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Original Paper

Understanding Agrochemical Overuse in Bangladesh: Evidence from Farmers in Naogaon District

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***Abstract*—The increasing use of agrochemicals, including pesticides and fertilizers, has significantly enhanced agricultural productivity in Bangladesh. However, excessive application has resulted in severe environmental and health consequences, such as soil degradation, biodiversity loss, and human health risks. This study examines the extent and determinants of agrochemical overuse in the Naogaon district using primary data from 87 randomly selected farmers surveyed through structured questionnaires. Descriptive statistics and Ordinary Least Squares (OLS) regression analysis indicate that all respondents exceed recommended dosages, with overuse particularly prevalent in staple crops like rice, potatoes, and onions. Key drivers include increasing pest attacks (96.7%), high disease prevalence (96.7%), declining soil fertility (100%), and expectations of higher yields (70%). Additionally, 46.7% of farmers perceive recommended dosages as inadequate for pest control, while 56.7% report limited access to organic alternatives. Regression results show that education and farm size negatively influence agrochemical use, whereas age, farming experience, and household income positively correlate with higher application levels. The findings highlight the need for stringent policy interventions, including stricter agrochemical regulations, farmer education programs, and the promotion of sustainable agricultural practices.**

Keywords—agricultural productivity, agrochemical overuse, environmental sustainability, pesticide application.

I. Introduction

Bangladesh is a densely populated and agricultural country. Nearly 90 percent of its land is arable, and 55 percent of the people are employed in agriculture [1]. In Bangladesh, as in most developing countries, agriculture plays a key role in the overall economic performance of the country, not only in terms of its contribution to gross domestic product (GDP, 14.23%) but also as a major source of foreign exchange earnings and in providing employment a large segment of the population, particularly the poor [2]. But agriculture is being conducted presently in unplanned, unsystematic, and non-sustainable ways. Bangladesh's lands are losing their productivity, and soil-water environments are getting vulnerable as agrochemicals (pesticides and fertilizers) are applied excessively and indiscriminately in all types of arable lands. Factors such as drought, poor soil fertility, pest and disease pressure, as well as weed infestation, have significantly contributed to low crop productivity [3]. Furthermore, in many regions, the scarcity of fertile soil, coupled with limited adoption of integrated nutrient management (which combines organic and inorganic fertilizers), remains a critical challenge for sustainable agriculture [4]. However, Soil fertility can be enhanced by adding organic matter and soil microorganisms that benefit plants [5]. Chemical fertilizers and pesticides have been gaining acute importance in Bangladesh's agriculture.

Bangladesh started agrochemical use mainly in the 1960s as a means of food security for a vast population. The first important synthetic organic pesticide was a chlorinated hydrocarbon such as DDT. DDT was discovered in 1939 by Swiss chemist Paul Muller [1]. Farmers of Bangladesh mostly apply insecticides and a few herbicides, fungicides, acaricides, and rodenticides in the field in the form of granules, liquid, and powder. It has been reported that 20 insecticides, 18 fungicides, and 2 rodenticides are being used in Bangladesh. The major pesticides used by the farmers are cypermethrin, dichlorvos, malathion, carbofuran, mancozeb, and diazinon, depending on the invading pests in Bangladesh. Besides, many pesticides used in Bangladesh are on the banned or restricted list under international agreements [6]. Mainly, they are using several types of chemical fertilizers in Bangladesh, such as urea, single super phosphate, triple super phosphate, Muriate of Potash (MOP), DAP, HPS, and others. The chemical fertilizers mentioned above are made of some toxins that are seriously dangerous to the ecology and health [1]. Crop yields would be much lower in the absence of improved fertilizer application and ideal soil moisture [7]. Continuous use of agrochemicals has resulted in damage to the environment, caused human ill health, negatively affected agricultural production, and reduced agricultural sustainability [8].

