The Integral Role of Plant Health in One Health\*

Draft Discussion Paper Prepared by the United States

*\*This paper is drawn from a more comprehensive analysis conducted by the U.S. Department of Agriculture (USDA) Plant Protection and Quarantine (PPQ) on the role of plant health in the broader “One Health” paradigm. You can request a copy of this PPQ paper by contacting the U.S. Official Contact Point.*

1. Introduction

The IPPC Commission on Phytosanitary Measures (CPM) has had ongoing discussions on the “One Health” concept. These discussions reveal a varied understanding among members of how plant health fits within the One Health paradigm. Wanting to better explore and understand the opportunities that may exist for the IPPC in this space, the CPM requested the IPPC Strategic Planning Group (SPG) to discuss the issues at its October 2022 meeting.

Ultimately, the SPG will need to consider the following key questions:

1. Is there consensus among CPM members that the IPPC should seek an active partnership with its veterinary and public health counterparts under the One Health umbrella?
2. What would be CPM’s primary goals and interests for joining the Food and Agriculture Organization (FAO) One Health discussions and future planning?
3. How should CPM engage in the One Health discussions, beyond requesting the Secretariat to monitor these discussions on behalf of CPM?
4. What would be the IPPC role in and scope of contributions in the One Health area?

This paper provides some analysis, observations, and suggestions as to how the IPPC community could proceed on in this area. Sections 5 and 6 present conclusions and suggestions regarding the elements and scope of IPPC contributions to One Health going forward.

2. Background

One Health is a collaborative concept that acknowledges the health of people, animals, and the environment are linked. Working across disciplines at the local, national, and global levels is intended to build capacity to achieve optimal health outcomes for people, domestic farm and food animals, wildlife, plants, and our environment when challenges arise (USDA APHIS, 2022b; USDA, 2022b). These challenges have been exacerbated by globalization, climate change, environmental contamination, human population growth, agricultural and urban development, and degraded ecosystems (Sleeman et al., 2017).

While the One Health approach focuses on the nexus between humans, animals, and the environment, One Health has historically been concerned with emerging infectious diseases (Andrivon et al., 2022). As a result, plant health has not consistently been included in One Health. However, plant pests can significantly reduce the productivity of important agricultural and horticultural crops resulting in global food and fiber shortages, while those that affect forests may alter forest composition, shift ecosystem processes, or trigger global forest product shortages.

Humans and animals depend on plants for food, and the quality and abundance of food have both direct and indirect effects on their health (Andrivon et al., 2022). For example, *Phytophthora* *infestans,* the causal agent of potato late blight, caused the Irish potato famine of the 1840s, which killed over one million people due to crop losses (Yoshida et al., 2013). Farmers continue to manage for *P. infestans*, which is estimated to cost $6.7 billion annually in yield losses and control costs (USDA ARS, 2021). This is one of the many examples of the connections that exist between plant, animal, and human health.

There is a strong link to One Health through the traditional national plant protection organization (NPPO) mission, which is to 1) protect agriculture and natural resources from pests and 2) facilitate safe agricultural trade. Pests can impact plant health, subsequently impacting national and international food security, and the risk of pest introductions increases with the growth in agricultural trade. To safeguard agriculture and facilitate safe trade, NPPOs tend to focus on pest risk analyses and management. Plant pest surveillance, detection, and response are also essential to maintaining a nation’s food supply. Climate change increases the threat plant pests pose keeping agriculture healthy.

3. Opportunities for the IPPC in One Health

Generally, NPPOs contribute to One Health through much of their traditional work. Opportunities exist for NPPOs to make additional contributions, and to actively collaborate with the animal and human health sectors in new and innovative ways. The opportunities identified below are not exhaustive; they are meant to generate ideas about how to formalize plant health’s role in One Health.

*a. Opportunities: Plant Pathogens*

On occasion, humans, plants, and animals can be infected by the same pathogens. For instance, *Fusarium* spp., which damages wheat crops, can also cause serious health problems in humans and animals (Sáenz et al., 2020). Monitoring *Fusarium* outbreaks in wheat crops and communicating these to animal and human health sectors is critical in preventing human and animal fusariosis, an infectious disease that is caused by fungi. Identifying pathogens of interest to the plant, animal, and human health sectors will create opportunities for collaboration.

