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Impact of global trade and human mobility on the health of agricultural crops and forests in Europe and Central Asia

Executive summary

- The purpose of this document is to highlight the main aspects of trade and human mobility as important risk factors for introductions and movement of plant pests internationally, with possible impacts on infestations of plants by pests in agriculture or forestry.
- Increases in global trade and human mobility have been the major drivers for the expansion of pests into regions in which they were previously absent. This phenomenon has affected the Europe and Central Asia region, with many new pests establishing, spreading and having impacts.
- New pest threats continue to emerge not only through regular international trade, but also through new patterns of trade, such as Internet trade.
- In addition, there is little information on the impact of human mobility, such as travel and migration, on the introduction of pests and diseases to new areas.
- Since plant pests entering new areas can be considered invasive alien species (IAS), greater integration of national and international cooperation among agencies concerned with plant health and IAS is recommended.
- FAO, working closely with the Secretariat of the International Plant Protection Convention (IPPC) and other partners, has provided assistance to Europe and Central Asian countries in response to the impacts of trade on plant health in the region.
- In order to address the impact of new patterns of trade and human mobility on plant health, there is an urgent need for the modification of existing risk assessment and surveillance methods. The risk assessment methods can be improved by the use of pathway models and analysing the structure of global trade networks.

Guidance sought

The ECA is invited to:

- Endorse the recommendation for Members as outlined in paragraph 29.
- Endorse the recommendations to FAO as outlined in paragraph 30.

I. Introduction

1. The major driver for the expansion of plant pests to new areas in various regions of the world is the huge increase in global trade that has occurred over the last century. Another driver receiving increasing attention is human mobility, covering tourism, work-related travel, and patterns of migration arising from human displacements caused by military, political and economic situations. Currently, this human-driven movement of pests is likely to occur more than before through trade, as shown in the World Trade Organization's World Trade Statistical Review, published on an annual basis. Travel is increasing in intensity and range. In 2017, it was estimated that the number of international tourist arrivals worldwide would reach approximately 1.32 billion.[1]

2. The purpose of this document is to highlight the main aspects of trade and human mobility as important risk factors for introductions and movement of plant pests internationally, with possible impacts on infestations of plants by pests in agriculture or forestry.

3. The document has three sections. The first section gives examples of pest introductions into the Europe and Central Asia region, with heavy implications for the economy and socio-economic development, and mentions efforts undertaken to address the key related risks and challenges. The second section highlights the role of FAO in addressing these plant health challenges. The last section includes recommendations for the Members and for FAO.

II. Impact of international trade and human mobility on plant health

International trade and human mobility as the main drivers of pest movements

4. The Europe and Central Asia region, as many other parts of the world, has experienced numerous introductions of plant pests from other regions, with documented impacts on plant production and performance, food security, and economic and social development. Notable examples of recent incursions through trade include the plant pathogenic bacterium *Xylella fastidiosa* devastating olive trees in southern Italy; chestnut blight (*Cryphonectria parasitica*)

[1] https://www.statista.com/statistics/209334/total-number-of-international-tourist-arrivals/

and brown marmorated stink bug (*Halyomorpha halys*) in Georgia; box wood moth (*Cydelima perspectalis*) in Europe and the Caucasus; and the red palm weevil (*Rhynchophorus ferrugineus*) affecting palm trees in some parts of the Mediterranean and the Caucasus. One of the pests that may in near future invade the region and potentially cause significant damage in maize production is the fall armyworm (*Spodoptera frugiperda*), which has rapidly spread across sub-Saharan Africa and recently was found in several countries in Asia.

5. Available data clearly show the significant increase of plant imports in recent decades. In the period from 2001 to 2018, the value of imports of fruits and vegetables increased globally, from more than USD 23 billion to more than USD 73 billion. For plants for planting, the increase was from nearly USD 9 billion to more than USD 20 billion, and for cereals from more than USD 37 billion to more than USD 117 billion.[2] For many individual countries, the increases reached hundreds of percent. Although data on trade volumes are not comprehensive across all years, a striking example of a huge increase is that of live plants, with global imports increasing from just under 2 million tons in 2001 to almost 26 million tons in 2013. It seems clear that even the enhancement of the phytosanitary capacities of national plant protection organizations (NPPOs) in that period could not fully match the pest risks resulting from such an increase of trade.

