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Opportunities and challenges of food production for human health and the environment in the Americas: *Challenges for public health*

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ABSTRACT

Resilient food production and supply chains are critical for achieving food security and public health. While attention is directed toward food safety as a public health priority, little evidence exists of a structured approach to evaluate and mitigate the biological, chemical, occupational, economic and psychosocial health risks associated with the food system as a whole. Failure to address these risks through a more integrated holistic approach places Latin American countries in a clear disadvantage to protect public health optimally and take full control of their economic potential by operating efficiently in the world food-trade. A multi-sector, trans-disciplinary approach is necessary to assure food security while effectively managing the health risks for humans, animals and the ecosystem. Risk analysis is proposed as a preventive approach to manage the risks using a set of tools to rigorously, objectively and scientifically assess food chain risks based on local realities. A holistic farm-to-table risk analysis approach improves our understanding of key issues and helps focus resources and interventions on particular points of the food chain where they are most necessary, useful and/or cost-effective for protecting public health.

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INTRODUCTION

Global food security involves access and availability of affordable, safe and nutritious food for all. While this broad concept of food security has been recognized by the countries of the world as a basic human right, public health typically looks at food solely through the lenses of food safety and nutrition. Achieving global food security requires the delivery of safe and nutritious food through extensive supply chains that connect food producers , food processors, distributors, retail and food service to consumers. Global food security is a shared responsibility that requires coordinated efforts at every stage of the food production and supply chain along with government and inter-governmental standard-setting and regulation. Furthermore, public heath must consider the health risks associated with the food production, processing and supply chains as well as the safety and nutrition of the food itself.

ANTECEDENTS

Food safety and nutrition are basic foundations for health. While food was solely the responsibility of the individual and family unit in the days of hunter-gatherer societies, the growth of societies and dramatic population increases globally mean that most of today's consumers rely on a myriad of local and global food systems for their daily nutrition. These food production and supply chains range from simple to complex, delivering an increasing variety of foods to meet consumer demands and their increased purchasing power. A mixture of formal and informal food chains exists in every country [1].

The World Health Organization has estimated the regional cause-specific mortality for the year 2008 (Table 1) [2].

Cause	**WORLD**		**Low and Middle income The Americas Region**	
Population (000)	*6,737.480 (000)*	*% total*	*568.578 (000)*	*% total*
TOTAL Deaths	56,888	100.0	3,374	100.0
Infectious and parasitic diseases	8,721	15.3	212	6.3
Diarrheal diseases	2,464	4.3	34	1.0
Nutritional deficiencies	418	0.7	49	1.4
Unintentional injuries	3,619	6.4	213	6.3
Poisoning	252	0.4	4	0.1
Intentional injuries	1,510	2.7	178	5.3
Self-inflicted	782	1.4	33	1.0

Table 1: Causes of death 2008 (adapted from WHO website)

The table shows infectious and parasitic diseases (8.7 million deaths) corresponded to 15.3% of total deaths globally and diarrheal diseases accounted for 4.3% [2]. Focusing on the low- and middle-income countries of the Latin American and Caribbean Sub-region, 34,000 deaths were attributed to diarrheal diseases which corresponded to 1% of total deaths and 6 deaths per 100,000 population. Nutritional deficiencies (protein-energy malnutrition, iodine deficiency, vitamin A deficiency and iron-deficiency anemia), accounted for 0.7% of total deaths globally and 1.4% of total deaths in the Latin American region for with 8.8 deaths per 100,000 population [2]. It is difficult to estimate from these data what proportion of the deaths is due to other risks related to the food production chain such as occupational accidents, chemical exposure and psychiatric disease. Using

disability-adjusted life years (DALY – a measure of years of healthy life lost that gives more weight to non-fatal loss of health and deaths at younger ages), unsafe water, sanitation and hygiene (which has an important food safety component) was positioned as the fourth leading cause of global risks for burden of disease in the world and the second cause for low-income countries [3].