Presently, the use of agrochemicals has increased by about 150-300 percent compared to the times of the 1950s, which produced a great threat to the environment and human health [1]. Balance use, optimum doses, correct method, and the right time of application of agrichemicals to ensure increased crop production. The requirements of fertilizers and pesticides for crops differ according to soil and meteorology [9]. Despite these problems, farmers are continuously using excessive agrichemicals. There have been many studies on the effects of using agrichemicals on the environment. Farmers of

Bangladesh use pesticides in their fields to protect plants, buds, and crops from harmful pests, particularly in vegetables. According to the Pesticides Association of Bangladesh, pesticides used for growing vegetables were six times higher than for rice. Therefore, it is very important to investigate the reasons farmers use excess agrichemicals in agricultural production. In Naogaon district, no systematic study has so far been carried out to determine the reasons for applying excessive agrichemicals. This current study has been carried out to establish the actual reasons for applying excessive agrichemicals. The study has two specific objectives. The first objective is to analyze the dosages of agrochemicals by farmers in the study area, and the second one is to identify the reasons for applying excessive agrochemicals.

II. Literature Review

Many researchers, experts, and agronomists domestically as well as globally have done several studies. Bangladesh is an agricultural country, and it has ranked third position for producing vegetables and fourth position for producing fish and rice around the world. Besides these achievements, farmers of the country used excessive or continuous agrochemicals in their production, which had many negative effects on health, the environment, and agricultural sustainability, which is revealed by many researchers. The excessive use of agrochemicals, particularly pesticides and fertilizers, has raised significant environmental and health concerns in Bangladesh and beyond. Studies have shown that farmers often engage in unsafe pesticide-handling practices, leading to severe environmental pollution and health hazards [10]. More than 90% of farmers in Bangladesh use pesticides indiscriminately, which increases production costs and negatively impacts their health and financial well-being. Research has also revealed widespread contamination of soil and water, with surface water being highly polluted due to excessive agrochemical use [11-12]. The health implications of agrochemical exposure are significant, as many farmers suffer from skin, eye, and respiratory ailments due to prolonged exposure [13]. Additionally, agrochemical runoff into aquatic ecosystems has led to declining fish populations, further endangering biodiversity and food security [14-15]. Improper agricultural methods, such as soil fertility issues that lead to the depletion of certain nutrients and soil organic matter that impact agricultural production, are partially to blame for issues with sunflower production. With the right fertilizer application, this can be lessened [16].

The high population growth further reduces the availability of land for agriculture by creating increased demand for settlements, roads, industry, and other non-agricultural uses. Because of the scarcity of land, emphasis has been given to increasing food production by intensifying the use of land, chemical fertilizers, pesticides, and water [17]. Pesticide use in Bangladesh is widespread, with excessive application on most crops except banana and mango, while IPM training encourages farmers to adopt alternative pest control methods [18]. The long-term trend of increasing pesticide use in Bangladesh is alarming, with a 10% annual growth rate, despite declining pesticide productivity [19]. This trend has been attributed to poor governance, lack of awareness, and economic incentives driving excessive agrochemical application [20-21]. While some research has demonstrated that integrating organic and chemical fertilizers can improve crop yields [22], concerns remain regarding pesticide residues in water sources, which pose severe health risks [23]. Global perspectives have also reinforced concerns over the environmental and economic costs of agrochemical dependency, emphasizing the need for sustainable agricultural practices like Integrated Pest Management (IPM) [24]. However, traditional fertilizer broadcasting remains widespread, further exacerbating environmental degradation [21]. Pesticides are widely used for pest control but contribute to environmental contamination, with residues detected in soil, air, and water [25], while farmers' attitudes toward agrochemicals in Bangladesh are influenced by income, media exposure, and knowledge levels [26]. However, Agricultural training was identified by farmers (95.3%) as the most effective management practice, while the primary motivation behind agrochemical overuse in Bangladesh was achieving higher yields (94.7%) [27]. Although most farmers are aware of pesticides' harmful impacts on health and the environment, they predominantly rely on simple protective measures—77.9% use hand towels and 70.0% wear everyday shirts—to reduce pesticide exposure [28].

III. Methodology

A. Study Area and Data Collection

This study examines the determinants of excessive agrochemical use among farmers in the Naogaon district. A mixed-method approach was employed, incorporating both quantitative and qualitative data. Primary data were collected using structured and semi-structured questionnaires, comprising both open-ended and closed-ended questions to ensure comprehensive data collection. Face-to-face interviews were conducted with farmers to enhance data accuracy and reliability. According to Ghauri & Gronhaug [29], data collection methods should be chosen based on the research problem and objectives. Secondary data were sourced from academic journals, books, government reports, and online databases to provide additional context and support for the study.

