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## Exploring the current consumer market status of chemical fertilizer Vs biofertilizer industries in West Bengal, India: An on-site investigation

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### Abstract

Increased awareness of the adversities imposed by the use of chemical fertilizers have compelled farmers to opt for sustainable alternatives, i.e., biofertilizers, over the past decades. West Bengal, being adjacent to rich alluvial zones of river Ganges, has an extensive stretch of fertile lands that makes agriculture the main occupation for the majority of people residing in those areas. The impact of the use of biofertilizers as an alternative to chemical fertilizers has hit the consumer market of chemical fertilizers, thus reducing the CAGR of chemical fertilizer industries significantly. On the contrary, the biofertilizer consumer market is trending to gear up by a considerable percentage. The present investigation tends to explore the current status of the fertilizer market in the heart of West Bengal rural areas with respect to this situation. After thorough surveys including 200 farmers from 4 different zones (50 sample population size from each) and 20 local fertilizer distributors, we conclude that, although farmers are opting out of purchasing chemical fertilizers for diverse reasons, yet a notable percentage have tended to shift to the use of biofertilizers over time. This study aimed at analysing the overall consumer market trend for fertilizer use in West Bengal, India, evaluation of factors that have affected their consumer market status and projecting strategic approaches that may help them troubleshoot the problem and thus maintain a stable position in the local competitive markets.

**Keywords:** Chemical fertilizer, biofertilizer, consumer market, sustainability

### Introduction

Chemical fertilizers have played a dominant role in agriculture for decades, thus contributing significantly to global food security (IFA, 2020) <sup>[10]</sup>. These synthetic fertilizers that are rich in essential nutrients, have played key role in increasing crop productivity and meeting up with the demands of a growing population (FAO, 2009) <sup>[7]</sup>. However, their widespread use has substantially influenced concerns regarding their long-term impacts on soil health (Girija Shankar *et al.*, 2020) <sup>[8]</sup> and water quality (Davidson *et al.*, 2012) <sup>[6]</sup>, along with shooting up of greenhouse gas emissions (Tubiello *et al.*, 2013) <sup>[16]</sup>.

The global agricultural landscape is utilized to feed the world population. At the epicentre of this critical juncture lies the discourse surrounding the chemical fertilizer and biofertilizer industries. Both offers distinct paradigms for enhancing soil fertility and crop productivity. These industries have taken centre stage as agriculture strives to reconcile the necessity of higher yields with the sustainable and environmentally friendly practices.

In response to these concerns, biofertilizers have emerged as a promising alternative. Biofertilizers utilise living microorganisms and organic materials to enhance nutrient availability and improve soil health (Rajendiran *et al.*, 2020) <sup>[14]</sup>. These biological agents offer a pathway to sustainable agriculture by mitigating the adverse environmental effects associated with chemical fertilizers (Bashan *et al.*, 2016) <sup>[3]</sup>.

This investigation embarks on a comprehensive market review of the chemical fertilizer and biofertilizer industries, aiming to illuminate their respective market dynamics, growth trajectories, and the multifaceted factors that influence their market. Through a meticulous analysis of market status, consumer preferences, regulatory frameworks, and ecological implications, this study seeks to provide critical insights into the current state and future prospects of these two vital sectors within the agricultural domain.

As we delve into this market research, it becomes increasingly evident that the decision between chemical fertilizers and biofertilizers transcends economics. It is a decision fraught with far-reaching implications, influencing our ability to harmonise food security with environmental sustainability.

By scrutinising the evolving landscape of these industries, this research endeavours to contribute substantially to the informed decision-making processes of farmers, policymakers, and stakeholders alike, as they chart a course towards a resilient and sustainable future for global agriculture.

The present study involved the collection of data related to the global market status of fertilizers. Depending on the observations made, a local field survey was done to correlate the local market trends with the global market status. A detailed survey was done that reflected the market status of local fertilizer industries in four different districts of West Bengal, India, namely Purba Bardhaman, Purba Medinipur, Hoogly and North 24 Parganas. A corroboration was done after thorough extrapolation of obtained information to reach a relevant conclusion to establish the correlation between global and local market status.

## 2. Materials and Methods

### 2.1. Materials

Multiple prerequisites had to be defined before initiating the investigation. For the successful completion of the study different tools were used. This included online search tools (Google search engine, Google scholar etc.), original research articles, reported review papers from authentic sources (reputed international journals), questionnaires for field surveys (separate surveys for distributors and consumers) and different data analysis tools.

