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Climate Change and Trade: The Link to Sanitary and Phytosanitary Standards

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Climate Change and Trade:
The Link to Sanitary and Phytosanitary Standards

Joint paper of the World Bank, Development Research Group, Trade and International Integration (DECTI) and the Standards and Trade Development Facility (STDF)

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ACRONYMS

CPM	Commission on Phytosanitary Measures (IPPC)
DECTI	Development Research Group, Trade and International Integration
EMPRES	Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (FAO)
EFSA	European Food Safety Authority
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLEWS	Global Early Warning System for Animal Disease including Zoonoses
IPM	Integrated Pest Management
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
LDC	Least Developed Country
OIE	World Organisation for Animal Health
SPS	Sanitary and Phytosanitary
STDF	Standards and Trade Development Facility
WAHIS	World Animal Health Information System (OIE)
WHO	World Health Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

1. Climate change is one of several global changes contributing to increased and new risks of concern for food safety, animal and plant health. While the effects of climate change on food safety, animal and plant health is a relatively new area of study, and information and data gaps persist, available evidence indicates that the effects are real and likely to increase in the future. Some countries have started to consider how climate change will affect sanitary and phytosanitary (SPS) risks in the future. However, much more work is needed to increase high-level awareness about these effects and to ensure that policies focused on agriculture and trade, as well as food safety, animal and plant health, adequately address them.

2. Climate change increases the need to effectively regulate the interface between trade and SPS risks. This is particularly important in the context of a rising global population and shifting agro-climatic zones, which are expected to produce new food deficit regions. Trade will be crucial to ensure continued access to food as part of the response to climate change. Yet improperly regulated trade may contribute towards the spread of SPS risks to new regions. In this context, it will be essential to ensure that future SPS measures facilitate global agri-food trade, while minimizing SPS risks. The existing international regulatory framework, specifically the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), is sufficiently flexible to cope with new and emerging SPS issues caused by climate change. However, climate change is likely to exacerbate the difficulties that many developing countries face in complying with international standards.

3. The challenges posed by climate change are compounded by inadequacies in SPS systems in many countries. Developing countries with weak SPS capacity may become "breeding grounds" for emerging SPS risks linked to rising temperatures and extreme weather events. Additional efforts to enhance SPS capacity as a practical approach to help reduce their vulnerability to climate change are therefore warranted. This will require attention to strengthen national SPS institutions and regulatory frameworks, as well as core capacities in monitoring and surveillance, inspection and diagnosis, risk analysis, emergency preparedness and response. It also calls for a systemic approach to minimize the constraints inherent in targeting particular areas of intervention in isolation, as well as additional resources for SPS capacity building including as part of future climate change adaptation programmes. In addition to enhancing food safety and improving disease and pest control, these efforts will contribute towards increased agricultural production and enhanced food security.

4. Increased pest and disease pressures arising from climate change intensify the demands for improved SPS management capacity at a national, regional and global level. Better collaboration among the concerned institutions both within and across countries will be important in this regard. In some cases, it may be preferable to build up effective regional SPS systems, for instance for detection and control, rather than spreading resources too thinly at a national level with less than optimal outcomes.

5. Further work and research is also needed to increase the resilience of agricultural systems to climate change and to better understand the SPS-related implications of a changing climate in order to prioritize risks and improve the reliability of predictions. This includes more dialogue in the scientific community and among trade policy practitioners on how to deal with issues related to climate change in risk assessment.

I. INTRODUCTION

1. Climate change is ongoing and accelerating. It will affect human health, animal diseases and plant pests as increasing temperatures, changing rainfall patterns and more frequent extreme weather events change the natural ranges of pests and diseases, and disrupt the "predator-prey" relationships that normally keep pest populations in check. In the public debate, these effects get much less attention than melting icebergs because the effects on food safety, animal and plant health – also known as sanitary and phytosanitary (SPS) issues – are much more complex and less intuitive.

2. Increasing pest and disease pressure may negatively impact food security, food safety and rural livelihoods in many developing countries where income from agricultural activities constitutes a significant share of total household and family income. The pest and disease situation is particularly problematic in countries with few technological, institutional and financial resources to make their agricultural sectors more resilient against a changing climate. This includes the least developed countries (LDCs) and other low income countries, where capacity building and technical cooperation is most needed.[1] Yet while many regions are expected to suffer from the negative effects of changing climate, some regions may experience benefits associated with climate change.

3. Various national, regional and international policies focused on issues related to human, animal and plant pests and diseases are already in place, and a number of institutions work to improve them every day. Amidst the bad news about a changing climate, this is the good news. Policies may be adjusted to reflect and address the threat from accelerating climate change. The threat to agriculture from plant pests and animal diseases is ever-changing. While risk may accelerate with climate change, there are already structures in place to deal with this risk. Resources are, however, in short supply. The need for increased attention to these issues, and additional resources to implement new measures in response to this evolving situation is recognized by practitioners. High-level awareness is also required to make change happen, particularly since the technical nature of discussions about animal diseases and plant pests can make it difficult for the general public and decision-makers to understand the issues. As such, more needs to be done to clarify, explain and disseminate the existing stock of knowledge to ensure that existing policies are adjusted appropriately.

4. Trade is one pathway, although not the only one, for the transfer of food safety risks, plant pests and animal diseases to new areas. Existing national, regional and international policy frameworks that regulate SPS issues include provisions to regulate trade. As such, they generally seek to carefully balance the benefits of trade and global economic efficiency against risks associated with food safety, plant pests and animal diseases.

