International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Examining the Impact of Agricultural Chemicals on Human Health in the Context of Increased Agricultural Intensity Using Artificial Intelligence

Trapty Agarwal[1], Shambhu Bharadwaj[2], K G Patel[3], Prakriti Kapoor[4], Amar Shankar S[5]

[1]Associate Professor, Maharishi School of Engineering & Technology, Maharishi University of Information Technology, Uttar Pradesh, India
[2]Associate Professor, College of Computing Science and Information Technology, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
[3]Dean and Principal, College of Agriculture, College of Agriculture , Parul University, PO Limda, Vadodara, Gujarat, India
[4]Centre of Research Impact and Outcome, Chitkara University, Rajpura, Punjab, India
[5]Assistant Professor, Department of Food Technology, Faculty of Engineering and Technology, JAIN (Deemed-to-be University), Bangalore, India

Abstract

Agricultural chemicals are substances used to regulate organisms that affect crops, including fungicides and insecticides. An accurate management approach and regulatory measures are required to maintain a healthy relationship between agricultural practices and human health, especially the intricate association between farming chemicals and human health. The indiscriminate use of agrochemicals to maximize agrarian productivity has detrimental effects on non-target creatures, air, water, soil, and human health. Sustainable agriculture and agricultural viability depend on minimizing the impact of agrochemicals on human health and the environment. This study explores the intricate connection between enhanced farming and its effects on human health, focusing on the use of agricultural chemicals. We analyze the effects of increased agricultural practices on human well-being by utilizing Artificial Intelligence (AI) approaches; including Deep Neural Networks (DNN).Farmers used safety measures while handling chemicals, including the use of gloves, masks, shoes and long-sleeved shirts for human health during agriculture chemical application. The requirements for gloves (9.71) and shoes' water-resistant pants (11.67) are addressed in the specification. Through the utilization of advanced AI methodologies, the goal is to describe developments, associations and possible solutions to achieve a balance between rice yield and human well-being. The results of this study provide information for the creation of sustainable farming methods that take rice productivity and the welfare of the farmer into account.

Keywords: Agricultural Chemicals, Human Health, Safety Measure, Pesticides, Annoyance

Full length article **Corresponding Author*, e-mail: trapty@muit.in

1. Introduction

The risks to human health are higher while pesticides are used. According to recent studies, 3 million individuals experience poisoning and 200 million people dead as a result of pesticide exposure each year worldwide. Every year it is anticipated, exposure to pesticides causes adverse effects for thousands of agriculturalists, especially in developing nations. In order to provide sustenance for the world's predicted 9 billion people by the middle of the twenty-first century, an ongoing development program for agrochemicals is required to protect crops worldwide and pests, consequently allowing improved yields of food and fiber with available lands [1]. Obstacles facing the agrochemical industry include regulatory environments that cause active ingredients is to destroyed, fungi, weeds and insects becoming more resistant to agrochemicals, expanding cost of research and development, public and

environmental pressure to reduce agrochemical use for the protection of human and animal health, including pollinators, and climate change-related changes in weather patterns like rising droughts, floods, and temperatures. The nutrients needed to improve crop development are provided by the usage of fertilizers, particularly nitrogen and phosphorus [3]. Pesticides reduce the possibility of agricultural output losses due to weeds, insect pests, and plant diseases. In general, chemical pesticides are divided into four categories: herbicides, bactericides, fungicides and rodenticides. These are included in key chemical groups such dithiocarbamates, triazines, carbamates and organochlorines. Pyrethrins and neonicotinoids are the newest additions, which are said to be safer substitutes. Depending on the chemical groups, the formulations have different impacts on the environment and human health [4]. A careless consumption of agrochemicals has several known negative effects on ecology and the environment. Although agriculture yields and efficiency increased, a new report on experiences learned from the environmental revolution asserts damages caused by the careless use of pesticides and fertilizers have far-reaching effects. Agrochemical manufacturing involves a large number of persistent and bioaccumulation-prone chemical substances. Excessive use of inorganic fertilizers is related to soil deposition of fluorine, arsenic, cadmium, mercury and lead. Addressing the negative externalities associated with agrochemical use requires a shift towards alternative options that balance crop productivity without compromising environmental and human health. This challenge is pronounced in resource-poor countries, where farmers may not have the means to utilize available resources. The indiscriminate use of agrochemicals in many regions further exacerbates these issues, leading to environmental degradation and adverse health effects. To address this, promoting cleaner production technologies becomes imperative [5]. A frequent application of fertilizers containing nitrogen causes nitrate to penetrate through waterbodies, causing eutrophication, which compromises aquatic organisms, and water quality. Phosphate absorbs into soil particles and transported to water bodies through a process, which is known as soil erosion. Excessive fertilizer application causes long-term soil acidity, which impacts soil production and conservation. Reliable nitrogen through chemical fertilizers has negative effects on biodiversity, the environment and human health it enters in ecosystems. The primary source of accidental exposure is pesticide residue found in food, drink and the atmosphere. Most of the exposure occurs through eating, inhalation, or skin contact. Chemicals are digested, eliminated, stored or bio accumulated in body fat after being exposed [6].

