

Review Article

PHYTOSANITARY ISSUES AND ACTIONS FOR INTERNATIONAL TRADE OF AGRICULTURE PRODUCTS IN NEPAL: A REVIEW

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ABSTRACT

Agriculture remains the single most important sector of the Nepal's economy. It is the major source of livelihood of about 80% of population, while this sector is greatly threatened by invasion of noxious plant pests in field and postharvest commodities. There is a great risk of entry, establishment and spread of invasive alien pests with their devastating economic impacts on crop production and trade as well. Therefore, a robust and stringent plant quarantine system is required for the prohibition of entry and spread of such pests associated with trade off agricultural products. Being a member of International Plant Protection Convention (IPPC) and World Trade Organization (WTO) of sanitary and phytosanitary (SPS) agreement, Nepal is obliged to implement International Standards for Phytosanitary Measures (ISPMs). In short span of time, Nepal has made remarkable progress in the Sanitary and Phytosanitary field since last decade. Several laws, regulations, policies, guidelines and standards related to SPS have been formulated and implemented in Nepal. Organizational set up to carry out quarantine authority has been amended and placed in federal jurisdiction in the new constitution. The Phytosanitary Capacity Evaluation (PCE) of NPPO-Nepal has been successfully completed with the technical assistance of IPPC and financial support of World Bank. Pest Risk Analysis (PRA) of around 25 crops, pest data base of more than 35 crops and their official documentation are the major milestone in the history of SPS development in Nepal. However, the main shortcomings are pest survey-surveillance and pest risk analysis, which are suffering from operation of dedicated diagnostic laboratory with skilled human resource. This task aims to examine current sanitary and phytosanitary (SPS) issues in Nepal, along with visible interventions at both technical and policy levels to strengthen the national SPS system. It specifically explores the risks posed by exotic insect pests and their potential spread from native habitats to new export destinations. Therefore, this formal assessment of SPS development in Nepal is a valuable resource for quarantine officials, researchers, academicians and policy makers.

Key words : Exotic pests, invasive species, international standards and obligations, sanitary and phytosanitary (SPS), SPS system.

INTRODUCTION

Nepal's agriculture sector plays a crucial role in contributing significantly to GDP, employment, and rural livelihoods (MoALD, 2022). Plants, which make up 80% of the food we eat, and produce 98%

of the oxygen we breathe, are “Under constant and increasing threat from pests and diseases” (UN, 2019). FAO (2020) has estimated that up to 40% of food crops are lost due to plant pests annually. Plant health is increasingly under threat. Climate change, and human activities, have altered ecosystems, reducing biodiversity and creating new niches where pests can thrive. At the same time, international travel and trade has tripled in volume in the last decade and spread pests and diseases around the world causing excessive damage to native plants and the environment (IYPH, 2020). Furthermore, technologies to detect pests and diseases have improved considerably. However, the fact that trade is a major pathway for the entry of exotic plant pathogens/pests which requires working protocol to determine the risk profile of commodities. Therefore, authorities and organizations responsible for biosecurity need to assess the risks associated with different pathways of pest introduction (Hulme, 2009).

International trade of plant and plant products face various issues and challenges because of sanitary and phytosanitary (SPS) requirements. These issues stem from stringent international standards designed to protect human, animal, and plant life from risks arising from pests and contaminants. For Nepal, a country with diverse agro-climatic zones and a variety of agricultural commodities, meeting these SPS requirements is essential to access in global markets and to ensure the safety and quality of its food supply while safeguarding its biosecurity. Despite its potential, Nepal’s agricultural exports face numerous hurdles, including compliance with SPS measures set by importing countries. These challenges include the presence of quarantine pests, pesticide residues, and other contaminants that may not meet international standards. Moreover, inadequate infrastructure, limited technical expertise, and lack of awareness among stakeholders further exacerbate these challenges. On the import side, Nepal must also ensure that incoming agricultural products do not introduce new pests that could threaten local agriculture (Sharma, 2018; USAID, 2018). It is necessary to take effective actions to prevent the introduction, establishment and spread of pests of plants and plant products, and to promote appropriate measures for their control. In this context, this paper presents the history of crop pest spread and economic loss, regional development of SPS organizations, insect pests in the Nepalese context, national agriculture related policies, quarantine functions, international standards and obligations as well as SPS issues and actions.

MATERIALS AND METHODS

This article is prepared based on review of national as well as international publications and online sources. Also, the authors have reviewed the relevant decisions made by National Plant Protection Organization (NPPO-Nepal). The quantitative and qualitative data and facts mentioned in this article are drawn from journals, books, proceedings and online resources including the publications of Plant Quarantine and Pesticide Management Centre, CABI Digital library (online source) and from other government organizations.