*b. Opportunities: Vector-borne diseases*

Vector-borne diseases also occasionally overlap the plant, animal, and human health systems. Some invasive snails and slugs damage agricultural crops and natural resources, including *Lissachatina fulica* (giant African land snail). *Lissachatina fulica* consumes more than 500 different plant species and poses a serious health risk to humans by carrying the parasite *Angiostrongylus cantonensis* (rat lungworm), which is known to cause meningitis in humans (FDACS, 2022).

*Dendrolimus punctatus* (Masson pine caterpillar), a pest on the U.S. Cooperative Agricultural Pest Survey (CAPS) national priority pest list, defoliates pines but can also cause health risks to humans who touch the larvae or pupae. The hairs of *D. punctatus* can cause reactions that include rashes, headaches, dizziness, and localized arthritis. This disorder is called pinemoth caterpillar disease (Lawson and Liu, 1986). Control of vectors such as *Lissachatina fulica* and *D. punctatus* is a shared goal where the three health systems can effectively collaborate under One Health.

*c. Opportunities: Climate change, pest detection, and pest risk analysis*

Factors such as climate change pose an unprecedented threat to our future, including how plant health organizations survey, detect, and respond to pests. As climates change, the pest profile in an area also will change. For example, areas once considered too cold for a pest to establish may eventually be warm enough for establishment to occur. This changing environment will affect how NPPOs survey and respond to pests in the future. This will also affect pest risk analysis because predictions made even 10 years ago may no longer apply if climates continue to shift. There is an opportunity for the IPPC and NPPOs to incorporate climate change into predictive models so that we can have a better understanding of where a pest might establish. Further, if models are applied globally, they may show areas where certain pests could not have survived when market access was given but are now becoming suitable.

Accordingly, the IPPC Commission on Phytosanitary Measures (CPM) made climate change a priority in its new 10-year Strategic Framework. In 2021, the Commission formed the Focus Group on Climate Change and Phytosanitary Issues (FG-CCPI), which will remain active through 2025 (FG-CCPI and IPPC, 2022) and includes a PPQ representative. The FG-CCPI will be 1) raising awareness about the impacts of climate change on plant health, 2) enhancing the evaluation and management of risks climate change poses to plant health, and 3) enhancing recognition of phytosanitary matters in international climate change discussions (FG-CCPI and IPPC, 2022). The FG-CCPI’s actions over this period can inform decision making on ways to address climate change effects on plant health and the associated effects on animal and human health, including hosting regional seminars and preparing information guides on climate change issues related to plant health.

Pest climate change forecasts could be used for strategic planning to mitigate potential impacts of a pest. For example, if an area is predicted to become highly suitable for a pest, then planting fewer susceptible crops could be an adaptation strategy. The pest climate change forecasts could also be used to model the spread of slow-moving plant pests to inform surveys and program decisions. An additional use could be in trade policy discussions. For example, if an area is predicted to be highly suitable for a pest in the future, this could be a justification for a trading partner to implement a treatment to prevent its introduction.

Because climate change is a global issue, there are opportunities for NPPOs to engage in international collaboration regarding plant health. Recommended areas of increased collaboration for plant pests under climate change include bio-surveillance for changes in pest distributions, pest reporting, research, and capacity building (FAO, 2021a).

In addition, NPPOs may have opportunities to engage in One Health through the routine use of community science. The recent development of community science tools has helped USDA analysts monitor new pest incursions and develop potential distribution maps based on the pests’ native habitat. iNaturalist and other apps allow users to upload photos and metadata to accessible databases so scientists can access the information when needed. For example, when *Vespa mandarinia* (Asian giant hornet), was detected in Washington State, USDA analysts tried to determine the inhabitable area around the detection site. To do this, the analysts used historical data by contacting museums with insect collections, coupled with modern community science data from social networking sites like iNaturalist.com. The analysts used data from citizens in the *V. mandarinia* native range who used their smartphones to upload a photograph and the GPS coordinates to iNaturalist. Using the native habitat coordinates and ecological niche modeling approaches, the analysts created a geospatial map of where it could survive within the United States. Interestingly, invasive pests are frequently detected for the first time on these community science apps. Using this community science information routinely could give the USDA more lead time to respond to an invasive pest population because the sooner a pest is detected, the easier it is to eradicate.