Agrochemicals have an influence on the environment and nonhuman biota. Humans are directly exposed to agrochemicals by unintentional, deliberate, or occupational circumstances; alternatively they are indirectly exposed through environmental and dietary residues. Humans at agrochemical production facilities are directly exposed, which occurs in merchants, pesticide applicators and other supply chain stages. It also affects living or close proximity to agricultural areas. In addition to unintentional intake, direct exposure occurs while drugs are consumed as a suicide tactic. Human health is affected by the molecules' bio concentration and bio magnification inside the human body. Multiple findings demonstrate that exposure to a variety of health issues, including neurological diseases, cancer, and birth abnormalities. While each person's health situation and mitigating behavior determines the extent of an impact on people experience. Encouraging the adoption of sustainable and safe agricultural practices, including the judicious use of pesticides enhances crop yields but also minimizes negative externalities. Emphasizing the safe use of agrochemicals contributes to environmental conservation and human well-being. By fostering awareness and providing support for cleaner production methods, we can create a more sustainable and responsible approach to agriculture, ensuring a balance between increased productivity and reduced negative impacts on the ecosystem and human health [7]. The study [8] examined the rising rate of invasive fungal infections worldwide, the prevalence of fungal allergies and the emergence of fungal diseases resistant to present classes of antifungals, making these organisms a significant hazard to human health. To prevent the effects of fungal illnesses and obtain a deeper understanding of the biology and motivations behind their formation, experts must coordinate worldwide research efforts, improve technological translation and engage with policymakers. The paper [9] provided a greater understanding of new discoveries about the ethical reuse of agricultural waste on-farm processing and compost-based tea treatment for soil with plants. There is a comprehensive discussion and comparison of the effective methods for reusing in presence leftover biomass with high-value chemical compounds for plants treatments and soil amendment. To enhance the quality of soil, compost incorporates humic materials, minerals, heavy metals and native microbes. The study [10] evaluated strategies to lower NH3 emissions from agricultural systems by an integrated evaluation and worldwide meta-analysis. Reducing NH3 emissions was achieved with the majority of the investigated mitigating techniques. The most efficient ways to reduce NH3 emissions in cropping systems were the use of higher-efficiency fertilizers, field application techniques and fertilizer sources. The paper [11] assessed the anaerobic digestion (AD) process was perform with cow dung (CM), agricultural solid wastes (ASWs) and chemical pre-treatment with NaHCO3 were combined. The study [12] suggested an evaluation system for potential agricultural pollution (PAP) in economically developed areas to pinpoint topics for regional priority research. The most important responsibility to ensure grain security and human health was identified and evaluate PAP. Large-scale PAP assessments are costly and they also provide a volume of data that deters decision-makers from evaluated. The paper [13] investigated the viability of health risk (HR) prediction using convolutional neural network (CNN) technology and using forward the CNNHR-IND indirect model and CNNHR-DIR direct model. The outcomes showed that both models were effective, with CNNHR-DIR exhibiting superior estimation accuracy. The study [14] used inductively coupled plasma mass spectrometry (ICP-MS) to measure the heavy metal content of 103 samples of agricultural soil, crops and water that were irrigated with wastewater or tube well water. The impacts of the investigated elements in the crops, both carcinogenic and non-carcinogenic were investigated and exposure levels were assessed using the Monte Carlo

simulation approach. The paper [15] prevented these kinds of difficulties through stringent pollution control laws and regulations, as well as their appropriate enforcement, together with efficient treatment technologies, sufficient treatment, water reuse, desalination, infrastructure upkeep and conservation, which were all crucial. In this study, we used DNN to reduce the quantity of agricultural chemicals used in rice cultivation for Human Health.

2. Materials and Methods

The study covers a wide range of concerns, such as the different types of agricultural pesticides used, possible routes of exposure, and the resulting health effects. In the farming sector, chemicals play a pivotal role, with major groups including fertilizers, plant growth stimulants, and plant protection chemicals. Technological advancements in the fertilizer-manufacturing sector have led to significant improvements in fertilizer formulations. Traditional fertilizers have evolved into nano-fertilizers, which are characterized by their nano-sized particles. This innovation allows for enhanced nutrient uptake by plants, promoting more efficient and targeted nutrient delivery. Furthermore, advancements have diversified fertilizer materials beyond conventional macronutrients like nitrogen, phosphorus, and potassium, to include micronutrients and soil ameliorants. The inclusion of micronutrients, such as zinc, iron, and copper, addresses specific plant nutritional needs, contributing to healthier and more resilient crops. Soil ameliorants like organic matter and conditioners; enhance soil structure and fertility, fostering sustainable agricultural practices. Overall, these technological advancements in fertilizer manufacturing contribute to more nuanced and tailored approach to crop nutrition and soil management in modern agriculture.

2.1. Dataset

All of Northeast India's maps for the 2017 seasonally planted rice paddy areas are presented. The Geotiff formatted datasets are accessed through the Fig share source. In the ESPG, the 4326 geographic reference structure and the dataset are available. Maps showing rice paddy fields and non-paddy rice regions, respectively, with values of 100 and 0 are included in the collection. Software comparable to ArcGIS or QGIS is used to examine and analyze the maps [16].

2.2. Determining the effectiveness of growing rice

Efficiency in the context of rice production refers to obtaining the highest possible output from a given amount of inputs. Producing output at the lowest feasible cost and the available input prices is known as cost or allocates efficiency. The quantity of resources that are saved by adhering to a certain farming method, which is represented in the lower prices which is determined with the assistance of efficiency measurement. Efficiency is quantified for a single farm, a collection of farms, or farms using various farming techniques. In an environment of decreased availability of essential resources and production variables, such as land or water in sufficient quantity and quality, a deeper comprehension and assessment of agricultural efficiency are required. Growing around 124 million tons of rice annually, rice is planted on 45,769 thousand hectares in India. Grains have been an important factor in helping individuals escape food instability and in assisting nations overcome the challenges of famine and hunger.