RESULTS AND DISCUSSION

International Scenario

Pest spread and economic loss: Many exotic pests have entered and established in different parts of the world due to lack of or weak quarantine measures (Table 1). The introduced and spread of exotic pests are destructive to crops in new environments (Table 2). Therefore, regulating/ restricting regulated pest spread is outmost importance to prevent their heavy loss to crops, for which technical sound and reliable SPS measures are necessary to meet the trading needs of partner countries.

Table 1. Pests introduced in different countries of the world

SN	Pests	Introduced in	Introduced from	Year
1	Late blight of potato (<i>Phytophthora infestans</i>)	Europe	South America	1830
2	Powdery mildew of grape (<i>Uncinula necator</i>)	England	USA	1845
3	Grape Phylloxera (<i>Phylloxera vitifoliae</i>)	France	USA	1845
4	Downy mildew of grape (<i>Plasmopara viticola</i>)	France	USA	1878
5	Golden nematode of potato (<i>Heterodera rostochinensis</i>)	USA, Mexico	Europe	1881
6	Mexican boll weevil (<i>Anthonomus grandis</i>)	USA	Mexico, C-America	1892
7	Chestnut blight (<i>Cryphonectria parasitica</i>)	USA	Asia	1904
8	Citrus cancer (<i>Xanthomonas citri</i>)	USA	Asia	1907
9	Blister rust of pine (<i>Cronarcium ribicola</i>)	USA	Europe	1910
10	Fire blight of apple (<i>Erwinia amylovora</i>)	New Zealand	N-America	1919
11	Onion smut (<i>Urocystis cepulae</i>)	Switzerland	France	1924
12	Dutch elm (<i>Ceratostomella ulmi</i>)	USA	Holland	1928-30
13	Bacterial canker of tomato (<i>Cornebacterium michiganense</i>)	UK	USA	1942
14	Coffee rust (<i>Hemilia vastatrix</i>)	Brazil	Africa, Asia	1970

Source: Daunde (2017); Sharma & Thakur (2007); Pundhir & Anshar (2011)

Many countries in the world are facing considerable economic losses due to invasion of exotic crop pathogens. Table 2 reflects the serious economic losses caused by wide range of crop diseases worldwide.

Table 2. Introduced exotic pests causing economic losses in different countries

SN	Disease	Host	Country	Introduced from	Economic loss
1	Canker	Citrus	USA	Japan	\$ 3 million; 19.5 million trees destroyed
2	Dutch elm	Elm	USA	Holland	\$ 25-50 million
3	Blight	Chestnut	USA	Eastern Asia	\$ 100-1000 million
4	Powdery mildew	Grapevine	France	USA	80% in wine production
5	Downy mildew	Grapevine	France	USA	\$ 50,000 million
6	Bunchy top	Banana	India	Sri Lanka	\$ 40 million crores
7	Wart	Potato	India	Netherland	2500 acres infected
8	South American leaf blight	Rubber	Dutch-Brazil	Guiana	40,000 trees destroyed
9	South American leaf blight	Rubber	North-Columbia	Brazil	78% trees destroyed
10	Blue mold	Tobacco	Europe	UK	\$ 50 million
11	Blue mold	Tobacco	Sweden	UK	1.2 million Kroner

Source: Daunde (2017); Sharma and Thakur (2007); Saini et al. (2022)

Regional development of SPS organizations: The SPS has received importance due to globalization and liberalization of international trade of plants and plant materials in the wake of SPS agreement with WTO. Hence, realizing the huge loss of crop wealth, many organizations have emerged at regional levels to prevent alien pests of economic importance from other countries in trade of plant products (Table 3). In accordance with International Plant Protection Convention (IPPC) requirements regional Plant Protection Organizations have been formed to cooperate with one another in establishing regional plant protection standards the oldest of which is the European Plant Protection Organization (EPPO) with over 50 member countries in Europe, North Africa and the near East.

Table 3. Establishment of regional plant protection organizations in the world

SN	Organization	Headquarter	Established year	No. member country
1	European and Mediterranean Plant Protection (EPPO)	Paris, France	1951	> 51
2	Organization International Regional de Sanidad Agropecuaria (OIRSA)	San Salvador, El Salvador	1953	9
3	Inter-African Phytosanitary Council (IAPSC)	Yaounde, Cameroon	1954	52
4	Asia and Pacific Plant Protection Commission (APPPC)	Bangkok, Thailand	1956	25
5	Comunidad Andina (CA)	Lima, Peru	1969	12
6	North American Plant Protection Organization (NAPPO)	Washington DC, USA	1976	3
7	Comide de Sanidad Vegetal del Cono Sur (COSAVE)	Montevideo, Uruguay	1989	7
8	Pacific Plant Protection Organization (PPPO)	Suva, Fiji	1994	27
9	Near East Plant Protection Organization (NEPPO)	Morocco	2009	12
10	Caribbean Agricultural Health and Food Safety Agency (CAHFSA)	Suriname	2010	15

Source: Kahn (1983); Sharma and Thakur (2007)

The most frequently cited 10 quarantine regulated pests in 125 countries among 614 species of insects and mites (Kahn, 1983) are followed.

