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USES AND ABUSES OF PESTICIDES IN BANGLADESH

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ABSTRACT

Bangladesh, spanning 148,460 km² with a 580 km coastline, confronts significant climate change challenges, experiencing rising temperatures and declining rainfall. With a population exceeding 170 million, its density could surpass 1200 people per km² by 2025, despite ranking 94th in land area and 8th in global population. Bangladesh ranks 3rd in rice and vegetable production and 10th in tropical fruits production: The country's pesticide use ranks 29th globally, with substantial variations per hectare compared to leading countries like China and Japan. Pesticides play a vital role in Bangladeshi agriculture to combat pests and diseases. Fluctuations in registered formulations from 2010 to 2022 indicate regulatory adjustments and market shifts, with biopesticide registrations witnessing growth. The pesticide industry has flourished, with the number of companies expected to reach 802 by 2024, reflecting increasing demand and regulatory approvals. However, pesticide consumption has shown fluctuation, with increases in both usage and market value. The heavy treatment of vegetables like brinjal highlights the necessity for targeted pest management strategies. Despite the benefits of pesticides in enhancing yields, their misuse poses significant health and environmental risks, necessitating sustainable pest management practices to ensure long-term agricultural and environmental sustainability in Bangladesh.

Keywords: Pesticides, industry, use, abuse, environment, health

Introduction

Pesticides have become an indispensable component of contemporary agriculture in Bangladesh, crucial for protecting crops and enhancing yields (Verger and Boobis 2013). Initially lauded during the Green Revolution for their ability to boost productivity and ensure stable food supplies, pesticides have been widely promoted by the government and agricultural experts. However, the widespread adoption of these chemicals has not been without significant drawbacks. Using pesticides comes with considerable costs, affecting both the environment and human health (John and Shaike 2015). Pesticide users and applicators are often exposed to these chemicals when they mix, load, apply, or come into contact with treated crops (Remoundou *et al*. 2014). Numerous studies have indicated potential links between pesticide exposure and serious health effects such as cancer and birth defects, although a direct causal relationship has not been firmly established (Shammi *et al*. 2017). Beyond these health risks, pesticide exposure is now believed to contribute to a range of non-communicable diseases in humans (Cremonese *et al*. 2014). Those exposed to pesticides can suffer from chronic illnesses, including minor skin and eye irritations to severe conditions like cancer, diabetes, Parkinson's, Alzheimer's, multiple sclerosis, aging, cardiovascular, and chronic kidney diseases (Dhouib *et al*. 2016).

In Bangladesh, pesticides are indispensable for enhancing crop yields and combating pests. However, their overuse and misuse lead to severe health risks, environmental degradation, and socio-economic challenges. For instance, farmers cultivating various vegetable species in Bangladesh heavily rely on pesticides throughout the production process (Dasgupta *et al*. 2007). Farmers often lack proper training, resulting in hazardous practices, increased healthcare costs, and pest resistance, which further complicates sustainable agriculture (Barua *et al*. 2022).

According to Bloom *et al*. (2011), non-communicable diseases, influenced by genetic, physiological, environmental, and behavioral factors, are the primary

cause of global deaths annually. Soil infertility, water contamination, and biodiversity loss are major environmental concerns for abuses of pesticides. The decline in beneficial insect populations, such as pollinators, further threatens agricultural sustainability and is also responsible for the high amount of pesticide use (Khatun *et al*. 2023).

Socio-economically, many farmers lack adequate knowledge and training on safe pesticide application, leading to hazardous practices and increased healthcare costs. The overreliance on pesticides also fosters pest resistance, creating a vicious cycle of escalating chemical use and rising expenses. The objectives of this document are to provide a comprehensive understanding of the complexities surrounding pesticide use and abuse in Bangladesh, thereby contributing to more informed decision-making and policy development.

Geographic location, climatic condition and population of Bangladesh: Bangladesh, a densely populated, low-lying country in South Asia, spans 148,460 square kilometers (57,320 square miles) with a 580 km (360 mi) coastline along the Bay of Bengal (BBS 2020). The delta plain of the Ganges, Brahmaputra, and Meghna rivers covers 79% of the land. The country is highly vulnerable to climate change (Chowdhury *et al*. 2022). Observations show a significant increase in minimum temperatures (0.80–2.4°C), with projections indicating a greater rise in mean minimum (0.20°C) than mean maximum (0.16°C) temperatures. Annual rainfall is expected to decrease by 153 mm from 2011 to 2020 (Rahman and Lateh 2017). With a rapidly growing population currently exceeding 170 million and projected to reach nearly 180 million by 2025, Bangladesh's population density could surpass 1200 people per km² by that year (Dewan *et al*. 2012).

