

Review

Conservation and Utilization of Insect Pollinators for Promotion of Agricultural Production in Bangladesh

Md. Ruhul Amin^{1,3}, Md. Shamim Hossain¹, Sang Jae Suh^{2,3}, and Yong Jung Kwon^{2,3*}

¹Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh

²School of Applied Biosciences, Kyungpook National University, Daegu 702-701, Korea

³Institute of Plant Medicine, Kyungpook National University, Daegu 702-701, Korea

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Abstract Agriculture in Bangladesh is slowly transforming to the production of high-value fruit and vegetable crops to satisfy the nutrient requirements of their large size population, and this transformation is creating new challenges as regards improving and maintaining the productivity and crop quality. The country has a declining trend of insect pollinators due to habitat loss, land use changes, monoculture-dominated agriculture, and the excessive and indiscriminate use of pesticides. Such pollinator deficiencies can cause reduced yields, thereby threatening the subsistence of marginal farmers. In Bangladesh, growers enjoy free pollination services from the naturally occurring insect populations. While honeybees pollinate mustard, onions, and melons, many other hymenopterans, coleopterans, hemipterans, dipterans, and thysanopterans also visit the crop fields, making these insects significant for the food security, environment, and economy of the nation. Therefore, attention should be given to public policy, research, and human resource development that promotes knowledge and appreciation of the conservation and utilization of insect pollinators.

Keywords: agricultural crops, bangladesh, insect pollinators

Introduction

Bangladesh is a subtropical country located between 20°34′-26°38′ north latitude and 88°01′-92°42′ east longitude, with an area of about 147570 km². It borders India on the west, north and east, Myanmar on the southeast, and the Bay of Bengal on the south. With a population of 160.2 million people, 75% live in rural areas and 62% depend on agriculture (BBS 2011). Thus, the agriculture sector has an overwhelming impact on the economy of the nation and has made significant progress in boosting national food production. However, a large part of the population still lacks access to sufficient, safe, and nutritious food.

Pollination is the process of transferring pollen from the male part of a flower (anthers) to the female part (stigma) of the same flower, another flower of the same crop, or another crop of the same species. This represents mutual cooperation between flora and fauna, and is vital for completing the life cycle of plants i.e. the production of full-bodied fruit and a full set of fertile seeds (Kevan, 2001). According to the convention on biological diversity ‘pollination is a key driver in the maintenance of biodiversity and ecosystem function. Insects pollinate about 80% of flowering plants, and assisted pollination is necessary when natural pollination is insufficient (FAO, 2007; Klein et al., 2007).

In order to increase crop production without disturbing natural pollinators and from the point of view of conservation, it is important to understand the pollinator abundance, diversity, and the impact of pollinators on crops. However, no study on insect pollinators in Bangladesh has yet been conducted. Therefore, this paper aims to identify the pollinating species, ascertain the current situation and problems of insect-pollinator utilization, and make recommendations to overcome the constraints in order to help solve the food and resource problems for human beings.

*Corresponding author: Yong Jung Kwon
Tel: 82-53-950-5764; Fax: 82-53-950-6758
E-mail: mramin.bsmrau@yahoo.com

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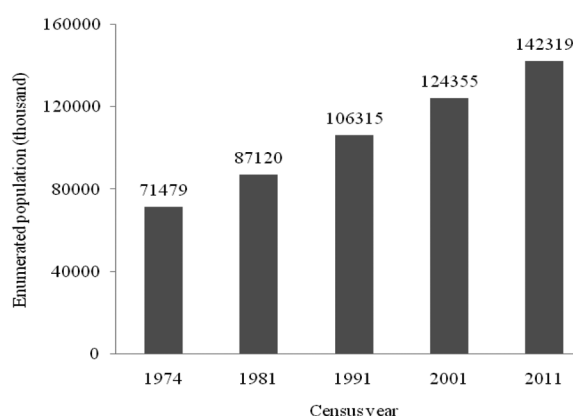


Figure 1. Population trend in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2011).

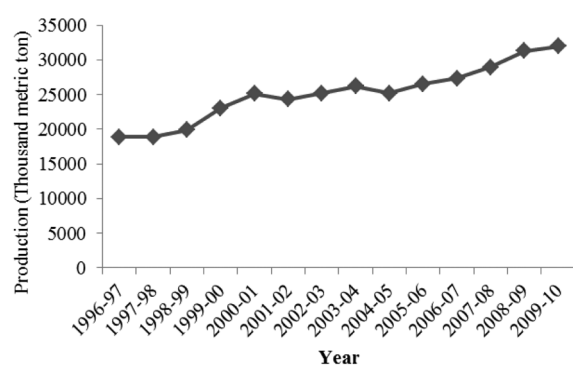


Figure 2. Rice production trend in Bangladesh, 1996-97 to 2009-10. (Source: Bangladesh Bureau of Statistics, BBS 2011).

