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Opportunity to Export Citrus Fruit from Nepal to China: Activities Accomplished on Plant Quarantine Concerned

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Abstract **– Citrus is a popular fruit widely used all over the world as fresh consumption, juice and processed products. The distribution of fruit from production site to the consumers requires trade. Restriction of prohibited insects and diseases in the import site are vital for the trade (local, national and international). This article highlighted the agreement between Nepal and China to export Nepalese citrus fruits to China on 2012 and the accomplished plant quarantine related activities. There is great opportunity to export Nepalese citrus fruit that will contribute for the international trade balance and boost up production of citrus fruit within the country. In this context, production in appropriate quality and quantity should be focused. Moreover, technical, infrastructural and managerial capacity for citrus export should be enhanced.**

Keywords **– Agreement, Citrus, Export, Production, Quarantine.**

I. INTRODUCTION

Citriculture in Nepal is a culture and citrus fruits especially SUNTALA (Mandarin) and JUNAR (Sweet Orange) has been traditionally grown in the mid hill region of the country. In terms of area coverage, production and export potential citrus is one of the important fruit crops of Nepal. Indeed, Nepal is one of the centers of citrus diversity and its many species are grown in the country. It is grown in more than 50 districts in Nepal (Adhikari and Rayamajhi, 2012; DoA and FAO, 2011; Tomiyasu *et al.*, 1998). However, commercialization and modernization in the production technologies with proper cultivation practices and investment to increase area and maximize production is present need. The citrus fruit trees are perennial in nature having long gestation period and require regular management measure to prevent losses due to several biotic and a-biotic factors and to increase productivity per unit area. Recent year, the citrus orchards are unmanaged and have resulted in severe decline in production and productivity. This is mainly due to the negligence by the orchard owners to manage the orchard and improper crop protection measures (DoA and FAO, 2011). Moreover, an epidemic biotic problem of insect pests and diseases (Chinese citrus fly, citrus greening etc.) causes challenges of citrus decline in Nepal (Adhikari *et al.*, 2019; Adhikari and Joshi, 2015). So, the science based knowledge and skills transfer is necessary to combat citrus decline problem in Nepal. The share of agriculture gross domestic products by citrus fruit is about 2 percent. Among which the contribution of mandarin is highest followed by sweet orange, lime and lemon respectively (MoALD, 2019a). So, citrus is the major fruit in Nepal that has a significant place in the socio-economic well being of the Nepalese farmers.

An agreement was done between the Nepali and Chinese governments in 2012 to export Nepali citrus to the Chinese market. The preparation was accomplished by the related authorities to export mandarin from Syangjya and sweet orange from Sindhuli district. But, citrus fruit was not eligible to be exported to the Chinese market due to the strict quarantine issues in the agreement. Signed agreement assumed to be produced the fruits having

no any quarantine pests and diseases in the orchards. The objective of this paper is to review the status of citrus fruit, Nepal China agreement 2012 and plant quarantine related activities accomplished after agreement in Nepal.

II. METHODOLOGY

This article was prepared through reviewing various literatures which was done using textbooks, research articles from journals and internet to assess the status of citrus fruit, Nepal China agreement and major activities accomplished for the quarantine pest surveillance and management. Information then gathered was analyzed and presented in tables and figures.

III. RESULTS AND DISCUSSIONS

Status of Citrus Fruit in Nepal

The total area of citrus is 44,424 ha. out of which only 25,964 ha. is productive. The total production is 2, 45,176 mt. however, the average productivity is only 9.4 mt/ha. in 2017/18 (MoALD, 2019b). Whereas, the global citrus cultivation area accounts 9.08 million ha. (i.e. 15.52% of total fruit cultivated area) (Our world in data, 2019). Brazil, China, the United States and Maxico are among the world's top citrus producing countries (Worlds atlas, 2019). The citrus farming has been a preferred economic activity in many parts of the world because it is not labor intensive business than other crops. The total monetary value of the citrus production in Nepal at the rate of NRs. 40/kg is NRs. 9,80,70,48,292 per annum, which is a significant amount in the fruit sector. There is wide gap between actual and attainable yield of citrus in Nepal. So, there is great potential for increasing Nepalese citrus fruit productivity. Worldwide, citrus yield ranges from 50 to 90 mt./hectare. India and Pakistan often reach 20-30 mt./ha. The productivity of Nepalese citrus can be increased to 15 mt./ha simply by improving orchard management practices such as training, pruning, proper fertilization, irrigation, mulching, disease and pest management etc. (DoA and FAO, 2011).

The area under citrus cultivation and the production in Nepal found increased in overall period from 2008/09 to 2017/18. However, the production of citrus fruit decreased. In this situation, there is great scope of productivity enhancement to fulfill the demand in national and international level.