Global food security and public health require an intricate web of systems of production, processing, and distribution of food around the world. Therefore, a complete consideration of the public health challenges and opportunities associated with food production and supply chains requires consideration of both their direct and indirect implications. Five broad areas of risk emerge from this systems perspective on food: i) *Biological* -food-borne pathogens, biological toxins, viruses and parasites that may be zoonotic (transmitted from animals to humans) or non-zoonotic (affecting only people) ; ii) *chemical* -natural toxicants, externally introduced chemical (pesticides, steroids, antibiotics, and food additives) and environmental contaminants (heavy metals); iii) *occupational* -human health risks associated with agricultural and food processing practices including close contact with animals and farming and manufacturing equipment, as well as exposure to zoonotic pathogens, pesticides, herbicides, and other chemical and biological products; iv) *economic* - decreased economic activity that may undermine public and private budgets, thereby affected the provision of basic health promotion and public health programs; and v) *psycho-social* -depression and suicide from interruptions of the food production and supply chains, loss of livelihoods and the disruption of social/cultural stability of communities). All five of these areas of risk must be considered as part of today's public health challenges and opportunities related to global food security. Figure 1 shows a representation of the food supply chain along with the mitigation strategies and risks that belong to each of the food chain steps.

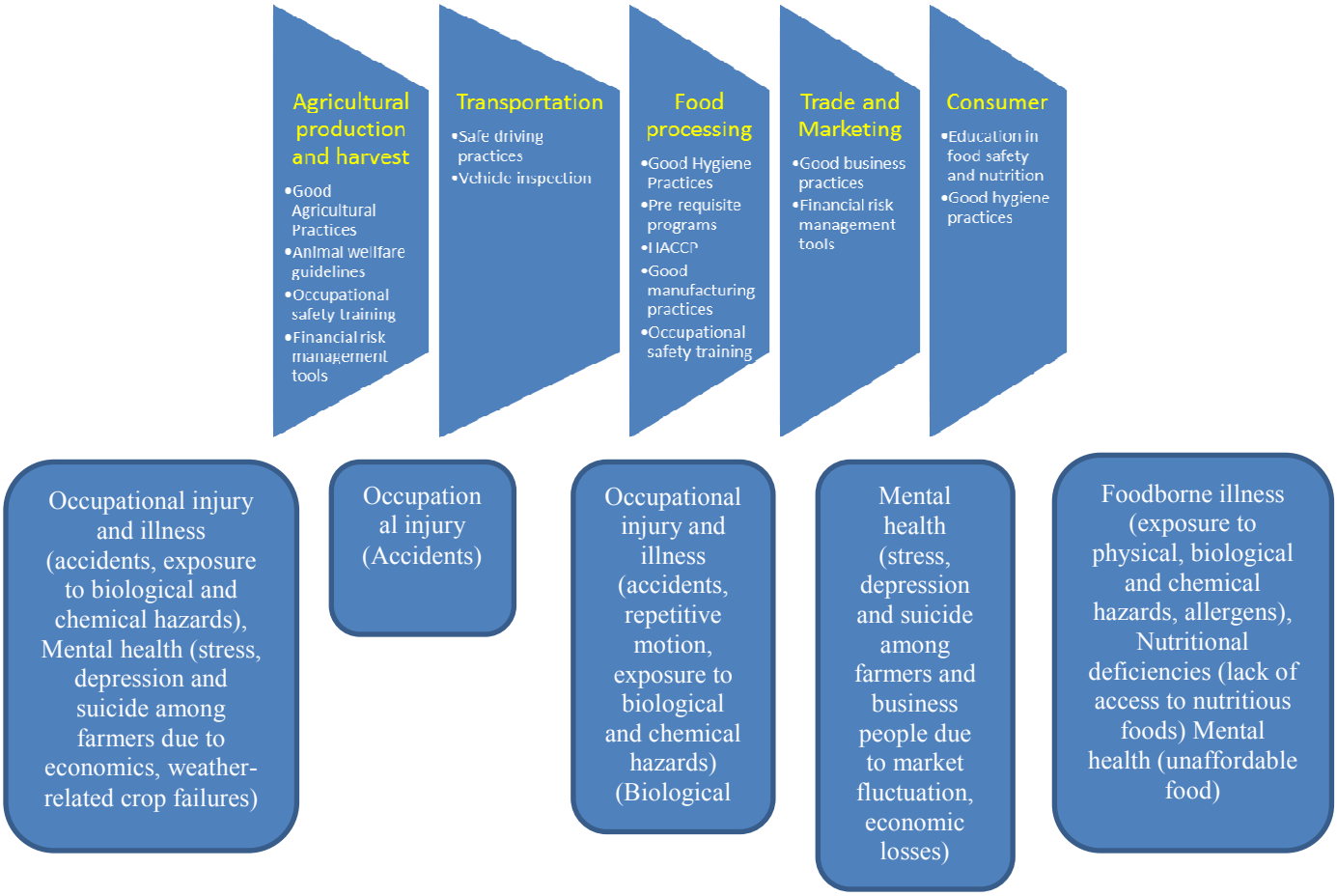

Figure 1: Food supply chain along with control measures and risks.

