, I cannot judge, but I have been told that pests mean harmful living creatures, and cide means killing, and indeed pesticides have been used through history to kill everything from bacteria to human beings - therefore there seems to be a good reason for control and restriction of use and trade and the search for alternatives. In this game the UN-organizations, responsible governments and consumers all over the world have a big role to play. Leaving pesticide production, trade, and consumption to the free market and a pesticide industry and farmers, with their main goal to make more profits every day, is threatening and will threaten the existence of all living creatures, turning the earth into a desert of poisonous substances at the same pace as the consumption of pesticides is increasing these years especially in low-income countries. Lets hope "the golden in-between" is to be found soon, which so often before in life has proved itself to be the best way forward.

Thanks for the support, inspiration and hard work done by the personnel and consultants of the PLAG-BOL project in Bolivia - MD Guido Condarco, MD Rafael Cervantes, Agr. Omar Huici and Lic. Tania Santivañez. Thanks to the PLAG-BOL project support group MD Jørgen Riis Jepsen, MD, PhD Flemming Lander, MD, PhD Martin Silberschmidt and MD, Doctor in Medicine Jesper Bælum. Thanks to my supervisor at the Department of International Health at the Copenhagen University PhD. Flemming Konradsen. Thanks to my workplace, the Clinic of Occupational Medicine at the Central Hospital of Esbjerg, for granting me leave and moral support. Last but not least thanks to my family allowing me these escapades in the daily struggle for keeping a family functioning with bread on the table, with or without pesticides.

June 2004, Erik Jørs

SUMMARY - ABSTRACT

Title: "Acute Pesticide Poisonings among small-scale farmers in La Paz county Bolivia".

By MD Erik Jørs, 2004

Key words: pesticides, acute pesticide poisonings, occupational, subsistence farming, Bolivia.

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Background: The thesis is based on data collected in La Paz county in Bolivia as part of a Danida financed project among small-scale farmers and health professionals promoting preventive measures to lower the negative impact of pesticide use for human health and environment. The population of the study area was approximately 10,000 persons, out of a total of 100,000 in the 4 municipalities comprised by the project. The data is a base-line collected in 2002, and will be the basis of a follow-up study to evaluate the impact of the Plag-Bol Project. Pesticide use is growing in low-income countries and studies from Bolivia and other low-income countries undertaken during the last decades have reported substantial and increasing problems of acute pesticide poisonings, chronic effects like neurological problems, cancers, teratogenity and sterility and environmental pollutions.

Objectives: The aim of the thesis is to 1) evaluate classes of pesticides used, 2) evaluate acute health impacts on the farmers, 3) identify risk factors for occupational poisonings, and 4) describe the ability of the health systems to diagnose and treat the acute pesticide poisonings.

Material and methods: Interviews and blood tests were done with 227 volunteering farmers representing 48 villages, 49 volunteering health professionals out of 76 in the 4 municipalities filled in a questionnaire and the ward registers of the 38 acute pesticide poisonings treated in the health facilities in the year 2001 were revised. Farmers were asked about occupational and hygienic factors when handling pesticides, and their experience and knowledge of negative impacts on themselves and others. Serum was examined for choline esterase activity as a measure for poisoning with organophosphates and carbamates. Health personnel were asked about knowledge of pesticides in general, and diagnosis and treatment of poisonings. The main limitation of the study was a non-random selection of the persons participating, hampering the ability to generalize the findings, although 20 years of working experience in Bolivia tells us that the groups participating in the study were fairly representative for the population in the study areas in general. The study was approved by the Bolivian medical ethical committee and by the National Institute of Occupational Medicine.

Results: The study showed that 90% of the farmers used pesticides mainly organophosphates belonging to the most toxic classes I and II and several of them banned or restricted in international conventions signed by Bolivia, and some even prohibited from sale in Bolivia. Pesticides were handled with carelessness considering the toxic potential of these chemicals, manifesting itself for the majority of the farmers in e.g. a lack of hygienic procedures, not using personal protective equipment, storing pesticides accessible to others, throwing empty containers in the fields and washing pesticide equipment in rivers or near water sources. The result was that almost half of the farmers having sprayed within the last month experienced toxic symptoms in connection with spraying. Significant relations were shown between the two indicators of pesticide poisoning 1) the experience of toxic symptoms and 2) a depressed choline-esterase activity and the risk-factors a) number of times sprayed last month and b) toxicity of the pesticide used; adjusted OR varying from 2.3-2.6; mean choline-esterase activity varying from 6.8 to 8.1 kU/L in the different farmer groups, $p<0.05$. Occupational and hygienic measures such as using personal protective equipment, reading instructions about pesticide use and not sucking the nozzle of the knapsack sprayer to clean were protective to experiencing toxic symptoms (OR varying from 2.8 to 4.5), while only reading instructions were protective for lowered choline-esterase activity. The main cause of non-fatal (67%) and fatal poisonings (92%) were suicidal attempts as told by the farmers and confirmed in the ward registers, often due to family problems, economic problems and mental illness and realised under the influence alcohol. Rough estimates of incidence of severe poisonings were 78 per 100,000 persons and the case-fatality rate was 12%. The health personnel's knowledge of pesticide poisoning and treatment, and the facilities for treatment, were poor. Most farmers did nothing when having symptoms of poisoning, as their experience told them that symptoms most often would disappear within hours.

Conclusion: The findings of this study shows clear negative impacts of pesticide use in line with other similar studies from low-income countries. The complexity of the problems demands a variety of solutions. Coordination between responsible governmental entities is needed, simplification and enforcement of laws and regulations is a way forward. A more effective control system for imports and commercialization is necessary. Farmers must have possibilities for advice and education to improve their knowledge of how to handle pesticides and use alternative ecological methods e.g. through agronomists employed by the municipalities and farmers' organizations. Health professionals need better educations, e.g. by including the topic in the curriculums at university level and giving refresher courses in the health districts. Outsourcing of the most toxic classes is a good idea, although it might be very hard to realize.

MAP OF STUDY AREA

ABBREVIATIONS

APIA	Asociación de Productores de Insumos Agrícolas
APP	Acute pesticide poisonings
ChE	Choline esterase
CONAPLA	Consejo Nacional de Plaguicidas
CONFEAGRO	Confederacion Agricola Nacional
FAO	Food and Agricultural Organization of the United Nations
GCPF	Global Crop Protection Federation
IARC	International Agency for Research on Cancer
ILO	International Labour Organization
INE	Instituto Nacional de Estadisticas
INSO	Instituto Nacional de Salud Ocupacional
IPCS	International Programme on Chemical Safety
IPM	Integrated pest management
kU/L	kilo units per liter
MACIA	Ministerio de Asuntos Campesinos, Indígenas y Agropecuarios
SENASAG	Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria
SNS	Secretaria Nacional de Salud
OPs	Organophosphates
OR	Odds ratio
PAN	Pesticide Action Network
PLAG-BOL	Plaguicidas Bolivia
POPs	Persistent organic pollutants
PPE	Personal Protective Equipment
RAP-AL	Red de Accion en Plaguicidas y sus Alternativas - Latino America
SD	Standard deviation

1. BACKGROUND

1.1 Background for the thesis

This work is based on data collected from small-scale farmers and health professionals through an ongoing Danida-financed project in Bolivia initiated and supervised by the thesis author, the PLAG-BOL project. In this project the Danish NGO Dialogos, in cooperation with the Bolivian National Institute of Occupational Medicine (INSO) and Care-Bolivia, is promoting preventive measures among farmers and health professionals to lower the number and effects of pesticide poisonings. The core of the project intervention is training of farmers in Integrated Pest Management (IPM), health professionals in diagnosis and treatment of cases of acute pesticide poisonings (APPs), and providing the school system with educational material about pesticides and their influence on humans and environment.

The thesis will concentrate on an analysis of the base-line data gathered by the thesis author and the personnel of the project at the start of the PLAG-BOL project in 2002 through interviews with small-scale farmers and health professionals about knowledge and practices concerning pesticide use and intoxications. At the end of the PLAG-BOL project data will be collected to evaluate the interventions in the project, and the data presented here will be part of a follow-up study.

1.2 Definition and classification of pesticides

Pesticides are poisonous chemicals intended for preventing, destroying or controlling any pest, including vectors of human and animal disease, unwanted species of plants or animals causing harm during the production, processing, storage, transport or marketing of food, agricultural commodities, wood or animal feedstuffs (1). They are mainly used in agriculture and horticulture but also in households, as well as in health campaigns e.g. to eradicate vector borne diseases such as yellow fever and malaria. Pesticides have been used for thousands of years, with natural pesticides as sulphur, pyrethrum and nicotine. From the 1930s an industrial production of synthetic pesticides started, and now more than 1,285 active ingredients are registered in The Pesticide Manual, 1994 (2).

Their use is increasing as can be seen from Table 1, where the import values of pesticides in US-dollars are interpreted as an indicator for the amount of pesticides used in the country, bearing in mind that the rate of exchange of the US-dollar has a strong influence on these figures. The rate of exchange of the dollar toward the Bolivian currency over the last decade though has been more or less stable as the Bolivian currency is closely connected to the dollar. Another factor that could make the interpretation of these figures difficult is those countries where pesticide production is taking place and own products are used, so that the import values are not reflecting the whole

amount of pesticides used. This is the fact for Denmark and many high-income countries, but not for Bolivia and most low-income countries, where no pesticide production takes place.

Table 1: Value in 1000 US-dollars/1000 capita of pesticide imports, 1993-2002

Country	1993	2002	Exponential growth rate in total value of imports - from 1993 to 2003
Low-income countries	0.61	0.75	4.12
Bolivia	1.55	4.27	18.12
Costa Rica	13.85	21.62	4.83
High-income countries	5.42	6.02	3.01
Denmark	28.37	18.44	-4.29

Source: FAOSTAT data, 2004

Low-income countries are growing markets for the pesticide industry as the use in the high-income countries is stagnating, among other things due to the increasing awareness among the consumers of the dangers of pesticides and residues in water and foods and possible negative health effects. Worryingly, "many pesticides that have been banned or the use of which has been severely restricted in industrialized countries are still marketed and used in developing countries, posing a serious risk to the health of millions of farmers" as stated by the Director-General of FAO in 1998 (3).

As seen from Table 1, the percentage of annual growth of pesticide import and subsequently use in Bolivia is impressive. On top of these official statistics, it is estimated that at least 30% has to be added due to illegal importation of pesticides from neighboring countries (pers com, APIA 2002). From national statistics for the year 2000 it is seen that more than a thousand commercial names of pesticides are registered in Bolivia, more than 300 active ingredients and mixtures of these are allowed, and 55 pesticide companies are importing from 36 different countries, among them from Denmark (4). Like the value of importation, these figures have increased substantially since the mid '90s, where little more than 400 commercial names of pesticides and 200 active ingredients were registered (5).

Pesticides are classified by 1) their chemical class as organochlorines, organophosphates, carbamates, pyrethroids, bipyridils etc., 2) their function as insecticides, fungicides, herbicides or rodenticides, and 3) by hazard in the toxicological classes Ia, extremely hazardous, Ib highly hazardous, II moderately hazardous, III slightly hazardous, U active ingredients unlikely to present any harm in normal use and O obsolete (6). In Bolivia class I is marked with the color red, class II with the color yellow, class III with the color blue and class U with the color green on the pesticide containers. Studies from Bolivia have shown that the use of the most toxic and even illegal pesticides is very common (5,7).

1.3 Health effects

Magnitude and causes of pesticide poisonings

Pesticides are poison meant to kill, they are entering the human body through oral ingestion, inhalation and the skin (2), so no wonder they can cause harm not only to pests but also to humans. The health effects of pesticides can be divided into acute poisonings and chronic health effects. World wide it is estimated that every year tens of millions of people experience symptoms of acute poisoning, more than 3 million people develop serious poisonings because of 1,000,000 unintentional poisonings and 2,000,000 intentional poisonings (2,8). The acute poisonings are most relevant for the farmers in the developing world where more than 95% of the cases are seen, although less than 40% of the global production of pesticides is used here (9,10). The main reason for the more than 300,000 fatalities annually seems to be an increasing number of suicides in the developing world (9,11); suicides are also the main problem in the comparably few poisonings in the high-income countries (2). Occupationally related poisonings are seen among factory workers producing or formulating pesticides, farmers mixing and spraying pesticides and farmers or others re-entering a newly sprayed field (2,12,13). Accidentally related poisonings are seen in bystanders inhaling pesticides from nearby spraying sites, consumers eating products with pesticide residues on or in them, and often children mistakingly ingesting pesticides or using pesticides as medicine on their body as also seen in Bolivia (5,8,14).

A cross sectional study from Bolivia of 731 farmers done by INSO and CIID (Centro Canadiense Internacional de Investigación Para el Desarollo) in 1989, showed that 2.1-11.5% of the farmers reported having experienced symptoms of acute pesticide poisoning after spraying, and 5-10% had decreased cholinesterase activity as a sign of actual exposure to organophosphate or carbamate insecticides, of whom 10% were children (7). Another study from 2000 reports a prevalence of symptoms after having sprayed by 58% of the 421 farmers interviewed (15).

Acute health effects of pesticide exposure

The symptoms from acute pesticide poisonings (APPs) are 1) General: extreme weakness and fatigue, 2) Skin: irritation, burning sensation, excessive sweating, staining, 3) Eyes: itching, burning sensation, watering, difficult or blurred vision, narrowed or widened pupils, 4) Digestive system: burning sensation in mouth and throat, excessive salivation, nausea, vomiting, abdominal pain, diarrhoea, 5) Nervous system: headaches, dizziness, confusion, restlessness, muscle twitching, staggering gait, slurred speech, fits, unconsciousness, 6) Respiratory system: cough, chest pain, tightness, difficulty with breathing, wheezing (16); for more details see Annex 2, table A.