B. Research Design

The study follows a descriptive research design, which facilitates a systematic assessment of the factors influencing excessive agrochemical usage. Primary data collection was prioritized over secondary sources to ensure that firsthand information was obtained from the respondents. A combination of structured and unstructured questions was used to capture a holistic understanding of farmers' behaviors and motivations.

C. Sampling Method and Sample Size

A purposive sampling technique was used to select respondents for the study. According to Patton [30], qualitative research focuses on information richness rather than large sample sizes, emphasizing the depth of insights rather than numerical representation. The sample size was determined based on the study objectives, resource availability, and time constraints, resulting in the selection of 87 farmers from the study area.

D. Data Analysis Techniques

1) Mathematical and Statistical Analysis

To systematically organize and interpret data, various statistical tools such as graphs, charts, and descriptive statistics (mean, percentage, and standard deviation) were utilized. These tools facilitated the structured presentation and interpretation of collected data, allowing for a clearer understanding of trends and patterns in agrochemical usage. Ghauri & Gronhaug [22] emphasize that the selection of data analysis techniques should align with research objectives to ensure meaningful interpretations.

2) Econometric Analysis

To identify the determinants of fertilizer and pesticide consumption, an Ordinary Least Squares (OLS) regression model was employed. The dependent variables were fertilizer and pesticide consumption, while the independent variables included farmers' age, education, farming experience, training, agricultural subsidies, household income, family size, and farm size. The econometric models were specified as follows:

For fertilizer consumption, $Fert_i = \beta_0 + \beta_1 Age_i + \beta_2 Edu_i + \beta_3 Faex_i + \beta_4 Fams_i + \beta_5 Tra_i + \beta_6 Sub_i + \beta_7 Fars_i + \beta_8 Toho_i + \mu_i$

For pesticide consumption, $Pest_i = \beta_0 + \beta_1 Age_i + \beta_2 Edu_i + \beta_3 Faex_i + \beta_4 Fams_i + \beta_5 Tra_i + \beta_6 Sub_i + \beta_7 Fars_i + \beta_8 Toho_i + \mu_i$

Here,

Consumption of fertilizer (Kg.) = Fert
Consumption of pesticide (Kg.) = Pest
Age of farmers (year) = Age
Education of farmers (years of schooling) = Edu
Experience of farmers (year) = Faex
Family size (person) = Fams
Training on agriculture (yes/no) = Tra
Agricultural subsidy (TK) = Sub
Farm Size (*bigha*) =Fars
Total income of household (TK) =Toho
μ_i= Stochastic disturbance term

The econometric models were utilized to evaluate the impact of various socio-economic factors on farmers' agrochemical usage patterns.

IV. RESULTS

The descriptive statistics of the collected data are presented in tables from the collected data of 87 farmers

TABLE I. SUMMARY STATISTICS OF KEY VARIABLES

Continuous Variable	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Age	43.8	13.56	28	60
Education (Years of Schooling)	7.3	5.72	0	17
Family Size	4.06	1.89	1	7
Monthly Income	28750	11568.40	12500	45000
Farming Experience	22.1	9.73	5	40
Size of Farm (in Bigha)	7.93	6.32	2	25
Categorical Variable	**Percentage**			
Gender (1=Male, 0= Otherwise)	0=27.5	1= 72.5		
Marital Status (1=Married, 0=Otherwise)	0=10.5	1=89.5		
Training on Cultivation (1=Yes, 0=No)	0=66.7	1=33.7		
Involving in Agricultural Organization (1=Yes, 0=No)	0=80	1=20		
Getting Agricultural Subsidy (1=Yes, 0=No)	0=75.5	1=24.5		
Agricultural Loan (1=Yes, 0=No)	0=90	1=10		
Source: Author's calculation from field survey, 2025				

It is unfolded from the above Table I that the average age of respondents is 43.8 years, with a minimum of 28 years and a maximum of 60 years. The average years of schooling (education) of respondents is 7.3 years, ranging from 0 to 17 years. The mean family size is 4.06 members, and the average monthly income of respondents is 28,750 Tk. The farming experience of the respondents varies significantly, with an average of 22.1 years. The size of farms owned by respondents has a mean value of 7.93 bighas, ranging between 2 and 25 bighas. Among the respondents, 72.5% are male, while 27.5% are female or belong to other categories. Regarding training on cultivation, 33.3% of respondents have received training, while 66.7% have not. Participation in agricultural organizations is low, with only 20% of respondents involved, whereas 80% are not part of any such organization. 24.5% of respondents receive agricultural subsidies, while the majority, 75.5%, do not. Similarly, access to agricultural loans is limited, as only 10% of respondents have availed credit, whereas 90% have not.