6. Hence, risks of further introductions and movement of pests into Europe and Central Asia are increasing due to intensified international trade, changing climatic conditions,[3] and the interaction between these two global drivers. The desire to strengthen national phytosanitary systems in order to better address the concerns about pest impacts in trade is reflected in the legislation adopted in the region. An example may be the concept of "high risk plants, plant products and other objects" for the European Union, recently introduced by the European Commission,[4] along with a quantitative assessment of pest-related criteria required to rank the candidate priority pests provided by the European Food Safety Agency (EFSA, 2019).

7. Regional economic integration may have additional both negative and positive impacts on the risks of pest movement between countries. Unification of procedures and requirements eliminates the necessity of border controls and may help in trade facilitation and the enhancement of economic development. The effectiveness of phytosanitary systems in preventing the spread of pests with traded commodities within the integrated areas may vary among the countries. It may depend on capacities of individual NPPOs to develop and operate specific surveillance programmes and to implement relevant pest risk management options. Exhaustive evidence on the impacts of economic integration processes on the effectiveness of phytosanitary systems in preventing introductions and the spread of pests is not available.

8. Despite the wide range of standards, guidance materials and tools available, there are certain areas of human activities that for a long time did not receive sufficient attention from the phytosanitary perspective. These include the international trade of plants for planting (including forestry species), Internet trade (e-commerce), and human mobility.

[2] http://www.intracen.org/itc/market-info-tools/statistics-import-product-country/

[3] See also ECA/41/19/4.

[4] EU Commission Implementing Regulation (EU) 2018/2019: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R2019

9. Plants for planting are generally considered to pose higher pest risks than other articles, as they are usually intended to be released to the environment in the area of destination (e.g. planted in soil in open fields) and grown for a relatively long time, which may allow potentially present pests to spread. The global trade of plants for planting is often considered the main reason for the rise in the number of introduced pests over the past 25 to 30 years, due in part to insufficient risk management measures being taken. In practice, the measures available to prevent incursions and to manage pests that have already entered the region are limited. For that reason, countries exporting plants for planting are increasingly encouraged to follow the systems approach in pest risk management. This has been supported, for example, through the adoption of ISPM 36 "Integrated measures for plants for planting",[5] which emphasizes the roles of producers of plants and countries of origin in making certain that exported plants are free from pests of quarantine status for the importing country.

10. The role of the Internet trade of plants, plant products or other regulated articles of phytosanitary concern as a pathway for the introduction and spread of pests has not been fully appreciated until recently. Its rapid, almost universal, development in recent years, as in other areas of commerce, has raised issues of phytosanitary concern due to the accompanying pest risks that are not adequately covered by current regulatory practices or in pest risk assessment methodologies. Plants purchased through e-commerce often originate in a country or a continent different from the country of destination and may carry dangerous pests. The individual consignments are usually small and delivered by mail companies, and their specific content may not even be fully known. In many cases, the phytosanitary import requirements of the country of destination are not considered, and phytosanitary controls both at the origin and at the country of destination are neglected, leading to increased pest risks. The Commission on Phytosanitary Measures has considered and addressed those concerns in CPM Recommendation R-05, adopted in 2014.[6] It encourages the IPPC contracting parties and their NPPOs, as well as the regional plant protection organizations, to conduct a range of activities; however, no reports on steps taken by countries to follow up on pest risks in the Internet trade of plants are available.

11. Another aspect that deserves greater attention is human mobility, whether from tourism, work-related travel or various patterns of migration. Available data show that in the period between 1950 and 2018, the number of international arrivals of tourists increased from 25.2 million to 1.32 billion people globally, and in Europe alone from 16.8 million to 671 million.[7] Individuals moving between countries, regions and continents quite often carry with them plants or parts of plants, such as twigs, fruits or seeds, which may harbour pests. Those plants may be planted indoors or outdoors in the environment or be discarded as waste, with the consequence that pests may transfer to local hosts, establish and spread. Countries in Europe and Central Asia do not usually require that individual travellers undergo regular phytosanitary checks at border crossings, which may be a symptom of the underestimation of the risk. It may also be noted that such controls might require considerable customs or NPPO resources that may not be available. An example of another relevant activity in the region aimed at raising the public

[5] http://www.fao.org/3/k8114e/k8114e.pdf
[6] https://www.ippc.int/en/publications/84232/
[7] https://ourworldindata.org/tourism

awareness of the risks involved may be the "Don't Risk It" campaign launched by the European and Mediterranean Plant Protection Organization (EPPO) in 2013.[8]

12. A historical analysis of the global expansion of plant pathogens showed that in the main, this was related to human activities and societal, technological and geopolitical changes (Santini *et al.*, 2018). Subsequently, databases have been used to determine and analyse rates of arrival and establishment of plant pests in individual countries and regions of the world. The initial spread rates of invasive insects in Europe was approximately three to four times higher after 1990 than for species that arrived earlier (Roques *et al.*, 2016). It was hypothesized that the post-1989 political changes in Europe facilitated this faster spread.