The symptoms are reflecting the mode of action of every pesticide. The very acute toxic pesticides, organophosphates and carbamates, are blocking the effect of the enzyme acetylcholine-

esterase, thus leading to an over stimulation in the neurons where acetylcholine is the transmitter substance, because the acetylcholine is not degraded at the speed it should be (2). The less acute toxic pesticides like the organochlorines and the pyretroids also have a mainly peripherical neurotoxic effect, due to alterations in the permeability for the salts over the cell membranes (2). Nowadays, fungicides are not very toxic, but e.g. dithiocarbamate has an antabus effect where degradation of acetaldehyde is hampered leading to death if alcohol is ingested shortly after spraying (2). The herbicide paraquat is very acute toxic leading to necrosis and subsequent fibrosis in the lungs, liver and kidneys due to the formation of free radicals destroying the tissues (2). The rodenticides are mainly vitamin K-antagonists hampering the normal coagulation of the blood (2).

The general treatment is maintenance of the vital functions and removal of the patient from the exposure. In some cases specific antidotic treatment can be installed like atropine/oximer for organophosphate intoxications, atropine for carbamate intoxications and vit K/fresh blood or plasma for anticoagulant poisonings (2). For more details see Annex 2, table A.

Long-term health effects of pesticide exposure

These can be divided into neurotoxic, reproductive, fetotoxic and carcinogenic effects, and they are very much discussed due to a lack of conclusive evidence in many cases.

The organophosphates like chlorpyrifos, dichlorvos, methamidophos, mipafox, trichlorfon and tri-o-cresylphosphate are known to have caused a delayed polyneuropathia in man, where lowered muscle strength, loss of reflexes and sensibility persist (2). It is discussed whether long-time organophosphate exposure can lead to lowered vibration sensibility and nerve conduction velocity in hand and feet, and neurophysiological changes such as lowered concentration and memory, fatigue, irritability, nervousity etc. (2,9,17).

Epidemiological investigations have shown that DBCP and chlordecone have spermatotoxic effects in man, while others like ethylene dibromide, carbaryl and 2,4-D are suspected to have the same effect. In animal experiments many more are shown to have spermatogenic effects (2,9). In a study of associations of pesticide exposure with time to pregnancy, no consistent pattern was found (18). A study from the US showed a moderate increase in risk of 1) early abortions for preconception exposure to phenoxy acetic acid herbicides, triazines and any herbicide, 2) late abortions for preconception exposure to glyphosate, thiocarbamate and a miscellaneous class of pesticides and 3) late spontaneous abortions for postconception exposures (OR from 1.4 to 1.8) (19). In a large study from Spain it is concluded that paternal agricultural work in the areas where pesticides are massively used increases the risk of fetal death from congenital anomalies (RR up to 1.6) (20). An investigation from Columbia showed an increased risk of being born with

hemangiomas for children with parents exposed to pesticides in the floriculture industry (OR 4.8) (21). Pesticides are found to be teratogenic in animals, but the varying results in the epidemiological studies mean that nothing conclusive can be said for humans (2).

IARC has examined approximately fifty active ingredients of pesticides. One (arsenic compounds) is found to be class 1=carcinogenic in man, two (ethylene dibromid and captafol) are found to be class 2A=probably carcinogenic in man, 19 are found to be class 2B=could be carcinogenic in man, and 34 are found to be class 3=cannot be classified due to lack of evidence (22). In epidemiological studies farming is found to be related to cancers like non-Hodgkin's and Hodgkin's lymphoma, multiple myeloma, leukemia, sarcomas, melanomas, cancer of prostate, brain and testis; but whether it is due to exposure to pesticides or other exposures in farming is unknown. Some pesticides are linked to specific cancers, but except for arsenic containing pesticides giving rise to cancers in skin and airways and phenoxyacidherbicides giving rise to soft tissue cancers and non-Hodgkin Lymphoma, the evidence is weak (2,9,22).

Less serious problems may arise due to irritative and allergic effects, and in recent years a discussion about hormonal disturbances due to pesticides and other chemicals has arisen (2).

Casuistics from Bolivia about chronic problems connected with pesticides like an elevated number of abortions, malformations and cancers among farming populations, where pesticides are used, are reported (5,23). Chromosomic aberrations are found in one study although the material is of limited size (23).

1.4 Strategies to minimize the hazards of pesticides

Elimination or substitution - training - personal protective equipment

The total elimination of pesticides is promoted by consumer groups, some scientists and other activists e.g. in networks or NGOs such as PAN (Pesticide Action Network), RAPAL (Red de Acción en Plaquicidas y sus Alternativas en Latino America), Environmental Justice Foundation etc., often quite radical in their argumentation and methods of fighting pesticide use, and promoting ecological methods of farming (24).

On the other extreme are the pesticide producers' organization (GCFP), governments, salesmen and farmers claiming that the world's need for food cannot be met without the use of pesticides, advocating for a "safe use concept" instead of banning pesticides. The concept includes 1) the use of personal protective equipment when producing, mixing and spraying, 2) safe storage, adequate destruction of used containers and obsolete pesticides, and 3) adequate instruction in rational use, dosification and safety measures (25,26). Often politicians have economic interests in the promotion of pesticide use, and subsidies are provided by governments thus increasing pesticide imports and use (5,27), and e.g. the possibility of getting small commercial agricultural loans in

Bolivia is often connected to the use of pesticides. As many authors states, the pesticide companies are interested in making profits for their shareholders and whatever they claim, a positive bottom line is the most important issue for them, even if it means selling pesticides for warfare, dumping obsolete products in third-world countries and selling products of the most toxic classes to farmers without the ability to read instructions for use and precautions or without economic means to buy even the simplest protective equipment for themselves (28).

A more balanced viewpoint is presented by FAO and others promoting Integrated Pest Management (IPM) methods where the use of pesticides is introduced as a last resort and were the least toxic pesticides are selected. IPM is broadly and very ambitiously defined as a social construction that combines: 1) Ecologically-based pest management practices (without pesticides); 2) Empowered communities making informed decisions in their local agro-ecosystems that are locally tested, locally criticized, and locally defended; 3) Public policies that nurture and protect those practices, communities, and the public good; and 4) A basis for local organizing by peoples' organization, community-based organizations, civil society organizations, nongovernmental organizations, green parties, and the public sector (29).

In line with IPM, a minimum pesticide list is suggested by some authors, where only the necessary and least poisonous active ingredients should be permitted (30,31), which seems viable in the light of the effect which the banning of the most poisonous pesticides has on lowering the number of deaths due to acute pesticide poisoning (32). An interesting approach is suggested by the International Institute of Environment and Development integrating all of the above mentioned principles in an impact prioritized list: 1) the most toxic pesticides should be eliminated, 2) safer products or alternative technologies should be substituted, 3) administrative controls should be implemented, including training and education, 4) finally, personal protective equipment should be introduced (25).

FAO, WHO, ILO, and IPCS among others have guidelines on many issues related to pesticides (12,13,34-41), where everybody can seek advice, provided they have access to the net and can read - which is not the case for the majority of the Bolivian farmers as well as for most small farmers in low-income countries.

International Conventions and Guidelines

On an international level, treaties are signed trying to restrict the use of the most problematic and toxic or persistent pesticides, set limits for residues in foods, regulate occupational exposure, control the trade and avoid dumping (1,13,42-45). The International Code of Conduct on the Distribution and Use of Pesticides (the Code) has "the objective to establish voluntary standards of conduct for all public and private entities engaged in or associated with the distribution and use of

pesticides, particularly where there is inadequate or no national legislation to regulate pesticides" (1). The Code puts an emphasis on the shared responsibility and the need for a cooperative effort to promote practices that minimize potential health and environmental risks associated with pesticides. The Rotterdam Convention on Prior Informed Consent (PIC) provides a list of pesticides considered to be so problematic that the exporting country has to inform and get the accept from the importing country about the pesticide going to be exported (42). The Stockholm Convention deals with the Persistent Organic Pollutants (POPs), among those we find 8 pesticides (aldrin, chlordane, endrin, dieldrin, heptachlor, DDT, toxaphene, mirex, and hexachlorbenzene), the use of which are banned by those signing the convention (43). Many countries have signed the two conventions and they are now ratified and put into function. This might help strengthen the regional and national regulations on pesticides, and as pointed out in The Guidelines for Legislation on the Control of Pesticides: "Governments have the overall responsibility to regulate the availability, distribution and use of pesticides in their countries and should ensure the allocation of adequate resources for this mandate" (15). It seems, however, to be a problem for many governments to implement and reinforce the international treaties, conventions, and even their own national laws, be it due to lack of resources, contradicting interests or lack of conscience about the dangers of pesticide use (5,9,28,46).

National laws and conventions signed by Bolivia and effects of these

Within the last 12 months, Bolivia has signed both the Rotterdam and the Stockholm conventions, and at the regional level Bolivia has signed the Andean Pact, where the Norma Andina No. 436 deals with pesticides copying the content of the Code of Conduct. This means that within a short time Bolivia has to live up to these international conventions which at the moment seems to become pretty difficult, not unlike for other low-income countries.

In Bolivia the responsibility for registration, control of import, distribution and sale, the use and supervision of pesticides for agricultural activities is by law no. 2061 (16/03/00) given to Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria (SENASAG) in the Ministry of Agriculture (MACIA). This law has later been specified in the Supreme Decree No. 25729 (7/04/00) and administrative resolutions Nos. 055/2002 and 059/2003. SENASAG is publicizing a list of commercial products of pesticides and active ingredients allowed in the country (4). According to the administrative resolution No. 059/2003, the Ministry of Agriculture has the responsibility for creating and heading a National Commission on Coordination of Pesticides (CONAPLA). This Commission is to be formed by SENASAG, the National Agricultural Confederation (CONFE-AGRO), the Association of Providers of Agricultural Products (APIA), the Ministry of Environment, and the Ministry of Health.

Through INSO, the Ministry of Health has the responsibility for evaluating the toxicological aspects of pesticides to protect the health of humans and avoid pollution of the environment, and control Public Health aspects of pesticides, as expressed in the pesticide regulations Art. Nos. 1 and 5 of the Health Codex (47). Through the customs, the Ministry of Finance has the responsibility for controlling the import of pesticides, where it is stated in The General Law of the Customs Art. 85 that it is prohibited to import toxic substances that have a negative effect on the environment (47). Through the Law of Environment No. 1333 and later amendments, the Ministry of Environment has the responsibility for the regulation and control of the production, introduction, and commercialization of drugs, agro chemicals and other dangerous substances and/or substances harmful to the health and/or environment. It gives only norms for temporary storage of obsolete pesticides and establishes limits for pesticides in waters (47). The Codex Alimentarius is followed for norms of residues in foods, where Instituto Boliviano de Normas y Control (IBNORCA) is performing these analyses (5).

One thing though is to have signed treaties and agreed upon laws and regulations to control the use of pesticides, but implementing and enforcing these measures is something quite different. Studies from Bolivia, show us that the value of conventions, treaties, laws etc. is very limited, if not taken seriously and put to work through efficient enforcement, control, education and information: 1) Illegal pesticides are entering the country and sold in the open, 2) Highly toxic and banned pesticides are still in use, 3) Transport, storage and sale of pesticides is taking place in close connection with human and animal foods, 4) Safe elimination of obsolete pesticides and containers is not existing, 4) Pesticides are sold by personnel not licensed, persons without sufficient knowledge about dangers and appropriate use, 5) The accessibility and use of personal protective equipment is very limited among small-scale or subsistence farmers, 6) Nationally controlled education of dealers or farmers is not taking place, 7) High pesticide residues in foods are found on the markets etc. (5,7,15,23,47).

2. JUSTIFICATION OF THE STUDY

With a quarter of the Bolivian workforce employed in agriculture, the rapidly growing use of pesticides, and subsequently elevated risks of poisoning of man, animal, and environment, there is a need for an ongoing documentation of actual problems and the trying out of methods to lower harmful effects and find sustainable solutions to the pesticide problems. This thesis will try to actualize the knowledge about pesticide poisonings among small-scale farmers in the rural districts of Bolivia, where studies done during the last decades have documented a growing use of pesticides and problems connected with this.

This thesis will be the basis of a follow-up study in the evaluation of the IPM-methods introduced

to the small-scale farmers by the PLAG-BOL project.

3. OBJECTIVES

3.1 Overall objective

To describe the characteristics of pesticide use among small-scale farmers and evaluate the acute pesticide poisonings, their background, diagnosis and treatment in the province of La Paz, rural Bolivia.

3.2 Specific objectives

- Through farmer surveys evaluate the classes of pesticides used, the existence of occupationally related acute pesticide poisonings and factors of importance for their occurrence.
- To describe the magnitude and reasons for acute pesticide poisonings including poisonings related to accidents, occupation and suicide attempts.
- To identify practices of diagnosis and treatment of persons with acute pesticide poisoning at government health facilities.

4. MATERIALS AND METHOD

4.1 The study area

The data were collected from 4 municipalities in La Paz county in Bolivia in the Andes Mountains where there is known to be a major use of pesticides in agriculture due to the production of crops such as vegetables, flowers and tomatoes for the market in the Capital La Paz and for exportation to Peru. The two municipalities near La Paz, Palca and Mecapaca, have a temperate climate, due to their location from 2,500-3,500m above sea level. The two other municipalities Caranavi and Guanay have a subtropical climate, and are situated in the Yungas region at an altitude from 500-2,000m above sea level. The municipalities are forming a bridge of valleys from the central plateau of Bolivia ‘the Altiplano’ 4,000m above sea level to the Amazon lowlands. The municipality of Guanay has been and to some extent still is a municipality where a lot of gold mining takes place, but due to falling prices of gold and fewer sources, the population is now increasingly basing their living on agriculture, and thus for many of them their experience with pesticides is quite recent. The population figures of the four municipalities and the study area appear from table 2. For comparison the total population of Bolivia is approximately 8.8 million, of which 40% are 15 years or younger and 4% are 65 years or older. Around 40% of the population is living in the countryside outside the bigger cities and approximately 25% of the Bolivian workforce of 3 million are occupied in agriculture (48,49).