5. The need to regulate the interface between trade and SPS risks is even more pressing in the context of a changing climate. Trade is inextricably linked to the expected effects of climate change on the global food supply. On the one hand, as climate change shifts global agro-climatic zones at a time when world population continues to rise, more agri-food trade will be needed to meet the needs of people living in the new food deficit regions that are expected to emerge. On

[1] For an overview of the challenges facing developing countries in complying with international standards, including the concept for a standards and development forum, which led to the establishment of the STDF see: John S. Wilson (September 2001) "Bridging the Standards Divide: Recommendations for Reform from a Development Perspective", background paper for The World Bank's World Development Report 2002: Building Institutions for Markets.

the other hand, improperly regulated trade may itself spread plant pests and animal diseases to new regions. Strict rules are central to ensure that protectionist trade measures are not introduced under the guise of sustainable food policies (Scannel 2009).

6. Agricultural trade, SPS risks and climate change are areas where scientific facts need to be properly understood and reflected in policy in order to protect food security, food safety and rural livelihoods. This paper seeks to raise awareness about issues related to SPS risks and standards in the context of agri-food trade and climate change. It reflects and builds on discussions at a seminar on this topic, organized by the World Bank's Development Research Group and the Standards and Trade Development Facility (STDF).[2] The paper is organized in four parts. Following the introduction, section two analyses the scientific understanding of the relationship between climate change, food safety, plant pests, animal diseases and trade. Section three identifies and discusses four key areas for future policy consideration, notably risk assessment, SPS capacity in developing countries, climate change resilience and basic research challenges. A conclusion is provided in section four.

II. BACKGROUND

7. The Intergovernmental Panel on Climate Change (IPCC) demonstrates that substantial changes in average temperatures and precipitation will take place as a result of changing and intensifying human activities and consumption patterns, known as anthropogenic climate change. Rising temperatures and changing precipitation patterns will increase the frequency and magnitude of extreme weather events. Human health and agricultural productivity will be affected, in part, through changing pressures related to food safety, animal diseases and plant pests. The actual impacts of climate change will depend on the policy responses adopted and implemented by governments, as well as the practices of all the stakeholders involved including companies, farmers and consumers.

8. Agricultural productivity must rise to satisfy the needs of the growing global population as well as changing consumer food preferences and consumption patterns, linked to increased incomes. However, growth in productivity has been declining, partly as a consequence of reduced spending on public-funded research and development (Ahmed and Martin 2009). Adverse climate impacts will likely exacerbate the challenge of increasing agricultural productivity, in part because new or spreading plant pests and animal diseases reduce harvests and decimate livestock. Policies focused on agricultural productivity and growth should therefore address these increased pest and disease pressures. Increased investment in agricultural research and development is crucial in this context. In an analysis of alternative policies to raise agricultural production, Ahmed and Martin (2009) find that investments in agricultural research and development have high economic returns, and can also help to reduce poverty along with traditional trade policies.

9. More effective SPS policy responses are needed to minimize negative effects from climate change in international trade. In addition, research must be directed towards developing forms of farming and agro-processing that take into account increased pest and disease pressure from climate change. This response would be preferable to, and more effective than, the introduction of more restrictive trade rules. Regulating trade must not be confused with

[2] This seminar, "Climate change and agricultural trade: Risks and responses", took place in Washington DC from 22-23 September 2009. Background documents, contributions from speakers and session chairs including presentations delivered, and a Briefing Note summarizing the main conclusions and key messages are available at: http://www.standardsfacility.org/en/TAClimateChange.htm

restricting trade. Designing and implementing SPS measures that take into account the challenges associated with climate change would facilitate trade, while limiting risks to human, animal and/or plant life or health. Similarly, adequate national capacity to implement appropriate SPS measures would contribute towards enhanced agricultural production and agri-food trade, needed to meet the demands of the increasing global population, while minimizing the spread of pests and diseases.

10. The relationship between climate change and SPS issues is highly complex. Many factors affect the emergence and spread of pests and diseases, and there is considerable uncertainty surrounding the individual factors involved and the relationships between them. Moreover, the way in which climate change influences food safety risks, animal diseases or plant pests varies, even within these broad categories. Some examples of the interaction between climate and SPS issues are discussed below. Despite the diversity of the expected effects, the overall direction of change is clear. Climate change affects food safety, animal and plant health in a way that makes the emergence of new or more serious threats inevitable.

11. The impact of climate change on food safety is discussed in a study by the Food and Agriculture Organization of the United Nations (FAO). The study examines several food safety issues including agents of foodborne disease such as mycotoxin contamination, biotoxins in fishery products and environmental contaminants in the food chain. Examples of foodborne diseases include salmonellosis and cholera. The incidence of salmonellosis increases with rising temperatures. Studies have shown a similar effect in the case of cholera. These studies demonstrate that *El Niño*-associated temperature rises coincide with increases in cholera outbreaks (FAO 2008b) as described in Box 1. Food safety may also be compromised by some animal diseases, known as zoonotic diseases, which may be transferred to humans. Such diseases may affect food safety and animal health if climate change influences the transmission cycle and increases the prevalence of vectors and animal reservoirs. In some regions, they may also result in the establishment of new diseases.