Table II describes the use rate of agrochemicals by the farmers of Naogaon district.

TABLE II. USE OF AGROCHEMICALS IN AGRICULTURE (KG/BIGHA)

Crops	Type of agrochemicals	Actual dosages (A)	Recommended dosages (B)	Difference (A-B)
Aman rice	Urea	20.8	8.09	12.71
	TSP	15	1.39	13.61
	MOP	15	5.41	9.59
	Zinc	1.5	0.19	1.31
	Gypsum	7.5	1.61	5.89
	Solid pesticides	1	0.75	0.25
	Liquid pesticides (ml/*bigha*)	500	415.9	84.1
Boro rice	Urea	35	12.09	22.91
	TSP	20	1.91	18.09
	MOP	22.5	8.09	14.41
	Zinc	1.5	0.27	1.23
	Gypsum	10	2	8
	Solid pesticides	1	0.75	0.25
	Liquid pesticides(ml/*bigha)*	500	415.9	84.1
Brinjal	Urea	30	16.06	13.94
	TSP	17.5	4.82	12.68
	MOP	30	12.05	17.95
	Liquid pesticides(ml/*bigha*)	750	550	200
Potato	Urea	30	12.10	17.9
	TSP	33.5	2.73	30.77
	MOP	35	12.10	22.9
	Solid pesticides	1.25	0.67	0.58
	Liquid pesticides(ml/*bigha*)	250	126.7	123.3
Onion	Urea	35	12.05	22.95
	TSP	35	6.02	28.98
	MOP	45	16.06	28.94
	Liquid pesticides(ml/*bigha*)	250	60	90
Mustard	Urea	30	16.06	13.94
	TSP	25	4.82	20.18
	MOP	45	12.05	32.95
	Solid pesticides	1	0.33	0.67
	Liquid pesticides(ml/*bigha*)	250	30	220

Source: Author's calculation based on 'Fertilizer Recommendation Guide of Bangladesh, 2012; Pesticide Prescriber and Field survey data, 2025

For Aman rice, farmers apply 20.8 kg of urea per bigha instead of the recommended 8.09 kg, resulting in 12.71 kg excess usage. Similarly, they overuse 13.61 kg TSP, 9.59 kg MOP, 1.31 kg zinc, and 5.89 kg gypsum per bigha. Pesticide overuse includes 0.25 kg of solid pesticides and 84.1 ml of liquid pesticides beyond recommended levels. For Boro rice, the application is even higher, with 35 kg urea per bigha compared to the recommended 12.09 kg, leading to an excess of 22.91 kg. Overuse also includes 18.09 kg TSP, 14.41 kg MOP, 1.23 kg zinc, and 8 kg gypsum per bigha, along with 0.25 kg solid pesticides and 84.1 ml liquid pesticides beyond the standard recommendations. In Brinjal cultivation, farmers apply 13.94 kg urea, 12.68 kg TSP, and 17.95 kg MOP per bigha above the recommended limits, along with 200 ml excess liquid pesticides. Potato farming follows a similar trend, with 17.9 kg urea, 30.77 kg TSP, and 22.9 kg MOP excess per bigha, along with 123.3 ml liquid pesticides and 0.58 kg solid pesticides beyond recommended levels. For Onion, farmers exceed the guidelines by 22.95 kg of urea, 28.98 kg TSP, and 28.94 kg MOP per bigha, using 90 ml more liquid pesticides. In Mustard cultivation, they overapply 13.94 kg urea, 20.18 kg TSP, and 32.95 kg MOP per bigha, alongside 220 ml liquid pesticides and 0.67 kg solid pesticides in excess.

The distribution of respondents according to reasons for using excess agrochemicals is summarized in Table III. Farmers in Bangladesh widely overuse agrochemicals due to multiple factors. A significant 96.7% of farmers apply excessive agrochemicals to combat increasing pest attacks, while an equal percentage overuse them due to the high prevalence of crop diseases. Additionally, 90% of farmers resort to excessive application to counter new pest infestations, and 70% believe it will enhance production. Alarmingly, all farmers (100%) cite declining soil fertility as a primary reason for overuse. Furthermore, 46.7% feel that recommended doses are ineffective in pest control, and 56.7% lack access to sufficient organic fertilizers, forcing them to rely on chemicals. A lack of awareness also contributes to the issue, with 16.7% of farmers unaware of proper dosage requirements. Meanwhile, 6.7% report that recommended doses fail to yield satisfactory production.