Global rank of Bangladesh: Bangladesh, ranked 94th in the world by land area, is a densely populated country, holding the 8th position globally by population. It ranks 35th in overall country rankings. Rice is a crucial crop, placing Bangladesh 3rd globally in rice production (Jamal *et al*. 2023). The country is 34th in maize production and ranks 3rd in vegetable production after China and India. Additionally, Bangladesh is among the top ten tropical fruit producers with ranking 10th. To protect food crops, pesticide use in Bangladesh is on the rise. Globally, Bangladesh is 29th in total pesticide use and 77th in pesticide use per hectare (FAO 2022).

Pesticide use per cropland area across various countries: The data on pesticide use per hectare across various countries (Figure 1) reveals significant disparities, with China leading at 14.8 kg/ha, representing 16.6% of the total use, followed by Korea (12.4 kg/ha, 13.9%) and Japan (11.9 kg/ha, 13.4%). Brazil (10.9 kg/ha, 12.2%)

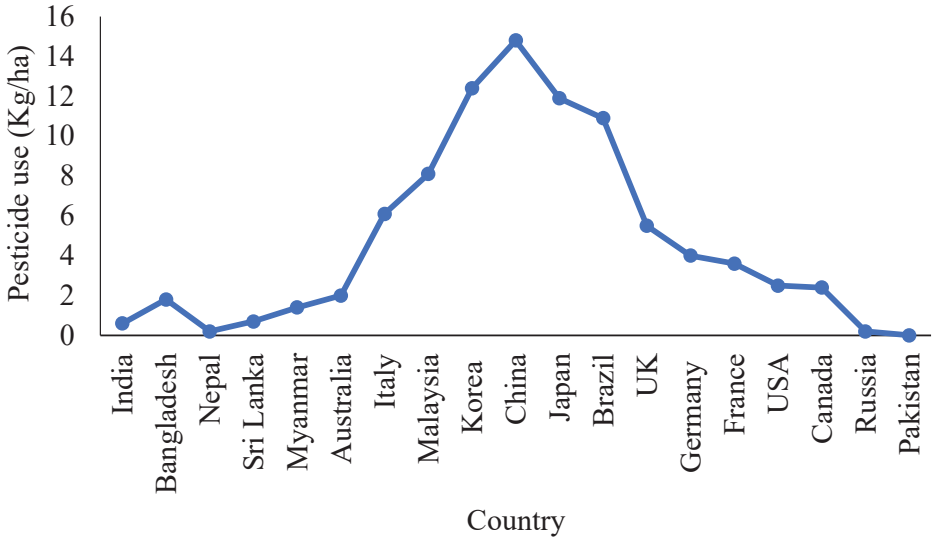


Figure 1. Per cropland pesticide use in different countries in 2021. (Source: Food and Agriculture Organization of the United Nations, FAO 2022).

and Malaysia (8.1 kg/ha, 9.1%) also show high usage, indicative of their large agricultural sectors. European countries such as Italy (6.1 kg/ha, 6.8%), the UK (5.5 kg/ha, 6.2%), Germany (4.0 kg/ha, 4.5%), and France (3.6 kg/ha, 4.0%) demonstrate moderate use, potentially due to stringent regulations and advanced pest management practices. In contrast, lower pesticide use is observed in Bangladesh (1.8 kg/ha, 2.0%), Myanmar (1.4 kg/ha, 1.6%), and Sri Lanka (0.7 kg/ha, 0.8%), with India and Russia showing minimal use at 0.6 kg/ha (0.7%) and 0.2 kg/ha (0.2%), respectively. Nepal and Pakistan have the least usage, with Nepal at 0.2 kg/ha (0.2%) and Pakistan at an almost negligible 0.003 kg/ha (0.0%), reflecting differences in agricultural practices, access to pesticides, and possibly the scale of farming operations (Figure 2).

Registered pesticide formulations and brands in Bangladesh: Pesticides are widely used on crops to combat insect infestations and diseases (Tudi *et al*. 2021). In Bangladesh, 84 active chemicals are registered under 242 trade names for crop protection (Ara *et al*. 2014). Data from the Bangladesh Crop Protection Association (2022) shows a diverse range of pesticides with insecticides leading at 160 formulations and 2,502 brands, fungicides with 103 formulations and 1,050 brands, and herbicides with 68 formulations and 888 brands. Public health pesticides have 77 formulations and 665 brands, while bio-pesticides have 20 formulations and 35 brands. Acaricides, stored grain pesticides, and rodenticides have fewer formulations and brands, reflecting specialized use. This diversity highlights the regulatory framework and demand for pesticides in Bangladesh's agriculture and public health sectors.