12. Mycotoxins are another food safety hazard that is influenced by the climate. Mycotoxins, such as aflatoxins, are toxic substances produced by certain fungi in foods and feeds. These fungi are strongly affected by the climate, notably moisture and temperature. Aflatoxins have acute toxicological effects if present in high levels and have long-term carcinogenic effects, even in smaller amounts. Climate change can also affect seafood safety where warmer sea temperatures induce harmful algal blooms. Some species of algae are toxic and become a food safety hazard if consumed by filter feeders such as mollusks.

13. Environmental contaminants are similarly affected by climate change and also present a risk to food safety. Pesticides and veterinary drugs are included in this category because of the risk posed by residues. Climate change may alter and, in some cases, increase the inappropriate use of pesticides and veterinary drugs. This is likely to occur when farmers increase applications in response to increased pest and disease pressures as a result of rising temperatures and extreme weather events. Chemical use is already a food safety hazard in many developing countries for various reasons including inappropriate knowledge and skills of producers, the absence of safety protocols for new chemicals and/or inadequate implementation of such protocols or weak local monitoring systems. Climate change may exacerbate these risks.

Box 1. Cholera, climate change and trade

Cholera is perhaps the best model for understanding the potential for climate-induced changes in the transmission of foodborne diseases (FAO 2008b). The agent of the potentially fatal disease is the organism *Vibrio cholera*. Cholera is predominantly a waterborne disease but foodborne transmission may occur through the use of contaminated water for food processing or irrigation. Outbreaks are often associated with deficient sewage systems and poor hygienic conditions, often found in developing countries. Major disease outbreaks are seasonal and associated with higher water temperature. Research has documented that the warm weather phenomenon, *El Niño*, has caused increased cholera outbreaks in Peru and Bangladesh. The *El Ninõ* phenomenon is of interest for the study of global warming impacts as it makes the study of disease trends possible in the presence, and absence of, higher temperatures. Furthermore, the phenomenon is itself thought to be affected by climate change.

Cholera outbreaks may lead to trade conflicts. In 1997, the European Union (EU) banned imports of the fish Nile Perch from Kenya, Uganda and Tanzania following a cholera outbreak in East Africa. The EU claimed that cholera could be transmitted during the processing stage if contaminated water was used. The trade conflict was discussed in the WTO SPS Committee. The World Health Organization issued a statement indicating that the transmission of cholera through fish exports was very unlikely. The trade conflict was eventually solved yet the story is a reminder of how the ability to manage food safety issues is a major parameter of competitiveness in high-end export markets. Several developing countries already face severe capacity constraints to upgrade their food safety management systems to meet requirements and standards imposed by developed countries. This problem is likely to increase if climate change further compromises the food safety situation.

Source: FAO (2008b), Thorpe and Bennett (2004).

14. As indicated above, the impact of climate change on food safety is highly complex. This is also the case in the area of plant and animal health. Climate variables, notably temperature, rainfall patterns and extreme weather events like drought and heat waves, strongly influence plant pest and animal disease pressures. Climate change could also create new ecological niches and affect the survival of predators, and may also influence natural corridors that promote or prevent the migration of pests and vectors. Climate change is expected to contribute to an increase in the population of many existing pests and diseases, as well as changes in their life cycles. The natural range of some pests and diseases is likely to expand, with increased disease pressures within existing ranges. Scientists also expect a reduction in crop tolerance and resistance (Sikora 2009), as well as the creation of permanent or transitional ecological niches. Permanent niches may be created through the possible emergence of new agro-climatic zones (with their own new and unique combination of growing degree days, latitude, precipitation patterns, etc.) which opportunistic species, including invasive alien species, may successfully colonize. When the climate changes, new areas open up for colonization. Plant pests and animal diseases may be among the species that establish themselves most rapidly, which may give them a head start and increase the tendency for them to dominate in areas affected by climate change (Campbell 2009).

15. In general, pressures linked to plant pests and animal diseases are expected to worsen in many parts of the world. For example, animal diseases such as Bluetongue, an insect-borne viral disease affecting ruminants (mainly sheep), are already migrating into new areas. Historically, the disease has been largely absent in Europe, however, six strains of the virus have spread across 12 European countries since 1998. Some studies have suggested a strong link with climate change. Recent changes in the European winter climate are believed to have allowed the virus to survive the winter, enabling the main bluetongue vector (Culicoides imicola) to expand northwards. The virus has also been transferred by European midges to areas beyond the main vector's range (Purse et al. 2005, University of Texas Medical Branch at Galveston 2009). Migrant moths of the Old World bollworm (*Helicoverpa armigera*) provide another example of a plant pest, which increased dramatically in the United Kingdom in the 1969-2004 period (FAO 2008a). While many other examples probably exist, the number of potential pests and diseases is so high that only a small share has been studied from a climate change perspective.

16. Plant and animal health problems already represent a severe constraint to agricultural productivity. Average yearly losses due to pests, diseases and weeds exceed 38 per cent of attainable yields in all agricultural crops (Sikora 2009). Climate change is expected to increase the pest and disease pressure and make it more difficult to secure the additional food production needed to feed the world's increasing and more prosperous population in the future. Research indicates that farmers in developing countries will be among the people affected most severely by rising temperatures and extreme weather events. Many of these farmers are subsistence-oriented and rely on stable yields to survive. They generally have very limited, if any, resources to withstand external shocks.