A proactive multi-sector, trans-disciplinary approach is necessary to assure food security while effectively managing these other health risks for humans, animals and the ecosystem. Unfortunately, the orientation of most public health and regulatory systems tends to be reactive and defined by narrow legal authorities and prescriptive enforcement criteria instead of using a flexible and dynamic preventive approach to assess and manage these inter-related risks simultaneously.

Unique public health challenges and opportunities of the food and supply chains in Latin America

Latin America and the Caribbean Sub-region have a long tradition in the production of traditional and artisanal foods, some of which are sold in traditional markets and even directly on the streets. However, in recent decades, this activity has increased due mainly to socio-economic causes such as the deterioration of the living conditions of rural areas that has fueled a growing migration to the cities and an expansion of poverty. The food sold on the streets can be considered a problem (food safety concerns), a challenge and an opportunity for development [4].

The agricultural sector is a giant engine for the economies of many Latin American countries, especially for the exports of agricultural commodities to international markets. Among the identified food production and supply chain risks in Latin America are the lack of an integrative and multi-sectorial approach for approaching the public health issues surrounding the food system, the lack of educational and sensitization programs about the importance of public health measures including occupational health and food safety, the lack of implementation of good agricultural practices (GAP), the lack of a standardized program of vaccination, eradication and prevention of endemic diseases, the overuse and misuse of pesticides and antibiotics, and the lack of effective pest control programs. All of these situations compromise the food safety record and endemic animal disease status of individual countries and can dramatically affect public health, as well as, the global demand and the perception of quality and safety of their exports to demanding markets.

We propose the risk analysis framework as a multi-sectorial and multidisciplinary approach to ensure food security, while effectively managing the health risks for humans, animals and the ecosystem associated with food production and supply chains.

Risk analysis: a multi-sectorial and trans-disciplinary approach to mitigate risks in the food production and supply chains.

Profound changes are occurring in the way countries manage food-chain risks at the national level. Food safety is changing from primarily an individual responsibility for food preparation at home, to a national priority for both public health and global trade. The regulation of food safety is evolving from mere adoption of international standards to a rigorous, objective and scientific analysis of biological and chemical hazards/risks based on local realities. This process has been called “evaluate first-decision thereafter” [5]. The complex nature of food systems requires relevant public health issues to be managed with a “systems-thinking” where the risks are evaluated in the context of the entire production and supply chain. Achieving this integrative approach for public health, requires the engagement of a number of public bodies related to the food production chain management (Agriculture, Health, Fishery, Labor and Commerce Ministries) as well as a broad range of stakeholders including consumers associations in the development of multidisciplinary scientific teams,.

Risk analysis can be used as a systems-level management tool to rigorously, objectively and scientifically analyze and control food chain risks based on local realities. Figure 2 shows the three interrelated components within risk analysis, risk assessment, risk management and risk communication.

Figure 2: Components of the risk analysis framework.

Risk analysis provides a structured and explicit approach for assessing and managing the risks associated with food chains [6]. Risk assessment provides a logical approach for estimating the risk for the human health of the presence of a hazard(s) based on available scientific information. The risk estimates reflect both the available scientific knowledge as well as accounting for biological variability and model uncertainty.

Food- related risk analysis most often is applied for a specific microbe, toxin or allergen/food item combination. The analysis of such a specific combination allows full attention to be placed on a very detailed set of questions. While very useful, this approach has serious limitations, because the design is so specific that one analysis cannot be generalized to other situations. An alternative approach examines a food product through the entire farm-to-table continuum allowing for evaluation of the relative contributions of risk at different stages and a comparison of the effectiveness and likelihood of success for different intervention strategies. Use of this holistic approach to develop scientifically-sound prevention and control strategies, that achieve a high level of voluntary compliance and a significant degree of risk reduction require extensive stakeholder engagement throughout the process in order to garner the most relevant information and the greatest degree of buy-in.