- *Quadraspidiotus perniciosus* (Comstock) (San Jose scale) (Hemiptera: Diaspididae) (n = 44)
- *Leptinotarsa decemlineata* Say (Colorado potato beetle) (Coleoptera: Chrysomelidae) (n = 40)
- *Ceratitis capitata* (Wiedemann) (Mediterranean fruit fly) (Diptera: Tephritidae) ((n = 39)
- *Rhagoletis pomonella* Walsh (Apple maggot) (Diptera: Tephritidae) (n = 33)
- *Dacus dorsalis* Hendel (Oriental fruit fly) (Diptera: Tephritidae) (n = 28)
- *Popillia japonica* Newman (Japanese beetle) (Coleoptera: Scarabaeidae) (n = 28)
- *Anthonomus grandis* Boheman (Boll weevil) (Coleoptera: Curculionidae) (n = 21)
- *Anastrepha ludens* (Loew) (Maxican fruit fly) (Diptera: Tephritidae) (n = 20)
- *Rhagoletis cerasi* Linneus (Cherry maggot) (Diptera: Tephritidae) (n = 20)
- *Phthorimaea operculella* Zeller (Potato tuber moth) (Lepidoptera: Gelechiidae) (n = 19)

Note : n = no. of countries citing insect

Colorado potato beetle and fruit flies can be dispersed on wind currents while other listed pests are not moved by such natural means (Sharma and Thakur, 2007).

Quadaraspidotus perniciosus (Joshi and KC, 1984), *Dacus dorsalis* (Joshi and Manandhar, 2001) and *Phthorimaea operculella* (Joshi and Manandhar, 2001) are also reportedly existed in Nepal.

Similarly, at global perspective, many of the plant viruses and bacteria have caused significant problems in terms of economic losses in a wide range of crops. In this respect, top ten plant pathogenic viruses and bacteria have been accused (BSPP, 2011, 2012), and their identities are followed.

Top ten plant viruses are; Tobacco mosaic virus (TMV), Tomato spotted wilt virus (TSWV), Tomato yellow leaf curl virus (TYLCV), Cucumber mosaic virus (CMV), Potato virus Y (PVY), Cauliflower mosaic virus (CaMV), African cassava mosaic virus (ACMV), Plum pox virus (PPV), Brome mosaic virus (BMV), Potato virus X (PVX).

Similarly, top ten plant bacteria are; *Pseudomonas syringae*, *Ralstonia solanacearum*, *Agrobacterium tumefaciens*, *Xanthomonas oryzae* pv. *oryzae*, *Xanthomonas campestris*, *Xanthomonas axonopodis* pv. *manihotis*, *Erwinia amylovora*, *Xylella fastidiosa*, *Dickeya* (*dadantii* and *solani*), *Pectobacterium carotovorum* (and *P. atrosepticum*)

International standards and obligations: International Standards for Phytosanitary Measures (ISPMs) are standards adopted by the Commission on Phytosanitary Measures (CPM), which is the governing body of the International Plant Protection Convention (IPPC). ISPMs can cover a wide range of issues including; surveillance, pest risk analysis, establishment of pest free areas, export certification, phytosanitary certificates and pest reporting. The intention of ISPMs is to harmonize phytosanitary measures for the purpose of facilitating international trade (IPPC, 2024). The first ISPM was adopted in 1993. As of April 2024, there are 46 adopted ISPMs (ISPM 30 being revoked), 33 Diagnostic Protocols and 46 Phytosanitary Treatments. These international standards support to i) protect sustainable agriculture and enhance global food security, ii) protect the environment, forests and biodiversity and iii) facilitate economic and trade development. The major ISPMs which are crucial for upgrading SPS and Quarantine system for Nepal are;

ISPM 1 : Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade

ISPM 2 : Framework for pest risk analysis

ISPM 5 : Glossary of Phytosanitary terms

ISPM 6 : Surveillance

ISPM 11 : Pest risk analysis for quarantine pests

ISPM 17 : Pest reporting

ISPM 21 : Pest risk analysis for regulated non-quarantine pests

Table 4. Summary of stated measures in regulation in different countries

S.N.	Quarantine measure	New Zealand	Australia	USA	Canada	India	China	Brazil	Kenya	South Africa	EU
1	Phytosanitary certificate	+	+	+	+	+	+	+	+	+	+
2	Import permit	+	+	+	+	+	+	+	+	+	-
3	Import inspections	+	+	+	+	+	+	+	+	+	+
4	Pathway risk analysis	+	+	#	+	+	+	+	#	#	-
5	No contaminants/soil	#	#	#	+	#	+	+	+	#	#
6	Pre-export treatments	+	+	#	#	#	#	+	#	#	#
7	Pest free area	#	#	#	#	#	#	#	#	#	#
8	Pest free production site	#	#	#	#	#	#	#	#	#	#
9	Shipping in specific season	#	+	#	#	-	-	-	-	-	#
10	Post-entry quarantine	+	+	#	#	#	#	+	#	#	#

Source: Eschen et al., 2015

Note: + = Measure is required for all live plants imports, - = Measures that are not required at all, and # = Additional measures required for specific genus-origin combinations.