17. Since food safety hazards, plant and animal health risks move easily across borders, SPS dimensions of trade and other cross-border movements should be an integral component of the discussion on climate change. Scientists agree that climate change will increase pressures linked to animal diseases and plant pests, and that trade will be an important pathway of spread. However, there is considerable uncertainty regarding the likely impact on individual pests and diseases, and on specific regions and countries. Scientists also disagree about the role played by climate change compared to other important factors that influence the prevalence and spread of transboundary pests and diseases (Box 2). The impact on the transfer of weeds, pests and diseases will vary with local climatic changes, the potential impact on local species and the potential creation of suitable new areas elsewhere. Unregulated trade in agricultural products plays a major role in connecting areas of origin with potential new areas, and must also be considered. SPS risks are determined by a chain of events of which many are likely influenced by climate change. However, it should be noted that several factors other than climate change are already influencing SPS risks and will continue to do so in the future.

18. Global agro-climatic zones are expected to shift as the climate changes. Trade patterns will also vary as a result of these changes (Sutherst 2008). Trade presents both opportunities and challenges in terms of the likely increase in SPS risks caused by climate change. For example, Fischer et al. (2001) modelled spatial variations in the expected effects of climate change on yields of rain-fed cereal crops in 2050. In general, this study found that cereal producing areas in northern regions (including Canada, Northern Europe and Russia) may see increased production due to extended growing seasons, while areas with an already warm and/or dry climate (including the American West, Eastern Brazil, Western Australia and many areas in Africa) may face declining yields. This will alter the location of food surplus and deficit regions in the world and the deficit regions will have to be supplied through trade. Part of the shift in food production is likely to occur due to increased pest and disease pressures. Trade will be an important instrument to counteract negative effects on food security, including in developing countries.

Box 2. Examples of factors* that affect the entry, establishment and spread of transboundary plant pests, animal diseases and invasive alien aquatic species

- Globalization
- Human population growth
- Ecosystem diversity, function and resilience
- Industrial and agricultural chemical pollution
- Land use, water storage and irrigation
- Atmospheric composition, CO2 and oceanic acidification by carbonic acid
- Species interactions with hosts, predators and competitors
- Trade and human movements, etc.

*These factors are not independent of each other and climate change interacts with each of them.

Source: FAO (2008a).

19. The challenge of promoting global efficiency through trade, while avoiding unwanted effects, is not new. While the WTO seeks to liberalize trade, in some cases its rules support maintaining trade barriers, for example to protect consumers from unsafe food products or to prevent the spread of disease. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) focuses specifically on the relationship between international trade and measures related to food safety, animal and plant life and health. It aims to strike a balance between the rights, or obligations, of governments to protect the health of consumers by ensuring food is safe and protecting plant health and animal health, while ensuring that such measures are not disguised restrictions on trade.

20. The SPS Agreement encourages WTO Members to use international standards, guidelines and recommendations where they exist.[3] However, Members may use measures which result in higher requirements if there is scientific justification. They can also set higher standards based on an appropriate assessment of risks as long as they are applied only to the extent necessary to protect human, animal or plant life or health, and do not arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail.

21. In addition to meeting international standards, producers and exporters are increasingly required to meet a number of private standards. There are very divergent views on the effects of private standards on trade in terms of the additional costs to producers, including smallholders, versus access to higher-value and more lucrative markets.[4] These effects have been studied and discussed in a number of documents. For instance, one recent study on voluntary and mandatory food standards in China found that harmonizing food standards to international standards has an export-expansion effect (Mangelsdorf, Portugal-Perez & Wilson 2011). In another example, the World Bank has compiled a database on EU standards for several sectors including agricultural products, which maps EU standards to international standards. This database has been useful to estimate the impact of standards harmonization on trade with the EU. Portugal-Perez, Reyes &

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[3] That is the standards adopted by the international standard-setting bodies, notably the FAO/WHO Codex Alimentarius Commission for food safety, the World Organisation for Animal Health (OIE) for animal health and the International Plant Protection Convention (IPPC) for plant health.

[4] See, for example, Jaffee S., Henson S. and Diaz Rios, L. Making the Grade: Smallholder Farmers, Emerging Standards, and Development Assistance Programs in Africa. A Research Program Synthesis. Report No. 62324-AFR The World Bank and University of Guelph. Available at: http://siteresources.worldbank.org/INTARD/Resources/Making_the_Grade_ePDF2.pdf.

Wilson (2010) and Czubala, Shepherd & Wilson (2007) have analysed the database and shown that EU product standards that are harmonized to international standards lead to higher EU imports of these products from third countries.

22. A primary tenet of the SPS Agreement is that SPS measures are to be based on scientific evidence as elaborated through a risk assessment.[5] Jurisprudence in this area has underlined the importance of ensuring the accuracy of the risk assessments on which SPS measures are based.[6] Given the expected impact of changing climate on SPS risks, thought needs to be given as to how this can be considered as part of the risk assessment process. Risk assessors have started to analyse how risk assessment models may be affected by climate change in order to enable risk managers to build their SPS measures on a legitimate and sound assessment of risks, as provided for in the SPS Agreement (STDF 2009). This will be discussed further below as a separate policy issue.

23. An effective policy response will be crucial to counter the expected negative impacts of climate change on food safety, plant and animal health. A sophisticated web of policies and institutions are already in place to manage SPS problems across the globe. Most policies are designed and implemented on a national basis by ministries of agriculture and health, based on international standards and regulations. International rules have been developed by a number of organizations with an explicit mandate in the SPS area, most importantly, with reference to the SPS Agreement, the FAO/WHO Codex Alimentarius Commission for food safety, the OIE for animal health, and the IPPC for plant health, as well as by the WHO for human health including food safety.