Fluctuating trends in the number of registered pesticide formulations in Bangladesh between 2010 and 2022 are presented in Figure 3. In 2010, there were 719 registered formulations, which significantly dropped to 512 by 2012 and further plummeted to a mere 34 by 2014. This sharp decline was followed by a recovery, with the number rising to 433 in 2016. However, another decrease was observed in 2018, with the number falling to 258. The number of formulations rebounded to 503 by 2020 but then decreased again to 363 by 2022. These fluctuations indicate periods of stringent regulatory changes, market adjustments, or varying levels of pest management needs and practices in the country.

The data from the Bangladesh Crop Protection Association (2022) indicates a growth trend in the registration of biopesticides in Bangladesh from 2012 to 2022 (Figure 4). Starting with 4 registered biopesticides in 2012, the number remained relatively stable, increasing slightly to 5 by 2018. A significant surge occurred by 2020,

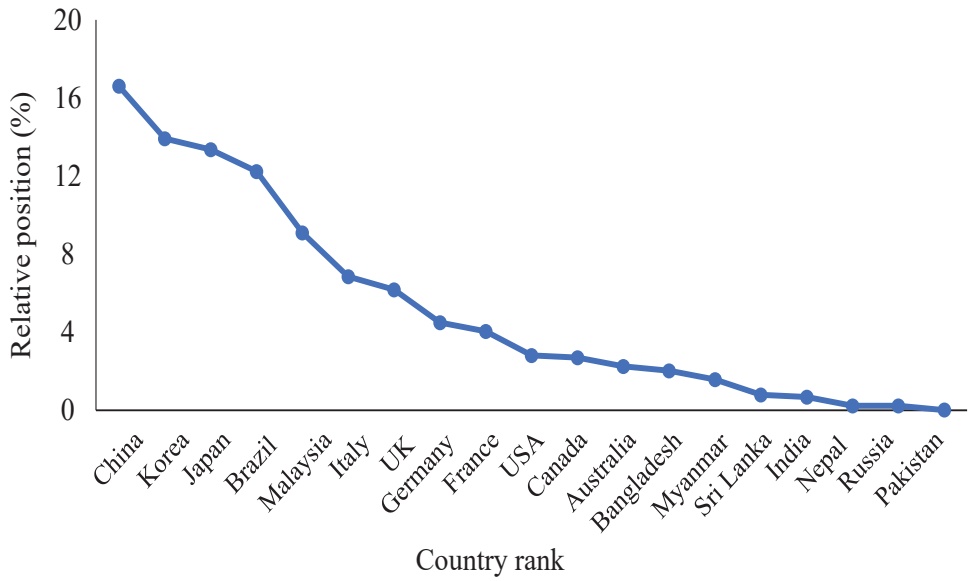


Figure 2. The relative position of different countries in using pesticides. (Source: Food and Agriculture Organization of the United Nations, FAO 2022).

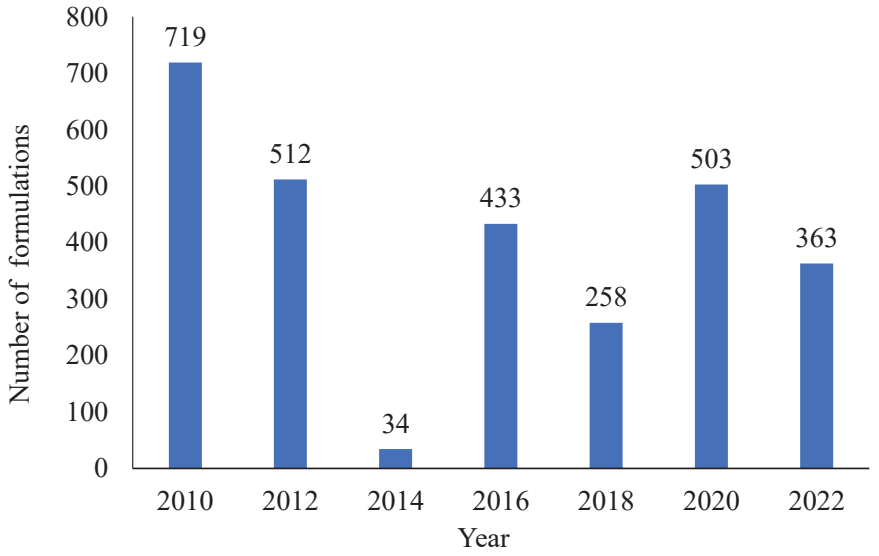


Figure 3. Trends of the number of registered formulations of pesticides in Bangladesh. (Source: Bangladesh Crop Protection Association, BCPA 2022).