National Scenario

National agriculture pest problems: Nepal has great diversity in land-geography, temperature, and climate which makes it a suitable habitat for organisms from different parts of the world. The biological invasion has raised problems in biodiversity conservation, agricultural production, and ecosystem services in Nepal. Invasive pests can result in reduced production of agricultural commodities and thus reflect in income which increases risk in the economy, food security, and native biodiversity (Shrestha, 2016). A total of 69 alien species of fauna have been reported in Nepal among which 20 species are insects (Budha, 2014). Among countries threatened by invasive alien species (IAS), the agriculture sector ranks third as Nepal is highly reliant on the import of agricultural products (Paini et al., 2016). Table 5 depicts some of the important invasive pests in the agricultural crops during a period of over 6 decades (PQPMC, 2024) and Table 6 reveals outbreaks of insect pests, diseases in crops and incurred production losses in Nepal (Shrestha, 2007).

Table 5. List of important invasive pests introduced in Nepal for over six decades (1962-2024)

SN	Common name	Scientific name	Year of introduction
1	African giant land snail	<i>Achatina fulica</i> Bowdich	1930-1940
2	San Jose scale	<i>Quadraspidiotus perniciosus</i> (Comstock)	1962
3	Potato tuber moth	<i>Phthorimaea operculella</i> (Zeller)	1966
4	Chinese citrus fly	<i>Bactrocera minax</i> (Enderlein)	1984
5	Tomato leaf miner	<i>Tuta absoluta</i> (Meyrick)	2016
6	Coffee leaf rust	<i>Hemelia vestatrix</i> (Berk and Br.)	2016
7	Fall armyworm	<i>Spodeoptera frugiperda</i> J.E. Smith	2019
8	Chilli thrips	<i>Thrips parvispinus</i> Karny,	2024
9	UG 99 race TTKTT of wheat rust	<i>Puccinia graminis f.sp. tritici</i>	2024

Source: PQPMC (2024)

Table 6. Outbreak of pests and estimated losses of agriculture commodities in Nepal

SN	Crop infested	Causal organism	Estimated loss (%)
1	Paddy	<i>Nilaparvata lugens</i> Stål	30-50
		<i>Pyricularia oryzae</i> Cavara	30-70
		<i>Brevienia rehi</i> (Lindinger), <i>Aleurolobus</i> spp.	15-25
2	Cole crop	<i>Plasmodiophora brassicae</i> Woronin	20-50
3	Citrus spp.	<i>Phytophthora</i> spp.	20-30
		CTV	20-60
4	Maize	<i>Podoptera</i> spp.	20-50
5	Apple	<i>Venturia inequalis</i> (Cooke) G.Winter, <i>Aonidiella aurantii</i> (Maskell), <i>Phytophthora</i> spp.	20-30
6	Legume	<i>Helicoverpa armigera</i> (Hubner)	20-80
7	Sugarcane	<i>Hieroglyphus</i> spp.	20-60
8	Ginger	<i>Fusarium</i> spp.	15-20
9	Potato	<i>Bemisia tabaci</i> (Genaadius)	20-40
10	Tomato	CMV	40-80
11	Cucumber	<i>Aulacophora foveicollis</i> Lucas	20
12	Chilli	<i>Thrips tabaci</i> Lindeman	20-40
13	Cardamom	Virus	30-40

Source: Shrestha (2007)

Agriculture related policies

Table 7 shows that there are several policies for the agriculture sectors (PRI, 2024; MoALD, 2024) that have played a major role in shaping the agriculture ecosystem (Bhattarai and Pandit, 2023). The policy environment has made friendlier to nurture private and community-based actors in agribusiness and supply sectors. Accordingly, the country's diverse agro-climatic conditions favor cultivation of a wide range of crops throughout the year. Nepal exports certain agricultural commodities, such as tea, cardamom, and ginger in different countries. In 2020, Nepal exported 5,063 mt of tea (worth \$ 7.1 million), 2,181 mt of cardamom (worth \$34.4 million), and 36,131 mt of ginger (worth \$ 25.2 million) (Trade Map, 2021). However, import of food has increased fourfold from 2011 to 2018 (NPC, 2019). The country suffers from low production and productivity of agricultural commodities; it is not growing at a rate that can meet the national/international demand. The production of major cereals, such as rice, maize, wheat, and millet, has been stagnant or rather declining after Covid-19 in Nepal (MoALD, 2021). Nepal is also vulnerable to food insecurity and recurring natural disasters such as floods, droughts, landslides, earthquakes, diseases, and pest outbreaks (FAO, 2019).