24. However, the quality of national SPS policies, and the capacity of the institutions responsible for their implementation, varies greatly. While some countries have highly sophisticated systems that offer the best protection possible against risks associated with food safety, animal and plant health, other countries have basic SPS systems in place. Several bilateral donors, regional development banks and international organizations are already providing developing and least developed countries with various types of support for agricultural development and trade, as well as assistance specifically focused on strengthening SPS capacity.

25. In view of the challenges faced, much more needs to be done by both the providers and recipients of technical cooperation. In addition, it is crucial to ensure that these efforts take account of the expected impact of climate change and the ways in which it is likely to exacerbate differences in the quality of SPS management across countries. Climate change will increase the demands on the institutions responsible for SPS management at the country level. This will have resource implications and it is likely that many developing countries will turn to donors and international organizations to help fill these gaps.

[5] Defined in Annex A of the SPS Agreement as: "The evaluation of the likelihood of entry, establishment or spread of a pest or disease within the territory of an importing Member according to the sanitary or phytosanitary measures which might be applied, and of the associated potential biological and economic consequences; or the evaluation of the potential for adverse effects on human or animal health arising from the presence of additives, contaminants, toxins or disease-causing organisms in food, beverages or feedstuffs."

[6] For instance, see WTO Appellate Body interpretations related to risk assessment for the Australia - salmon case and the Australia apples case.

III. POLICY AREAS OF RELEVANCE TO CLIMATE CHANGE AND SPS

A. RISK ASSESSMENT

26. As discussed above, the concept of risk assessment is a central tenet of the SPS Agreement. Some experts, including Campbell (2009) and Sikora (2000), have expressed concerns that risk assessment processes have not yet adequately addressed aspects related to climate change. For instance, Campbell (2009) identifies one particular issue related to the shifting of the natural range of individual species, whereby a species would be considered alien if found outside its native range, and highlights the fact that many risk assessment processes fail to consider possible changes to the definition of native ranges due to climate change.

27. Risk assessment and climate change were discussed in 2008 at the third annual meeting of the Commission on Phytosanitary Measures (CPM), the governing body of the IPPC. During the meeting, it was recognized that climate change would very likely affect pest distribution directly through changes in native ranges and host plant conditions, and indirectly by changed pest movement through trade. One conclusion was that pest risk assessment techniques would need to incorporate climate change models (Campbell 2008). However, some IPPC members cautioned against relying on climate change models as these might have unwanted effects on SPS regulations for trade due to uncertainties inherent in the predictions of such models (IPPC 2008).

28. The use of models for supporting pest risk assessment was also discussed by scientists at a meeting on pest risk assessment organized by the European Food Safety Authority (EFSA) in 2007. They concluded that while modelling is useful for the analysis of complex data sets by simulation of different climate change scenarios, and for the exploration of the influence of alternative parameter values, the predictive capabilities are limited due to the inaccuracy of the basic data. This is because models need to take into account biological data of the life cycles of pests and plants at a fairly detailed level. Further research will be needed specific to each species. In addition, models must be developed to forecast future land use, biomass production and soil coverage. The analysis itself is complex as many factors interact.

29. Climate change also introduces particular data problems in pest risk analysis. Often, climate matching is used to determine the similarity between climatic conditions in the area at risk of pest invasion and the area of origin. Unfortunately, climatic data that is available for 1960-1990 may not accurately reflect the situation today, nor the situation in the future when climate change accelerates. At present, risk assessments are made for current conditions because long-term effects of climate change are difficult to assess. Furthermore, climate change models only generate average predictions, while regional and local climate change could have a major influence on pest invasions (EFSA 2007).

30. The impact of climate change on the emergence and re-emergence of animal diseases was confirmed by a majority of the 174 OIE Members in a worldwide study conducted by the OIE among all its national Delegates and presented at the 77th OIE General Assembly (May 2009). One hundred and twenty six of the OIE's Member Countries and Territories took part in this study, entitled "Impact of climate change and environmental changes on emerging and re-emerging animal disease and animal production".[7] Of the participating countries, 71 per cent stated they were extremely concerned at the expected impact of climate change on emerging and re-emerging diseases, and 58 per cent identified at least one emerging or re-emerging disease on their territory that was believed to be associated with climate change. The conclusions of this

[7] Available at: http://www.oie.int/doc/ged/D9755.PDF

study call for a new approach to prevent the new dangers and OIE Members at the General Assembly gave the Organisation a mandate to address the issue of climate change through its scientific capabilities and networks. In particular, they advocated additional action at the levels of research, national capacity building for public and private animal health systems, and communication, in order to prevent or reduce the effects of climate change on animal production and diseases, including zoonoses.

31. There is no agreement in the scientific community, or among trade policy practitioners, on how to deal with climate change in risk assessment. The central question is whether risk assessments should reflect the current situation or include future climate change scenarios. The problem is that while climate change is occurring and accelerating, and will impact the SPS situation, the nature and size of the impact is highly uncertain and will vary in different scenarios.