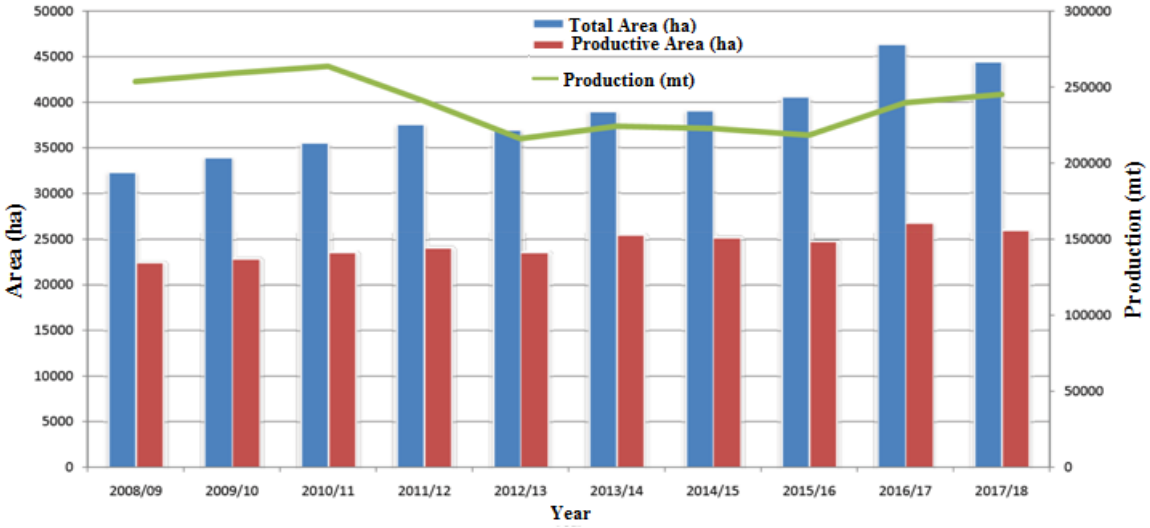

Fig. 1. Area and production of citrus fruit in Nepal. (Source: MoALD, 2019b).

Nepal China Agreement to Export Citrus Fruit from Nepal

Nepal made an agreement with China to export Nepalese citrus in 2012. A condition for pest free area (PFA) was agreed in the bilateral agreement. Five species of fruit flies, citrus greening and citrus canker was stated as quarantine pest by the importing country (Nepal-China Agreement, 2012). National Plant Protection Organization (NPPO) deserves the major responsibility for pest surveillance, performing PRA and declaring PFA. Plant Protection Directorate (currently, Plant Quarantine and Pesticide Management Centre) as NPPO of Nepal has taken the responsibility for the pest surveillance in the given pests and initiated the job.

Conditions in the Agreement:

Nepal China Agreement to export Nepalese citrus fruits was held on 2012 that had highlighted following articles regarding the quarantine issue.

- Article 2 - "Citrus shall be free of any quarantine pest concerned by China".
- Article 4 - "The citrus orchards shall be monitored and found free of the seven quarantine pests. If any of these pests are detected, the relevant orchards will be banned from exporting citrus to China for the season.
- Article 6 - "Processing, packing, storage and transportation of citrus shall be conducted under the quarantine supervision of Department of Agriculture (DoA).

A clause in the agreement states that the orchards where citrus fruit produced should be free of quarantine concerned insect pests and diseases. The surveillance of those quarantine pest revealed that the fruit fly species in the quarantine pest list namely *Bactrocera correcta, B. cucurbitae, B. dorsalis, B. tsuneonis* and *B. zonata* were also observed in the orchards and it is really difficult to make fruit fly free orchards in the condition of Nepalese farming. Moreover, there will be high amount of cost to get rid of those insect pests from the orchards, which will render the product non-competitive in the market due to high price.

List of Quarantine Pests in Nepal-China Agreement:

Listed quarantine pests in the article 4 of the agreement are presented in the table 1.

Table 1. List of quarantine pest in Nepal China Agreement 2012.

S. No.	Quarantine Pest	Common Name	Category of the pest
1	*Bactrocera correcta (Bezzi)*	Guava fruit fly	Insect pest
2	*Bactrocera cucurbitae (Coquillett)*	Melon fruit fly	Insect pest
3	*Bactrocera dorsalis (Hendel)*	Oriental fruit fly	Insect pest
4	*Bactrocera tsuneonis (Miyake)*	Japanese citrus fly	Insect pest
5	*Bactrocera zonata (Saunders)*	Peach fruit fly	Insect pest
6	*Xanthomonas campestris* pv. citri (Hasse)	Citrus canker	Disease
7	*Candidatus liberibacter asiaticus*	Citrus huanglongbing (greening)	Disease

Surveillance Activities for the Establishment of Pest Free Areas for Fruit Flies (Tephritidae)

According to Adhikari *et al.*, 2018 the work towards compliance after Nepal-China agreement 2012 by NPPO

Nepal was presented in figure 2. All the activities were conducted in the technical and managerial supervision of NPPO in both districts namely Sindhuli for sweet orange and Syanjya for mandarin.