According to Mishra and Poudel (2023), the growth of agriculture production and productivity are low due to several factors including an ineffective and underfunded agricultural research and technology transfer system, lack of an effective mechanism for linking research extension and farmers, very low coverage of year-round irrigation facility, the limited availability and affordability of key production inputs (fertilizer, seed, breeds, etc.), declining soil fertility, poor integration of research and extension with the agricultural education system, and high incidence of pests. Due to a

low adoption of good agriculture practice, and manufacturing practices, it has been difficult for Nepalese farm products to comply with international quality standards. Resulting, Nepalese products have to face non-tariff measures as per the provision of Sanitary and Phytosanitary (SPS) agreement and other technical challenges in the export markets. Thus, this sector needs keen attention for more investment, boosting the capacity of laboratory and technical staff and ultimately it will be supportive to increase quality production, productivity and compete in the global market.

Table 7. List of agriculture policies related to SPS in Nepal

SN	Policies	Year
1	The Plant Quarantine and Protection Act	2007
2	The Pesticide Management Act	2019
3	The National Agriculture Policy	2004
4	Agricultural Development Strategy	2014
5	Nepal Trade Integration Strategy	2016
6	National Science and Technology Act	1989
7	The Commerce Policy	2008
8	Agri-Business Promotion Policy	2006
9	Climate Change Policy	2010
10	National Tea Policy	2000
11	National Coffee Policy	2003
12	Science and Technology Policy	2012
13	Biotechnology Policy	2006
14	National Seeds Policy	1999
15	National Food Safety Policy	2019
16	Agro Biodiversity Policy	2006
17	The Seed Act	1988

Source: PRI (2024); MoALD (2024)

Organizational arrangement to implement SPS system in Nepal: The Plant Quarantine and Pesticide Management Centre is the apex body to perform and carryout all the legal enforcement and technical activities related to phytosanitary (PS) system across the country. For this, it has 17 subsidiary quarantine offices located in the Nepal-India and Nepal-China customs borders as well as in International airports to inspect, verify, and issue entry permits and Phytosanitary Certificates for the import and export of plant and plant products.

Quarantine offices located at Indo-Nepal border:

- i. Quarantine Office, Kakarbhitta, Jhapa
- ii. Quarantine Office, Birgunj, Parsa
- iii. Quarantine Office, Bhairahawa, Rupandehi
- iv. Quarantine Office, Nepalgunj, Banke
- v. Quarantine Office, Gaddachauki, Kanchanpur.
- vi. Quarantine office, Bhandbari, Sunsari

- vii. Quarantine Office, Biratnagar, Morang
- viii. Quarantine Office, Malangawa, Sarlahi
- ix. Quarantine Office, Jaleswor, Mahottari
- x. Quarantine Office, Krishnanagar, Kapilwastu
- xi. Quarantine Office, Jhulaghat, Baitadi

Quarantine offices located at China-Nepal border:

- i. Quarantine Office, Tatopani, Sindhupalchowk
- ii. Quarantine Office, Lomanthang, Mustang
- iii. Plant Quarantine Office, Timure, Rasuwa

Three Quarantine Offices are located at Tribhuvan International airport, Pokhara International airport and Gautam Buddha International airport in Kathmandu, Pokhara and Bhairahawa respectively to provide quarantine services for the plant and plant products entering Nepal via Airways.

National SPS system: SPS measures are quarantine and biosecurity measures which are applied to protect human, animal or plant life or health from risks arising from the introduction, establishment and spread of pests. Each WTO member has right to take SPS measures necessary for the appropriate level of protection of human, animal or plant life or health, provided that such measures are not inconsistent with the provisions of the agreement. Being a member of WTO, IPPC and other international binding legal instruments and commitments, Nepal has strengthened its SPS capacity since last decade. Table 12 shows some of the interventions that have been carried out by Nepal (PCE, 2022; Humagain, 2022; GON, 2024).

Table 8. Chronology of development of SPS system in Nepal

SN	Achievements	Year
1	Member of Asia Pacific Plant Protection Commission (APPPC) and establishment of Central Plant Quarantine Unit in Plant Pathology Division, Khumaltar, Lalitpur under Department of Agriculture, Ministry of Agriculture	1965
2	Enactment of Plant Protection Act, 1972	1972
3	Enactment of Plant Protection Regulation, 1974, Nepal opened 7 Quarantine Check post and Nepal prohibited 16 different crops on importation by applying SPS measures	1974
4	Plant Quarantine Unit, NARSC merged into DOA	1974
5	FAO-Nepal launched TCP-2903A project in Nepal. The TCP was envisioned for Strengthening of Plant Quarantine of Nepal, which prepared the pest and disease's inventory of 18 different exportable commodities	2003-2005
6	Nepal became 147th member of WTO; strengthened its SPS capacity by enlarging its organizational structure i.e. 5 Regional Quarantine Offices, 8 National Plant Quarantine Posts and 2 Plant Quarantine Sub-Check post headed National Plant Quarantine Program under Plant Protection Directorate	2004
7	WTO section of Agribusiness Promotion Division of Ministry of Agriculture and Cooperative (MoAC) was designated as National Authority of WTO SPS agreement and Department of Food Technology and Quality Control was recognized as SPS Enquiry Point	2005