13. The predominant effect of trade is mainly on the initial entry of plant pests and pathogens into a new region, country or continent – an effect that is likely to be amplified if international trade continues to increase. In some cases, the time of the first entry of a pest may have preceded its first detection by several years. An advance pest risk analysis (PRA)[9] of potential known threats and an implementation of preventive measures would be of great value in avoiding pest incursions but may not be sufficient given the time lags noted above, especially if there are uncertainties over the pest identity and potential host range.

14. Moreover, the entry itself does not necessarily lead to significant impacts on plant health, whether of food or non-food crops, forests or native plant biodiversity. For that to occur, the pest must be able to establish and spread in the new environment, and for this, the climatic conditions and host availability must be conducive. Both the invasiveness of an insect species and the invasibility of the receiving ecosystem, understood as the extent to which a given ecosystem is vulnerable to being invaded by a given invasive species, were studied by Hill *et al.* (2016). The outcome of such an analysis is then made uncertain with climate change and the adaptations present in the pest and in the potentially affected hosts.

Assessment of pest risks associated with human activities in the region

15. Plant pests entering new areas can be considered invasive alien species (IAS). The change in terminology to "invasion" rather than "incursion" or "introduction" is instructive. Many of the more general reviews on pest introduction now take an invasion biology perspective to the consequences of increased global trade and human mobility.

16. In principle, the ways in which the risks of IAS due to global trade and human mobility are assessed, and the options for mitigating those risks, are very similar to those in pest risk assessment. Surveillance is critical to identify the distribution of both plant pests and IAS. Attempts are being made to harmonize two databases concerned with the categorization of alien invasive species: the European Alien Species Information Network (EASIN) and the classification scheme of the Convention on Biological Diversity (CBD) (Tsiamis *et al.*, 2017). In the EASIN scheme, there is a single category corresponding to trade of contaminated commodities, whereas in the CBD scheme there are ten subcategories, six of which refer to plants or plant pests. This indicates that IAS cover a broader range of organisms than plant

[8] https://www.eppo.int/RESOURCES/eppo_publications/don_t_risk_it

[9] See also the concept note for a side session on PRA.

pests. The two groups are also subject to different regulatory regimes, but this should not present obstacles to closer collaboration and the exchange of ideas among those involved in scientific investigations and risk assessments and the respective decision-makers. Further development of concepts and models for analysis of trade networks – local, regional and global – is essential in both areas.

17. New imports are perceived as a source of relatively high risks of entry of pests or IAS due to insufficient information necessary to assess the risk and implement appropriate measures for the new pathways. As noted by Seebens (2019), an example may be China's aspirations to build a modern Silk Road, which may open new avenues for species to spread into areas outside their native range.

18. A relatively new trend in assessing the impact of global trade on the introduction of pests to new areas is the use of quantitative methods in assessing pest risks, although qualitative methods continue to play an important role. Global shipping routes provide a network of trade connections that is central to the spread of invasive species worldwide. Based largely on socio-economic analyses, Sardain *et al.* (2019) predict up to a thousand percent increase in global maritime traffic by 2050, with up to a 20-fold increase in global invasion risk. Such predictions support the development and increased use of quantitative methods. The use of quantitative pathway models for IAS and pest risk assessment gives estimates of the risks of introduction and of the effectiveness of risk-reducing options. In Douma *et al.* (2016), two approaches were distinguished based on the literature: in one cluster of models, the pathway model was based on the movement of produce, and in the second, on the movement of individual pest agents. Other clusters were distinguished that were a combination of these two approaches or that represented their interaction. The choice of model in an actual risk assessment would depend on the terms of reference and assessment objectives, and on time and resource constraints.