Related International Standards for Phytosanitary Measures (ISPMs)	
• **Major criteria**	✓ **Procedure followed**
ISPM 4: Requirements for Pest Free Area (PFA)	
• Systems to establish freedom • Phyto-sanitary measures to maintain freedom • Checks to verify freedom has been maintained	✓ Pest detection survey carried out as a basic step to support pest risk analysis (PRA) and PFA. √ Pest data recording
ISPM 6: Guidelines for surveillance	
• Guidelines for general and specific survey	✓ Followed in pest specific survey protocol preparation
ISPM 8: Determination of pest status in an area	
• Presence of the pest • Absence of the pest • Transience of the pest	✓ Pest detection survey to support the pest determination
ISPM 10: Requirements for the establishment of pest free place of production (PFPP) and pest free production sites (PFPS)	
• Systems to establish pest freedom • Systems to maintain pest freedom • Verification that pest freedom has been attained or maintained • Product identity and phyto-sanitary	✓ Orchard selection, registration ✓ Pest detection survey ✓ Pest recording ✓ Pest management activities
ISPM 26: Establishment of PFA for fruit flies (Tephritidae)	
• The characterization of the FF-PFA • The establishment and maintenance of the FF-PFA.	✓ Mainly pest monitoring work ✓ Realized very difficult task
ISPM 29: Recognition of pest free areas and areas of low pest prevalence (ALPP)	
• Procedure for PFA recognition	✓ Preparation for dialogue with trading partner after the agreement

Fig. 2. Work accomplished towards compliance after Nepal-China agreement -2012.

The Activities Accomplished by NPPO Nepal after Nepal China agreement

1. Discussion, review, guidelines preparation and field works to support agreement.
2. Interaction among stakeholders at various levels.
3. Plant Protection Directorate as NPPO has focused on specific survey to detect the concerned pests.
4. Pest survey protocols for quarantine pests and survey plans are prepared.
5. Orchard selection and registration (by respective District Agriculture Development Office)
6. Field survey for the particular pests is continued since May, 2014.
7. Internal quarantine directive.

Fruit Fly Surveillance Activities and Key Findings

Tephritid fruit flies are one of the world's most destructive horticultural pests and poses risk to most commercial fruit and vegetable crops. Fruit flies cause direct damage to fruits and vegetables which can lead to upto 90-100% yield loss depending on the situations. (Asian Fruit Fly IPM Project, 2011). In connection to above responsibility NPPO of Nepal has prepared and endorsed the pest survey protocol for the listed pests in

2014 and started pest surveillance activities and the field survey in two districts namely Sindhuli and Syangja are ongoing. Pest surveillance was carried out in coordination with Regional Plant Protection Laboratory (RPPL) and respective District Agricultural Development Offices (DADO). Fruit fly traps according to the protocol has been fixed with pheromone lure (methyl eugenol and cue lure) and protein hydrolyses bait for monitoring of fruit fly species, their identification and preparation of database. Trained facilitators were selected as pest collector in the respective district in coordination with local plant protection officer. Plant protection officers of respective DADO were recognized as pest identifier in the survey plan as endorsed by NPPO meeting. Orientation training was given to the pest collector and identifier in May 2014. Pest surveillance activity to establish pest free area of production is continued till date. Selected citrus pockets in Sindhuli district for sweet orange was 64 ha. and mandarin was 70 ha in Syangjya district as presented in the figure 3 and 4. Both districts are mid-hill region of Nepal. Sindhuli is located in the central part and Syangjya is in western part of Nepal.