### 2.2 Collection of data

#### 2.2.1. Collection from online sources

Initial global market data was obtained via internet survey from authentic web portals and online sources that included company websites and the online brokerage firms. The data available reflected market status and current stock scenario for each company studied under this investigation (Wu *et al.* 2023) <sup>[11]</sup>. Each company's information was extensively studied to extract and record essential information. Specific importance was given to the fluctuation in stock market and share prices for individual companies in the last three years. Any interesting observations were recorded.

#### 2.2.2. Collection through field survey

Specific questionnaires were prepared for field surveys with respect to information that were needed to carry out this research. Separate questionnaires were prepared for farmers and fertilizer distributors of that particular area (Figure: A1-A and A1-B). Four areas namely, Bardhaman, North 24 Parganas, Hooghly and Medinipur were selected, given the fertile land area available for agricultural activities in those areas (Ning *et al.* 2023). Answers were recorded and kept for further analysis. A detailed profiling of the type of fertilizer that is being used as well as the one that was previously used were noted. Current preferences regarding the type of fertilizer to be used were also recorded. Market status of biofertilizers were investigated by following up with the local fertilizer distributors and statements were recorded. Awareness status of both consumers and sellers

were also confirmed through specific questions included in the questionnaire (see Figure A1 in Appendix-I)

## 2.3. Data interpretation and analysis

The collected from different online sources and through field surveys were recorded. Data were put chronologically and suitable graphs were plotted to interpret the final market status and emerging trends in the local fertilizer market of West Bengal, India. The findings were corroborated with the global reports collected from the online sources previously and a relevant conclusion was drawn from the research.

## 3. Results and Discussions

### 3.1. Analysis and interpretation of market trend of well-known global fertilizer industries

After thorough investigation from available online repositories and databases, the global trend of fertilizer industries was analysed and interesting findings revealed a common trend in majority of the cases. An intense shift of consumer market towards organic farming and biofertilizer dependent farming has come forth that indicates to have enormous effect in the market status of conventionally used chemical fertilizers. The findings have been discussed in detail in this section.

#### 3.1.2. Declining Trends in the Chemical Fertilizer Industry

The chemical fertilizer industry has witnessed a noticeable and sustained decline over the past three years (J Ye *et al.*). This decline can be attributed to several interconnected factors, impacting both the production and consumption aspects of this critical sector. This might be a result of increased production costs, primarily driven by rising energy prices and stricter environmental regulations.

A significant factor contributing to the industry's downturn is the reduced global demand for chemical fertilizers (W Liu *et al.*). Farmers are seeking more sustainable and environmentally friendly alternatives to conventional fertilizers. The present investigation has revealed similar results that indicate significant decline in the stock prices of well-known Indian chemical fertilizer companies (Fig 1A and 1B). Analysis of past three years shows similarity in declining trend for most of them (Figure 2).

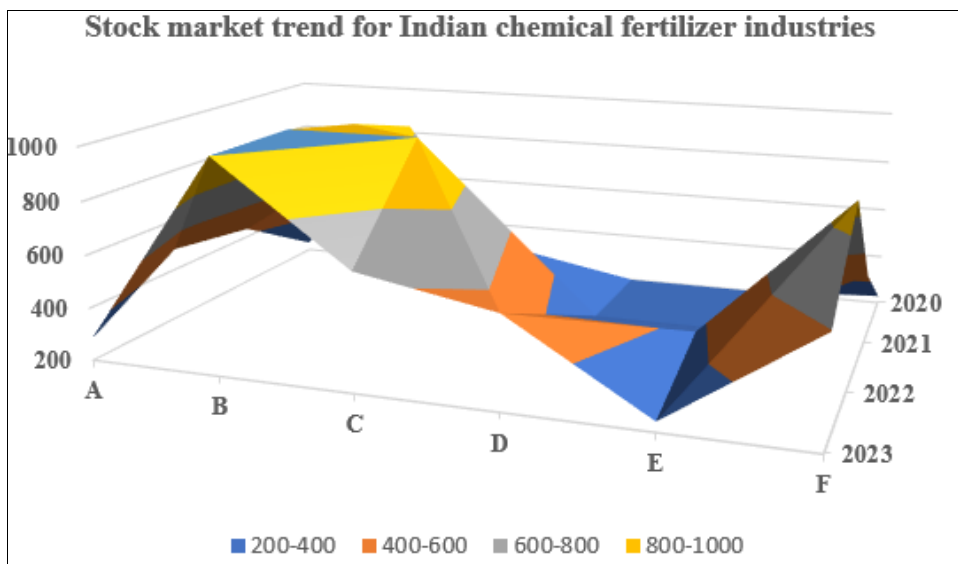
The growing preference for organic farming practices has diverted the attention of farmers away from chemical fertilizers, favouring organic alternatives that are perceived as safer and more environmentally responsible. (KR Dahal *et al.*) Escalating environmental concerns, particularly related to nutrient runoff and soil degradation, have led to stricter regulations, adding additional pressures on the chemical fertilizer industry.