19. Pathway models can be seen as essentially one-dimensional, not adequately representing the connectivity present in the flow of plants and plant products in trade, ranging from within a country to the international scale. These flows can be conceptualized and represented as trade networks. A relatively recent innovation is to develop and apply network-based approaches to study trade networks (Jeger *et al.*, 2007). Conceptually, a network consists of a set of "nodes" connected by "links" that may be uni- or bi-directional. The nodes may correspond to physical locations: starting with field production and harvesting, then to processing and produce distribution centres, followed by movement within or between regions, countries, or continents. The links in a trade network are then the transportation pathways (road, ship or plane) that connect the nodes. An example of a trade network representing the flow of ornamental plants in Europe is given in Figure 1.

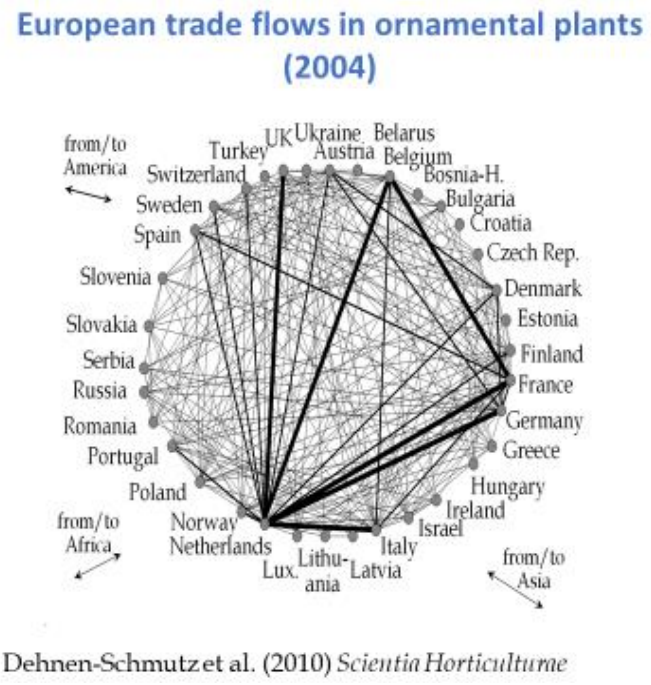

Figure 1. Network of trade interactions of European countries, based on the sum of imports and exports of ornamental horticultural products, excluding seeds, in 2003. Arrow thickness is proportional to trade volume.

20. The role of trade networks in the spread of invasive species is a developing field of research that provides new tools to study invasions. Networks with differing topologies (structure and connectivity) determine the likelihood of spread through trade and transport networks and can be used to determine key points of vulnerability within the network where interventions could be most effective (Banks *et al.*, 2015). A specific example using this approach for a nematode pest is given by Banks *et al.* (2018).

21. It is often assumed that trade networks explain the large-scale distributions of non-native species, but this assumption remains largely untested. Chapman *et al.* (2017), using data on a range of traded commodities (live plants, forest products, fruit and vegetables, and seeds), found that connectivity through trade (including transport) networks was found to provide a better explanation of invasion than import volumes, species' global presence, geographical distance, or climate. The findings provide a framework for improved surveillance, biosecurity and risk assessment.

22. Network approaches are increasingly being used in plant pathology and pest management at all levels of biological organization, from genetic or biochemical networks involved in host-plant resistance to trade in plants between countries and continents (Moslonka-Lefebvre *et al.*, 2011). Different types of network structures give different outcomes in terms of the spread of pathogens and potentially different strategies in terms of disease management (Pautasso and Jeger, 2014). Trade networks enable human-mediated or human-altered dispersal of species and have the effect of "rewiring" spatial networks, with sometimes unexpected

ecological and epidemiological consequences (Bullock *et al.*, 2018). The implications of such dynamic spatial networks for invasive plant pests remain to be explored.

III. The role and activities of FAO

23. FAO promotes international cooperation, preventive approaches, monitoring, early warning and rapid response systems, and integrated pest management. The Regional Office for Europe and Central Asia also assists Members in the implementation of international standards and coordinates activities related to plant health in the region.

24. The Secretariat of the IPPC coordinates international efforts to develop and adopt globally agreed guidance and methods of pest detection and pest risk reduction, as well as recommendations on other issues relating to the prevention of the introduction and spread of plant pests. Standard-setting activities are accompanied by relevant activities aiming at the implementation of the IPPC and its international standards by countries, as well as at raising the awareness of stakeholders on issues related to plant health. The IPPC Secretariat also has worked closely with the Secretariat of the Convention on Biological Diversity (CBD) to promote the use of the IPPC framework to manage invasive alien species (IAS). In this context, two significant publications were developed, one relating to the identification of risks and management of invasive alien species using the IPPC framework (IPPC Secretariat, 2005), and one to international trade and invasive alien species (Lopian and Stephen, 2013).