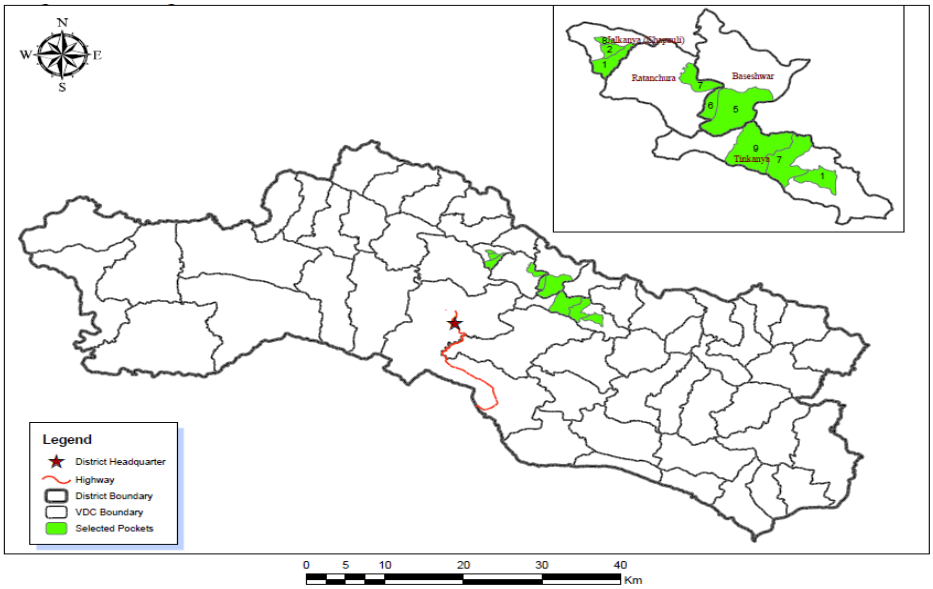

Fig. 3. Selected sweet orange orchard of Sindhuli district (Area: 64 hectare).

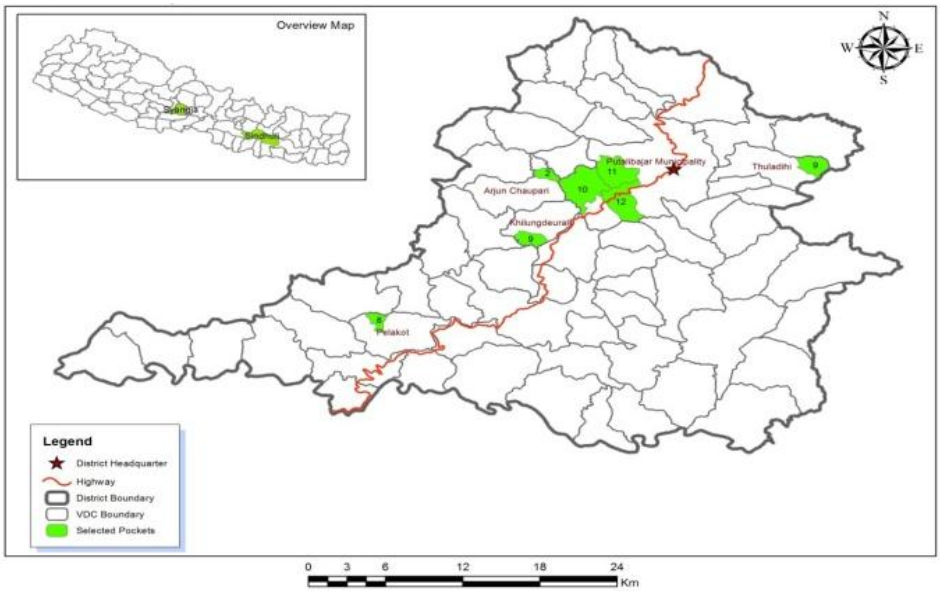

Fig. 4. Selected mandarin orchard of Syangjya district (Area: 70 hectare).

The fruit fly species reported in the surveillance activity in the sweet orange orchards of Sindhuli district were *Bactrocera dorsalis, B. zonata, B. cucurbitae, B. tau, B. scutellaris, B. minax and Dacus longicornis* (Adhikari *et al.,* 2018 and Sharma *et al.,* 2015). Among them only *Bactrocera dorsalis, B. cucurbitae and B. zonata* were listed in the quarantine pest of China. The quarantine fruit fly species of China namely *Bactrocera correcta and B. tsuneonis* were not trapped in the surveillance activities. Adhikari *et al.,* 2019 highlighted the *Bactrocera minax* was misidentified as *Bactrocera tsuneonis and B. tsuneonis* is not presence in Nepal. So, the misidentification should be amended soon (Poudel, 2015). The protocol of agreement between two countries has been recently amended in Oct., 2019 and for the quarantine fruit fly pest species of concern to China, citrus fruits shall come from the orchards that conduct cold treatment before export according the international standards or the standard that both sides agreed (Nepal-China Agreement, 2019). Still there are much more technical and managerial actives to be performed as preparatory action. The capacity building on technical and managerial aspects and infrastructure development as well as the production enhancement should be focused.

IV. Conclusion

Citrus fruit is one of the potential fruit crops in the mid hill region of Nepal that contributes nutrition security as well as income generation of the people. Fruit flies are one of the world's most destructive pests of most fruit and vegetable crops both in terms of production and trade. Presently, the Nepal-China Agreement, 2012 to export Nepalese citrus has been revised; and the fruit fly pest free products by proper treatment mechanism could be exported. The accomplished activities as per agreement in concern with quarantine pest should be taken in the due consideration for further action. Technical and infrastructural support as well as stakeholder's functional coordination is necessary to achieve the objective of citrus export. Moreover, the enhancement of citrus production both in terms of quantity and quality is paramount.

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