Table 2: Population and health staffing in study area

Provinces	Total population (INE 2001)	Population in project area (INE 2001)	Population in the health districts covered by the project (INE 2001)	Staffing at health facilities in the municipalities (SNS 2002)
Caranavi (subtropical)	51,764	2,486	17,891	7 doctors 4 nurses 24 assistant nurses
Guanay (subtropical)	28,480	2,648	10,645	6 doctors 2 nurses 11 assistant nurses
Palca (temperate)	14,107	2,027	11,809	3 doctors 2 nurses 5 assistant nurses
Mecapaca (temperate)	12,073	3,402	8,391	4 doctors 1 nurse 7 assistant nurses
Total no.	106,424	10,563	48,736	20 doctors 9 nurses 47 assistant nurses

4.2 Study design

The thesis is based upon: 1) a structured interview among small-scale farmers, followed by blood-samples taken and analyzed for serum cholinesterase activity (ChE-activity), 2) a questionnaire answered by health personnel concerning their knowledge and routines when diagnosing and treating patients with acute pesticide poisoning, and 3) an evaluation of hospital registrations of treatment of patients with acute pesticide poisoning during the whole year of 2001.

Structured interviews and blood test taken with farmers

The interviews were undertaken with 227 farmers from the 48 small villages of the Plag-Bol project area in four municipalities in the La Paz province. The population was approximately 10,000 persons in the villages of the study area, and the total population approximately 100,000 persons in the four municipalities (table 2). A general description of the respondents is seen from table 3.

Farmers from the villages were not randomly selected, because of a well known resistance of having blood-samples taken, but volunteered to do the interviews and blood-tests following introductory meetings in the four capital towns of the municipalities and six nearby villages going to participate in the PLAG-BOL project. The number of farmers included was based on a wish from the PLAG-BOL project to examine the 80 farmers elected by the people in 40 villages invited to take part in the courses offered by the project, and have a control group of farmers not participating

in the courses for later evaluation of the project impact. Calculations of statistical force were done to estimate sampling size, based on knowledge of symptom frequency and choline-esterase measurements from former studies (7).

Table 3: General description of respondents (n=227)

Age	Sex	Weight and height	Education*	Marital status	Smoking
Median age 36 years, (15-79)	Males 88%	Mean weight 61,5 kg SD 8,7	Primary 47%	Alone 32%	Yes 9%
Age classes: <20 9% 20-29 25% 30-39 28% 40+ 38%	Females 12%	Mean height 161cm SD 7,2	Secondary or higher 53%	Couple 68%	No 91%

*55% of the population over 15 years of age are functional illiterates (48).

The interviews were worked out by the author in coordination with the project personnel and members of the NGO Dialogos on the background of experience with interview-schemes from Bolivia, Denmark and the US, and consisted of closed as well as open-ended questions (Annex 4). The interviews with the farmers included: 1) general questions about age, sex, education, family status, size of land etc., 2) questions about knowledge, attitudes and practice when buying, handling and storing pesticides, and 3) questions about health impact, dangers of pesticides, own experiences with APPs and toxic symptoms after spraying (Annex 4).

After they had been tested on 10 volunteers and adjusted where necessary, the interviews were conducted in Marts and April 2002 by the author and the project personnel.

The blood-tests were taken by laboratory personnel from the INSO at the same time as the interviews were performed, they were centrifuged on the spot, the serum cooled down and later frozen in La Paz and transported to Odense University Hospital in Denmark for analysis of the serum cholinesterase activity (ChE activity).

The serum ChE activity is measured by a spectrofotometric method where ChE is used in the first step of a reduction of potassium hexacyanoferrate leading to a color change that can be measured with a variance below 2.3% within the same set of analysis. The measurements are given in kU/L (kilo units per litre). Due to inter-individual variance a normal variation for a population is too broad for any practical use, the results can only be used at the individual level if you have a blood test from that person taken when he has not been in contact with organophosphates for months. But on a group level you can compare the mean serum ChE activity of the different groups, assuming that individuals with different basis activity of ChE are evenly distributed within the groups (50). The ChE activity is known to be influenced by weight, sex, age, liver-diseases,

alcoholism and the use of contraceptive pills (50).

The interview with the farmers was used to identify and classify the different pesticides used according to the WHO toxicology classification, and compare the actual use with international conventions and national registers of pesticides. The interviews and blood tests were used to evaluate the existence of an influence on farmers' health by pesticides.

Possible risk factors for APPs such as the use of personal protective equipment when spraying, different hygienic measures, awareness of pesticide handling and toxicity, educational level etc. were tested against two outcome variables for acute poisonings being 1) self reported symptoms of APPs after spraying during the past month and 2) serum ChE activity. For personal protective equipment (PPE) an aggregated variable was formed from answers about the use of gloves, boots, plastic poncho and mask, where the use of more than one of these PPEs was regarded as protective. Another aggregated variable was formed from answers about personal hygienic measures when spraying, namely a) washing hands after spraying, b) washing the whole body after spraying, c) changing clothes after spraying and d) not eating, chewing coca and smoking while in the process of spraying. Complying with more than two of these measures was regarded as being protective for having toxic symptoms after spraying and a lowered serum ChE activity.

Evaluation of hospital registered acute pesticide poisonings

The ward registers of 38 patients diagnosed by doctors and treated for APPs during the whole year of 2001 in the health facilities covering the project area were revised. Data about age, sex, date, diagnosis of the toxic agent, the reason for the poisoning, and the treatment were extracted. The data were gathered by the project personnel.

From the review of the ward registers the incidences of the APPs reaching the health centers and the case-fatality rate were roughly estimated.

Health personnel questionnaires

The questionnaires were answered by 49 health professionals from the health districts in the four municipalities at the start of a course on ’pesticide poisonings, symptoms and treatment’ in 2002. The questionnaire consisted of closed and open-ended questions, and was elaborated by the doctor in the project after consultations with the author (Annex 5). The 49 health persons were people assigned to take part in the course by their superior, out of the total of 76 health personnel in the four health districts of the municipalities.

The questionnaires answered by the health professionals were used to evaluate their knowledge and practices of diagnosing and treating APPs. The level of knowledge was compared between doctors and other health personnel. Due to the wish of anonymization, age and sex are not

variables in the questionnaire, but experience tells us that doctors mostly are males, and nurses and assistant nurses are females. Likewise the mean age is judged to be around 35 years of age.

4.3 Data Analysis

Data were entered and analyzed in the statistical program SPSS version 10.0. The data from interviews with farmers were entered by the statistician at the INSO under the guidance of the author, the rest of the data were entered by the author and all three databases were re-entered by the author. The data analysis included frequencies, ?2-test, ?2-test of linearity, one way ANOVA, student T-test and binary logistical regression analysis.

Initially 227 farmers were selected as respondents, out of these, 25 farmers were known ecological coffee farmers primarily meant to be included in the study as a reference group for the measurements of serum ChE. Of the remaining 202 conventional farmers 186 were using pesticides, and most of the analyses are concentrating on this group and a subgroup of 125 farmers having sprayed within the last month and answered a question about toxic symptoms immediately after spraying. The control group varied from analyzis to analyzis depending on the question to be answered, e.g. those using protective equipment versus those who do not, those having sprayed with organophosphates within the last month versus those who have not etc..

One of the conventional farmers was excluded from the analysis including ChE because of a known liver disease. Contraceptive pills and alcoholism are hardly seen among the farmers for economic and traditional reasons, and as sex, weight and age were evenly distributed in the groups analyzed, it was not regarded as necessary to control for theses factors in the univariate analysis.

In the logistic regression analysis of symptoms after spraying within the last month, age, education, times sprayed during last month and marital status were controlled for. In the T-test analysis for differences in the ChE activity between subtropical and temperate farmers stratification for number of times sprayed last month were done.

4.4 Ethics

The Medical Ethical Committee in Bolivia and the National Institute of Occupational Health gave their permission to perform interviews and collect blood samples as planned in the project (Annex 6). The participants were advised in advance about the study, its relevance and what it meant for each one if they volunteered to be part of the study. During interviews and collection of blood samples, the participants signed an informed consent (Annex 7). The study was not presented to the medical ethical comittée in Denmark, which it rightfully should have been, since danish ressources where used to realize it.

5. RESULTS

5.1 General findings

The distribution among responding farmers from the subtropical and from the temperate regions is almost equal, but the farm-land sizes are bigger in the subtropical region ($p<0.00$). Pesticides are used by 92% of the farmers, without difference between the two regions.

Table 4: Description of farming circumstances of responding farmers (n=227)

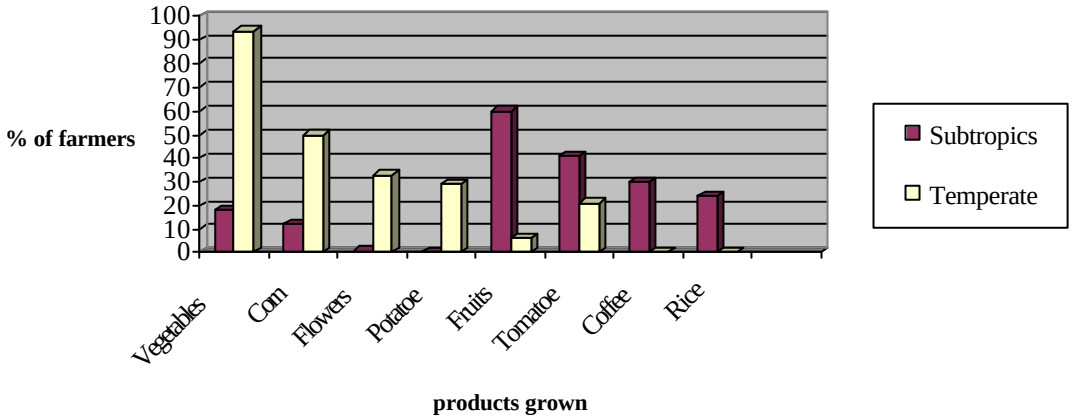
Region	Working years in farming	Hectares grown	Use of pesticides*
total study area	mean 20 (1-60)	mean 1.6 (0-11)	92%, 186/202
subtropics 52%	mean 17.8	mean 2.4 (0.1-11)	88%, 83/94
temperate 48%	mean 22.7	mean 0.7 (0-3)	95%, 103/108

* Excluded in this analysis are 25 farmers who were selected because they were ecological coffee farmers

Differences in hectares grown are seen among couples compared (n=155) to singles (n=72) - mean hectares grown 1.5 (SD 1.8), versus 1.0 (SD 1.3), p=0.03.

The eight most frequent crops grown in two climate zones of the study areas are seen from Fig. 1.

Figure 1: Eight most grown crops - a comparison between the subtropical and temperate zones in the study areas



5.2 Pesticides used

An overview of the pesticides and the classes of pesticides reported by the 186 farmers using pesticides can be seen from table 6 below and table B in Annex 2. Conflict-ridden pesticides, like aldicarb (2.2%), aldrin (4.3%), DDT (1.1%), monocrotophos (0.5%), methamidophos (68.8%), paraquat (0.5%) and parathion (23.7%), were mentioned by 76.9% of the farmers. Insecticides were the most mentioned in both regions (97%), followed by fungicides (64%) being more frequently mentioned in the temperate region, and herbicides (32%) being more frequently mentioned in the

subtropical region. Of the chemical classes, organophosphates were by far the most widely mentioned pesticides. The most toxic classes Ia and Ib were quite frequently mentioned in both subtropical and temperate regions, significant difference was found in the less toxic classes III and U, both being more mentioned in the temperate regions. On average 4 different active ingredients and 4 commercial names of pesticide products were mentioned per farmer (min 1 - max 12), without difference between the subtropics and temperate regions.