The farm-to-table holistic approach to risk analysis improves our understanding of key issues and helps focus resources and interventions on the specific stages of the food chain, where they are most necessary and/or useful for protecting public health. This approach also helps to identify where there are data gaps and additional information may be needed, thereby facilitating the identification of research needs, the establishment of research priorities, and the design of commissioned studies. The lack of a structured approach to evaluate and mitigate the food system risks place the Latin American countries in a clear disadvantage to protect public health optimally, and take full control of their economic potential by operating efficiently in the world food-trade.

An effective risk assessment, with a “systems-thinking” approach requires scientific multidisciplinary teams able to assess the risks and propose risk mitigation strategies aimed at critical control points in the food chain. The scientific evidence that emerges from risk assessment provides a basis for establishing sanitary and phytosanitary

policies by national public bodies in charge of food safety regulations (mainly Agriculture, Health and Commerce Ministries), known in the risk analysis paradigm as risk managers, thus increasing the role of science in the process of decision making [6]. Effective risk management requires a common effort among different ministries and key stakeholders along the food production and supply chain as well as the scientific community, a process known as risk communication.

The international standards, guidelines and recommendations for risk analysis according to the Sanitary and Phytosanitary Agreement of the World Trade Organization are provided by the Codex Alimentarius Commission (CAC) for biological and chemical risks in foods, the World Organization for Animal Health (OIE) for animal health and zoonoses risks and the International Plant Protection Convention (IPPC) for phytosanitary risks. However, guidelines for risk analysis of new emerging risks from occupational and psycho-social health hazards are still underdeveloped.

The introduction of risk analysis at the national level is facilitated by creation of multi-sectorial government entities responsible for the food safety (i.e., food safety agencies, commissions). Peru, Chile and Panama provide good examples for that approach. Peru created in 2008 the Comisión Multisectorial Permanente de Inocuidad Alimentaria (COMPIAL) based on the 2008 food safety law, governed by the Ministerio de Salud and constituted also by the Ministerio de Agricultura and Ministerio de Producción [7]. The COMPIAL has functioning regulations and is assigned the coordination and follow-up of the implementation of the food safety law in the different levels of Government as well as coordination with consumers and different stakeholders involved in any of the stages of the food chain. Chile created the Agencia Chilena para la Inocuidad de Alimentos (ACHIPIA) in 2005, located inside the Ministerio de Agricultura and composed also by the Ministerio General de la Presidencia, Ministerio de Salud, Ministerio de Asuntos Exteriores y Ministerio de Economía [8]. ACHIPIA is a Presidential Advisory Commission whose main functions are the development of an integrated national system of quality and food safety, and coordinating agencies with responsibilities associated with them through establishing networks with the Academy, the productive sector and consumers. Panamá created in 2006 the Autoridad Panameña en Seguridad de Alimentos (AUPSA) composed by the Ministerio de Desarrollo Agropecuario, Ministerio de Salud y Ministerio de Comercio e Industrias, which it is the leading national body created to ensure compliance with and implementation of food safety laws and regulations of food introduced into the national territory, under criteria strictly scientific and technical [9].

Case studies in Latin America for multi-sectorial and trans-disciplinary approaches to mitigate the food chain risks

Biological Hazards

Estimation of foodborne disease burden is an essential tool to understand the real impact of the risks posed by the food production chain. However, the lack of systematic studies on the real cost of foodborne diseases burden underestimates their effects and skews the correct allocation of resources. It is believed that more than 60 percent of emerging infectious diseases have zoonotic origins, yet scientists acknowledge a deficit in high-consequence zoonotic pathogen research and a misallocation of surveillance resources. The impact of zoonotic epidemics from 1995 to 2008, many of them preventable, exceeded $120 billion globally [10]. In the USA, the health impact of foodborne diseases was estimated based on the monetary cost of illness and loss of Quality Adjusted Life Years (QALYs) [11]. Fourteen (14) foodborne pathogens caused 14.1 billion (2009 dollars) in cost of illness, and loss of over 61,000 QALYs per year. More than 90 percent of this health burden was caused by five pathogens: *Salmonella* spp., *Campylobacter* spp., *Listeria monocytogenes*, *Toxoplasma gondii* and norovirus. *Campylobacter* in poultry ranked highest in the pathogen-food combinations in both QALYs and dollars Poultry was estimated to have the greatest public health impact among foods, responsible for an estimated $2.4 billion in estimated costs of illness annually and loss of 15,000 QALY a year [11]. Unfortunately, no similar estimates are available for other countries in the Americas.