32. It is not yet clear what role this uncertainty will play in trade policy. Article 5.7 of the SPS Agreement addresses the case of insufficient scientific information. In such cases, the SPS Agreement permits WTO Members to introduce SPS measures if they seek additional information and review the imposed measure(s) "within a reasonable period of time". It is likely that the introduction of more scientific uncertainty may lead to an increase in the number of specific trade concerns expressed in the WTO SPS Committee, as well as under bilateral and/or regional trade agreements. In this context, additional research and the development of commonly agreed risk assessment methodologies that take into account climate change, by the international standard-setting bodies recognized as reference organizations under the SPS Agreement, would be very useful. EFSA (2007) observes that the current focus on conducting risk assessments on the basis of individual organisms will be too costly in the future, and suggests the use of more generic approaches. Such approaches would include consideration of groups of organisms and analysis of risk factors based on biological characteristics, in addition to pathway and commodity risk analysis.

B. SPS MANAGEMENT CAPACITY IN DEVELOPING COUNTRIES

33. Climate change poses additional challenges for SPS management, which is already weak in many developing countries. Scientists and researchers have presented a number of examples of the challenges of climate change for SPS management. For instance, in many developing countries, extension systems are unable to provide adequate support to farmers on pesticide use, which causes health problems linked to misuse or irrational use of pesticides and also translates into more limited market access (Sikora 2009). Climate change is likely to exacerbate current problems by increasing the need for crop protection. Higher winter temperatures may allow new pests to settle, for example, which will lead to increased demands for new pesticides. This will increase the need for stronger and more capable extension services, and require additional support to help developing countries absorb new technologies.

34. Some developing countries, such as Colombia, have carried out some research on the expected effects of climate change on agricultural production, which has generated evidence that can help inform the development of more effective SPS management strategies. However, specific information about the impact of climate change on particular types of production, including subsistence farming, is not usually available in developing countries. This lack of knowledge presents a concern both from a socio-economic perspective, as well as from a national economy perspective given the significant contribution of smallholders to agricultural production in developing countries (Cardenas-Lopez 2009).

35. While progress has been made to strengthen SPS management capacity in some countries, in many others several SPS capacity needs and gaps persist. This is despite a number of interventions by governments and the international donor community to upgrade SPS management systems in general and address the challenges presented by climate change in particular (Garcia 2009). An expert consultation on Climate-Related Transboundary Pests and Diseases, organized by FAO in 2008, identified weak management of transboundary movements of pests and diseases in developing countries as a clear challenge to global food and agricultural production (FAO 2008a). This challenge is present at all levels from basic research to risk management.

36. SPS capacity building challenges exist at the level of prevention, eradication and containment/management. It should be noted that costs of control generally increase as problems become more established. Prevention is generally the most cost effective option, followed by eradication with containment the most costly, but sometimes unavoidable, option.[8] Prevention includes early warning systems that require forecasting, early detection, early control and research. Many developing countries have little in the form of operational systems to undertake any of these tasks. Even in developing countries with relatively good systems, such as Columbia, upgrading will still be necessary to meet the challenge of climate change, and particular sub-sectors (such as small farmers) that are presently not well covered by existing systems (Cardenas-Lopez 2009).

37. Investments in early control and detection mechanisms are critical in this context. International systems for disease reporting exist, notably FAO's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES)[9] and the OIE World Animal Health Information System (WAHIS).[10] However, even if capacity to diagnose and report exists, the willingness of countries to report may be limited by concerns about the impact on trade of reporting diseases. Existing systems are already struggling with current SPS problems and may be overburdened by the additional challenge of climate change. One of the main challenges for many developing countries is that an effective system requires financial resources as well as capable and pro-active institutions. Both elements are essential to ensure inter-agency and inter-disciplinary collaboration at a national and regional level, as well as information exchange between farmers, the private sector and governments. FAO has proposed building regional systems for early control and detection as an alternative to national systems that are often unable to execute the range of activities required for prevention, early warning and control (FAO 2008a).

38. The use of border controls in compliance with the SPS Agreement is essential but costly. Border control measures need to balance the costs of invasive pests and diseases with trade losses. Border control is a central part of prevention and it is also the part of the SPS management system most frequently subject to trade disputes. It is difficult, even for high income countries, to strike the right balance between SPS protection and trade. The SPS Agreement establishes basic rules but resources are needed to apply the provisions of the Agreement. The challenges for developing country governments are large. At present, many countries have insufficient resources and lack appropriate regulatory frameworks. Moreover,

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[8] On the cost-effectiveness of prevention, see: http://www.standardsfacility.org/TAEcoAnalysis.htm and http://www.oie.int/fileadmin/Home/eng/Support_to_OIE_Members/docs/ppt/OIE-Costs_of_National_Prevention_Systems-final_report_-_Exec_Sum.pdf

[9] See: http://www.fao.org/ag/againfo/programmes/en/empres/home.asp

[10] See: http://www.oie.int/en/animal-health-in-the-world/the-world-animal-health-information-system/the-oie-data-system/

capacity is often weak in other areas including the application of control measures at the point of production, surveillance and monitoring, border control and inspections, risk assessment, diagnosis (including taxonomy), data collection and management. Similarly, there are often weaknesses in the ability to respond rapidly to food safety crises. There are also challenges in managing the entry, establishment and spread of plant pests and animal diseases, and in making effective use of information provided through national, regional and/or international networks. Regional and international systems to support and coordinate action to address problems in these areas need to be strengthened (FAO 2008a).