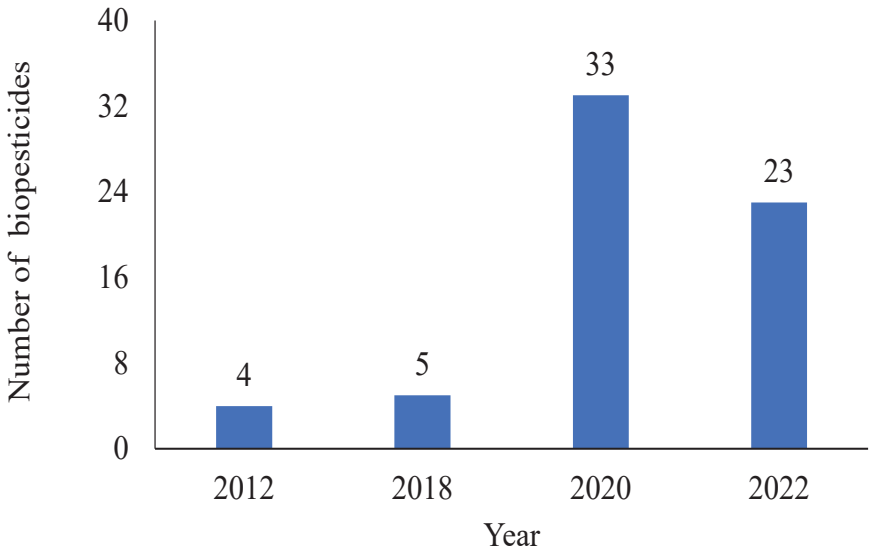


Figure 4. Number of registered biopesticides in Bangladesh during 2012-2022. (Source: Bangladesh Crop Protection Association,BCPA 2022).

with the number of registered biopesticides rising to 33. However, this number saw a decrease to 23 by 2022. This trend suggests an initial slow adoption of biopesticides, followed by a substantial increase in registrations, reflecting growing interest and potential market expansion in sustainable pest management solutions. The decrease after 2020 might indicate market corrections or regulatory adjustments.

Pesticide industry in Bangladesh: A significant increase in the number of pesticide companies in Bangladesh from 2010 to 2024 is presented in Figure 5. In 2010, there were 124 companies, which steadily rose to 138 in 2012 and 195 in 2014. A notable surge occurred in the following years, with the number reaching 290 by 2016 and 439 by 2018. This growth trend continued, with 589 companies registered by 2020, 751 by 2022, and an anticipated 802

Table 1. Types and number of registered pesticide formulations and brands in Bangladesh

Types of pesticides	Number of formulations	Number of brands
Acaricides	7	204
Fungicides	103	1050
Insecticides	160	2502
Herbicides	68	888
Stored grain pesticides	3	88
Rodenticides	3	15
Bio pesticides	20	35
Public health pesticides	77	665

(Source: Bangladesh Crop Protection Association, BCPA 2022).

companies by 2024. This rapid expansion indicates a robust growth in the pesticide industry in Bangladesh, reflecting increasing demand and possibly more regulatory approvals and market opportunities in the sector.

Pesticide consumption trends in Bangladesh: In Bangladesh, over 90% of pesticides are used excessively due to farmers' lack of awareness (Khatun *et al*. 2023). There has been a rise in pesticide use and brands in recent years (Rahman 2013). The government promotes pesticide use to enhance productivity and yields (Amin *et al*. 2014). Table 2 presents pesticide consumption in Bangladesh, clearly indicating that the use of insecticides, fungicides, herbicides, and rodenticides is increasing over time. Farmers use these pesticides understanding their purposes, but improper usage is common due to a lack of knowledge.

The total consumption of pesticides in Bangladesh is presented in Figure 6. Over this period, there's a notable fluctuation in pesticide consumption, with peaks and troughs reflecting dynamic agricultural practices, pest pressures, and regulatory influences. From 2012 to 2015, there was a gradual decline in pesticide consumption, with the lowest point recorded in 2015 at 33371.6 MT. However, starting from 2016, there's a reversal of this trend, marked by a steady increase in pesticide consumption by 2021, pesticide consumption reaches a peak of 39542.75 MT,