SN	Achievements	Year
8	United Nation, Food and Agriculture (FAO) launched Standard and Trade Development Facility (STDF) project and over 80 officials were trained in 8 different modules of SPS	2006
9	Enactment and notification of new Plant Protection Act in Nepal Gazette	2007
10	Enactment and notification of new Plant Protection Regulation in Nepal Gazette. Initiation of issuing of entry permit and phytosanitary certificate during import and export of plant and plant based articles	2010
11	Notification of Regulated Quarantine Pests of 18 different crops in Nepal Gazette	2014
12	Government of Nepal working in collaboration with CABI PlantwisePlus and related plant health programs at national, provincial and local levels since 2014	2014
13	Nepal Constitution 2015 in the country and plant quarantine- sole function of the Federal Government as mentioned in constitution	2015
14	The agreement of Phytosanitary Protocol between Government of Nepal and People's Republic of China to export citrus fruits from Nepal	2019
15	Nepal being the member of e-phyto hub of IPPC, Phytosanitary certification system has been linked with the e-phyto hub of IPPC	2021
16	Phytosanitary Capacity Evaluation of PQPMC accomplished in 2022, SPS capacity of PQPMC strengthened for safe trade and Nepal National Single Window (NNSW) for import and export of plant and plant based article as well as pesticide	2022
17	The old Plant Protection Act (1972) and Plant Protection Regulation (1974) amendment made in 2022 and 2023	2022, 2023
18	The old Pesticide Act, 1992 and Pesticide Regulation 1994 amendment made as Pesticide Management Act and Regulation in 2019 and 2024	2019, 2024
19	Nepal government ministerial council meeting in 2080/01/12 decided PQPMC to be acting as NPPO- Nepal.	2023
20	With the assistance from the World Bank funded Project for Agriculture Commercialization and Trade (PACT), Fumigation Chamber and Post-entry Quarantine Facilities at Kirtipur, Kathmandu constructed and handed over to NPPO.	2023
21	The agreement of Phytosanitary protocol between Government of Nepal and People's Republic of China to export 15 different medicinal and aromatic plants from Nepal to China	2023
22	Basic laboratory facilities and equipment are available in the major Quarantine offices. Construction of Quarantine Laboratory Building at Kakarbhitta and Strengthening of SPS Lab at Birgunj and Biratnagar are in progress.	2024
23	Newly constructed Phytosanitary and Diagnostic Lab in Hariharbhawan is targeted to develop as resource center for basic laboratories at the entry points	2023
24	The Government of Nepal established two new quarantine offices in Pokhara international airport and Bhairahawa international airport	2024

Source: PCE (2022); Humagain (2022); GON (2024)

The regulated quarantine pests of agricultural commodities: All the member countries of IPPC are required to prepare and update the lists of regulated quarantine pest in order to assist in preventing

the introduction and spread of pests, and to facilitate safe trade by enhancing transparency. At the national level, NPPO-Nepal has prepared and notified the regulated quarantine pests of a number of agricultural commodities (Nepal Gazette, 2014; PQPMC, 2024) (Table 9).

Table 9. Lists of regulated quarantine pests of Nepal

SN	Commodity	Numbers of regulated quarantine insect/mite pests	Number of regulated quarantine diseases
1	Apple	27	20
2	Citrus	38	26
3	Banana	34	16
4	Coffee	25	17
5	Potato	2	38
6	Ginger	2	28
7	Garlic	5	19
8	Pumpkin	20	11
9	Cucumber	9	27
10	Bitter gourd	7	7
11	Radish	5	10
12	Gerbera	12	2
13	Carnation	14	19
14	Cabbage	6	11
15	Cauliflower	10	9
16	Chili	11	6
17	Large Cardamom	1	1
18	Tea	27	2
19	Maize	17	17
20	Finger Millet		1
21	Lentil	4	5
22	Rice	11	13
23	Marigold	11	4

Source: Nepal Gazette (2014); PQPMC (2024)

Documentation of SPS works in Nepal: In Nepal, Plant Quarantine and Pesticide Management Centre (PQPMC) plays a leading role for the development of SPS measures i.e. legislation, directives, SOPs and guidelines and its implementation related to sanitary and phytosanitary issues. These measures are part of international trade agreements and are critical to ensuring safe imports and exports, particularly for agriculture and food products. Some of the important documents developed by PQPMC under the consultation of technical experts (Nepal Gazette, 2014; PPD, 2014, PQPMC, 2025) have been listed as followed.