39. Many border control measures rely on sophisticated technology and procedures that have been conceived and initiated in developed countries. Some have argued that new approaches to border control may need to be developed that are more appropriate for LDCs and other low income countries. Many countries in Africa already face difficulties in implementing food safety standards and procedures that have been developed for more advanced economies.[11] Attempts to introduce Codex Alimentarius standards for dairy products in East Africa provide a case in point (Jensen et al. 2010). Given the East African custom of boiling milk prior to consumption, which eliminates the need for obligatory pasteurization, Codex dairy standards are overly restrictive for local products and risk making most East African dairy products technically illegal.

40. Problems such as the one described above are likely to intensify as climate change increases the demand for new SPS measures. Yet inappropriate measures may do little more than convert formal trade into informal trade. In addition, the establishment of border controls to enforce measures that are out of line with local needs will lead to a waste of scarce resources. Climate change increases the need for SPS controls to be appropriate for local contexts. As such, there is a strong need to support the development of new SPS measures that meet the challenge presented by climate change and, at the same time, take into account the local situation.

41. Inadequacies also persist in behind-the-border controls. The eradication and/or containment of invasive pests and diseases is challenging for animal and plant health services in many developing countries. Such services are often seriously short of funding and fragmented across a number of government institutions. It is widely accepted that extension services and other channels through which collaboration with farmers and the private sector could take place are patchy. Climate change is likely to exacerbate the costs of weak animal and plant health services. Many developing countries will need serious increases in external assistance to build up even basic systems. The countries themselves, international organizations and the donor community will need to develop new financing models to ensure that such systems are sustainable. Most assistance is currently targeting particular areas of intervention in isolation, such as the eradication of particular diseases, and fails to take a systemic view. Existing early warning systems, such as the Global Early Warning System for Animal Disease including Zoonoses (GLEWS)[12], often succeed in picking up new threats. However, many developing countries are unable to adequately react to knowledge about new or existing pests and diseases due to weaknesses in their national plant and animal services.

42. Climate change highlights the "global public good" dimension of effective SPS management. In many cases, pests and diseases that emerge in one country may cause most harm in another country. For instance, risks associated with variants of Black Stem Rust (e.g. Ug99), a disease affecting cereal crops including wheat, appear to be centred on Uganda and Kenya, where

[11] For a collection of case studies on standards in Africa, refer to Wilson & Abiola (2003).
[12] GLEWS is a joint OIE/FAO/WHO initiative that combines the alert and response mechanisms of the three organizations. See: http://www.glews.net

wheat is neither a major crop nor a top priority. However, if this disease were to spread to the Middle East, it would have serious consequences. In such cases, the country or countries of origin bear the financial burden of containing the initial pest or disease outbreak through surveillance and eradication efforts, even though the pest or disease in question may not be of serious concern to them. In such cases, there may be limited commitment to ensure an adequate response and to allocate the necessary resources, given national perceptions regarding the limited expected benefits. In the worse cases, insufficient incentives to contain pests and diseases at the national level may lead to SPS challenges and weaknesses at a regional and/or global level (Smith 2009).

43. Increased pest and disease pressures arising from climate change intensify the demands for improved SPS management capacity at a national, regional and global level. Developed countries in temperate regions may face the risk of increased migration of plant pests and animal diseases from developing countries in tropical regions. Good SPS management depends on the capacity of both the area of origin of a given problem, as well as the area at risk of entry or spread. Ineffective SPS border and internal controls in many developing countries may therefore have a much larger potential impact on agricultural production in other countries. In the case of animal services, Black (2009) identifies a need to improve the capacity of veterinary services worldwide to identify, diagnose and respond to animal diseases and emphasizes the global public good nature of the prevention and control of animal diseases.

C. DEVELOPING CLIMATE CHANGE RESILIENCE

44. The development of agricultural systems that are more resilient to climate change will help to minimize the negative effects from climate change. In the area of plant protection, Ayres (2009) recommends optimizing plant production systems to reduce their susceptibility to new potential pests and their tendency to produce exportable populations of existing pests. Given the scarcity of research on the linkages between global SPS issues and climate change, Ayers also proposes the creation of a competitive grants programme to fund research into more climate resilient plant production systems. While pests and diseases will continue to spread, regardless of the volume of resources allocated to SPS management, effective SPS management will reduce their incidence and intensity.

45. Technologies already exist that will help agriculture adapt to increased pest and disease pressures. Technology transfer plays a great role in building up climate change resilience. The nature of the technology used should be tailor-made to the problem. Sikora (2009) recommends the development of methodologies, based on Integrated Pest Management (IPM), to identify regions and cropping systems vulnerable to increased pest damage, as well as efforts to improve capacity to identify dangerous invasive pest and disease organisms.

46. Efforts will also be needed to enhance climate change resilience within agri-food value chains susceptible to particular food safety risks such as aflatoxins. Rising temperatures are expected to increase aflatoxin contamination in many developing countries since the moulds involved grow well in warm, humid climates and post-harvest management is often inadequate. Genetic enhancement is one option to enhance host resistance to aflatoxins through either conventional breeding or the use of transgenic plants. The aflatoxin-producing strain of *Aspergillus flavus* could also be reduced through a technique known as competitive exclusion, based on soil inoculation with non-toxigenic strains indigenous to the country of production. In

addition, detection technology could be used. Rapid testing kits are now available and could be developed further to produce low-cost ELISA detection tools for aflatoxins.[13]

47. It will be important to mainstream SPS issues into climate change adaptation strategies, as well as existing and future donor programmes and funding mechanisms for adaptation. The development of national adaptation strategies for climate change is very resource intensive and requires, as a minimum, basic data and information from research on the most important threats and how they interact with local environments. Data and knowledge on SPS risks, and the expected effects of climate change on food safety, animal and plant health at the country level, should also feed into this process. The existence of effective national institutions to anticipate and prepare for climate risks and to mainstream adaptation is also essential.