Traditionally, biological risks have been controlled by two primary systems, good hygienic practices (GHPs) and the hazard analysis of critical control points (HACCP). The latter is a management tool to identify the hazards that are likely to occur in a food-specific chain followed by the implementation of mitigations to control those hazards to an acceptable level. These systems have been widely and successfully applied in the private sector. However, throughout the years food safety has become increasingly complex and new tools are needed to address these new realities. Microbial risk assessment (MRA) techniques provide additional tools to HACCP plans for relating food manufacturing operations to public health goals and providing more objective means for establishing critical limits that need to be achieved at a critical point. In addition to that, MRA assists risk managers in decision-making and provides additional tools such as: i) collecting and evaluating information on a risk issue; ii) facilitating communication between groups affected; iii) evaluation of proposed management strategies to reduce the risk; iv) highlighting data gaps and research needs [4].

Several approaches have been taken by different Latin American countries to develop multi-sectorial and multidisciplinary projects related to the management of biological hazards in the food chain. One approach taken by Argentina involves managing the risk of cholera transmitted by contaminated water and food [12]. The Ministerio de Salud took the lead on developing the plan by creating strategic partnerships with Ministries from other areas (i.e., Ministerio de Desarrollo Social, Ministerio de Educación, Ministerio de Planificación Federal, Inversión Pública y Servicios, Ministerio del Interior, Ministerio de Economía y Finanzas, Ministerio de Trabajo, Empleo y Seguridad Social) as well as other sectors of society in order to achieve the coordination and integration of health actions. Among the deliverables from the project was the organization and constitution of the National Emergency Operations Centre (COE), National Health Operations Centre (COS) and a situation room along with provincial COE and/or premises in municipalities or communes that would provide cross-cutting coordination between the institutions of the different sectors involved in the mitigation of the damage and the emergency care during a cholera outbreak.

Colombia implemented an Integrated Program for Antimicrobial Resistance Surveillance (namely COIPARS) as an appropriate response to meet the animal health and welfare requirements of industries and address the public health concerns about antimicrobial resistance of foodborne pathogens [13]. The objectives of the pilot program were: 1) to establish baseline data, and 2) to adapt working processes between national institutes and future stakeholders of the COIPARS. A consortium of Colombian private and public organizations was firstly assembled to facilitate access to the sites of sampling and to adequate laboratory capacities which included the National Institute of Agricultural Research (CORPOICA) the National Institute for Agriculture (ICA), the Colombian Food and Drug Administration (INVIMA), the National Health Institute (INS), two academic research groups, the largest retail chain in Colombia and poultry companies. The poultry industry was selected because it was by far the most integrated and standardized animal production system in Colombia, and offered an excellent tracking system of production from the farm level through to the retail sales outlets.

Non-zoonotic diseases, such as Foot and Mouth Disease (FMD) also have brought international attention in past years due to the devastating effects on national agricultural sectors and exports based on animal health status of countries. These diseases can create an animal health emergency, where local and state veterinarians need to apply different measures to contain the animal disease spread usually by control and elimination strategies such as depopulation, quarantine and animal movement restriction measures. However, these control measures themselves may cause catastrophic consequences in the food chain. Risk assessment may be used to inform movement protocols for animals and food products in order to effectively manage the risk associated with the movement of agricultural commodity while also minimizing the disruption of food production and supply chains. Completing holistic, integrated risk assessments in a timely manner during an outbreak can be challenging. Risk assessments take more time to conduct than the shelf-life of some of the perishable ingredients or products that need to be moved. The available storage capacity might be inadequate for holding the product while the risk assessment is being completed, which may result in disposal of product. For this reason, risk can be evaluated before an outbreak occurs as part of the emergency preparedness process in order to support development of

mitigation steps to reduce the potential for disease spread during an outbreak. The risk assessment does not guarantee that movement will be permitted during an outbreak. However, the assessment provides a framework for decision makers to quickly assess the effectiveness of the current control practices and preventive measures as they pertain to the transport of a commodity from farms to processing. The risk assessment will also allow decision makers to consider implementation of additional control measures.