Many regions have reached a point of market saturation with chemical fertilizers, leaving little room for growth, as farmers increasingly focus on soil health and sustainability. Some governments have reduced subsidies for chemical fertilizers, making them less affordable for farmers and discouraging their use.



Source: Online web portal Groww (India)

**Fig 1(A-B):** Declining trends of stock prices in past 1 year-3year for well-known chemical fertilizer companies



Source: Online web portal Groww (India)

**Fig 2:** Declining trend of chemical fertilizer companies since 2020

### 3.1.3. Upward Trajectory of the Biofertilizer Industry

The biofertilizer industry has experienced a remarkable upward trend, signifying a pivotal shift in agricultural practices towards sustainable and environmentally friendly solutions (KR Dahal *et al*). Several factors have contributed to this growth and have positioned biofertilizers as a key player in modern agriculture. Growing environmental consciousness among farmers and consumers has fuelled the demand for biofertilizers, which are perceived as eco-friendly alternatives to chemical fertilizers.

Biofertilizers are known for enhancing soil health by promoting beneficial microbial activity and improving nutrient cycling, aligning with the long-term goals of sustainable agriculture (Et alori *et al*). Global stock prices of top biofertilizer companies of India have gained momentum that has come up in the current study (Fig 3A and 3B). The surge in organic farming practices has provided a significant

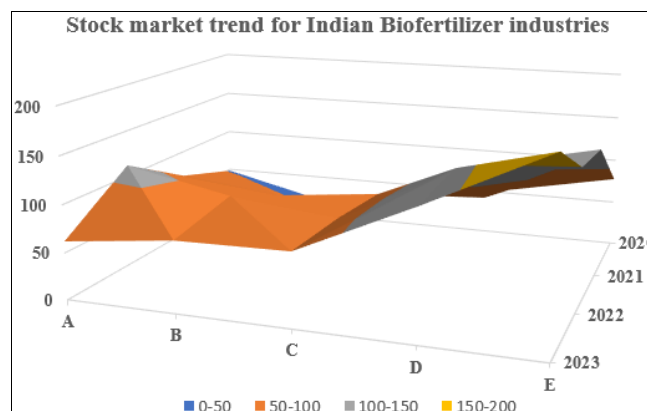
boost to the biofertilizer industry, as these products are often a crucial component of organic agriculture. Most of the companies reveal a similar trend with respect to stock market prices (Figure 4).

Biofertilizers mitigate the environmental impact associated with chemical fertilizers, as they release nutrients gradually and have a minimal risk of contributing to nutrient runoff and water pollution (Sharma *et al.* 2023) [15]. The biofertilizer market has expanded its reach into new regions and crop sectors, increasing its global presence and market share. With ongoing advancements in technology and research, biofertilizers are poised to play a pivotal role in fostering global food security while minimising the environmental footprint of agricultural activities. Further research and innovation in this sector are expected to drive continued expansion and adoption within the agricultural community.



Source: Online web portal Grow (India)

**Fig 3(A-B):** Upward trajectory of stock market prices of well-known biofertilizer industries since 2020



Source: Online web portal Grow (India)