48. Some donors, including the EU and Germany, are providing support to enable developing countries to implement adaptation strategies and develop agricultural systems that are resilient to climate change. For instance, the German technical cooperation agency (GIZ) is implementing a research programme focused on the adaption of African agriculture to climate change, which includes research on cropping systems, plant breeding, grazing management, agro-forestry, water management and policy research. Initial experiences from donor-supported programmes provide some important lessons for future technical cooperation in this area. Firstly, it is essential to tailor external support to in-country circumstances since the effects of climate change depend, to a significant degree, on prevailing local conditions such as the variety of existing species and/or cropping systems, as well as political and socio-cultural factors. Secondly, an interdisciplinary and multi-institutional approach is valuable to enhance knowledge and understanding about the complexities and challenges inherent in climate change adaptation (Garcia 2009).

49. Three particular funds have been established to assist developing countries in adapting to climate change in different areas: (i) the Least Developed Countries Fund; (ii) the Special Climate Change Fund; and (iii) the Adaptation Fund under the Kyoto Protocol. The Global Environment Facility also has a trust fund with a funding scheme targeting climate change adaptation. Although agriculture is considered within these funding initiatives, SPS issues are rarely specifically addressed. This is of particular concern since improved SPS capacity, including the availability of resources, is a critical part of increasing the resilience of agriculture to climate change in many developing countries (STDF 2009). Future climate change adaptation programmes should include a specific focus on SPS issues, which will require additional funding.

D. RESEARCH CHALLENGES

50. Effective SPS management at the national and regional level depends on the existence of a sufficient knowledge base that understands the nature and scope of existing food safety, animal and plant health risks based on prevailing local environments, and is able to predict future risks. Knowledge about the effects of climate change on food safety, plant pests and animal diseases, and the interactions with trade, is far from complete. The challenges vary from basic scientific research into issues like pest phenology and the impact of CO_2 fertilization on plants to more specific issues like modelling the spread of invasive pests and diseases (Campbell 2009).

51. Most of the SPS problems currently studied affect temperate regions, while knowledge on the likely effects of climate change on the incidence and spread of SPS risks affecting

[13] ELISA stands for enzyme-linked immunosorbent assay and is one of several available testing tools that uses advance in biotechnology to provide highly specific anti-body based tests that can identify and measure aflatoxins in food in less than 10 minutes.

developing countries is particularly scarce. This knowledge gap results from a general lack of knowledge on the existence of SPS risks in many developing countries, as well as inadequate knowledge on the specific impact of climate change. The lack of baseline data and information makes the study of climate-specific effects difficult. For instance, pest lists are incomplete for many developing countries, including in Africa. Additional research is required to generate information on the distribution of pests and diseases, as well as pest phenology and disease epidemiology. FAO (2008a) identified a specific need for better surveillance methodologies, fast and cheap identification methods, epidemiological knowledge and information on biological control organisms and mechanisms, resistant crops and resistant animal breed and species.

IV. CONCLUSION

52. Inadequate data makes it difficult to obtain precise predictions about the effects of climate change on food safety, animal and plant health. However, recent research and evidence on the ground indicate that there are important and complex implications for SPS risks. Climate change will alter the natural boundaries for plant pests and animal diseases and allow SPS problems to migrate to new areas. It is likely to provoke new SPS problems and exacerbate the challenges faced by food safety, animal and plant health services, which are already over-stretched in many developing countries. Increasing temperature and extreme weather events are likely to stimulate a shift in agro-climatic zones and open up ecological niches in new areas that may be colonized by vectors of disease. Increased food safety risks are expected to directly threaten human health, while greater pest and disease pressures will jeopardize agricultural productivity.

53. While trade represents one pathway for the spread of SPS problems, it is also crucial to ensure continued access to food as part of the response to climate change. As climate change shifts agro-climatic zones, some countries will rely on imports to meet their needs for particular food and agricultural raw materials. More trade will also be necessary to feed an increasing and more affluent global population. In this context, it will be essential to design future SPS measures appropriately to facilitate agri-food trade, while minimizing risks associated with food safety, plant pests and animal diseases.

54. Existing trade regulations, including the WTO SPS Agreement, are believed to be sufficiently flexible to cope with new and emerging SPS issues caused by climate change. However, some questions have been raised regarding the ability of existing risk assessment procedures to address the increased uncertainty of food safety, animal and plant health issues in the context of climate change, with calls for further work in this area to ensure their continued relevance and performance.

55. Compliance with SPS requirements is already a challenge for many countries, and climate change will exacerbate this. Developing countries with weak SPS capacity may become "breeding grounds" for emerging SPS risks linked to rising temperatures and extreme weather events. Additional efforts are required to strengthen SPS systems, which will help to mitigate the negative effects of climate change on agricultural production and will also contribute towards enhanced food security. This will require collaboration, as well as funding, on both an international and regional level. In addition to increased emphasis on strengthening SPS capacity in developing countries, further work and research is also needed to increase the resilience of agricultural systems to climate change and to better understand the implications of a changing climate for SPS risks in order to prioritize risks and improve the reliability of predictions.

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