These preventive scenarios have been placed in different Latin American countries such as Peru and Bolivia regarding the FMD control. Bolivia performed a simulation scenario of a FMD outbreak with the aid of FAO where more than 100 health officials from Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria (SENASAG) simulated all the disease preparedness and actuation steps in case of an outbreak [14]. The campaign of health education on foot and mouth disease in Peru was carried out by the Servicio Nacional de Sanidad Agraria (SENASA) and FAO [15]. Peru is a regional example in control and eradication of FMD with almost 8 years without the presentation of outbreaks where the education of farmers in good practices is the key to success. The proposal of the health education program involved the three agricultural areas in which the Peruvian territory is divided, adapted to the geographical, economic and cultural conditions of each region, seeking greater effectiveness with each group of partners. These actions seeks the country continue its strengthening to achieve by 2012, recognition as a country free from FMD without vaccination by the World Organization for Animal Health (OIE).

Chemical hazards

Chemical hazards include the chemical substances added intentionally to the food such as additives, externally introduced such as pesticides and veterinary drugs and environmental contaminants such as heavy metals. Chemical risk assessment follows the same structure as the microbial risk assessment but some differences need to be considered. Analytical methods for identifying chemicals and toxins are well developed, standardized and automated so quantitative identification is rapid and specific in contrast to the microbial identification methods [16]. The quantitative analysis of the presence of a chemical substance in the food chain is fairly linear and the total quantity consumed can be estimated based on dilution and/or concentration factors depending on the production process. The chemical exposure assessment is a more complex phenomenon due to the variety of its occurrence (ingestion, inhalation, dermal contact) whereas the dose-response assessment is more predictable [16].

The risk assessment of the presence of chemical hazards in the food chain by Latin American countries is fairly underdeveloped and more initiatives need to take place in the future for a better understanding of the effects of the agricultural practices and environmental contamination on the human health. One of the examples of a multi-sectorial approach to chemical risks in the food chain was undertaken by Bolivia through a national project on compliance with the Convention of Stockholm on polluting organic persistent (COPs) substances led by the Ministerio de Desarrollo Sostenible [17]. To ensure that the topic was a priority for the country and had political support and resources, the programme was joined by the Ministerio de Relaciones Exteriores y Culto, Ministerio de Defensa Nacional, Ministerio de Desarrollo Económico, Ministerio de Educación, Ministerio de Salud y Deportes, Ministerio de Trabajo, Ministerio de Asuntos Campesinos y Agropecuarios and other NGOs. The project identified seven (7) fundamental pillars that defined the national strategy of Bolivia in relation to organic pollutants: i) National inventory of COPs; ii) Training on the rational use of COPs and their impact on the environment; iii) Specific regulations of COPs; iv) Sectorial strengthening for the management of COPs; v) Incentives for the implementation of the project among the collaborating entities; vi) Monitoring and surveillance. The final goal of the project was reduce and eliminate permanently the stockpiles and wastes of COPs in Bolivia through the best available alternatives, considering mitigation measures, to prevent the generation of impacts in the process of their destruction.

In order to address both an agricultural pest and the risk of pesticide exposure to farm workers, Colombia implemented an integrated pest management (IPM) program for coffee berry borer (*Hypothenemus hampei*) in

coffee plantations [18]. Hands-on training was provided for farm staff and harvest workers managing production. Participants attended workshops describing pest management strategies, and focusing on cultural practices, i.e., efficient harvesting of mature berries to eliminate coffee berry borer habitats, along with establishing a comprehensive monitoring program to reduce chemical insecticides and encouraging use of a biological-based insecticide. The rationale was that adopting new practices would enable growers to transition away from chemical insecticides. Results over 3 years showed widespread adoption of cultural, physical, and biological control methods. Overall, the IPM program was considered successful because problems associated with insect damage on the coffee crop decreased, despite reductions in insecticide use.