Table 5: Classes of pesticides as mentioned by responding farmers (n=186), a comparison between farmers living in the subtropical and temperate zones

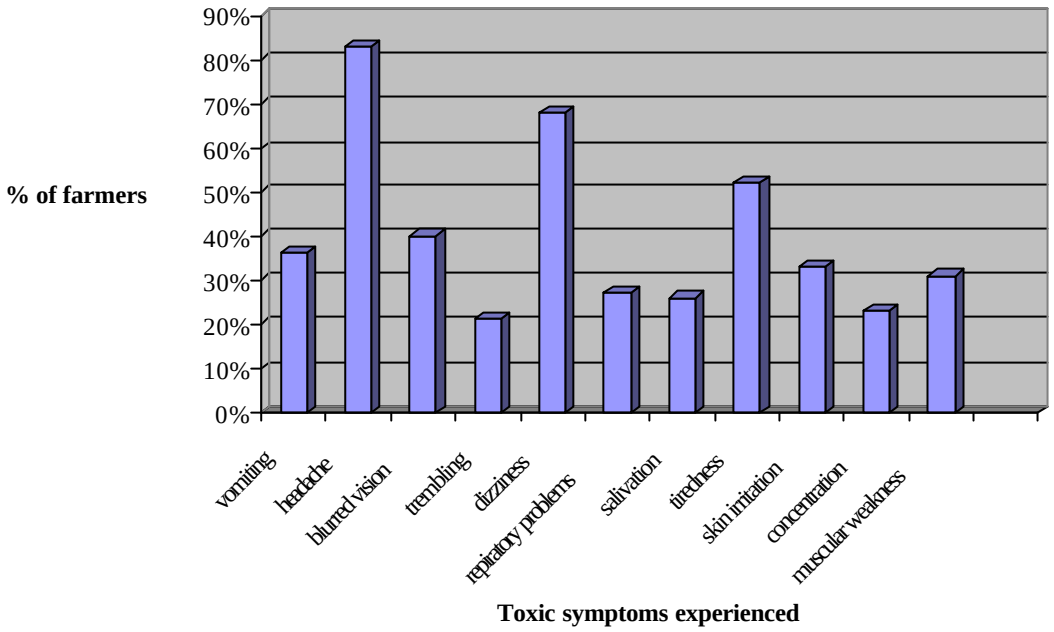
Pesticide classes*	**All farmers (n=186)**	**Subtropical farmers (n=83)**	**Temperate farmers (n=103)**	**?2-test ?2-value**	**p value****
class Ia	25%	21%	28%		
Ib	69%	72%	67%		
II	75%	65%	83%	7.4	<0.00
III	23%	23%	23%		
U	66%	58%	72%	3.4	0.046
O	4%	1%	7%		
Insecticides	97%	94%	99%		
Fungicides	64%	48%	77%	16.2	<0.00
Herbicides	32%	42%	24%	6.7	<0.01
Organophosphates	88%	82%	92%	4.5	0.03
Organochlorines	5%	4%	7%		
Carbamates	2%	0	4%		
Pyretroides	48%	36%	57%	8.2	0.00
Sulphur	41%	18%	59%	19.6	<0.00
Propineb	25%	41%	13%	32.2	<0.00
Spinosad	25%	43%	10%	28.0	<0.00

* Pesticides identified and classed according to the WHO Recommended Classification of Pesticides by Hazard
** Only significant values noted

5.3 General factors with an impact on farmers' health when handling pesticides

Of the 138 farmers having sprayed last month, 125 answered a question about symptoms after spraying. Of these 46% farmers reported having suffered from toxic symptoms of poisoning immediately after spraying. Toxic symptoms experienced after spraying during the past year were reported by 69% of the 186 pesticide using farmers, as seen in Fig. 2.

Figure 2: Toxic symptoms of acute pesticide poisonings experienced by responding farmers after spraying within the last year (n=128)



When comparing having experienced toxic symptoms past month after spraying and the serum ChE activity, a borderline significance was seen between those having had symptoms (n=58), ChE=7.0 kU/L (SD 1.4), compared to those without symptoms (n=67), ChE=7.4 kU/L (SD 1.4), p=0.07. As can be seen from table 6 the number of times sprayed, spraying with OPs or not, and the number of times sprayed with OPs all have important impact on the experience of symptoms within the last month after spraying and the serum ChE activity. The odds-ratios (OR) presented are adjusted ORs, but the crude ORs were showing the same picture.

A significant risk factor for having experienced toxic symptoms after spraying was found to be living in a couple (n=85) compared to living as a single (n=40), OR=2.8 (95% CI:1.2-6.1).

Table 6: Effect of spraying on prevalence of toxic symptoms and serum choline esterase activity

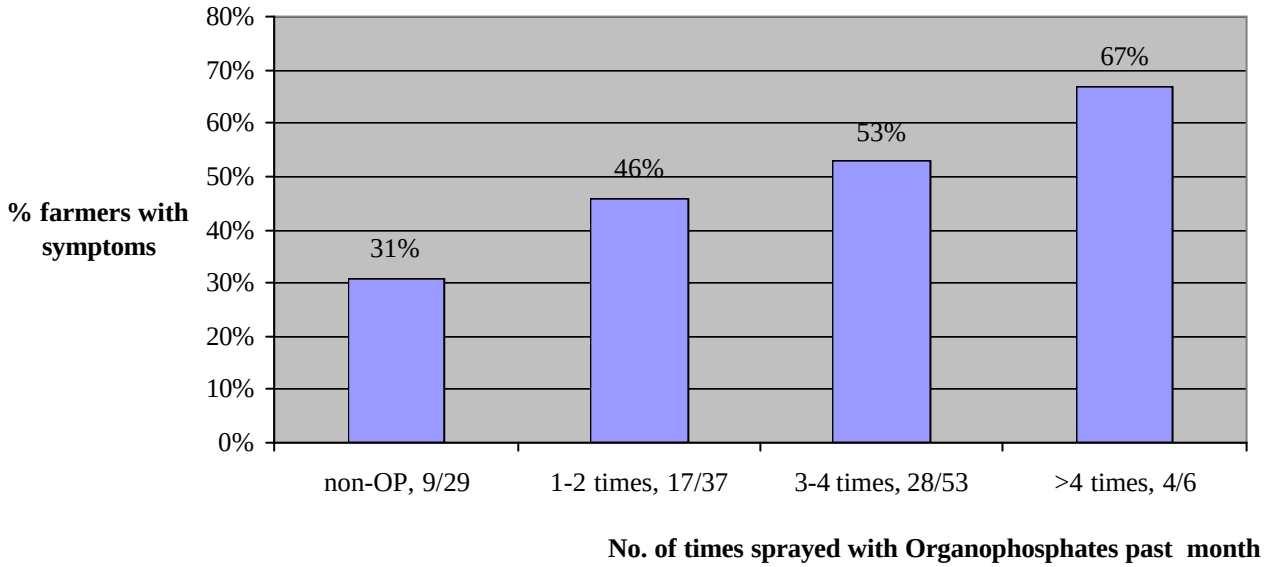
Spraying within past month	Toxic symptoms			Serum choline esterase activity			
	n	OR	95%CI	n	mean (kU/L)	SD	p-value
Sprayed = 3 times	74		-	79	7.4	1.5	0.046
Sprayed > 3 times	51	2.3*	1.1-4.9	59	6.9	1.2	-
Sprayed with non-OPs	29		-	70	8.1	1.5	<0.000
Sprayed with OPs	96	2.6**	1.0-6.8	106	7.0	1.4	-
Sprayed 1-3 times with OPs	54		-	67	7.4	1.4	0.057
Sprayed > 3 times with OPs	42	2.5*	1.1-6.0	58	6.8	1.2	-

*OR controlled for age, education, marital status

** OR controlled for age, education, marital status and no. of times sprayed last month

The increase in toxic symptoms with increasing number of times sprayed with OPs can also be illustrated by the positive trend seen in Fig. 3; ?2-analysis for linearity: value 4.42 p=0.035.

Figure 3: Percentage of responding farmers with toxic symptoms after spraying with organophosphates or other pesticides (non-OP) within past month (n=125)

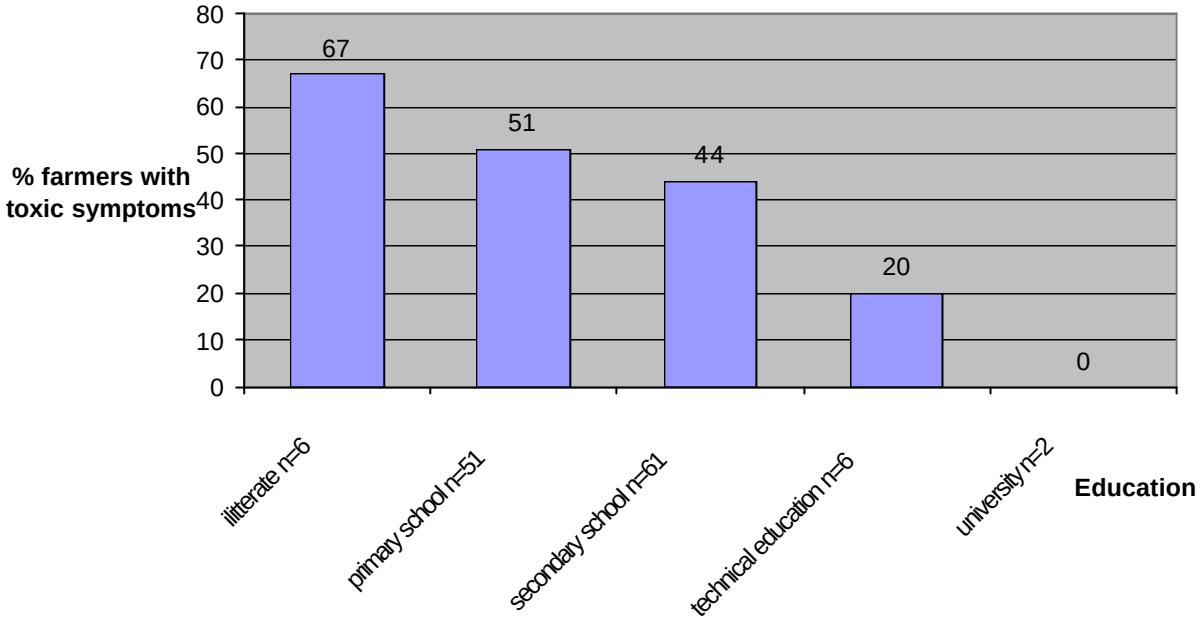


A positive trend for toxic symptoms after spraying was seen for increasing age and a negative trend was seen for education (Fig. 4), ?2-analysis for linearity: value 3.89 p=0.049.

Factors like sex, climate, bodyweight and hectares of land cultivated did not seem to have any influence on toxic symptoms after spraying.

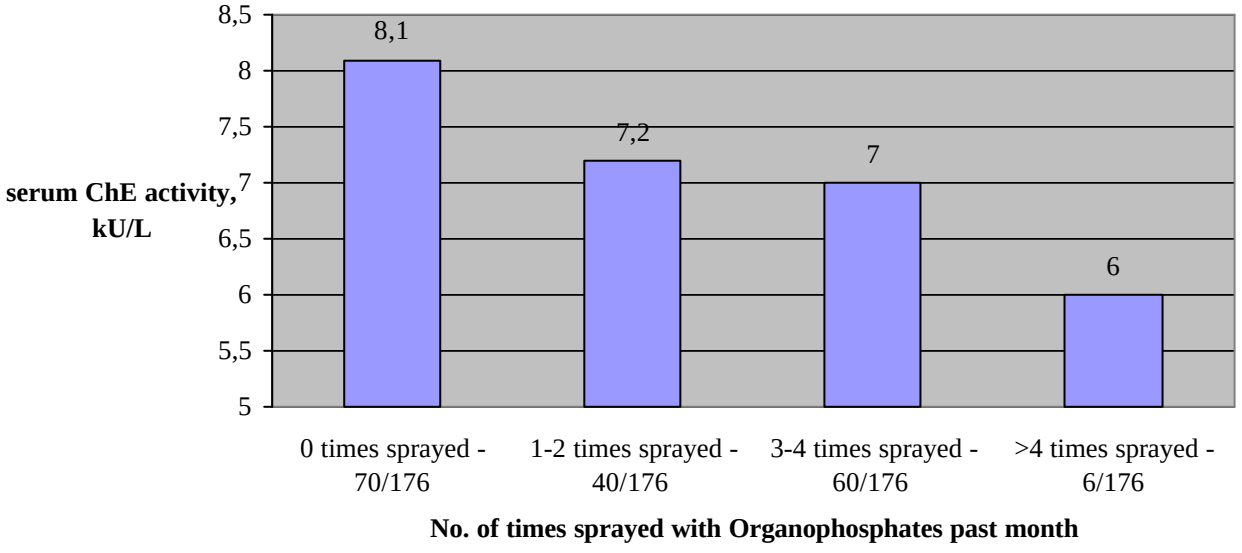
The impact of spraying could likewise be illustrated when comparing the level of serum ChE activity between a group who has not been spraying or sprayed with other pesticides than organophosphates (n=70) and groups of farmers having sprayed with varying frequency with organophosphates within the last month (n=106) (Fig. 5).

Figure 4: Effect of education on symptoms among responding farmers after mixing/spraying within past month (n=125)



A one way ANOVA showed a significant negative trend for ChE activity compared to number of times sprayed with OP, value 8.44 p<0.00, as illustrated in Fig 5.

Figure 5: Level of cholinesterase activity among responding farmers compared to frequency of spraying with organophosphates within the past month (n=176)



Comparing the pesticide-using farmers from the tropics (n=83) with the farmers from the temperate region (n=102) a significant lower serum ChE activity was seen, ChE=7.1 (SD=1.4) versus ChE=7.6 (SD=1.6), p=0.01. This significance tends to disappear if the data is stratified into two groups according to number of times sprayed within the past month: 1) sprayed 1-3 times ChE =6.9 (SD=1.5) versus ChE =7.5 (SD=1.5), p=0.12, and 2) sprayed >3 times ChE =6.9 (SD=1.2) versus

ChE =7.0 (SD=1.2), p=0.62). The mean no. of times sprayed past month was 2.1 times for the temperate zone (n=103) and 2.4 for the subtropics (n=75).

As seen from Table 7, difference in the mean serum ChE activity was found for farmers cultivating mainly ecological coffee, rice and tomatoes.

Table 7: Differences in serum choline esterase activity by farmers cultivating different crops

Crop cultivated	Mean ChE activity (kU/L)	SD	p-value
ecological coffee farmers (n=25)	7.1	1.4	0.01
farmers who haven't being spraying past month (n=55)	8.1	1.5	-
rice growing farmers (n=25)	6.8	1.6	0.04
other farmers using pesticides (n=160)	7.5	1.5	-
tomato growing farmers (n=71)	7.1	1.2	0.03
other farmers using pesticides (n=114)	7.6	1.7	-

The farmers growing tomatoes had also experienced more toxic symptoms after spraying within the last month compared to the other farmers using pesticides, OR=2.8 (95% CI:1.4-5.6).

5.4 Occupational and hygienic measures with an impact on farmers' health when handling pesticides

Farmers used their daily clothes when mixing and spraying, normally consisting of a pair of pants/skirt, sandals, a shirt or T-shirt and a hat or cap. Apart from this some personal protective equipment (PPE) was used by some of the farmers when mixing and spraying, such as gloves (16%, 30/186), boots (15%, 28/186), plastic poncho (3%, 5/186) and mask (16%, 30/186). An aggregated variable of PPE showed an effect on the risk of toxic symptoms after spraying within the last month among the group using less than 2 PPEs, as seen from Table 8.