25. Further significant advances in the facilitation of safe trade may be expected from the development and adoption of International Standards for Phytosanitary Measures (ISPMs) providing guidance on phytosanitary measures in trade for individual commodities, pathways, or groups of commodities, which was agreed by the Fourteenth Session of the Commission on Phytosanitary Measures (CPM-14) in 2019.[10] With the approach to commodity and pathway standards proposed, pest risk management options for major regulated pests or major groups of pests associated with a commodity or pathway will be identified and endorsed for global use. Countries will retain their sovereign right to set the conditions for the safe import of goods and will remain free to negotiate measures for pests of concern not fully covered by the commodity- or pathway-specific ISPMs.

26. In recent years, the plant health international community has successfully promoted the initiative to hold an International Year of Plant Health (IYPH) in 2020. The IPPC community, through the established IYPH Steering Committee, has been the leader in the process of adoption of the declaration in various FAO bodies and in the United Nations General Assembly. The Steering Committee has successfully promoted the idea of IYPH and has coordinated the preparation of different forms of IYPH communication materials for different groups of stakeholders and for the general public. Currently, the new IYPH International Steering Committee, in continuation of previous efforts, acts to guide the development and

[10] CPM-14 (2019) Report: https://www.ippc.int/en/publications/87271/

implementation of the IYPH action plan, stimulate dialogue with partners, and help mobilize political and financial support for the IYPH.

27. The FAO Regional Office for Europe and Central Asia (REU) delivers activities related to plant health and phytosanitary systems in the framework of the Regional Initiative "Improving agrifood trade and market integration" (RI-2). REU cooperates with relevant international organizations in Europe and Central Asia, especially with the IPPC Secretariat and with EPPO, on initiatives relating to addressing plant health issues. Examples of cooperation comprise joint organization of workshops, meetings, sessions or other events, as well as participation of experts and joint technical support for development projects implemented in the countries of the region with a focus on plant health.

Conclusions and recommendations

28. Human activities such as trade (including-commerce) and human mobility are considered the major means of the movement of pests between countries and continents. The introductions of pests into new areas may bring enormous threats to plants in agriculture and natural environments. These pest risks are extremely difficult for individual countries to handle and require international cooperation and harmonization of measures applied. In that respect, the following recommendations can be made for Members and FAO on activities aiming at the increased prevention of pest risks in the region.

Recommendations for Members

29. ECA may wish to recommend that Members undertake the following:

1) **Consider** how the relevant international standards and recommendations relating to the assessment of pest risks (PRA) can best be implemented to prevent movement of pests with consignments in trade.
2) **Consider** what additional guidance, activities or measures, including inspection and diagnostic techniques, can be implemented to enhance national capacities and improve pest risk management in the international trade of plants.
3) **Consider** activities (e.g. awareness-raising campaigns) that may reduce pest risks coming from human mobility.
4) **Consider** the implementation of the CPM "Recommendation on Internet trade (e-commerce) in plant and other regulated articles" to prevent pest risks arising from Internet trade.
5) **Integrate** elements related to plant health into national strategies, with regard to invasive alien species, biodiversity and the protection of the environment.
6) **Identify** and exploit cooperation opportunities on subregional, regional and global levels in order to increase national capacities to address common challenges related to plant health.

Recommendations for FAO

30. The ECA is invited to recommend that FAO:

1) Through REU Regional Initiative 2, **support** Members in their participation in the development and effective implementation of internationally adopted standards and procedures to support local and international markets and develop efficient agrifood systems.
2) **Evaluate** whether training programmes are sufficiently in place and coordinated to maintain and improve the abilities of phytosanitary staff in identifying and addressing pest risks coming from human-driven activities.
3) **Support**, on a continuing basis, training programmes run by FAO and other regional and international agencies.
4) **Promote,** at the international level, the adoption of the IPPC, ISPMs and international recommendations relevant for the prevention of human-driven pest movements.
5) **Support** farmers, advisory services and consultants by updating their knowledge, skills and practices with respect to current and new pest threats to their crops.

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