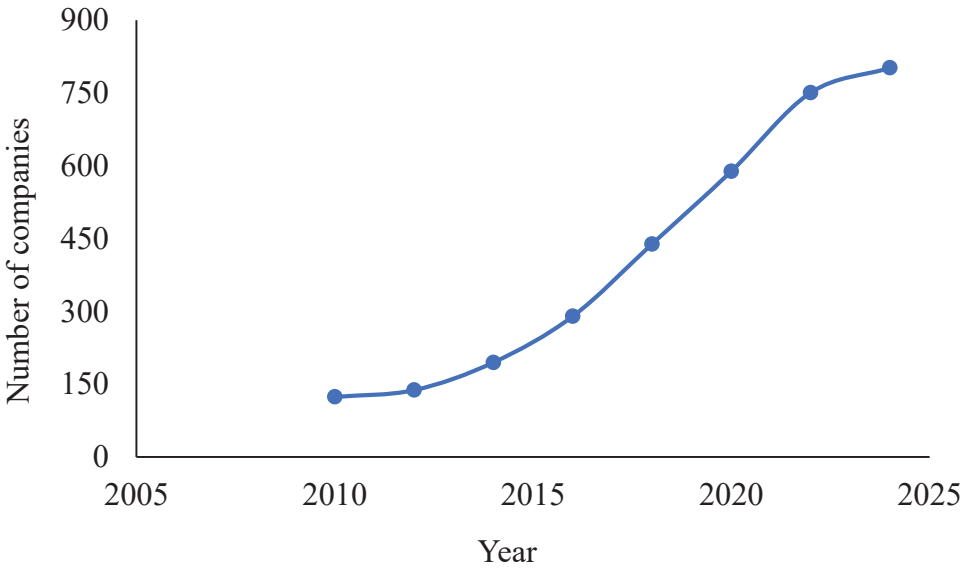


Figure 5. Number of registered pesticide companies in Bangladesh.(Source: Bangladesh Crop Protection Association, BCPA 2022).

Table 2. Pesticides consumption in Bangladesh

Year	Consumption of pesticide (MT/KL)						
	Insecticide			Fungicide		Herbicide	Rodenticide
	Granular	Liquid	Powder	General	Sulphur		
2018	8495.94	4927.75	1414.60	6199.66	10768.31	6996.6	76.80
2019	6456.28	5321.54	1632.35	6695.50	10445.00	7416.41	78.30
2020	5045.78	5542.68	1840.25	6802.85	10525.00	7605.5	80
2021	4636.25	6345.50	2240.20	7385.80	10835.00	7880.5	87
2022	3950.00	6330.00	2243.00	7480.00	10500.00	8050	95

(Source: Bangladesh Bureau of Statistics, BBS 2023)

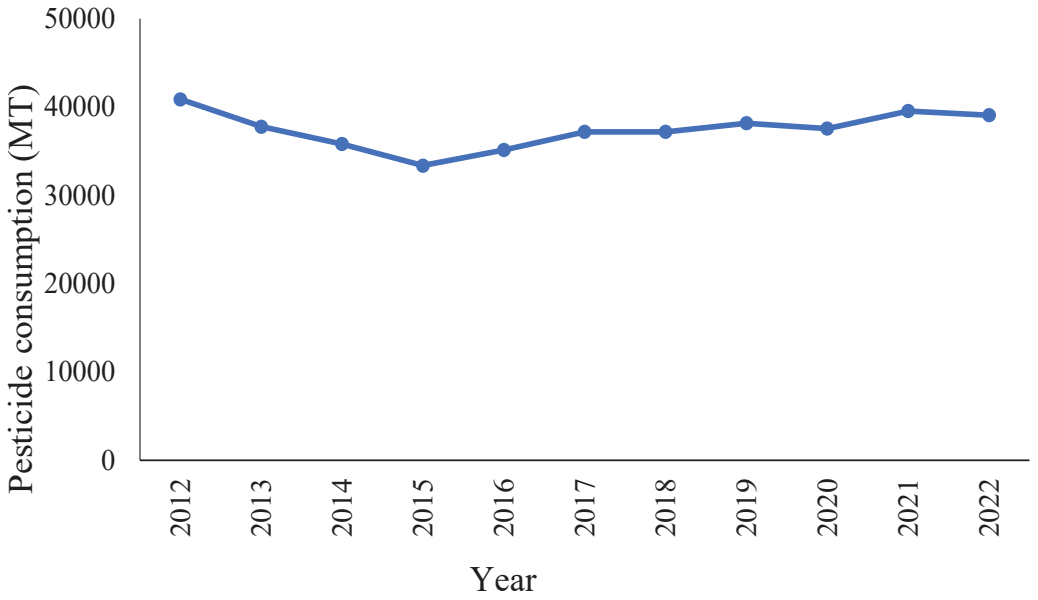


Figure 6. Total consumption of pesticides in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2023; Bangladesh Crop Protection Association, BCPA 2022).

indicating a substantial uptake in usage. However, in 2022, there's a slight decrease to 39083 MT. By the way, pesticides have become an essential component of agricultural practices and public health measures (Sharma *et al*. 2010). These fluctuations in pesticide consumption underscore the complex interplay of factors influencing agricultural practices in Bangladesh, including changes in pest dynamics, advancements in pest management technologies, shifts in crop cultivation patterns, and evolving regulatory frameworks.