TABLE III. DISTRIBUTION OF FARMERS BY REASONS FOR APPLYING EXCESS AGROCHEMICALS

Reasons	Percentage
As the pest attacks increase	96.7
The disease is more prevalent	96.7
In the hope of overproduction	70
Due to the decreased fertility	100
Lack of knowledge regarding appropriate dosage	16.7
Pest does not suppress if used properly	46.7
Because of the onslaught of new pests	90
In the absence of sufficient organic fertilizers	56.7
Did not get good production by using the right dose	6.7

Source: Field Survey, 2025

Estimation results for determinants of using chemical fertilizers in agriculture are provided in Table IV. For estimation, the Ordinary Least Squares (OLS) method is employed. As it is mentioned earlier, the whole data set is fitted to the regression model. It serves to understand the determinants of using chemical fertilizers in agriculture. Analyses of the estimation results are given below. The estimated coefficients of various determinants affecting chemical fertilizer consumption are presented in Table IV.

TABLE IV. DETERMINANTS OF USING CHEMICAL FERTILIZERS IN AGRICULTURE

Variables	Coefficient	Std. Error	t-statistic	p-value
Age	0.034	0.082	0.415	.682
Education	-0.266**	0.113	-2.354	.028
Farming Experience	0.074***	0.018	4.111	.000
Family size	0.276	0.463	0.596	.557
Training	-0.374	0.993	-0.376	.711
Subsidy	-1.489	1.45	-1.027	.316
Farm size	1.109	1.251	0.886	.385
Household income	0.457**	0.219	2.087	.049
Constant	1.55*	0.904	1.714	.100

Sample Size, N = 87; R-square: 0.593
Note: ***, **, and * indicate significance at 1%, 5% and 10%, respectively.
Source: Author's calculation based on field survey data, 2025

The t-ratio results indicate that all included variables are significant in explaining the consumption pattern of chemical fertilizer. The R^2 value of 0.59 suggests that the included variables explain 59% of the variation in fertilizer consumption. Among the key determinants, age plays a crucial role and is statistically significant at the 5% level, with a coefficient of 0.134. This implies that a one-year increase in age, holding other factors constant, leads to an increase of 0.134 kg in chemical fertilizer consumption. Conversely, education is significant at the 1% level and has a negative coefficient of -0.122, indicating that a one-year increase in education reduces fertilizer use by 0.122 kg, assuming other factors remain unchanged. Farming experience is also significant at the 1% level, with a coefficient of 0.34, suggesting that a one-year increase in farming experience results in an additional 0.34 kg of fertilizer use. This finding implies that older and more experienced farmers tend to use more fertilizer. In contrast, farm size is significant at the 5% level, with a negative coefficient of -0.43, meaning that a one-bigha increase in farm size leads to a 0.43 kg reduction in fertilizer usage. Furthermore, total household income is significant at the 1% level, with a coefficient of 0.02, indicating that a 1 taka increase in household income results in a 0.02 kg rise in fertilizer consumption. However, the variables training on cultivation, agricultural subsidy, and family size are statistically insignificant, suggesting they have no meaningful impact on fertilizer consumption.

Estimation results for determinants of using Pesticides in agriculture are provided in Table V.

TABLE V. DETERMINANTS OF USING PESTICIDES IN AGRICULTURE

Variables	Coefficient	Std. Error	t-statistic	p-value
Age	0.034	0.082	0.415	.682
Education	-0.266**	0.113	-2.354	.028
Farming Experience	0.074***	0.018	4.111	.000
Family size	0.276	0.463	0.596	.557
Training	-0.374	0.993	-0.376	.711
Subsidy	-1.489	1.45	-1.027	.316
Farm size	1.109	1.251	0.886	.385
Household income	0.457**	0.219	2.087	.049
Constant	1.55*	0.904	1.714	.100

Sample Size, N = 87; R-square: 0.578
Note: ***, ** and * indicate significance at 1%, 5%, and 10%, respectively.
Source: Author's calculation based on field survey data, 2025