2.3. Use of agrochemicals and resource conservation

The amount of land, water, energy and labor that is used in agricultural output is referred to as resource use efficiency. It is an integral concept in agricultural sustainability; it enhances production and profitability while lessening agriculture's detrimental effects on the environment. Agrochemicals get into nearby water and land areas, entering the food chain and causing bioaccumulation. While considering the way these pesticides affect crops, overuse produces a large number of residues. These residues lead an imbalance in nutrients and a decrease in the quality of agricultural products. According to the study, peripheral farms have substantial land-use efficiency, while small farms have better labor productivity. The results for manures and fertilizers show that their effects are more prominent and significant on marginal farms. Most agrochemicals that enter the body have negative consequences; even small amounts of the most toxic ones are dangerous.

2.4. Effects of agrochemical use on rice yield

The use of agrochemicals has a variety of impacts on rice output and is essential to contemporary agriculture. Maintaining high rice yields while reducing environmental damage and guaranteeing long-term agricultural sustainability requires finding the ideal balance in pesticide usage. The most reported chemical class, 46% of farmers, seemed to utilize amino phosphonates. The amide and pyridine families, which are utilized around 46% of farmers, followed subsequently. 5.3% of farmers used the aryloxyacide family of herbicides, which made up 15.8% of reported herbicides. There was a small representation of herbicide families such as sulfonylureas, pyridines, and triazines. In terms of insecticides, pyrethroids were most frequently listed, either by themselves or in conjunction with acetamiprid, whereas other pesticide families, such as carbamates, organophosphates, and organochlorines, collectively accounted for 8% of insecticides registered for rice production.

2.5. Agrochemicals application risk to human health

Exposure to agricultural chemicals presents a dual risk to human health, involving both immediate and long-term effects. Initially after exposure, acute health impacts appear and temporary. It includes symptoms such as blindness and burning eyes, as well as nausea, vomiting, constipation, pimples, and acne in the worst cases, with the potential for fatal outcomes. On the reverse together, the long-term consequences on one's health develop gradually over months or even years. Chronic contact with agrochemicals that is associated with serious and long-lasting health problems, including as neurological diseases, immune toxicity, cancer, birth abnormalities and reproductive damage. The insidious character of prolonged pesticide exposure is shown by the endocrine system

disturbances and toxic to the nervous system and developmental systems. To reduce the harmful health effects connected to the use of agrochemicals, this underscores the importance to implement strict laws, safety precautions and sustainable farming methods.

2.6. Deep neural network

A number of farmers are battling to manage the risks and hazards associated with pesticides in crops to prevent diseases and other pests. As these elements join together, the farmers are faced with a brand-new difficulty. Because the majority of agriculture's output is dependent on natural factors, such as rain and other unforeseen circumstances, farmers face significant pressure each year due to a lack of workers and a growing need to increase yields by using DNN. DNNs are essential to changing rice farming methods to reduce down on the amount of agricultural chemicals applied, improving human health in the process. DNNs assess a complex statistics pertaining to weather patterns, crop health and soil conditions with unparalleled precision by utilizing AI. This makes possible for farmers to apply precision agricultural methods, focusing the delivery of fertilizer, herbicides and insecticides on problem regions rather than distributing them. Moreover, DNNs are efficient at using image recognition to identify pest and disease outbreaks early on, enabling prompt and focused treatments. The DNN technique is used to calculate the desired amount of inputs needed at a specific rice production level. Using DNN, it was possible to evaluate the connection between human health's specifically, eye, cough, skin as well as Nausea and pesticide toxicity that occurred during rice application in equation (1).

$$w_0 = concatenate(V_j, U_i) \quad (1)$$

Where both vectors are concatenated using the procedure combination (V_j, U_i), the result of the initial hidden layer is determined by the subsequent equation after w_0 passes through in equation (2)**.**

$$w_1 = activation(X_1 w_0 + a_1) \quad (2)$$

The value of $activation()$ represents the activation function, a_1 is the bias vector and $X_1$is the matrix of weights among the input layer and the first hidden layer.Used ReLU models for activation function as it is more efficient and to reduce agriculture chemicals.This structure is intended to provide nonlinear neural network models and multilayer neural networks significance in equation (3).

$$w_k = ReLU\ (X_k w_{k-1} + a_k) \quad (3)$$

To estimate the agriculture chemical rating scorew_k in the output layer.

$$\hat{z} = softmax(X_{out} w_g + a_{out}) \quad (4)$$

Whereas X_{out} and a_{out} denote the output layer's weight as well as bias and the value of g stands for the amount of hidden layers.

$$\varepsilon = -\sum_{j=1}^{c} \left(z_j In(\hat{z}_j) + (1 - z_j) In\left(1 - \hat{z}_j\right)\right) \quad (5)$$

Where c stands for the vector $z$dimension, which corresponds to the number of neurons in the output layer, the following equation represents DNN predicts the rating score of the j^{th} user on the j^{th} to protect human health; DNN is reducing the number of agricultural chemicals used in rice farming.Mix the amount of chemicals needed for the current task. Ensure enough ventilation in the area used for mixing and decanting.

$$\hat{Q}_{ji} = \underset{l}{\arg max}(\hat{z}_l) \quad (6)$$

In the event that is not feasible, make sure that the personal protective equipment (PPE) meant for enclosed spaces is worn. To protect human health against agrochemical exposure in $\hat{Q}_{ji}$, adopt safe handling techniques, wear protective gear as needed and wash one's body completely after using the restroom, eating, drinking, or smoking after work.Maintaining a consistent production of rice allowed the DNN to predict the desired levels of agrochemicals used on rice farms. Farmers apply several fungicides to safeguard their rice crop because pathogens that cause sheath blight thrive in an environment that is conducive to their usage of nitrogenous fertilizer. Because there are intolerable amounts of pesticide residues present in the food grains, this widespread use of pesticides poses health dangers to both consumers and field workers of the food crop. In order to determine the desired amounts of materials at the specified level of rice production, a DNN approach was applied. To increase rice efficiency, realistic amounts of pesticide and fertilizer consumption were approximated using the DNN approach.