**Fig 4:** Upward trajectory of Indian biofertilizer market status since 2020



## 3.2. On-site investigation to analyse consumer market status of fertilizers in West Bengal, India

### 3.2.1. Chemical fertilizer market scenario

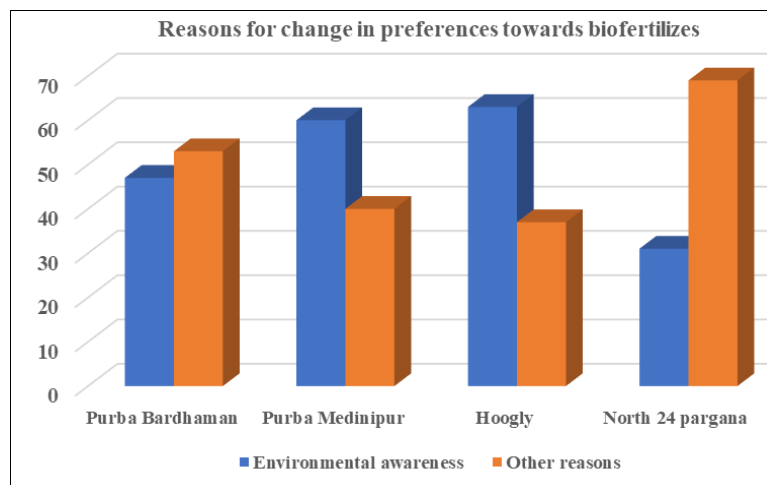
Agriculture in India, particularly in states like West Bengal, has long been reliant on chemical fertilizers for enhancing crop productivity. Till date a majority percentage of farmers are found to use chemical fertilizers, which quantifies to approximately 63%, as per our study as shown in Table 1 (S Patra *et al.*). So, it is evident that a substantial number of farmers (approximately 37%) have opted for alternative practices. However, recent years have witnessed a paradigm shift as farmers increasingly recognize the adverse environmental and health effects associated with these chemicals. This scientific article presents findings from a comprehensive questionnaire-based field investigation in West Bengal, shedding light on how farmers are becoming more aware and discontinuing the use of chemical fertilizers.

Our study reveals a significant increase in farmers' awareness of environmental issues, such as soil degradation and water pollution, linked to chemical fertilizer usage. According to our survey, around 50.25% of farmers are well aware of the negative effects of chemical fertilizers. Although awareness programs need to be arranged for the rest of the people (49.75%) who are supposedly ignorant of the facts (Figure 5). This heightened consciousness has led to a shift in their approach to farming. Farmer's concerns

about their own health and that of their families have grown substantially. They now recognize the potential health risks associated with prolonged exposure to chemical fertilizers. Government-led awareness campaigns and incentives to promote organic and sustainable farming practices have played a pivotal role in educating farmers about the advantages of reducing chemical fertilizer usage.

Access to information, facilitated by mobile phones and the internet, has empowered farmers to seek knowledge about sustainable farming practices and biofertilizers (T Bhattacharayya *et al.*). Farmer cooperatives and local NGOs have been instrumental in organising awareness programs and providing training on sustainable farming, facilitating the shift away from chemical fertilizers. Based on the findings of this study, we propose policy recommendations aimed at further promoting sustainable agriculture and reducing the usage of chemical fertilizers, ensuring a more ecologically and economically sustainable future for farmers in West Bengal and beyond.

Our questionnaire-based field investigation in West Bengal, India, highlights a significant and positive shift in farmers' awareness and practices, leading to a reduced dependency on chemical fertilizers. This transition not only contributes to the environmental and health well-being of the farming community but also paves the way for a more sustainable and resilient agricultural sector in the region.



**Fig 5:** Reasons for shift in preference towards the use of biofertilizers

Source: Data from collective questionnaire (for farmers) analysis

\*Other reasons include low price and easy availability

### 3.2.3. Biofertilizer market scenario

In the fertile agricultural landscapes of West Bengal, India, traditional farming practices have often relied heavily on chemical fertilizers (J Barisonet *et al.*). However, there is an encouraging shift towards sustainable agriculture as farmers become increasingly aware of the benefits of biofertilizers. This scientific article presents findings from an in-depth questionnaire-based field investigation in West Bengal, shedding light on how farmers are embracing biofertilizers as a viable alternative to chemical inputs. On an average approximately 36% of the farmers have shifted from chemical fertilizers to biofertilizers in past 3 years and the number is increasing each month (Table 1). These farmers have stated various reasons for their changed preferences which includes environmental awareness, cost-friendliness and easy availability.

Our study reveals a noteworthy increase in farmers' environmental consciousness, leading to a realisation of the adverse ecological impacts of chemical fertilizers. This heightened awareness has been a driving force behind the adoption of biofertilizers. Farmers are now acknowledging the role of biofertilizers in improving soil health by fostering beneficial microbial activity and nutrient cycling, which ultimately boosts crop productivity.

Farmers have recognized the economic viability of biofertilizers, which not only reduce input costs but also fetch premium prices for organic produce in the market. Collaborative learning among farmers, facilitated by community networks and local cooperatives, has been pivotal in spreading awareness and knowledge about biofertilizers. Farmers are gradually reducing their reliance on chemical fertilizers, opting for integrated nutrient

management strategies that include biofertilizers and organic inputs. Based on our findings (R Mawar *et al.*), we propose policy recommendations to strengthen support for biofertilizer adoption, including increased investment in research and extension services, and continued promotion of sustainable agricultural practices.