Sucking the nozzle of the knapsack sprayer when obstructed and not reading instructions on the pesticide container before using the pesticide were also found to be two significant risk factors for having toxic symptoms after spraying (Table 8).

An increasing trend was found showing that the better the education the more the labels of the pesticide containers were read, ?2 test for linearity value 8.2 p<0.00.

Personal hygienic measures such as washing hands, washing body and changing clothes after mixing and spraying, and not chewing coca leaves/smoking or eating while spraying did not seem to have any significant effect on symptoms or blood cholinesterase level, whether analyzed alone or aggregated into one variable.

Table 8: Risk factors for toxic symptoms among respondents after mixing and spraying within the last month (n=125)

Risk factors analyzed	Toxic symptoms		Risk of toxic symptoms			
	yes	no	Crude OR, 95% CI		Adjusted OR*, 95% CI	
Using >one piece PPE	5	14				
Using =one piece PPE	53	53	2.8	0.94-8.3	4.5	1.4-14.8
Using >two hygiene measures	31	32				
Using =two hygiene measures	22	30	0.8	0.4-1.6	0.7	0.3-1.7
Do not suck nozzle of sprayer to clean it	23	40				
Suck nozzle of sprayer to clean it	33	24	2.4	1.2-5.0	2.8	1.3-6.2
Re-entry to sprayed field after = 1 day	38	48				
Re-entry to sprayed field after < 1 day	19	17	1.4	0.7-3.1	1.5	0.7-3.4
Reading pesticide instructions	38	56				
Do not read pesticide instructions	19	9	3.1	1.3-7.6	3.4	1.3-9.0

* OR adjusted for no. of times sprayed last month, age, education and marital status

Trends were seen for years in agriculture, having received some instructions in pesticide use, and re-entry into a newly sprayed field, but without any significance.

Factors like storage of pesticides, handling of empty containers, revision of knapsack sprayer, spraying alone or with helper did not seem to have any influence on toxic symptoms after spraying.

The only difference for serum ChE activity was found for reading instructions (n=135) or not (n=43) on the pesticide container label before use, ChE=7.6 kU/L (SD 1.6) versus ChE=6.9 kU/L (SD 1.3), p=0.01. The same was the case after stratifying for number of times sprayed past month.

5.5 Causes of acute pesticide poisonings, magnitude of poisonings and outcome

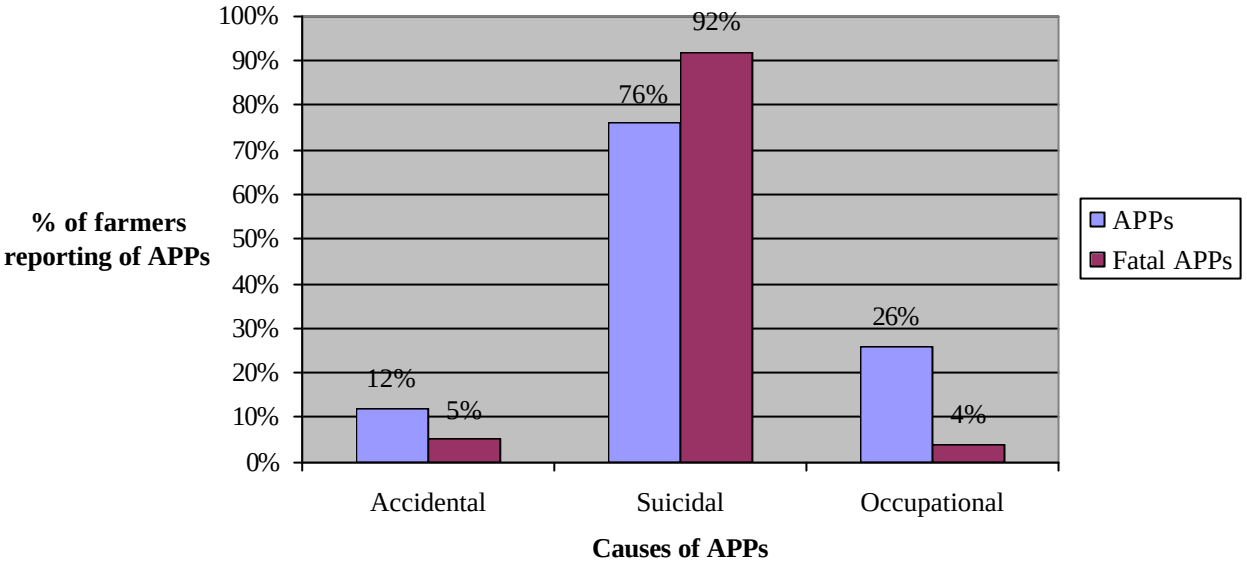
Interviews with farmers

Fifty-four % (118/217) of the farmers interviewed told about acute pesticide poisonings (APPs) and 41% (84/207) told about fatal APPs in their village during the last 5 years. The farmers came from 48 different villages of which APPs were reported in 34 and fatal APPs in 24 of these villages. Asked about the reason for APPs, suicide seems to be the most common cause as illustrated in Fig. 6., where 76% (78/103) of the farmers who know of an APP and 92% (77/84) of the farmers who know of a case of fatal APP, claimed suicide to be the motive.

When talking with farmers individually and in groups, reasons for suicide were stated to be problems with a partner, economic problems, depressions and the majority were done by young people under the influence of alcohol. Examples of accidents as told by the farmers were 1) people curing themselves for skin diseases with pesticides, where smearing it on the skin is found to be

normal practice for 31% (37/119) of the interviewed in this study; 2) children and adults eating or drinking it because they think it is something else or are eating contaminated foods; 3) people entering into their house shortly after it has been sprayed, as often done by farmers themselves e.g. with spared pesticide mixtures instead of throwing them away (50%, 59/118).

Figure 6: Causes of acute pesticide poisonings (APPs) as reported by respondents (n=177)

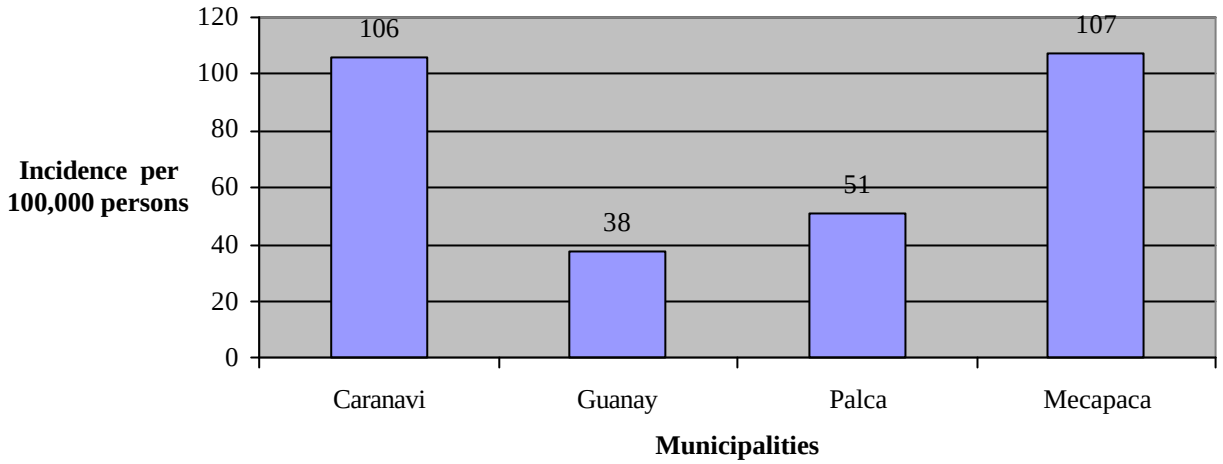


The pesticides were stored in the houses (24%, 32/175) or in the fields (76%, 133/175), and only 8% (14/175) were kept in a locked-up storage. Pesticides were mixed near water sources in 35% (62/176) of the cases and in the house in 7% (12/176) of the cases; empty pesticide containers were in 78% (134/172) of the cases just thrown away in the field, river or garbage area, and knapsacks were washed in or near a water source or in the house in 55% (66/120) of the cases.

Hospital registers

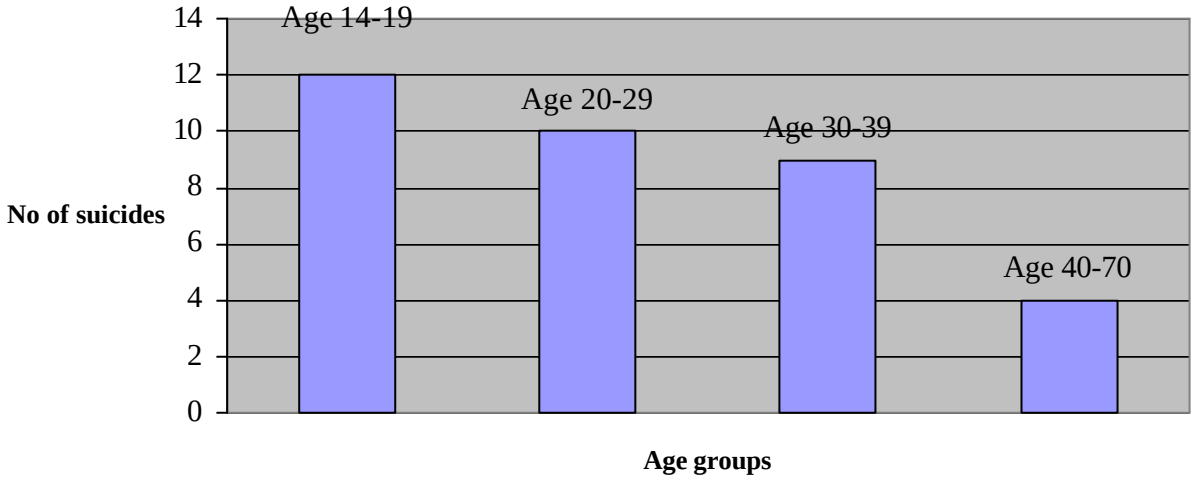
Revising the ward registers from the health facilities in the project area for the year 2001, 38 cases of acute poisoning were found of which 92% were due to suicidal attempts, 5.5% accidental and 2.5% occupational. Based on the population size, the incidence of severe pesticide poisonings per 100,000 inhabitants was estimated to be 78 for the four municipalities. The incidence for each municipality can be seen in Fig. 7, with no significant difference between the subtropical and the temperate region, but significant difference within the two municipalities in each of the two regions.

Figure 7: Incidence of patients treated for acute pesticide poisonings in the four health centers of the catchment areas per 100,000 persons (n=38)



The mean age for APPs was 27 years (SD 13.9, min. 3 years – max. 70 years). The age distribution of suicidal attempt is seen in Fig. 8., where a maximum in actual numbers was found among the teenage population.

Figure 8: Actual numbers of suicides in different age groups



The distribution of suicides over the year corresponds to the most active farming month in Bolivia, where 80% is occurring from October to April where the use of pesticides is highest. The distribution between males and females was found to be quite even with 19 males and 21 females. Of the 25 poisonings with known outcome (the rest was transferred or dismissed themselves before end of treatment) 3 died, giving a roughly estimated case-fatality rate of 12%. The cause of the poisoning in 74% of the cases was noted as organophosphates, 13% as rodenticides and the rest just insecticides or poisonous chemicals.

5.6 Diagnosis and treatment of persons with acute pesticide poisoning

Treatment at home as informed by responding farmers

When it comes to treatment, people mostly did nothing (61%, 80/131) or used household remedies (34%, 44/131) such as drinking milk, taking aspirins, washing the body or resting a while. They experienced that symptoms generally disappeared within few hours (69%, 87/127). Only 5% stated that they would seek help in the health centre.

Treatment in health facilities

A total of 20 doctors and 29 nurses (nurses and nursing aids) completed the questionnaire. Asked about the different classes of pesticides, 23% (11/48) could mention organophosphates, while 4 doctors do mention organochlorines, pyretroids and mercury-derivates. If asked about commercial names, 63% (30/48) could mention one or more, organophosphates being mentioned by most responders, 50% (24/48). Ninety percent of the pesticides mentioned belonged to the toxic classes I and II, 10 % to less toxic classes. Doctors were better at mentioning the different classes, p=0.02, while there were no difference in the recording of commercial names.

Thirty-one percent (15/48) of the health personnel did know the three routes of poisoning - respiratory, oral, and dermal, while 63% (30/48) could mention one or two and 6% (3/48) did not know any, again with better knowledge among the doctors (p=0.03). When asked which relevant questions to ask a person apparently suffering from poisoning the answers could be indexed in the categories as seen in Table 9.