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National pest lists of Nepal: Preparing inventory of agricultural crops pests and diseases is the basic step for developing a national pest directory to conduct a proper national plant protection activities, and at the same time a prime quarantine activity that helps knowing exotic pests and diseases in the imported agricultural commodity from an abroad trade partner's nation. Its importance in the international trade concern is obviously observed when a National Plant Protection Organization (NPPO) shows concerns for the crop surveillance to know the status of pests and diseases status of the country. For each and every member country of International Plant Protection Convention, FAO is obliged to develop national pests- and diseases- inventory of each of the potentially important exportable agricultural commodities which commences right from the general surveillance of the crop/s to record national pests of agricultural crops (PQPMC, 2024) (Table10).

Table 10. Number of national pests of crops in Nepal

SN	Common name	Numbers of national insect and mite pest	Numbers of national plant disease
1	Ladies finger	20	29
2	Eggplant	47	32
3	Sponge gourd	14	9

SN	Common name	Numbers of national insect and mite pest	Numbers of national plant disease
4	Bottle gourd	16	13
5	Sweet orange	50	25
6	Mandarin orange	39	21
7	Kiwi fruit	5	10
8	Cinnamon (Tejpat)	11	5
9	Kutki	2	10
10	Prickly ash (Siltimur)	2	
11	Amala	8	6
12	Sikakai	4	3
13	Pakhanved	3	3
14	Nagbeli	5	3
15	Attees	3	2
16	Wild Sparagus	9	8
17	Indreni	2	7
18	Bisma		2
19	Bia Bidang	1	1
20	Kaladan	2	2

Source: PQPMC (2024)

ISSUES AND ACTIONS

SPS compliance: SPS compliance is becoming a serious bottleneck for Nepalese agricultural products to achieve smooth and sustainable access to international markets. Sharma (2018) reported many issues concerning in- country stakeholders who are unable to fulfill the SPS measures demanded by the importing countries and consequently, they fail in exporting their products to key international markets.

For instance, Nepal and China signed a phytosanitary protocol in 2019 to enable citrus fruit exports from Nepal to China (Adhikari et al., 2022). However, implementation has stalled. On one hand, Nepal faces challenges meeting China's stringent plant quarantine requirements, which are difficult to fully comply with. On the other hand, Nepal lacks the capacity to issue credible phytosanitary certificates for exports such as haylage and medicinal or herbal plants. This is largely due to the absence of an authentic national pest database and standardized pest survey protocols for key export commodities.

Exporting citrus fruits to China requires adherence to stringent phytosanitary standards to prevent the introduction of pests like citrus fruit flies and diseases such as citrus greening. Effective pest management and compliance with China's quarantine regulations are essential for successful market access. The establishment of efficient cold chain facilities and logistics systems is critical for maintaining the quality and freshness of citrus fruits during transportation. Besides, proper documentation and certification, including phytosanitary certificates (PC) and other relevant export documentation (NPWG, 2020) are the primary requirements to export citrus fruits to China.

Similarly, export of grocery items to Australia, there is compulsory need for fumigation of materials with methyl bromide and marked with the ISPM 15 stamp. Right now, such certification and fumigation facilities are not available in Nepal and consequently, exporters are unable to expand in the international markets (ITC, 2017). Nepalese traders fail to fulfil these conditions due to many reasons including landlocked geography, exposure to climate impacts, low economic opportunities, inconsistent markets, lack of access to the global market, lack of modern technologies and storage houses, absence of accredited laboratories, skilled human resources, insufficient technically competent cadre of pest risk analysis and R&D work for pests and disease identification..

Weak enforcement of the provisions of Plant Quarantine and Protection Act and Regulation that results in high risk on biosecurity with a tendency of importers to bypass the biosecurity procedures. The key SPS issues are as follows.

- i. Nepal's current SPS system has major capacity gaps and weaknesses in WTO compliance.
- ii. SPS system is not risk-based.
- iii. SPS agencies and laboratories suffer from frequent rotation of staff.
- iv. Insufficient capacity in plant pest surveillance and diagnostics.
- v. No capacity to control pesticides.
- vi. SPS import inspection is hardly in place and ineffective.
- vii. Weak risk assessment, identification and risk management activities as increasing threat on biosecurity.
- viii. A main shortcoming is that there is only ad-hoc-pest surveillance and no central diagnostics laboratory with specimen collection. The country has not planned a systematic surveillance activity, leading to inability to meet national reporting obligations under the IPPC.

Pre-entry actions: Nepal needs to upgrade its implementation of SPS standards for plant quarantine and food safety to comply with international standards, or at least to the standards of the countries it is targeting for export. In addition, Nepalese farmers and traders must adopt good farming and manufacturing practices to comply with quality standards so that their products find acceptance by the export markets. The following actions should be carried out before the entry of any plant and plant based articles from foreign countries.