Population and Agricultural Profile

Bangladesh gained its independence from Pakistan in 1971, and the first nationwide census was conducted in 1974, which confirmed a population of 71,479,000. An increasing population trend has since been recorded every decade (Figure 1). The last official census was carried out in 2011, when the population was 142,319,000. Thus, while Bangladesh is ranked 94th in terms of land area, it ranks 8th in terms of population among the 182 countries in the world. For every Km² of land, there is an average of 1,074 people (BBS, 2011).

Agriculture is the largest economic sector in Bangladesh, contributing 18.6% of the country's GDP. About 160 crop species grow in Bangladesh (Razzaque and Hossain, 2007), where rice, wheat, sugarcane, jute, tea, pulses, oilseeds, potatoes, and vegetables are the main crops.

Rice is the staple food and this crop occupies 77% of agricultural land use (IRRI, 2012). Rice production has been increasing from 19.2 million metric tons in 1996-97 to 32.0 million metric tons in 2009-10 (Figure 2). However, while the yield of pollination-independent crops, like rice and wheat, has been increasing, the plants that rely on pollination have shown a decreasing yield.

Jute was the main export item in Bangladesh in the 1970s and

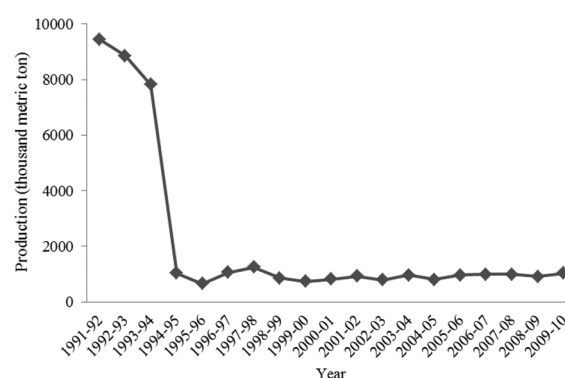


Figure 3. Jute production trend in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2011).



Figure 4. Vegetable production trend in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2011).

represented a significant source of foreign exchange earnings. Previously the world's largest producer of jute, Bangladesh now holds the second position in terms of production volume (Islam and Allauddin, 2012). The production area and yield of jute in Bangladesh decreased drastically in 1991-92 (Figure 3), and have since been slightly increasing with a fluctuating trend. In the fiscal year 1991-92, the jute production was 9451 thousand metric tons, while in 2009-10, it was estimated at 1080 thousand metric tons. Land previously used to produce jute is now being used to cultivate cereal crops, vegetables, and fruits due to their high demand and market value.

Commercial agriculture in Bangladesh produces vegetable and fruit crops in parallel with traditional cereal crops. With the recent rapid increase in vegetable production, some vegetables are now exported to a number of countries in the Middle East and European Union. Vegetable production in Bangladesh increased from 4.9 million metric tons in 2002-03 to 10.1 million metric tons in 2009-10 (Figure 4). To increase the yield, farmers are using fertilizers, pesticides, irrigation, and flower induction hormones. Yet, while these conditions are helpful for a higher stage of flowering, the fruit will not set without pollination.

The fruit crop production in Bangladesh is moving at a fast pace throughout the country and includes bananas, mangos, jackfruit, pineapples, papayas, melons, guavas, litchi, citrus fruits,

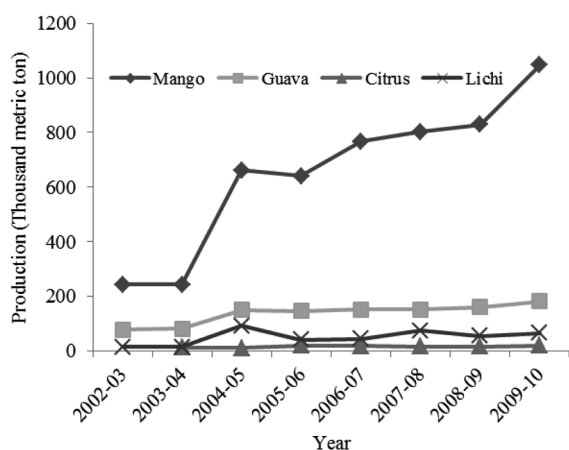


Figure 5. Major fruit production trend in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2011).

and coconuts. Among these fruit crops, mangos are the most favorite, where their production increased from 0.24 million metric tons in 2002-03 to 1.1 million metric tons in 2009-10 (Figure 5). Other fruit crops are also increasing in production. A total of 250 insect and mite species have been reported to attack mango crops at different growth stages (Babu et al., 2001; Sahoo and Jha, 2008), yet the most significant damage is caused by mango hoppers, fruit flies, defoliators, stone weevils, and leaf cutting weevils. While pesticides have been applied to protect the crops, this significantly reduces the bee population. Insects from Diptera and Hymenoptera are the major pollinators of mangos (Singh, 1997; Dag and Gazit, 2000). Farjado et al. (2008) reported that introducing bee colonies to mango orchards significantly increased the fruit setting.