Pesticide consumption in Bangladesh from 2017 to 2022 reveals fluctuations in usage and value (Figure 7). Pesticide consumption showed an overall increasing trend and the value of pesticide consumption also increased significantly, from 78.82 in 2017 to 175.44 in 2022. Notably, there was a sharp rise in value between 2020 and 2021, indicating a substantial increase in the cost or market value of pesticides during this period. This data suggests growing reliance on pesticides alongside rising costs in Bangladesh's agricultural sector.

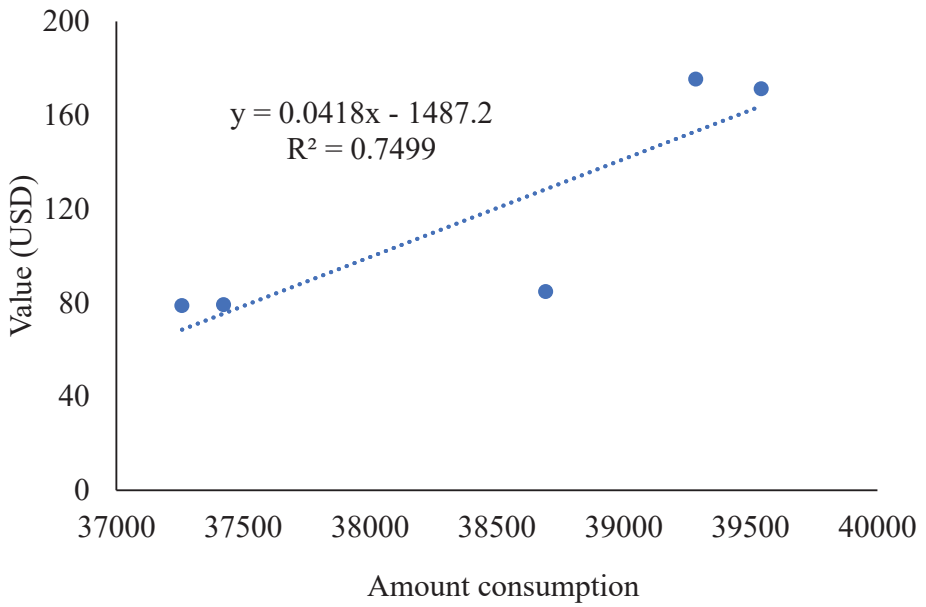


Figure 7. Relationship between import value and consumption of pesticide (Source: Bangladesh Crop Protection Association, BCPA 2022).

Variation in pesticide usage and abuses across Bangladesh: A wide range of synthetic pesticides is heavily used on Bangladeshi farmlands to manage insects, pests, and diseases (Nahar *et al*. 2020, Rahman 2013), though their use was minimal until the 1960s. Over the last forty years, the rate of pesticide application has increased dramatically in Bangladesh (Sarker *et al*. 2021). According to data (Figure 8), insecticides were the most commonly used type of pesticide for pest management, accounting for approximately 33.15% of the total pesticide usage. Fungicides followed closely behind, representing 45.77% of pesticide applications. Herbicides accounted for 20.49%, while miticides and rodenticides were used to a lesser extent, at 0.34% and 0.24% respectively.

As reported by BBS (2020) and Khatun *et al*. in 2023, offers insights into the distribution of pesticide use across various vegetables in Bangladesh (Figure 9). Brinjal emerged as the vegetable with the highest pesticide usage, with a reported application rate of 12%. This was followed by pumpkin and tomato, both with a usage rate of 7% each. Radish and beans had slightly lower usage rates of 6 and 5% respectively, while cauliflower and cabbage each recorded 5 and 4% of pesticide use. Further down the list, sweet gourd, bitter gourd, and point gourd had similar pesticide application rates of 4, 4, and 2% respectively. Notably, a significant portion of pesticide usage, accounting for 39%, was attributed to other vegetables, suggesting a diverse range of crops with varying pest management needs.This distribution highlights the importance of targeted pest management strategies tailored to the specific requirements of different vegetables cultivated in Bangladesh.