*d. Opportunities: Geospatial technology*

Geographic information systems (GIS) may be an important tool to support One Health. Geospatial mapping and other visualization tools enable users to communicate program data, event patterns, and decision options. Mobile technologies can be used to collect data related to routine and emergency plant health investigations.

Geospatial technology now touches nearly all aspects of PPQ’s pest surveillance and response programs and efforts. Recent years have seen an increase in “WebGIS”, or web-based data collection, management, interactive mapping, and decision-making support.

Technology is advancing rapidly relative to generating maps, data, analytics, and tools that support pest program management and overall decision-making.

*e. Opportunities: Antimicrobial Resistance (AMR)*

While AMR is a well-known problem in the human and animal health sectors, the links between AMR and plant health have not been explored as extensively due to them being used less frequently. In the United States, the amount of antibiotics applied to plants accounts for less than 0.5% of the total antibiotics use (McManus et al., 2002), with growers most frequently applying antibiotics to treat bacterial diseases in orchards. Some studies have indicated that there are no significant residues in harvested fruits, no adverse effects on human health related to orchard spraying, and no persistent impacts on the environment (Stockwell and Duffy, 2012). However, more studies are needed to understand the effect of orchard spraying on AMR and animal and human health. Because the USDA has historically gathered limited data on antibiotics and fungicide use in plants collected through surveys (USDA NASS, 2012), and the IPPC is interested in collecting more data on AMR in plants, this represents an opportunity for NPPOs to participate.

NPPOs, through the IPPC, may be able to contribute to a One Health approach for AMR by further examining the role pests play in the movement of bacteria, including resistant strains, to other locations. In the USDA’s Antimicrobial Resistance Action Plan, the agency acknowledges the many pathways that connect resident bacterial populations in one setting to those in other settings, including pests, crops, fruits, and vegetables (Figure 1; USDA, 2014).



**Figure 1.** Using the One Health approach, the USDA shows how a collective antimicrobial resistance ecosystem interconnects pests, crops, fruits, and vegetables with other sources of antimicrobial resistance (Image source: USDA, 2014).

4. Knowledge Gaps

Closing a few of the existing knowledge gaps could help integrate plant health into the One Health approach more seamlessly. The extent of pathogens shared by plants, animals, and humans that enter countries through trade, and their origin countries, is not well documented. Long-term pest interception data from inspection and customs and border agencies may provide an opportunity to learn more about pathogens intercepted at ports of entry that may impact humans, animals, and the environment.

A common knowledge gap with pest forecasting is the availability of biological information needed to parameterize the forecast models. It would also be useful to have information on the relationship between pest damage and pest prevalence (e.g., the number of pest generations). This information could be used to estimate increases in pest damage under climate change, which could inform One Health strategic planning in the near and long term.

There is limited data, at least in the United States, on chemicals that are applied on plants. Developing a full understanding of the type, extent, locations, and trends of antimicrobial and antifungal use for agricultural and horticultural crops would help the plant health community make connections to the scale of AMR attributed to chemical sprays on plants. The potential human health related impacts resulting from chemicals sprayed on plants also need further investigation.

5. Conclusion

Knowingly or not, the IPPC community already contributes to the One Health agenda through its long-standing plant protection programs, standard setting, capacity building, and other activities aimed at detecting pests and taking measures to prevent their spread. This should be acknowledged and recognized.

Core plant protection programs operated by NPPOs under the IPPC will continue to be the main ways for countries to anticipate and respond to the changing distribution, dynamics, and spread of plant pests which may be exacerbated by climate change. This is primarily done through surveillance, detection, pest reporting, and response systems. The CPM should continue to emphasize these core NPPO functions and perhaps prioritize them for continued capacity development opportunities while supporting new innovations in these areas.