3. Results and Discussion

The use of pesticides is frequently employed to reduce crop losses, although there are consequences to its application. The main categories of exposure skin annoyance, eye annoyance, cough, dizziness, Nausea or vomiting and diarrhea were examined in an extensive investigation centered on farmers. Human health was prioritized in an attempt to reduce the amount of agricultural pesticides needed in rice farming through the use of DNN. Farmers used safety measures while handling chemicals, including the use of gloves, masks, shoes and long-sleeved shirts for human health. While applying chemicals, field workers requested to adopt safety precautions, such as wearing long pants and shirts with sleeves, goggles, masks, boots, and gloves.

3.1. Frequency range of rice cultivation

Rice is cultivated at different frequencies in different climates and areas, which reflects the variety of agricultural techniques used globally. Rice grows in tropical and subtropical climates, where cultivation occurs in a year over a few growing seasons. The plantation frequency is 0.9 to 0.10, 0.7 to 0.9, 0.6 to 0.7,0.2 to 0.4, and 0.2 to 0.3 ranges of 15.67, 14.92, 70.58, 43.68 and 22.71 is depicts on fig.1 and table (1).

Table 1. Plantation frequency numerical outcomes

Plantation Frequency	Range
0.9 to 0.10	15.67
0.7 to 0.9	14.92
0.6 to 0.7	70.58
0.2 to 0.4	43.68
0.2 to 0.3	22.71

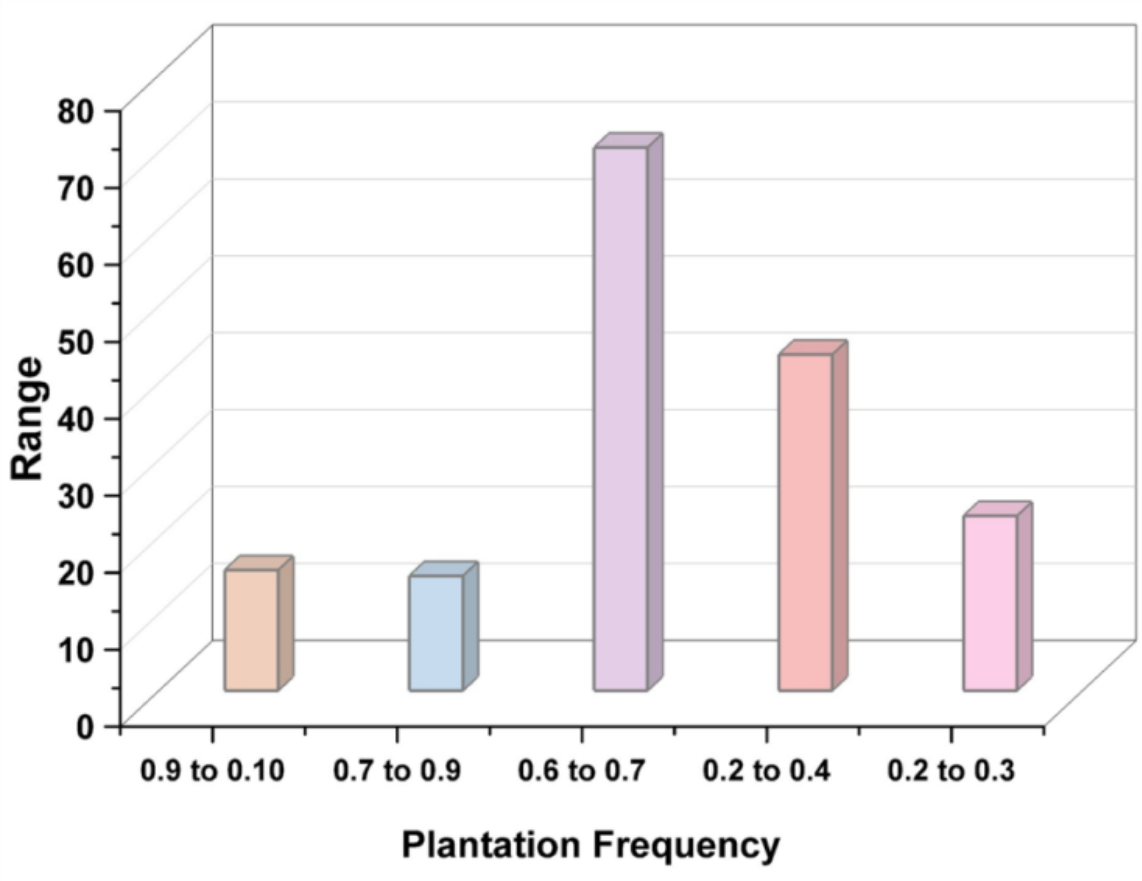

Figure 1. Plantation frequency graphical representation

Table 2. Pesticide usage in India numerical outcomes

Pesticides in India	Pesticides usage
Insecticides	60.08
Herbicides	16.53
Fungicides	18.25
Bio-pesticides	3.41
Others	3.78