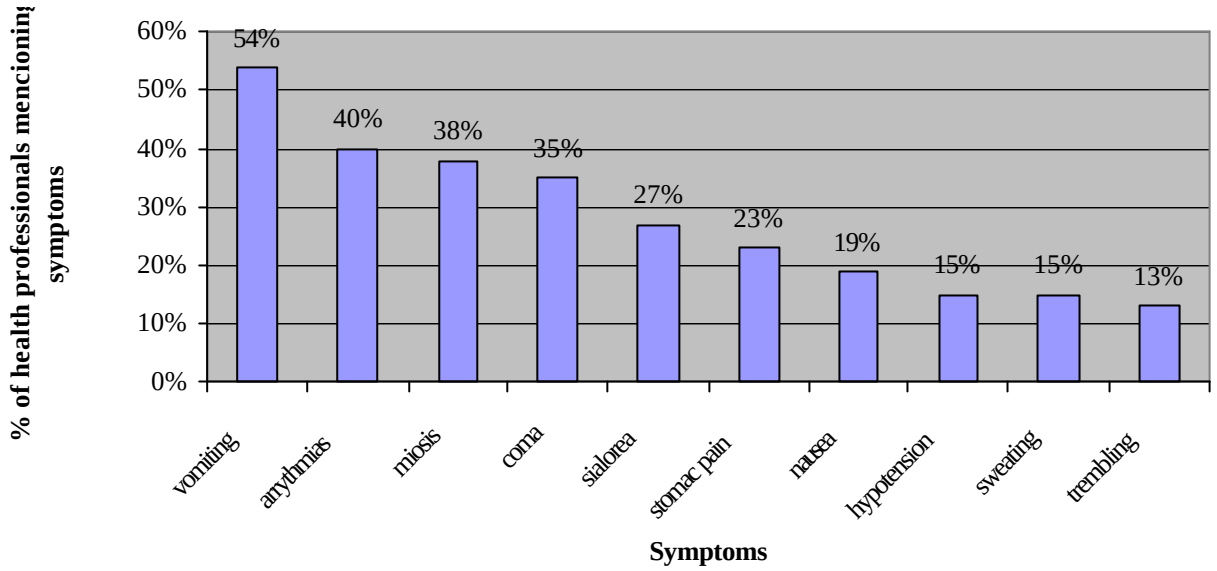
Table 9: Relevant questions to ask a when suspecting a pesticide poisoning

Question	Questions suggested by health personnel (n=48)
Which pesticides was used	34 ~ 71%
Which amount of pesticide was used	9 ~ 19%
How long time did you use it	12 ~ 25%
How was the contact (respiratory/dermal/oral)	18 ~ 38%
When did you use it	18 ~ 48%

Doctors mentioned more of these relevant diagnostic questions than the rest of the health personnel, 2.5 versus 1.5, p=0.04.

When asked about typical symptoms of acute poisoning with organophosphates, 73% (132/180) of the symptoms mentioned were of the muscarine receptor type, 7% (12/180) of the nicotine receptor type, and 20% (36/180) symptoms from the central nervous system. The most frequently mentioned symptoms are seen in Fig. 9.

Figure 9: Symptoms of acute pesticide poisoning mentioned by health professionals



Again doctors mention more relevant symptoms than nurses, mean 4.8 versus 2.6, $p<0.00$.

Suggestions for treatment were general measures such as gastric lavage mentioned by 55% (26/47), bathing, securing free airways, securing venous entrance, and control of vital signs all mentioned by less than 10% of the health personnel. Specific treatments, such as atropine and vitamin K, were suggested by 45% (21/47) of the respondents, without significant differences between doctors and nurses.

From the hospital files we saw that in 17 of the 27 cases of poisoning due to organophosphates specific treatment with atropine was given, and in 2 out of the 5 cases of poisoning due to marcoumar derivatives vitamin K was administered. The remaining treatments given were not specific, e.g. venoclisis (16%), furosemide (11%), antacida (47%), activated carbon (13%), gastric lavage (32%), vitamine B (3%), diazepam (3%), and a laxantia (3%). When it comes to chronic poisoning and treatment there was little knowledge, and no differences were found between the groups of health personnel; 21% mentioned neurologic problems, 4-6% mentioned dermatological problems, cancer and/or reproductive problems as signs of chronic damage due to pesticide poisoning.

Nine % (4/43) of the responders claimed that norms and procedures for diagnosis and treatment of acute pesticide poisonings existed in their health centre, while 37% (17/46) said they had the necessary drugs for specific treatments. None of the centers had possibilities for diagnosis and monitoring of cholinesterase levels.

6. DISCUSSION

Pesticides used

This study shows that a majority of the pesticides used are organophosphates belonging to the most toxic classes I and II. They were the classes mentioned most frequently both by the responding farmers and the health professionals and found in the ward registers as reasons for intoxications. The idea of banning the most toxic classes to lower the number non fatal as well as fatal APPs, be they due to suicidal attempts, accidents or occupationally related, is highly relevant, but would certainly need an extraordinary effort to succeed in Bolivia (31).

The study confirms that a majority of the farmers use pesticides banned or restricted through international conventions signed by Bolivia and some not even registered in Bolivia (5,7,15). Twenty six percent of the farmers were using the pesticides aldicarb, aldrin, DDT, and parathion not included in the list of registered pesticides in Bolivia and thus illegal, and 76 % used aldrin, DDT, metamidophos and parathion banned or restricted by the Rotterdam and/or Stockholm Conventions (42,43). One of the reasons for the use of illegal pesticides might be smuggling from neighboring countries (7), which is possible because of a lack of efficient control at the Bolivian borders and the publicly known bribery of customs, police, and civil servants, who were meant to exert control with these poisonous substances (5). Another reason might be the lack of coordination between the responsible ministries and the laws and decrees not followed as stated by some Bolivian authors (5,7,47). Some of these pesticides might be left-overs from former donations to Bolivia from high-income countries (5). The banned pesticides are sold on the streets and in ordinary shops due to a lack of control of the salesmen mostly operating without a license or with a faked license not complying with the Bolivian law for selling pesticides, as told to the author by the farmers and dealers themselves, and also discussed in other studies (5,7). On the streets, markets and in the shops everyone can buy pesticides that are stored and sold next to foodstuff, and where no effort is done to hide banned pesticides, see photo documentation in Annex 3. Paraquat one of the most popular pesticides for suicide world wide (9), is not found to be common in the study area, but is known from other areas like the coca producing Chapare region in Bolivia (5).

Bolivia has to deal with this obviously chaotic situation if they want to live up to international treaties and their own laws and regulations. This should mean a larger commitment by politicians and relevant authorities e.g. enforcing a better control with import licenses, firms and dealers selling pesticides, and a transparency of economic interests involved in the pesticide business. It could also imply a simplification of the many laws and authorities involved in the control with pesticides or at least a better coordination among them, as foreseen with the formation of CONAPLA, to stop the actual situation where “everybody is responsible so nobody is responsible” (7). A weakness of this study is that the only official statistics to support data from the interviews is the FAO statistics

showing a rapidly increasing value of the pesticides imported to the country, but getting official numbers from the government or pesticide importers without to much difficulty is not easy. We do not know the amount in value or weight of pesticides used by the farmers, although we did ask for number of times sprayed in each crop. Due to recall-bias, reliable figures from the farmers would probably demand continuous registration of the use by the farmers themselves.

General factors with an impact on farmers' health when handling pesticides

This study demonstrates a clear impact on farmer's health due to pesticides, being able to connect spraying circumstances and farmers experience of toxic symptoms and measurable changes in serum ChE activity. These straightforward and significant findings are rare in high-income countries such as Denmark (50), where the work environment in the former most heavily pesticide exposed working places such as the greenhouses has improved substantially during the last decades. If the findings in this study had happened in Denmark, the public, authorities and activist groups would probably have demanded major investigations, the closure of the work places, boycott of the products, etc. The reaction in Bolivia to former findings such as these is mostly silence, although sometimes a little discussion is raised in the press, mainly when journalists realize that they themselves are eating food contaminated with pesticides (5,7,15,23).

The linkage between number of times sprayed and classes of pesticide used with symptoms within the last month and ChE activity is also shown in other studies (10). This means that asking about toxic symptoms within the last month might to a certain extent replace the use of ChE measurements, which is interesting because blood-tests can be difficult to achieve and costly to analyze. The frequency of symptoms within the last month of 46% among those who have being spraying and 69% within the last year among those who use pesticides is a higher number than found in previous Bolivian studies, where figures from similar study areas as ours showed a lifetime experience of poisonings in 1989 of 10.5% and in 2000 of 48% (7,15). A study from Sri Lanka showed that 24% of responding farmers had suffered at least once from APP (51). A study from Nicaragua reported a frequency of 25% intoxication symptoms experienced by farmers during the last 12 months, 48% at one point in time and 11% the last month (52). This difference from other studies might be explained by: 1) the figures were calculated on the basis of the whole population interviewed, 2) many of the responders were not small-scale or subsistence farmers, and 3) the different kind of pesticides used. Using many pesticides of classes I and II, as the farmers do in our study, means a greater risk of experiencing occupational APPs. The increasing figures for APPs found compared to former studies from Bolivia, might reflect the increasing use of pesticides in Bolivia creating more problems of intoxications, as one study from Central America showed a positive correlation between kg of pesticides imported and the incidence rate of APPs (10).

A limitation of the study is the lack of possibility to differentiate between the seriousness of the toxic symptoms experienced within the past month after spraying, as we did not ask for the kind of and number of symptoms experienced, neither for how long the symptoms did last. Recall bias is another problem, as we do not know how long time people can recall APPs and symptoms connected with the specific episodes, although it must be presumed that the more serious the episodes the easier to recall.

Lack of education seems to be a risk factor for APPs in this study, which could be explained by e.g. inability to read instructions about pesticide use and necessary precautions. This finding is in contradiction to another study (51), but seems plausible as an increasing trend was found in our study showing that the better the education the more the labels of the pesticide containers were read. Marital status (being married or living as a couple) as a risk factor for APPs is not directly straightforward to explain. One reason could be that couples are growing more land and thus probably do use larger amounts of pesticides and spend more time spraying, though no influence of the size of land grown on toxic symptoms could be shown in this study.

Although negligible when controlling for times sprayed, subtropical climate might be a risk factor for APPs, as also found in the former study by INSO were lower numbers of APPs where found in the temperate climate and higher in the subtropical valleys (7). This could be explained by the bigger areas of land cultivated in the tropics, and the pressure of pests meaning more time spend spraying in the subtropical region. Skin absorption could be higher due to lighter clothes worn and open pores of the skin when sweating in the heat. But also the crops grown as a risk factor for APPs as indicated by the findings in our study could be an explanation.

In this study, age and sex did not show any significant influence on the risk of getting an APP, as shown in another study, where also smoking and alcohol use were shown to be of no significance (51).

Surprisingly the ecological farmers did have quite a low level of ChE, probably because they are spraying other crops than the ecologic coffee they grow or because the coffee might not be that ecologic. We also find significant differences in ChE levels for tomato and rice-growing farmers and for symptoms among tomato-growing farmers, which show the different pest pressures on the different crops. This has an implication for giving small credits for growing certain crops like tomatoes that can promote increasing use of pesticides indirectly and thus affecting the health of the farmers. To avoid these negative consequences a health risk assessment must be performed, when establishing such possibilities, e.g. coupling healthy practices of farming as a condition for getting the loans.

Occupational and hygienic factors with an impact on farmers' health when handling pesticides

Risk-factors for having had toxic symptoms within the last month after spraying and a lowered ChE-activity were as could be expected, although some studies do not find these connections (51,53).

Personal hygienic measures were surprisingly without any importance, which might reflect a gap between knowledge and practice, where people state what they ought to be doing instead of what they actually do, thus affecting the validity of the data by creating information-bias.

The use of PPE was very limited, which might be due to a lack of availability, lack of money to buy them and inappropriateness for use in hot climates as mentioned by other studies (9,25), and told to us by our respondents when discussing this matter.

Some dangerous practices like using pesticides to cure diseases as scabies and spraying houses for mosquitoes with the pesticide leftovers from spraying the fields are highly alarming and show us that although most farmers recognize the potential dangers of pesticides to man, animal and environment, they do not take this threat seriously, maybe reflecting a fatalistic view of life while living under tough life conditions. The same is true for tasting the mixture of the pesticide to judge its strength, washing the knapsack sprayers in the rivers and waterholes and leaving empty pesticide containers in the open having potential serious implications not only for the individual farmer, but also for other humans, animals and environment.

There should be little doubt about the importance of the use of PPE, a certain level of personal hygiene when spraying, and a knowledge of pesticide dangers as risk factors for toxic symptoms and depressed blood ChE-level in farmers using pesticides, which is confirmed by various studies (9,54-57). Concluding that PPE has no effect under tropical conditions as done by a group from Central America seems to be problematic considering the limited number of data presented as background for such a provocative conclusion (53). In a study from Malaysia no smoking while spraying, good sprayer conditions, wearing a hat while spraying and changing clothes immediately after spraying were shown to be protective against APPs (57).

A limitation of the interviews with the farmers is the non-random selection, which might restrict the ability of the study to generalize the findings to other regions, it should, however, not hamper the validity of the data. It is the author’s experience from 25 years of work among Bolivian subsistence farmers that the group of farmers participating in this study seemed to be quite representative for the small-scale farmers of these regions. The farmers participating are mostly men, reflecting the fact of the ‘machismo culture’, where mainly men are participating and expressing themselves in public meetings. We know that also women and sometimes children are spraying with pesticides and affected by it (7,23), but the actual study is not able to highlight this situation.

Causes of acute pesticide poisonings

The most common cause of non-fatal as well as fatal APPs as reported by the responding farmers were intentional ingestion followed by occupational poisonings and accidents. This is in good agreement with the ward data, where 92 % were due to suicidal attempt, 5.5% accidental and 2.5% occupational. In a study among women of APPs registered from 1995-2000 in Nicaragua, 16% were found to be for occupational reasons, 20% because of accidents, and 64% due to suicidal attempts (58). The percentages varied among the countries in Central America in the year 2000: 60% occupational APPs in Guatemala, 50% in Belize, 41% in Panama, 37% in Costa Rica, 33% in Nicaragua, 27% in El Salvador (10). In Sri Lanka 68% of serious APPs are reported to be due to intentional ingestion (59).

In Bolivia, like in other low-income countries, the popularity of committing suicide with pesticides might be due to the widely used very toxic pesticides and the easy access where everybody can buy pesticides, where pesticides are kept in the open and not stored in a locked up place (59,11). The connection with accessibility of the pesticide is probably also the reason for the most suicides being realized in the months October to April where pesticides are mostly used. On a personal plan our respondents tell us about common reasons for suicidal behavior being drunkenness, violence, unrequited love, family stress, depressions, physical illness and other similar social and socioeconomic problems, which is also mentioned by other authors (31,59).