In Bangladesh, the misuse and overuse of pesticides initially introduced to enhance agricultural productivity, have led to severe health, environmental, and socio-economic consequences. Figure 10 presents some impacts and controls abuse of pesticide use in Bangladesh. Positive impacts include increased crop yield, effective pest control, higher productivity and economic benefits. However, human health is significantly impacted, with acute and chronic toxicity causing various illnesses, including cancer and respiratory issues (IRAC 2021). Long-term exposure to pesticides can lead to serious conditions like cancer, birth defects, lung and liver issues, and even death (Eddleston 2020). Environmental degradation is evident through soil contamination (Barua *et al*. 2022), water pollution (Islam and Mostafa 2021). Control measures, such as government regulation, farmer education, and training, should be adopted in Bangladesh (Islam and Mostafa 2021).

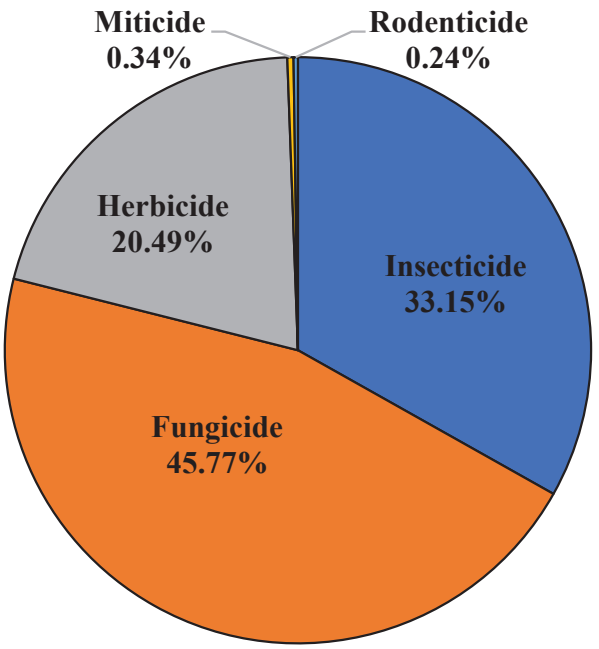


Figure 8. Amount (%) of pesticides used for management of different pests. (Source: Bangladesh Bureau of Statistics, BBS 2022, Bangladesh Crop Protection Association, BCPA 2022).

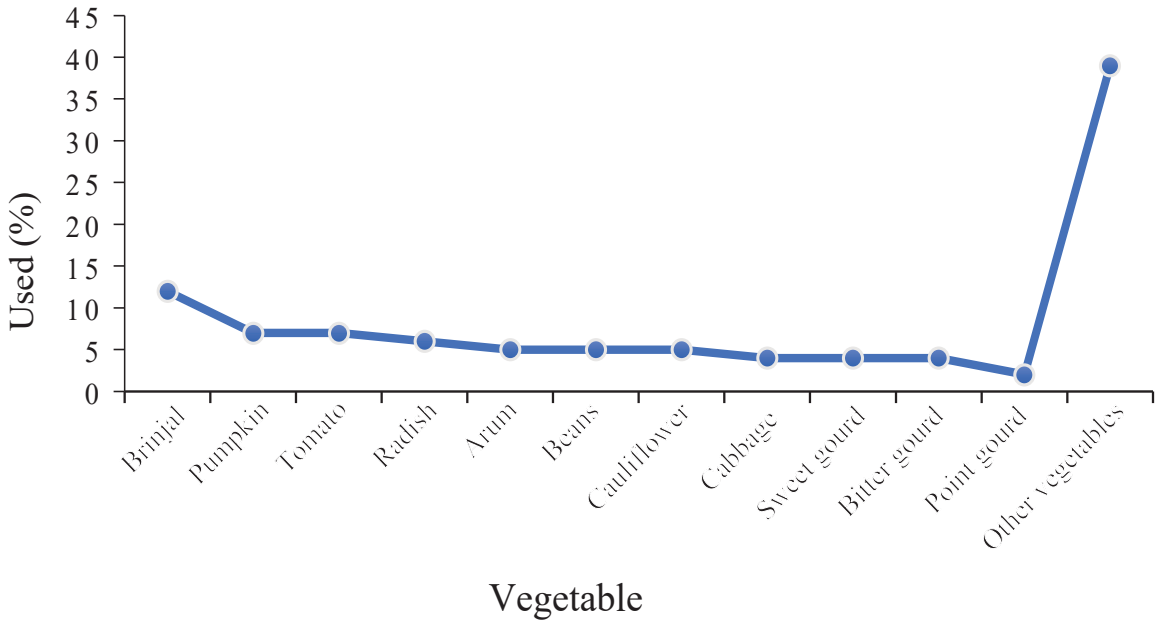


Figure 9. Pesticide use in different vegetables in Bangladesh (Source: Bangladesh Bureau of Statistics, BBS 2020, Khatun *et al*. 2023).