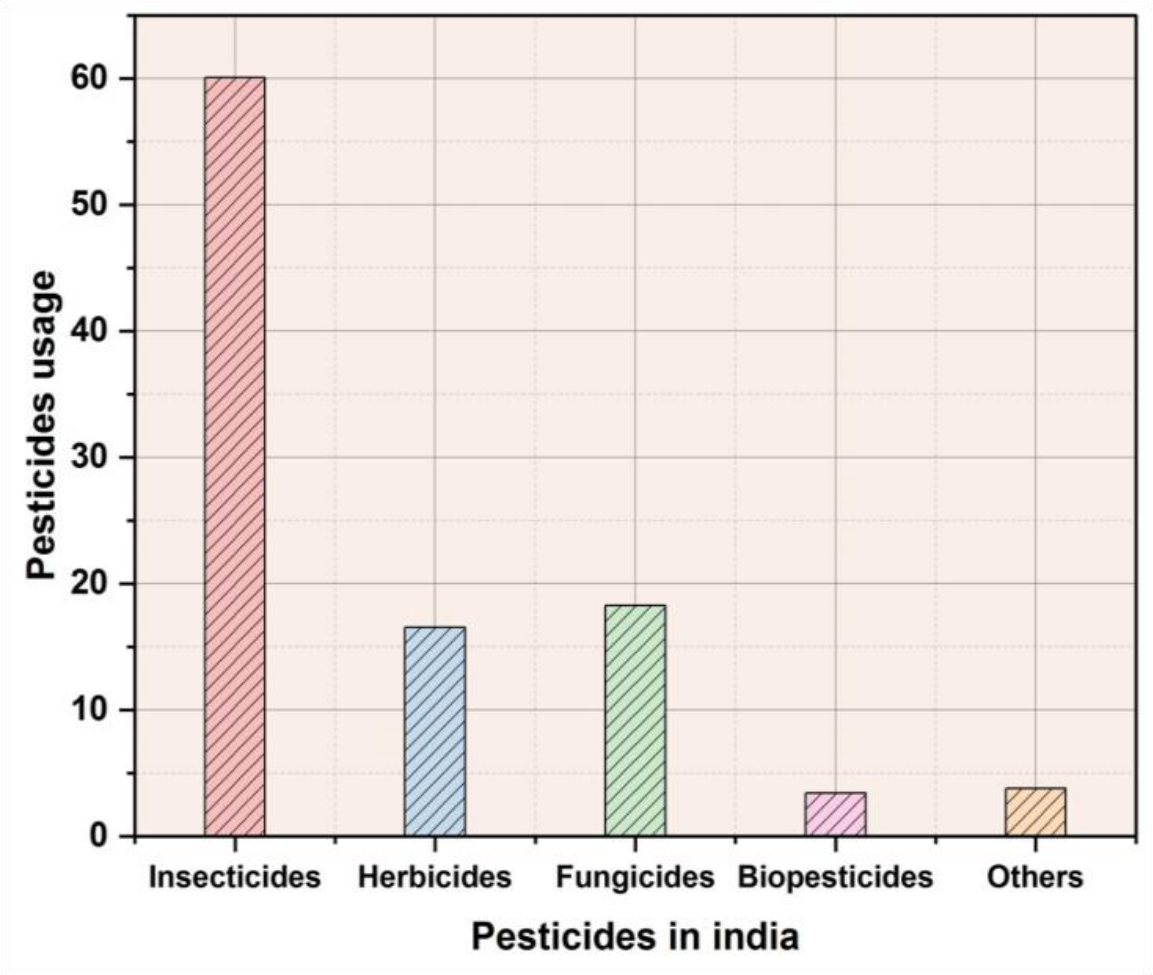

Figure 2. Pesticide usage in India graphical representation

Table 3. Pesticide usage limitation numerical outcomes

Limitation of Pesticides	Percentage of Farmworkers
Toxic	15.75
Hazardous	26.89
Require Extreme Caution	44.21
Harmful Overdose	11.52
Exorbitant	4.67