Suicide was found to be common in younger age groups as also found in other studies (11). The suicides were seen to be quite evenly distributed between sexes, which is a change from earlier years in low-income countries, where men dominated (10, pers com F Konradsen).

The main cause of serious APPs in low-income countries though seems to be suicidal attempts, and the easy access to pesticides, poverty, and alcohol seem to constitute a deadly cocktail.

Significant differences in the incidence of APPs were found between the two tropical regions, where Caranavi had a higher incidence corresponding to the longer agricultural tradition in this municipality, compared to Guanay, a former mining municipality, now slowly changing to become an agricultural municipality. The same significant difference is seen in the two municipalities of the temperate region, where the higher incidence of APPs might be explained by the higher percentage of farmers growing pesticide intensive crops such as flowers and vegetables in Mecapaca, meaning easier access to pesticides in this municipality. Another explanation could be the ability of the hospitals to diagnose and treat poisonings, where Guanay as a medical post in comparison with the regional hospital in Caranavi has much less skilled manpower and resources. The same is true for Palca located quite close to La Paz and thus competing with the bigger hospitals of La Paz.

Registration, diagnose and treatment of acute pesticide poisonings

As seen from this and other studies, most APPs are ignored or treated with household remedies (34), and never reach the hospital for treatment or registration, making the under-registration of APPs substantial, calculated to be between 80-99% in most Central American countries (10). A reason for this is probably the familiarity with the APPs, known to be of short duration and often with only mild symptoms, as stated by our respondents and found by others (10).

The knowledge of pesticides, poisoning symptoms, and treatment was found to be poor among the health professionals in this study, reflected both in the answers to the questionnaires and in the ward registers, likewise protocols and remedies for handling APPs were lacking. This is also found by others, stating that as pesticide related diseases appear similar to many common medical conditions there is a general failure by doctors to recognize pesticide poisonings (14), and the few resources make it difficult for medical staff to handle APP in a correct manner (7,30). This is also contributing to the mentioned sub-registration of APPs.

In spite of this we could roughly estimate an incidence rate of severe poisoning varying from 38 to 107 cases per 100,000 persons, which seems plausible comparing with the regional incidence rate in Central America found to be 20 cases per 100,000 inhabitants, and rates in local areas being much higher e.g. 700 cases per 100,000 persons among banana plantation workers in Central America (10,58).

In our study we roughly estimate a case-fatality rate of 12%, which might be somewhat higher as we do not know the result of the treatment of the patients referred to the more specialized hospitals in La Paz. In Central America a case-fatality rate of 11% was found for the year 2000 (10).

7. CONCLUSION AND RECOMMENDATIONS

This study did find a complex of problems concerning pesticide use and poisonings in the study area populated mainly by small-scale farmers. The problems are of different kinds and therefore demand a variety of efforts to improve the situation.

The use of pesticides restricted or banned by international conventions signed by Bolivia and pesticides not registered and thus not allowed in Bolivia seem to be very common. Likewise the most toxic classes I and II are used by most of the farmers in the study area.

The health of the farmers is affected by the use of pesticides in agriculture. This is shown by more than half of the farmers claiming to have experienced toxic symptoms after spraying with pesticides. Symptoms that were significantly associated with the number of times sprayed and the toxic class of pesticide sprayed with. The same was found for serum choline-esterase activity, an enzyme whose activity is lowered by intoxications with organophosphates and carbamates.

A high level of education, reading instructions on the pesticide containers before use, using some personal protective equipment and not sucking or blowing the nozzle of the knapsack sprayer when obstructed were shown to be protective for symptoms after spraying. Reading instructions on pesticide containers before use was shown to be protective for maintaining a normal serum cholinesterase activity. Surprisingly personal hygiene measures when spraying did not seem to have any positive influence on acute pesticide poisoning.

More than sixty percent of the known reasons for non-fatal acute pesticide poisonings and more than ninety percent of the fatal ones were due to intentional ingestion as stated by the farmers. These figures were supported by the findings in the ward registers of the health facilities of the attachment areas of the study, where more than ninety percent of these serious poisonings were caused by self-harm. Many young people were among the serious suicidal attempts treated in hospitals, and most cases were seen in the spraying season from October to April. Farmers told about family problems, alcohol and illness being reasons for the suicidal attempts they heard of, and indeed easy access to pesticides, poverty, and alcohol seem to be a lethal cocktail.

The incidence of acute pesticide poisonings was roughly calculated to be 78 per 100.000 persons, comparable to figures found in other countries.

When it comes to diagnosis and treatment, knowledge among the health professionals seems to be lacking as shown by the answers to the questionnaires filled in by the personnel and confirmed when revising the hospital ward registers in the study area. A case-fatality rate for the catchment area is estimated to be 12% on the basis of the ward registers. The poor equipment and non-existence of treatment guidelines are also a problem for the health personnel. This is leading to sub-registration of pesticide poisoning being a potential problem for the planning and supervision of the central authorities.

To improve the situation, the coordination between the different governmental institutions and ministries should be made to function through the coordinating organ CONAPLA. Laws, regulations and responsibilities must be revised in order to simplify and eventually give the main tasks of regulation and control to one responsible governmental actor.

An option for education and a possibility for farmers to seek advice should be established, either through the state or the municipalities, the latter entity at the moment investing money in productive initiatives. The simple promotion of personal protective equipment is far too conservative to deal with the multifaceted problems. Outsourcing of the most toxic pesticides is a strategy supported internationally through conventions and regulations and is effective not only for occupational poisonings but also for accidental and suicidal cases. Strategies of integrated pest management must be applied, where farmers can immediately minimize the risk of occupational poisonings when handling pesticides and at the same time save money when not buying more than

the necessary amount of pesticides. Studies have shown that pesticide use can be decreased by at least 50% without reducing the yield by applying alternative traditional and ecological methods (53,60).

Suicides can be lowered by regulations (32) or establishing a minimum pesticide list as suggested by some authors (30,31), this would also have a positive effect on other reasons for APPs. Keeping pesticides locked up, enforcing the law by demanding license to pesticide dealers and eventually to farmers using pesticides allowing only persons with license to by and use pesticides, would restrict the accessibility being so crucial for these often sudden impulsive acts of suicidal attempts (11).

The knowledge of the health professionals about pesticide diagnosis and the treatment of poisonings could be improved by including this theme in refresher courses offered by the Bolivian health authorities regularly to their health personnel, and often financed by UN-organizations. A more permanent solution would be to include this topic in the curriculum of health sciences at university level which does not seem to be an overkill due to the magnitude of the problem and the size of the farming population in Bolivia. Pesticides are probably the largest toxicological problem in Bolivian context both for man and environment.

At last a kind of wide public education should be started, focusing on the problem in the mass medias and e.g. introduction of the theme in the public schools as done by the PLAG-BOL project providing education material to schools all over Bolivia.

ANNEX 1

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ANNEX 2

Table A: Symptoms of acute pesticide poisoning

Pesticide class	Symptoms of acute poisoning	Treatment
organochlorines	headache, trembling, dizziness, paralysis of the tongue/ lips/face muscles, vomiting and convulsions, irritability, sleeplessness, hypersensitivity to external stimuli	remove from exposure, symptomatic, symptoms will disappear in 1-3 days
organophosphates	tear flow, salivation, sweating, myosis, ptosis, blurred vision, read eyes, dyspnoe, cyanosis, coughing, oppression in the breast, running nose, arrhythmias, blood tension disturbances, increased urination and incontinence, paleness, nausea, vomiting, colic's, diarrhea, cramps, paralysis, ataxias, drowsiness, confusion, restlessness, lowered concentration, lack of memory, headache, coma	remove from exposure, atropine and oximer, symptomatic most symptoms disappear within days or weeks, some neurological symptoms might persist for months
carbamates	such as organophosphates	remove from exposure, atropine, symptomatic symptoms disappear within hours to days
pyrethroides	skin irritation and anesthesia, stomach pain, nausea, dizziness, muscular trembling, blurred vision, headache, fatigue, oppression in the breast, cramps, unconsciousness	remove from exposure, symptomatic symptoms disappear within a day, cramps may appear after weeks
fungicides (dithiocarbamates)	stomach pain, nausea, vomiting, headache, dizziness, blushing, muscular trembling, cramps	remove from exposure, symptomatic symptoms disappear within a day
herbicides (paraquat, diquat)	symptoms due to necrosis of the liver, the kidneys and fibrosis of the lungs, skin, eye and nail damage	remove from exposure, pump out, administrate activated carbon or haemodialysis, symptomatic treatment, symptoms can persist due to permanent damage to the tissues
rodenticides (anticoagulants)	bleedings from teeth, nose, skin, inner bleedings	vitamin K, fresh blood or plasma

Table B: Pesticides used in project area

Active ingredient	Commercial names	Toxic class	Generic class	Use	Mentioned in Stock-holm and/ or Rotter-dam convention	Not allowed in Bolivia
alfa-cypermethrin	Fastac, Nurelle, Polytrim	II	PY	I		
aldicarb	Temik	Ia	C	I		*
aldrin	Aldrin	O	OC	I	*	*
azoxystrobine	Priori	U		F		
benomyl	Benlate	U		F		
captan	Captan	U		F		
carbendazim	Bavistin, Match	U		F		
chlorothalonil	Bravo 500	U		F		
chlorpyrifos	Lorsban	II	OP	I		
copper oxychoride	Cupravit, Ramcaf	III		F		
cyfluthrin	Baytroid	II	PY	I		
cypermethrin	Cypermethrin, Mapex	II	PY	I		
DDT	DDT	II	OC	I	*	*
dimethoate	Dimethoate, Perfection	II	OP	I		
difenoconazole	Score	III		F		
fenthion	Baitex	II	OP	I		
firponil	Blitz	II		I		
lambda cyhalotrin	Karate	II	PY	I		
malathion	Folimir	III	OP	I		
mancozeb	Mancozeb, Thiram	U		F		
maneb	Padam, Dithane	U		F		
methamidophos	Caporal, Metagol, Patrole, Stermin, Tamaron, Todoron	Ib	OP	I	*	
metalaxyl	Ridomil	III		F		
metribuzin	Lexone	II		H		
monocrotophos	Monodrin	Ib	OP	I	* (in suggestion for R)	
paraquat	Gramoxone	II		H		
parathion	Folidol, Parathion	Ia	OP	I	*	*
permethrin	Ambusch	II	PY	I		
propenofos	Curacron	II	OP	I		
propineb	Antracol	U		H		
spinosad	Succes	U		I		
sulphur	Azufre, Cumulo	U		F,I		
sulfluramid	Mirex	III		I		
tebuconazol	Titano	III		F		

(C=carbamate, OC=organochloride, OP=organophosphate, PY=pyretroide)

ANNEX 3

ANNEX 4

DIALOGOS DANIDA **CARE**
BOLIVIA
INSTITUTO NACIONAL DE SALUD OCUPACIONAL
PROYECTO PLAGBOL **Nro** ☐

Municipio _____

ENTREVISTA A LOS AGRICULTORES

Nombre del entrevistador:_____ Fecha de la entrevista _____

Nombre del entrevistado _____ / _____ / _____

Lugar de la entrevista: Comunidad/Colonia _____

A. Datos personales

1. Que edad tienes?_____
2. Estado civil 1. Casado ☐ 2. Soltero ☐ 3. Concubino ☐ 4. Otro ☐
3. Sabes leer 1. Si ☐ 2. No ☐ 4. Sabes escribir 1. Si ☐ 2. No ☐
4. Que nivel de educacion tienes:
   1. Analfabeta ☐ 2. Primaria ☐ 3.Secundaria ☐ 4.Técnica ☐ 5. Universitari ☐
5. Cuantos años has trabajado en la agricultura?_____
6. Actualmente sufres de alguna enfermedad? 1. Si ☐ 2. No ☐
7. Si la anterior respuesta es si, indique cual enfermedad? _____
8. Actualmente estás tomando algún medicamento ? ☐ 1. Si ☐ 2. No
9. Si la anterior respuesta es si, indique que medicamento?

   _____
10. Fumas a diario ? 1. Si ☐ 2. No ☐ 3. A veces ☐

B. Compra de plaguicidas y nivel de instruccíón

11. De donde compras los plaguicidas? _____
12. Cuando compras un plaguicida recibes algúna información sobre el peligro que tiene?
    1. Si ☐ 2. No ☐ 3. A veces ☐
13. Cuando compras un plaguicida recibes instruccion del vendedor, sobre como se usa y para que sirve?
    1. Si ☐ 2. No ☐ 3. A veces ☐
14. Los frascos de plaguicidas tienen etiqueta cuando los compras?
    1. Si ☐ 2. No ☐ 3. A veces ☐
15. Cuando compras un plaguicida lees las etiquetas? 1. Si ☐ 2. No ☐ 3. A veces ☐
16. Has participado en algún cursillo sobre el uso y manejo de plaguicidas?
    1. Si ☐ 2. No ☐
17. Cuantas veces has participado en estos cursillos? .....

☐ ☐ ☐

18. Eran cursillos de? 1. Horas 2. Un día 3. Varios días

19. Cuando recibiste un cursillo la ultima vez? .....

20. Mediante que organizacion recibiste el cursillo?_____

21 Que has aprendido en el/los cursillos a los que asististe ?

_____

22. Que te faltaria o gustaría aprender?

_____

_____

C. Datos de los cultivos sembrados, uso de plaguicidas y opiniones sobre su accionar y sus alternativas

23.Actualmente cuantas hectarias estás sembrando? _____

24.Quienes te ayudan en el trabajo diario en la finca? _____

25.Quienes te ayudan cuando con las fumigas?_____

26.Cuales son tus 5 principales cultivos en donde usas plaguicidas? Y Que cantidad sembrada tienes?