Significance of Insect Pollination

Klein et al. (2007) previously reported that 70% of tropical crop species depend on pollinators for optimum yields. Plus, the United Nations (UN) Food and Agricultural Organization (FAO) reported that about 100 crop species provide 90% of the food supply for 146 countries. Among those crops, 71 are pollinated by bees, while the others are pollinated by butterflies, moths, thrips, and wasps. It has also been estimated that 35% of the human diet depends on insect pollination (Klein et al., 2007). Thus, the estimated annual value of insect pollination services on a global scale is about 217 billion USD (Science Daily, 2008). In most developing countries, growers enjoy pollination services freely from natural populations of honeybees and other insects.

Scenario of Beekeeping and crop Pollination

Bangladesh has 70 species of pollinating bees, and Bhuiya and

Miah (1990) reported that the following species of social bees, *Apis dorsata*, *A. cerana*, *A. florea*, *A. mellifera*, *Trigona fuscobaltiata*, *Bombus eximius*, and *B. montivagus*, play a very important role in the ecosystem as natural pollinators of various plant species. The utilization of honeybees for the pollination of sweet gourds, *Cucurbita moscheta* (Cucurbitaceae), in Bangladesh is presented in figure 6. Bangladesh also uses honeybees for the pollination of mustard, onions, melons, mangos, and litchi (Hannan, 2007). Plus, many coleopterans, hemipeterans, dipterans, hymenopterans, and thysanopterans have been reported as frequent visitors of mango and litchi orchards. Bangladesh Small and Cottage Industries Corporation (BSCIC), a state-owned organization, and three non-government organizations viz. Bangladesh Rural Advancement Committee (BRAC), *Proshika*, and *Palli Karma-Sahayak Foundation (PKSF)* are currently producing honeybee colonies for the production of honey and crop pollination. The commercial rearing of honey bees is increasing in Bangladesh, and their use for crop pollination is also increasing.

Causes of Decline in Pollinators

In Bangladesh, insect pollinators are declining due to the reduction



Figure 6. Utilization of honeybee colonies for pollination of sweet gourds. Farmer consulting with research and extension specialists.

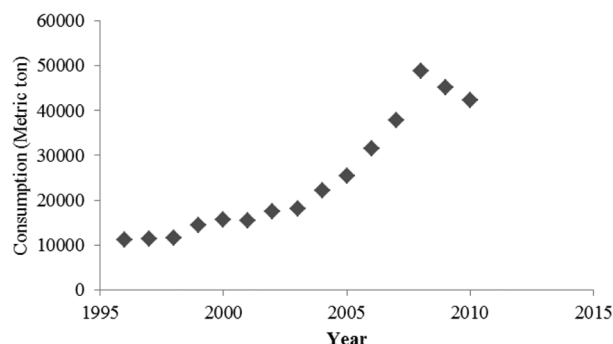


Figure 7. Pesticide use in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2011).

of wilderness, loss of habitat, land use changes, monoculture-dominated agriculture, and the excessive and indiscriminate use of agricultural chemicals and pesticides. The government of Bangladesh promoted the use of pesticides to expand its agricultural frontiers and increase the output per acre of land (Hossain, 1988). As a result, the use of pesticides has been increasing. The consumption of pesticides increased from 11224.9 metric tons in 1996 to 48690.2 metric tons in 2008 (Figure 7).

Constraints in using Insect Pollinators

Silkworms and honey bees are generally considered to be beneficial for human beings, while other insect species are viewed as pests (Chen, 2008). In Bangladesh, most farmers are illiterate and unaware of pollination. Due to this ignorance, farmers use pesticides in improper, unplanned, and unscientific ways, thereby blocking the abundance and diversity of pollinating insects. Plus, the utilization of pollinating insects is not a focus due to insufficient communication and coordination with world authorities and /or institutions. Meanwhile, the commercial rearing of pollinating insects is not developing due to a lack of related information, institutional research, sufficient machinery, and equipment. Plus, there is almost no training available for beekeeping.

What can do Bangladesh for Insect Pollination?

The pollination problem in Bangladesh can be solved by conserving the populations of natural insect pollinators, promoting integrated pest management, and the judicious application of chemical fertilizers and pesticides. However, for practical solutions to protect and increase insect pollinators, research needs to be encouraged to determine which crops and wild flowers are bee pollinated, which bee species pollinate them best and at what densities, and the economic benefits of bee pollination per crop and per region. Relevant research and agricultural policies need to be adopted to ensure adequate populations of appropriate pollinators for different crops in different regions. Particular attention should also be given to develop the beekeeping industry. Plus, land use policies need to be promoted to encourage the appropriate management of agricultural, forest, semi-natural, conservation and amenity areas to improve the habitats for wild and managed bees.

Conclusions

The relationship between flowering plants and flower-visiting

insects is of great importance for developing countries like Bangladesh in order to develop their food security, nature, and economy. Yet the people of Bangladesh have a poor knowledge of insects. Understanding the benefits of insects will allow their protection for a safer environment and improved agriculture. Therefore, attention needs to be given to policy reorientation, research, extension, and institutional capabilities for human resource development.

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