Occupational and Psycho-social health hazards

Farming is recognized as one of the most dangerous occupations as a result of direct contact with animals, machinery, chemicals and other potential hazards. For example, the use of synthetic chemical pesticides entails the risk of harmful consequences for the health of the workers and consumers, either by direct or indirect exposure. They can produce acute intoxication (mild, moderate or severe), subchronic, chronic, diseases and even death. Pesticides also can pollute water, soil, air and food. In recent decades, the harmful effects of pesticides have been documented in many localities and regions of the world. The results show that the effects will worsen and spread if the trend of increasing use of these products is not reversed. Costa Rica through the Ministerio de Salud carried out a project of integration, systematization and analysis of the national information on the negative impact of the use of pesticides in both the Costa Rican population and the environment [19]. While is generally accepted that exposure is higher in workers that apply and manipulate pesticides, scientific studies carried out in Costa Rica have shown that women, children and elderly workers who live, study or work inside or close to areas where these products are applied, also are exposed to different concentrations of pesticides. The study showed 7,352 cases of acute poisoning by pesticides in Costa Rica in the period from 1992 to 2002 with a cumulative 149 deaths in the period from 1996 to 2002. The incidence was estimated to be 8.1 cases per 100,000 population in 1992 but 17.1 cases per 100,000 population in 2002. Among the cases, the study showed that the largest proportion of poisoning cases was related to work activities (76.8%). The groups most affected were small farmers (51%), agricultural workers (17.3%) and housewives (13.3%). A remarkable number of underreported cases were noticed, where on average only 8% of the total number of poisoning cases by pesticides was reported.

Less well recognized are the psycho-social health issues of farmers. The uncertainties of farming caused by vagaries of weather, animal and plant disease spread, and market fluctuations contribute to mental health problems of farmers and ranchers. Suicide is a recognized occupational health risk of farmers. While large scale commercial agriculture has greater access to the knowledge and resources to invest in occupational safety measures, small family farms may not. Farming also provides the primary livelihood for significant proportions of rural populations across Latin America, as well as, a major proportion of the gross domestic product and export market. Family farming has been established by different Latin American governments as a way to improve food security. Family farming allows diversifying the food base of the population through the consumption of traditional products such as cassava, beans, and potatoes, cushioning the volatility of prices and boosting rural economies [20]. However, inadequate public policy, low volumes of production and lack of competitiveness, lack of information and weak infrastructure are some of the constraints that small producers suffer to protect the health of their families and participate successfully in the productive chains of agriculture. Several countries such as Brazil, Colombia and Ecuador have implemented family farming strategies and significant percentages of some important agricultural products (milk, corn, beans, cassava, potato, onion) are produced by this type of farming. Brazil and Argentina have also created offices in their government structures to support this type of farming [20]. Brazil has developed an intense program on family farming and requires by law that at least 30 per cent of resources of public schools meals are used to buy products of family farming.

Another notable case is in El Salvador through a family farming program, directed both to the subsistence producer (by helping him at home and garden level) and the producer who already has been introduced into the market by strengthening his competitiveness and market connections. Thanks to these policies and institutions, structural problems facing the sector, such as access to markets, credit, insurance and technical assistance have been tackled.

However, the small farm agricultural sector still requires public health programs and policies that address occupational and mental health. The ability to transmit information from consumer to producer and vice versa, is required to support the inclusion of family farming in markets and able to respond faster to public health issues and the changes in consumer demands. These changes require joint and coordinated efforts by the actors in the food chain, involving private, public-private, state and scientific organizations [21].

CONCLUSIONS

The complexity of food production and supply chains across Latin America necessitates integrated approaches for addressing risks to producers, food processors and consumers in order to protect and promote public health. The lack of a structured approach to evaluate and mitigate the food chain risks threatens public health and also places the Latin American countries in a clear disadvantage in capturing their economic potential in the world food-trading system. Risk analysis is proposed as a multi-sectorial and trans-disciplinary approach to assure food security, while effectively managing public health risks associated with biological, chemical, occupational, economic and mental health hazards.

RECOMMENDATIONS

- Ministries of Health and Agriculture partner in development on integrated food security/food safety systems based on risk analysis methods to support optimal public health programs and policies that address biological, chemical, occupational, economic and psycho-social public health risks while contributing maximally to food security;
- Implementation of risk analysis process at national level that captures input and expertise from public, private and academic sectors
- Establishment of multi-sectorial and multidisciplinary risk analysis approaches that allow for the simultaneous management of risks related to the food production and supply chain;
- Use of risk analysis tools to inform emergency preparedness planning through proactive assessments of the impacts and implications of various response strategies for zoonoses and high consequence animal diseases
- Application of burden of disease and injury (DALYs) studies to the food production and supply chains to recognize the impact of foodborne diseases on public health, and help identify areas where intervention could have the greatest impact.

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