Cultivo	**Hectarias sembradas**
1._____	1._____
2._____	2._____
3._____	3._____
4._____	4._____
5._____	5._____

27.Que plaquicidas y con que frecuencia los utilizas en tus cultivos principales?

Cultivo	**Plagas**	**Plaguicidas usados**	**Fumigaciones al año**	**Cuanto tiempo fumigas**
1._____	1._____	1._____	1._____	1._____
	2._____	2._____		
	3._____	3._____		
2._____	1._____	1._____	2._____	2._____
	2._____	2._____		
	3._____	3._____		
3._____	1._____	1._____	3._____	3._____
	2._____	2._____		
	3._____	3._____		
4._____	1._____	1._____	4._____	4._____
	2._____	2._____		
	3._____	3._____		

5._____ 1._____ 1._____ 5._____ 5._____

2._____ 2._____

3._____ 3._____

28.Piensas que el uso de plaguicidas se podria disminuir en algunos cultivos sin que se perjudique tu cosecha?

1. Si ☐ 2. No ☐ No Sé /N.R ☐

29.Si la respuesta anterior es es si, como se podría disminuir?

_____

_____

30.Conoces algunos metodos alternativos/ecologicos para el control de las plagas?

1. Si ☐ 2. No ☐

31.Si la respuesta anterior es sí , indique que métodos conoce

_____

D. La mezcla y la fumigación

32.Estas usando protección personal cuando preparas el caldo? 1. Si ☐ 2. No ☐

33.Que tipo de protección estas usando (puede seleccionar varias respuestas)?

1. Camisa manga larga ☐ 2. Pantalon largo ☐
3. Guantes ☐ 4. Sombrero ☐
5. Botas ☐ 6. Delantal cuero/tela ☐
7. Mascarrilla con filtro ☐ 8. Mascarilla sin filtro ☐
9. Otros ☐

34.Estas usando protección personal cuando fumigas? 1. Si ☐ 2. No ☐

35.Que tipo de protección estas usando (puede seleccionar varias respuestas)?

1. Camisa manga larga ☐ 2. Pantalon largo ☐
3. Guantes ☐ 4. Sombrero ☐
5. Botas ☐ 6. Delantal cuero/tela ☐
7. Mascarrilla con filtro ☐ 8. Mascarilla sin filtro ☐
9. Otros ☐

36.Sabes que significan los colores de las etiquetas y sabes cuales son son?

_____

37.Cual es el más peligroso? _____

38.Cual es el menos peligroso? _____

39.Estas haciendo alguna higiene personal cuando manejas plaguicidas? 1. Si ☐ 2. No ☐

40.Si la anterior respuesta es si que estas haciendo (puede seleccionar varias respuestas)?

1. Lavar las manos inmediadamente despues de mezclar y fumigar ☐

☐

2. Lavar las manos antes de comer
3. Lavar las manos antes de fumar ☐
4. Lavar las manos antes de orinar ☐
5. Lavar el cuerpo inmediadamente despues de fumigar ☐
6. Cambiar la ropa inmediadamente despues de fumigar ☐
7. Otros (cual?)_____

41.Pigchas,comes o fumas mientras fumigas en la chacra? 1. Si ☐ 2. No ☐

42.Que tiempo antes de la cosecha estas fumigando?(Marcar con una cruz)

	horas	**dias**	**semanas**
Cultivo 1	.....	.....	.....
Cultivo 2	....	.....	.....
Cultivo 3.	.....	.....	.....
Cultivo 4	..... .	.....	.....
Cultivo 5.	.....	.....	.....

43.Estas fumigando los productos antes de llevarlos al mercado? 1. Si ☐ 2. No ☐

44.Si la anterior respuesta es sí, indique que productos

_____

_____

45.En Total cuantas veces has fumigado durante el ultimo mes?_____

46.Avisas a otros cuando fumigas para que no entren al terreno fumigado?

1. Si ☐ 2.No ☐ 3. A veces ☐

47.Estás fumigando según: 1. Planificación ☐ 2. Necesidad ☐

48.Qué plaguicidas has usado en el ultimo més y cuando ?

	Cuales	**Cuando**
1.-	.....	.....
2. .-	.....	.....
3. .-	.....	.....
4. .-	.....	.....
5. .-	.....	.....

49. A que tiempo de fumigar vuelve a ingresar al terreno fumigado? (Marque con una cruz)

	el mismo día	al día siguente	después de 2 días
Cultivo 1.	.....	.....	.....
Cultivo 2.	.....	.....	.....
Cultivo 3.	.....	.....	.....
Cultivo 4.	.....	.....	.....

Cultivo 5. ....

50.Que equipo utilizas para fumigar?

1. Mochila ☐ 2. Equipo adaptado☐ Cual..... 3.Otros ☐Cual.....

51 Revisas tu mochila antes de fumigar? 1. Si ☐ 2. No ☐ 3. A veces ☐

52 Si la respuesta anterior es es si, como lo revisas?

_____53

.Soplas las boquillas de la bomba cuando se obstruyen? 1. Si☐ 2. No ☐

3. A veces ☐

54 Donde preparas el caldo (puede seleccionar varias respuestas)

1. En la casa ☐ 2. En el terreno ☐ 3. Cerca a una fuente de agua ☐

4.Otros ☐

55.Como estas controlando las dosis de la mezcla?

1. Lo pruebas2.☐ 2. Lo mides con cuchara ☐ 3. Lo mides con tapa ☐

4. Lo mides con copa ☐ 5. Según experiencia ☐

56.Mezclas varias tipos de plaguicidas en una sola preparación?

1. Si ☐ 2. No ☐ 3 .A veces ☐

57.Si la respuesta anterior es es si, indique que plaguicidas mezcla?

_____

58.Donde guardas los plaguicidas? (puede seleccionar varias respuestas)

1. Dentro de la casa ☐ 2. Fuera de la casa ☐

3. Bajo candado ☐

59.Que haces con los envases vacìos de los plaguicidas ? (puede seleccionar varias respuestas)

1. Los usas para guardar alimentos/agua ☐ 2. Los entierras ☐

3. Los quemas ☐ 4. Los bota a la basura ☐ 5. Los boto al rio ☐

60 Que haces con el caldo que sobra ?(puede seleccionar varias respuestas)

1. Lo botas al rio 2. ☐ botas al terreno ☐3. Lo entierras ☐

4. Los bota a la basura 5. ☐unca sobra ☐

61 Lavas el equipo de fumigar despues de usarlo? 1. Si ☐ 2. No ☐ 3. A Veces ☐

62 Si la respuesta anterior es sí, donde lo lavas (puede seleccionar varias respuestas)?

1. En el rio ☐ 2. En el vertiente ☐ 3.Cerca de fuente de agua ☐

4. En el terreno ☐ 5. En la casa ☐

E. Conocimientos de los efectos adversos a la salud ocasiona dos por los plaguicidas:

63 Crees que los plaguicidas pueden tener efectos dañinos a tu salud?

1. Si ☐ 2. No ☐ 3. No se ☐

64 Si Conoces algunos efectos dañinos a la salud podrías mencionar algunos?

_____

65.Para Usted una intoxicación aguda por plaguicidas significa:– (puede seleccionar varias respuestas)

1. Deja a la persona muy mal, salivando, con calambres, y necesita de ayuda ☐
2. Puede dar pocos sintomas como mareo y dolor de cabeza ☐
3. Puede afectar solo la respiración ☐
4. Puede afectar solo la piel de las personas ☐
5. Puede afectar solo las uñas y los ojo ☐

66.Dentro del ultimo año te has sentido mal despues de haber fumigado? 1. Si ☐ 2. No ☐

67.Si es si, que has sentido, despues de haber fumigado (puede seleccionar varias respuestas)

1. Ganas de vomitar	☐	2. Dolor de cabeza	☐
3. Vista turbia	☐	4. Temblando los manos	☐
5. Mareos	☐	6. Difilcutad respiratoria	☐
7. Salivación	☐	8. Cansancio	☐
9. Piel irritada	☐	10. Falta de concentración	☐
11. Debilidad muscular	☐	12. Otros, cuales	☐

68.Cuantas veces durante el ultimo año has sentido algunos de estos sintomas despues de haber fumigado?.....

69.Que plaguicidas has usado antes de sentir estos sintomas?.....

70.Que tiempo duran los efectos? 1. Horas ☐ 2. Días ☐ 3. Semanas ☐

71.Que haces para curarte (puede seleccionar varias respuestas)?

1. Nada ☐ 2. Remedios caseros ☐ 3. Voy al centro de salud ☐

72.Cuantas veces te has sentido mal despues de haber mezclado o fumigado en toda tu vida?

73.Cuantas veces te has sentido mal despues de haber mezclado o fumigado durante el ultimo mes?.....

74.Que plaguicidas has usado durante el ultimo més antes de sentir estos sintomas?

_____

75.Alguien en tu familia se ha sentido mal despues del contacto con plaguicidas?1.Si ☐ 2. N ☐

76.Han habido intoxicaciones por plaguicidas aqui en la comunidad, dentro de los ultimos 5 años?

1. Si 2. No ☐ ☐

77.Porque se han intoxicado?Y Cuántos fueron

		Nro
1. accidental	☐	.....
2. intento suicidio	☐	.....
	☐	

3. laboral .....

4. Otros ☐ .....

78.Cuando fue el ultimo caso?.....

79.Han habido muertos por plaguicidas aqui en la comunidad, dentro de los ultimos 5 años?

1. Si ☐ 2. No ☐

80.Porque se han muerto?

Nro

1. accidental ☐ .....
2. intento suicidio ☐ .....
3. laboral ☐ .....
4. Otros ☐ .....

81.Cuando fue el ultimo caso?.....

82.Hay diferencia en el efecto venenoso de los plaguicidas? 1. Si ☐ 2. No ☐

3. No se ☐

83.Cuales son los plaguicidas más fuertes que utilizas?

1 ..... 2..... 3. ..... 4. .....5.....

84.Cuales son los plaguicidas menos fuertes que utilizas?

1..... 2.....3.....4. .....5.....

85.Crees que los plaguicidas pueden tener efectos dañinos a tu familia?

1. Si ☐ 2. No ☐ 3. No se ☐

86.Si la anterior respuesta es si , indica que efectos?

_____

87.Crees que los plaguicidas pueden tener efectos dañinos a tus animales?

1. Si ☐ 2. No ☐ 3. No se ☐

88.Si la anterior respuesta es si , indica que efectos

_____

89.Crees que los plaguicidas pueden tener efectos dañinos al medio ambiente? (suelo, agua, aire)

1. Si ☐ 2. No ☐ 3. No se ☐

90.Si la anterior respuesta es si , indica que efectos

_____

91.Aparte de fumigar los cultivos para que otra cosa utilizas los plaguicidas?

1. Fumigar mi casa ☐
2. Curar granos y semilla ☐
3. Uso en personas (parasitos, piojos) ☐

4. Otras actividades ☐

OBSERVACIONES

.....

.....

.....

.....

.....

Firma del Encuestador

ANNEX 5

ANNEX 6

ANNEX 7

MINISTERIO DE SALUD Y PREVISION SOCIAL

INSTITUTO NACIONAL DE SALUD OCUPACIONAL
CARE BOLIVIA - DIALOGOS DANIDA

PROYECTO PLAG-BOL

INTOXICACIÓN POR PLAGUICIDAS: MONITOREO BIOLÓGICO DE NIVELES DE ENZIMA COLINESTERASA EN SANGRE DE AGRICULTORES EXPUESTOS Y NO EXPUESTOS A PLAGUICIDAS

CARTA DE CONSENTIMIENTO INFORMADO

El Ministerio de Salud y Previsión Social , a través del Instituto Nacional de Salud Ocupacional (INSO), en coordinación con CARE BOLIVIA y con el financiamiento de DIALOGOS - DANIDA, viene desarrollando un Proyecto Integral de capacitación al personal de Salud, educación y a los propios agricultores sobre el uso y manejo adecuado de plaguicidas, daños a la salud y al medio ambiente que producen y métodos alternativos de control de Plagas. Para tal efecto necesitamos recolectar una serie de datos que nos permitan elaborar los módulos de capacitación y es por ello que solicitamos de su valiosa ayuda en el llenado de las hojas de entrevista . Asimismo solicitamos su consentimiento para tomarle una muestra de sangre que nos permitirá ver si está o no envenenado con plaguicidas y si tiene alguna otra enfermedad del hígado.

En las muestras de sangre se analizarán algunos elementos que nos permiten saber si usted tiene o no plaguicidas en su organismo y si tiene alguna enfermedad en el hígado. En caso de que así fuere el resultado se lo notificaremos por escrito y se le hará saber las medidas y/o tratamiento que debe realizar. Estos procedimientos serán llevados a cabo por personal capacitado y para la muestra se utilizara material estéril y desechable.

Toda la información que usted nos proporcione, así como el resultado del análisis de sangre es completamente confidencial y los usaremos solamente en conjunto con los resultados de los demás participantes. Asimismo todos los estudios aquí referidos no tendrán ningún costo. Usted podrá no aceptar participar de este estudio si así lo desea, sin embargo consideramos que es de mucha importancia que usted participe en este estudio.

Nro:
Lugar y Fecha:

Habiendo leído y/o recibido la información referente al estudio (en la hoja 1 de este formulario de consentimiento informado), y dado que los propósitos han sido explicados a mi satisfacción, otorgo mi consentimiento para mi participación en este estudio.

NOMBRE: ——————————— *FIRMA* ———————

ENTREVISTADOR ——————————— *FIRMA* ———————

TESTIGO ——————————— *FIRMA* ———————