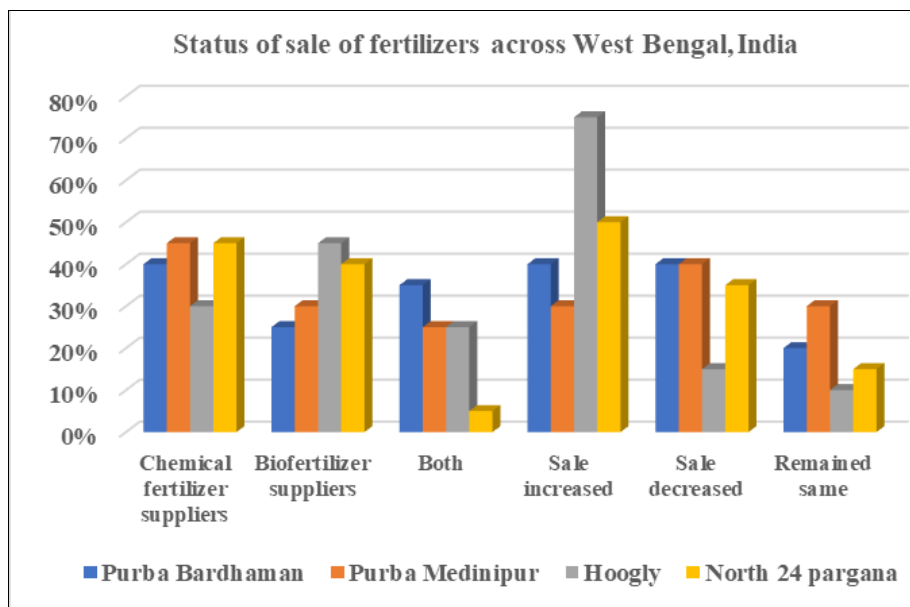
Accordingly, the fertilizer suppliers, being aware of the changing trend and preferences of the farmers have opted for shifting their selling preferences to biofertilizers. According to the survey done, most of the suppliers have either opted for shifting totally to biofertilizer, others have

started to think about doing so and some have started keeping both. Figure 6 shows the current status of selling preferences as well as the trend (increased or decreased) of sale of the products of local fertilizer distributors in the four different districts of West Bengal, India. In order to sustain in the market selling biofertilizers is becoming need of the hour for the distributors which is reflected in the fact that in most of the instances where the sale has increased or remained same, the suppliers have opted for selling biofertilizers fully or in combination with chemical fertilizers.

**Table 1:** Status of consumer market for fertilizers in four districts of West Bengal, India

Sl. No.	District	Chemical fertilizer users (%)	Biofertilizer users (%)
1	Purba Bardhaman	66	34
2	Purba Medinipur	60	40
3	Hoogly	62	38
4	North 24 Parganas	64	36

Source: Data from collective questionnaire (for farmers) analysis



Source: Data from collective questionnaire (for suppliers) analysis

**Fig 6:** Sale status of fertilizers across four different districts of West Bengal, India

**Conclusion**

The findings of our extensive field survey conducted through questionnaires in West Bengal, India, have illuminated the transformative impact of biofertilizers on the chemical fertilizer market in the region. The evidence presented in this study demonstrates a notable shift in farmers' preferences and practices, with biofertilizers emerging to shape the agricultural sector. The increasing awareness among farmers about the advantages of biofertilizers has led to a gradual reduction in the reliance on chemical fertilizers. This shift has not only positively affected the environment by mitigating soil degradation and nutrient runoff but has also safeguarded the health of farming communities, marking a significant milestone in the pursuit of sustainable agricultural practices. Policy recommendations derived from this research emphasize the need for continued support in the form of subsidies, research funding, and extension services to further promote sustainable agriculture in West Bengal, India. The impact on the chemical fertilizer market is evident, as it grapples with diminishing demand in the wake of increasing biofertilizer

usage. This transition provides valuable insights for policymakers, urging them to consider the changing dynamics of the agricultural input sector and formulate policies that align with the growing momentum of sustainable farming practices. The questionnaire-based field investigation conducted unveils a transformative narrative in the realm of agriculture, marked by the ascendance of biofertilizers and a decline in the dominance of chemical fertilizers. This shift not only exemplifies the commitment of farmers to eco-friendly and sustainable practices but also necessitates proactive policy measures to ensure the continued success of the agricultural sector in the region.

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