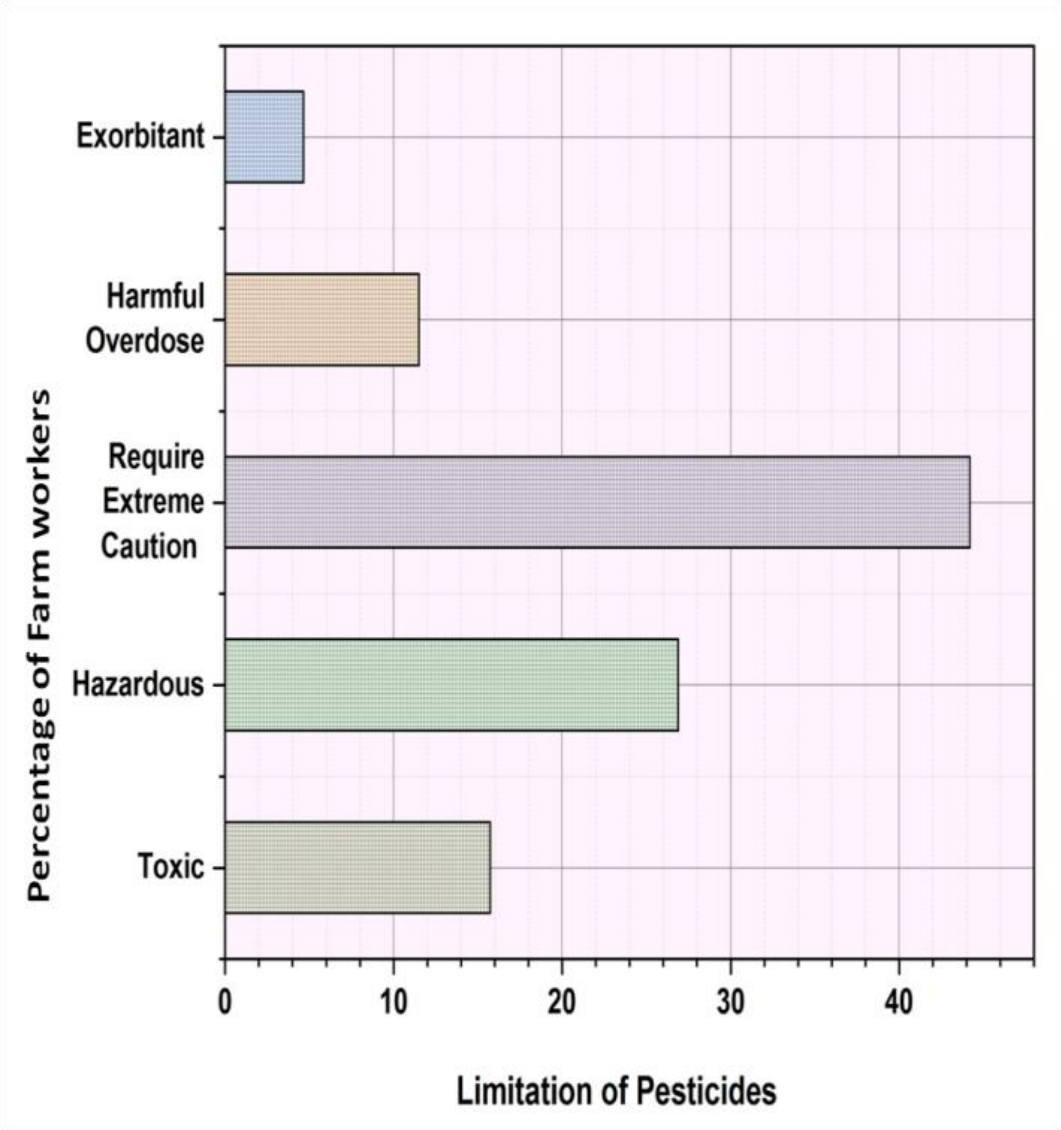

Figure 3. Pesticide usage limitation graphical representation

Table 4. Rice yielder health problem numerical outcomes

Disease	Rice yielder health problem	
	Usage of pesticides	Usage of Fertilizer
Eye annoyance	1.3	0.44
Skin annoyance	1.37	0.64
Dizziness	1.3	1.19
Cough	1.14	0.31
Nausea	1.5	0.65