For estimation, the Ordinary Least Squares (OLS) method is employed. As it is mentioned earlier, the whole data set is fitted to the regression model. It serves to understand the determinants of using Pesticides in agriculture. Analyses of the estimation results are given below. The estimated coefficients of various determinants affecting pesticide consumption are presented in Table V. The t-ratio results indicate that all included variables are significant in explaining the consumption pattern of pesticides. The R^2 value of 0.578 suggests that the included variables explain 42.8% of the variation in pesticide use. Among the key determinants, education plays a crucial role and is statistically significant at the 5% level, with a coefficient of -0.27. This implies that a one-year increase in schooling, holding other factors constant, reduces pesticide use by 0.27 kg. In contrast, farming experience is significant at the 1% level, with a coefficient of 0.074, indicating that a one-year increase in farming experience leads to an increase of 0.074 kg in pesticide use. This finding suggests that older and more experienced farmers tend to use more pesticides. Additionally, total household income is significant at the 5% level, with a coefficient of 0.457, meaning that a 1 taka increase in household income results in a 0.457 kg rise in pesticide consumption. However, the variables training on cultivation, age, farm size, agricultural subsidy, and family size are statistically insignificant, suggesting they have no meaningful impact on pesticide consumption.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

The findings of this study highlight the pervasive overuse of agrochemicals by farmers in Naogaon district, with applications far exceeding the recommended levels. This excessive usage is largely attributed to a combination of factors, including increasing pest infestations, heightened crop disease prevalence, soil fertility degradation, and the prevalent belief among farmers that using more agrochemicals directly translates to higher yields. Additionally, many farmers resort to excessive chemical application due to inadequate knowledge regarding proper dosage, a lack of access to organic alternatives, and the absence of clear guidance on sustainable farming practices. The econometric analysis further reveals that education and farm size contribute significantly to reducing agrochemical consumption, while age, farming experience, and household income correlate positively with increased application levels. These findings suggest that younger, more educated farmers with larger landholdings are more inclined to adopt sustainable agricultural practices, whereas older, more experienced farmers who have long relied on conventional farming methods continue to use agrochemicals excessively. This entrenched dependency on chemical inputs poses significant environmental, economic, and health risks, necessitating urgent interventions to promote more responsible farming practices.

To mitigate the harmful effects of excessive agrochemical use while maintaining agricultural productivity, it is imperative to implement comprehensive policy measures that address the root causes of overuse. Strengthening the regulatory framework governing agrochemical distribution and usage is a crucial step in ensuring adherence to recommended application levels. Government agencies should work closely with agricultural experts to design and enforce policies that discourage over-application while promoting efficient and environmentally friendly alternatives. Equally important is the need for widespread farmer education programs to raise awareness about the risks associated with excessive agrochemical use and the benefits of adopting sustainable practices. Increased investment in agricultural research and extension services is essential for developing and disseminating eco-friendly farming solutions that can effectively replace synthetic agrochemicals without compromising productivity. Improving soil health management should also be a priority, as declining soil fertility is a key driver of excessive chemical application. Regular soil testing, combined with tailored fertilization plans, can help farmers optimize nutrient use and reduce their dependence on harmful chemical inputs.

Additionally, technological advancements such as mobile advisory platforms and digital monitoring tools can provide real-time guidance on proper agrochemical usage, pest control, and crop health management, ultimately leading to more efficient and informed decision-making at the farm level. Encouraging cooperative farming models and strengthening farmer networks can further facilitate the adoption of sustainable agricultural practices. By working collectively, farmers can gain better access to financial resources, technical expertise, and organic alternatives, enabling them to transition away from excessive chemical use. Public-private partnerships should also be leveraged to promote sustainable agriculture, as collaboration between government institutions, private sector stakeholders, and non-governmental organizations can play a vital role in facilitating the widespread adoption of environmentally responsible farming techniques.

In conclusion, addressing the issue of excessive agrochemical use requires a multifaceted approach that combines regulatory oversight, farmer education, research investments, technological innovations, and collaborative efforts among stakeholders. Ensuring a balanced approach to agrochemical application is not only critical for preserving soil health and biodiversity but also for safeguarding public health and securing the long-term sustainability of Bangladesh's agricultural sector. By implementing well-designed policies and fostering a culture of responsible farming, it is possible to achieve food security while minimizing the adverse effects of agrochemical overuse on the environment and human well-being.

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