However, we also recognize that the global operating context has changed dramatically. Today, a major factor driving the One Health discussion is related to the impact that climate change will have on agriculture, food security, the environment, and the spread of pests. We need to expect that some plant pests may become more prevalent as a result of climate change.

Given this focus on climate change—within the One Health context—the CPM can look to the work and planning already underway by the newly established IPPC Focus Group on Climate Change. This Focus Group will explore the issues and develop an action plan that can help inform and support IPPC discussions and interactions with the One Health Community at the FAO.

In terms of dialogue with animal and public health counterparts, we recognize there are some plant pests and vector-borne diseases that intersect the human, animal, and environmental health sectors. These may become more prevalent as a result of anthropogenic factors and climate change. These could be identified and form the basis of a dialogue with the One Health Community at the FAO. This may lead to specific actions on these specific pests of cross cutting interests.

We see that the new Focus Group on Pest Outbreak Alert and Response (POAR) may be the appropriate IPPC focus group to work with the Secretariat to develop and communicate the existing and future work at IPPC to share with the FAO partners and others, including relevant ISPMs, technical standards, action plan developed by the Focus Group on Climate Change, and other associated work topics.

An important element of the One Health dialogue that may need further analysis is the AMR subject. More analysis is needed to better identify the phytosanitary issues—including the scope of the problem and level of risk--before we consider specific actions which may be appropriate for the IPPC and its NPPOs to take. Perhaps some research could be contracted out to study this issue.

While increased agricultural trade is a contributor to the movement of plant pests, the way NPPOs respond to these pests can also contribute to challenges faced by the One Health community. In this regard, the CPM should continue to promote the development of new methods for treatments of commodities and eradication of pests.

The IPPC Secretariat should continue to monitor and interact with the other partners at the FAO, representing plant health viewpoints and exploring specific areas for collaboration. The Secretariat will be an important link between FAO One Health discussions and the IPPC Bureau and Commission.

The Secretariat can help communicate the relevance of IPPC standards, its implementation and capacity building activities, and status of other current and future planned work program initiatives that contribute to food security, environmental health, safe trade, etc. to ensure these are broadly seen and counted as contributing to the overall One Health mission.

6. CPM Role in One Health

In summary, our view is that IPPC’s involvement in the One Health agenda should be based on the CPM programs, standards, and initiatives already in place. This activity may need to be communicated in a way that the One Health community can clearly recognize how these existing programs play a direct and indirect role in supporting agricultural, environmental, human, and animal health. Key elements of a CPM One Health action plan could include:

* plans developed by the Focus Group on Climate Change
* CPM surveillance and pest reporting systems
* standards setting (ISPMs) especially those related to surveillance, diagnostics, export inspection, certification, and other important safeguarding functions
* efforts by the Technical Panel on Phytosanitary Treatments and the Technical Panel on Diagnostic Protocols to expand the list of pest mitigation options and diagnostic protocols
* work being addressed by the POARS
* capacity development programs related surveillance, early detection, and pest response planning
* participation in meetings with animal and public health counterparts at the FAO that focus on plant pests and vector-borne diseases that intersect the human, animal, and environmental health sectors
* further analysis and research of the AMR risk issues from a plant health perspective
* Secretariat’s continued participation in FAO One Health meetings and events to communicate IPPC’s specific activities in its annual work program which contribute to the overall One Health mission (i.e. agricultural, environmental, human, and animal health).

The SPG is invited to:

1. *Discuss* the key points of intersection between plant health and the broader One Health agenda that relates to human, animal, and environmental health.
2. *Discuss* the strategic reasons and merits for the CPM to engage in the One Health Concept and Strategy.
3. *Define* the ways that IPPC could contribute to the One Health planning at FAO, if there is agreement that this is the appropriate direction for CPM to take.
4. *Consider* the role and scope of IPPC’s involvement in the One Health area going forward.