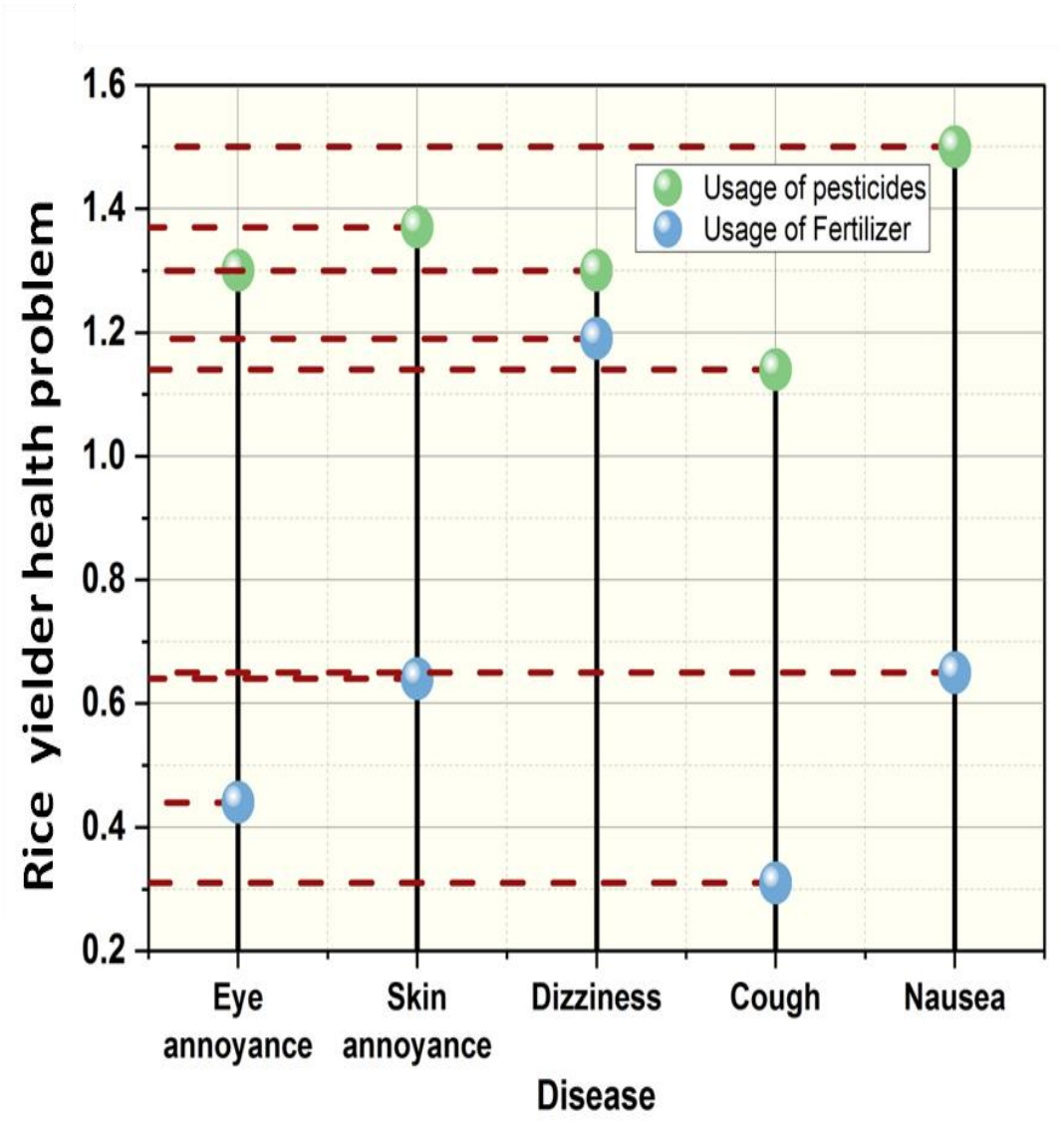

Figure 4. Rice yielder health problem graphical representation

Table 5. Preventing human health numerical outcomes

Equipment	Percentage
Never Carried Safety gear	76.58
Shoes , Water Resistant Pant	11.67
Gloves	9.71
Gloves With Chemicals	3.8
Outer Cloth	1.1

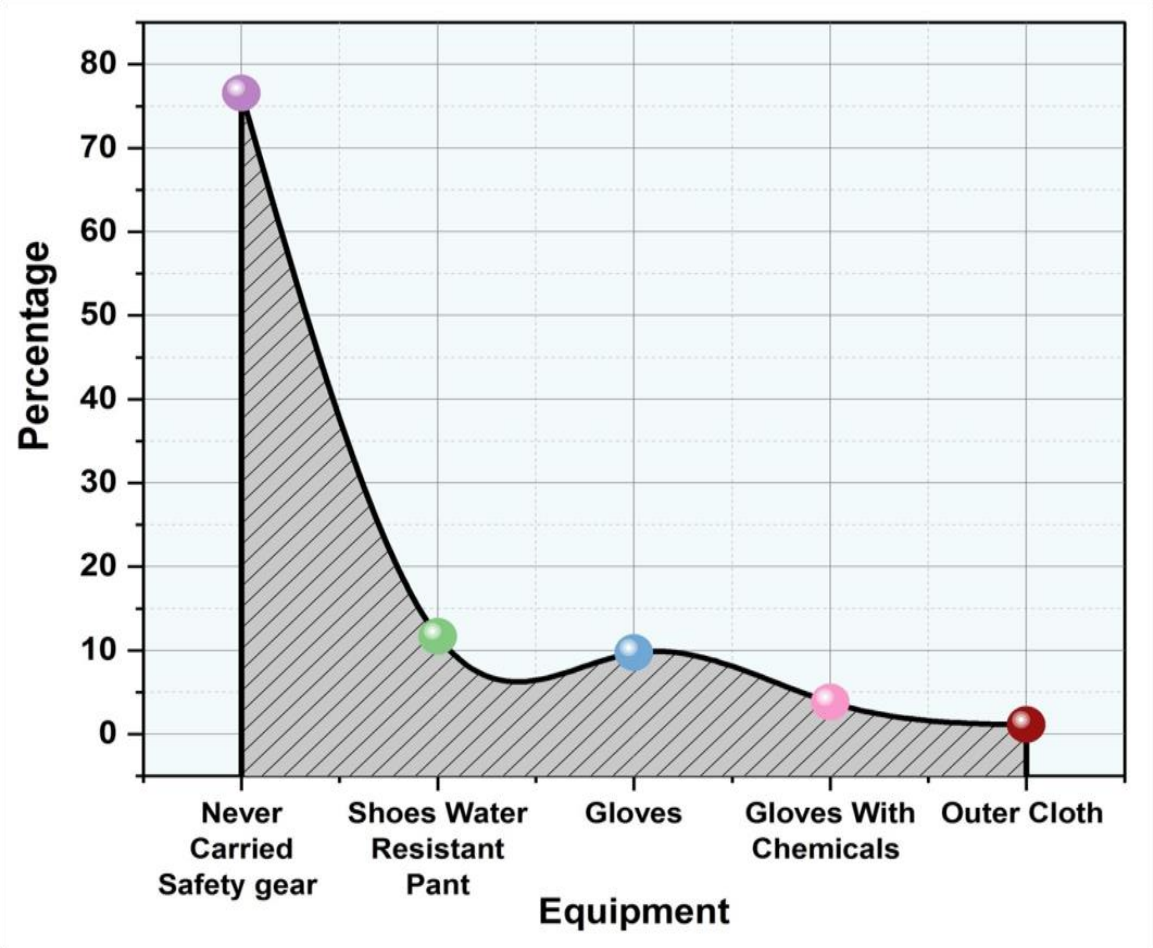

Figure 5. Preventing human health graphical representation

3.2. Usage of pesticides in rice yield

Using pesticides during rice farming is a standard procedure used to protect rice yields from possible losses due to pests and illnesses. Pesticides are an essential part of pest management strategies to protect rice crops from harm and maintain maximum yield. Pesticides are Insecticides (60.08), Herbicides (16.53), Fungicides (18.25), Bio-pesticides (3.41), and others (3.78), is depicts on Fig. 2 and Table (2).

3.3. Constraints in the use of agrochemicals

A number of restrictions that affect farming methods restricts agrochemical use. One major barrier that prevents small-scale farmers from accessing some agrochemical inputs is the financial strain brought on their high cost. Sustainable and environmentally friendly alternatives are required because of additional constraints, including potential ecological harm and environmental concerns. Pesticides constraints are toxic (15.75), Hazardous (26.89), Require Extreme Caution (44.21), Harmful Overdose (11.52), and Exorbitant (4.67), is depicts on Fig. 3 and Table (3).