- PQPMC should develop awareness raising programs and materials related with SPS for key regional, national, sectoral and community target groups and other academic institutions.
- NARC (somewhere in the earlier text the full form and its abbreviated term should have occurred at least once) and other relevant institutions should prioritize and focus on SPS as main researchable area.
- Establish and implement effective systems for assessing risk and prioritizing invasive species for management.
- Develop and implement improved inspection, treatment, packing and transportation procedures and methods.
- Create awareness on the biosecurity issues, awareness raising activities on the importance of Phytosanitary Border Control.
- Communicate the potential impact of pest invasion and the need of phytosanitary control.
- Develop central SPS laboratory as "Centre of Excellence".
- Support to the development of SOPs on inspection, sampling, and surveillance.

- Improve compliance with WTO requirements by introducing risk-based SPS measures, which includes SPS policy reform, strengthening of the legal framework and risk-categorization.
- Develop, promote and adopt an effective policy and legal framework for invasive species management in the region.

Point of entry actions: Imported commodities that may be regulated include articles that may be infested or contaminated with regulated pests. The regulated pests are either quarantine pests or regulated non-quarantine pests. Products for consumption or processing cannot be regulated for regulated non-quarantine pests. Regulated non-quarantine pests can only be regulated with respect to plants for planting (ISPM 20). Phytosanitary measures that may be required at the point of entry include:

- Documentation checks.
- Verification of consignment integrity.
- Verification of treatment during shipment.
- Phytosanitary inspection.
- Testing and treatment.
- Detention of consignments pending the results of testing or verification of the efficacy of treatment.

Post-entry actions: Imported planting materials have potential to introduce quarantine pests. Considering phytosanitary measures for such commodities, NPPOs should apply measures based on the principle of managed risk (NSPM 1). In order to assess the pest risks and identify appropriate phytosanitary measures for particular pathways. For many commodities that are traded internationally NPPOs of importing countries identify risk management measures that mitigate pest risk. The following are effective phytosanitary measures that NPPO of importing country may apply to traded commodities.

- Detention in quarantine (such as in a post-entry quarantine station) for inspection, testing or treatment.
- Detention at a designated place pending specified measures.
- Restrictions on the distribution or use of the consignment (for example for specified processing).

Other phytosanitary measures, which may be necessary include:

- Requirements for licenses or permits.
- Limitations on the points of entry for specified commodities.
- The requirement that importers notify in advance the arrival of specified consignments.
- Audit of procedures in the exporting country.
- Pre-clearance.

Phytosanitary actions which may be taken when an imported consignment or other regulated articles does not comply with phytosanitary regulations and is initially refused entry include:

- Treatment of materials.
- Sorting or reconditioning.

- Disinfection of regulated articles (including equipment, premises, storage areas, means of transportation).
- Direction to a particular end use such as processing.
- Reshipment of the materials after treatment.
- Destruction (such as incineration) of materials.
- Notification of non-compliance.
- Pest reporting.

CONCLUSIONS

Market access for plant products is most important for promoting Nepal's exports. Phytosanitary requirements for most plant products are dominant in India, China and most other countries. About 70% of Nepal's export trade is with India. Nepal is the 147th member of WTO, and has to fulfill various obligations and the requirements of SPS. The SPS has great scope on plant protection and pest free trade and WTO members are encouraged to use international standards, guidelines, and recommendations. The IPPC is a multilateral treaty for international cooperation in plant protection adopted in over 160 countries. For the control of spread of insects and pests from one country to another or from one place to another, correct phytosanitary measures must be implemented, and government needs to formulate correct SPS measures by aid of strong legislative procedures with highly trained human resource, appropriate lab facilities and enough government funding. However, Nepal is still lacking efficient capacity in plant pest surveillance and diagnosis that meets international requirements. Working relations between SPS authorities in Nepal and international trade partners are limited and their improvement could enhance transparency and mutual trust. In 2019, Nepal and GACC of People Republic of China, agreed on a SPS protocol for citrus exports, but successful implementation is pending because Nepal has not met the SPS requirements yet. By addressing the issues of SPS concerns, the manuscript seeks to contribute to the development of effective strategies for overcoming SPS barriers, thereby enhancing the competitiveness of Nepal's agricultural sector in the global market.

By international standards, plant pest screening and issuance of PCs always needs backup from crop pest surveillance, a reference laboratory, and inspection at production and/or packing sites. Nepal has not initiated an identification and diagnosis of plant pests and diseases at national SPS laboratory yet. Without addressing these deficiencies, Nepal shall face the invasion of alien species in the days to come as well as unable to export the potential agriculture commodities. The following SPS actions are needed to improve the compliance with WTO requirements by introducing risk-based SPS measures.

- SPS policy reform, strengthening of the legal framework and risk-categorization.
- Address on the retention of SPS specialists and staffs in SPS laboratory for its full fledged operation.
- The principle of quarantine first should be properly enacted at the border check points.
- Risk based inspection of the consignments.
- Development of national standards on plant quarantine; segregation of HS code on the basis of commodity-based pest lists and its associated hosts.
- Establish a plant diagnostic reference laboratory and support the enhancement of a program for pest surveillance.

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