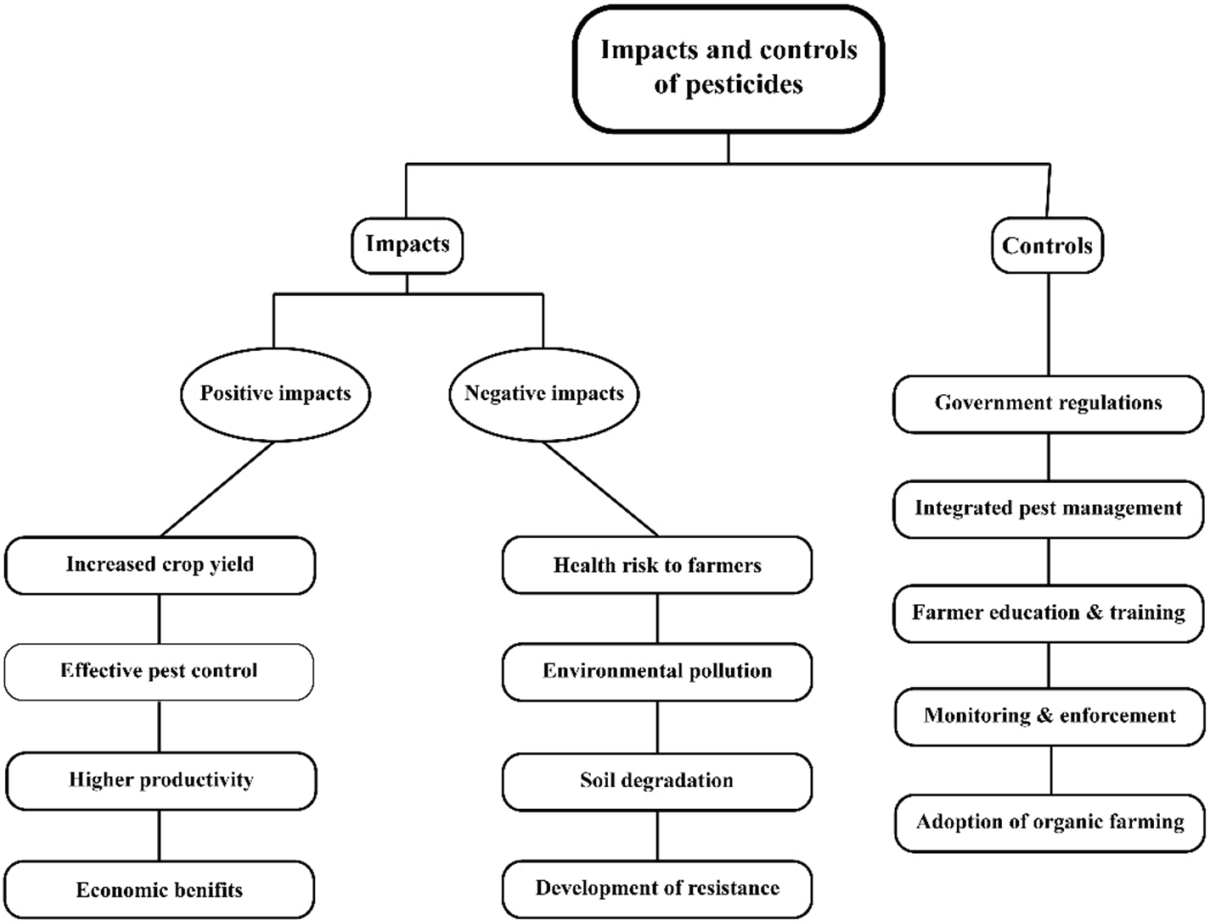


Figure 10. List of impacts and controls of abuse of pesticides in Bangladesh (Source: Islam and Mostafa 2021, Rahman 2013, Tudi *et al*. 2021).

Conclusions

Pesticide usage in Bangladesh has significantly increased due to the country's efforts to boost agricultural productivity. However, this rise in pesticide use has led to widespread misuse and overuse, largely due to a lack of farmer awareness. This misuse poses severe health risks, including chronic illnesses and acute toxicity, and contributes to environmental degradation through soil and water contamination and loss of biodiversity. The data highlights the increasing reliance on pesticides, with notable fluctuations in consumption patterns and costs. Despite these challenges, the growth in registered pesticide formulations and companies indicates a dynamic market with the potential for better pest management practices. Addressing these issues requires comprehensive studies and effective regulatory measures to ensure sustainable and safe pesticide use, safeguarding both human health and the environment.

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