3.4. Health issues among rice yielders using agrochemicals

A fieldwork experience led to a considerable decrease in skin and eye discomfort. Because smoking significantly reduces the frequency of coughing among field workers, it leads to anomalies in the respiratory system. It is possible that pesticides make a cough worse, but its unclear big role that have in cough incidence. The cough response becomes more sensitive after smoking. A scale parameter split by the degree of freedom is used to estimate over dispersion or under dispersion. All Poison regression models showed no issues with either over dispersion or under dispersion. Agriculture chemicals of pesticides and fertilizer caused eye annoyance (1.3, 0.44), Skin annoyance (1.37, 0.64), Dizziness (1.3, 1.19), Cough (1.14, 0.31), and Nausea (1.5, 0.65) is depicts on fig.4 and table (4).

3.5. To safeguard human health from the impact of agricultural chemical applications

Working with agrochemicals requires wearing protective clothes. The components needed vary depending on the agrochemicals used and the negative consequences. In actuality, the necessary amount of protection is usually indicated on the label that is included with the agrochemical. The specification is the required thickness of gloves (9.71) and shoes Water Resistant Pants (11.67) for the quality. To prevent the accidental release of hazardous substances while opening or emptying containers, use a face shield that covers the whole forehead and face down to the area below the jaw is depicts on Fig. 5 and Table (5). The findings demonstrated that in areas where pesticide usage was mainly unregulated, farm workers protective gear, such as masks, gloves, boots, goggles and protective garments, which had greater health exposures. Farmers used protective gear improperly with great negligence. While applying chemicals, farmers utilized goggles, masks or boots. The primary causes of the hazardous and excessive application of pesticides were apparently determined due to inadequate education for farmers and inaccurate pesticide supplier advice. According to the DNN, safeguarding human health greatly decreased skin and ocular discomfort. The need for protection against pests has been a persistent challenge throughout human record, and dating back to antiquity. In ancient times, both organic and chemical substances were employed as pesticides to safeguard crops from the detrimental impact of pests. Over the centuries, the evolution of agriculture has witnessed the development of numerous chemical pesticides aimed at enhancing crop yields and preserving food supplies. In contemporary times, multinational agrochemical companies have emerged as key players, exerting considerable influence over global food production. These corporations introduce new chemical substances with potent pesticide properties, incorporating biotechnological advances into their strategies. This departure from traditional agricultural methods reflects a shift towards more technologically sophisticated and scientifically driven approaches to pest management, underscoring the ongoing quest for effective and sustainable solutions in the face of evolving agricultural challenges. The lack of an agricultural system, temperature changes, groundwater density, food shortages as well as waste, many other issues have been confronting agriculture. Receiving different cognitive solutions determines the future of cultivating largely. The sector is severely underserved, despite the fact with research is active and certain applications already exist on the market. Farming is in the early stages while it comes to use independent choices and predictive techniques to address the real-world problems that are a farmer's experience. Additionally, after applying pesticides, farmers received inquiries about cleaning themselves. Merely 45% bathed, 35% frequently cleansed their face and 20% simply cleaned their hands because of their ignorance of the dangers posed by pesticides [17]. A further examination said that after spraying, about 40% of the farmers would eat on the field. Exposure can happen if hands are not cleaned with soap. Pesticide residues cannot be eliminated by rubbing hands in dirt. 80% of farmers were uneducated about preventative measures and lacked training [18]. Only two percent of agricultural producers obtained information on the safety of using pesticides from extension agents, five percent from pesticide suppliers, 13% from their own experiences and the remainder farmers learned through personal experience [19]. Because of their lack of training, most field workers do not take precautions while applying pesticides to field crops. Evidence demonstrates that farmers lack preventive measures, knowledge and training while using pesticides. The failure to implement security precautions during chemical application due to a lack of funding or environmental laws [20].

4. Conclusions

To increase crop yields and ensure food security, agricultural chemicals such as insecticides, fertilizers and herbicides are essential components of contemporary farming techniques. The increased level of agricultural activity has prompted concerns about possible adverse consequences on human health. The DNN analyzes agricultural data, including plant health with production forecasts to soil composition and temperature trends. DNNs

provide farmers precise guidance by revealing the most effective times to plant, the quantity of water plants need, and to control insects. The deployment of DNN was executed with the primary goal of protecting human health in an attempt to reduce the amount of agricultural pesticides used in rice growing. Using protective gear, including masks, gloves (9.71%), water resistant pants (11.67%), and shoes, farmers diligently followed safety protocols when handling chemicals. Field personnel always promoted and followed safety procedures when applying chemicals, such as wearing long sleeves and pants are using goggles, masks, boots, and gloves. To protect human health in the face of changing farming methods, extensive research, strict regulatory measures and sustainable agricultural practices are essential. These are highlighted by the difficulties in identifying and mitigating the health hazards associated with growing agricultural intensity. To handle the changing difficulties of contemporary agriculture, it will be crucial to examine at the potential effects of agricultural chemicals on human health in the context of growing agricultural intensity in the future.

References

[1] L. Rani, K. Thapa, N. Kanojia, N. Sharma, S. Singh, A.S. Grewal, J. Kaushal. (2021). An extensive review on the consequences of chemical pesticides on human health and environment. Journal of cleaner production. 283 124657.

[2] E. Elahi, C. Weijun, H. Zhang, M. Nazeer. (2019). Agricultural intensification and damages to human health in relation to agrochemicals: Application of artificial intelligence. Land use policy. 83 461-474.

[3] A. Alengebawy, S.T. Abdelkhalek, S.R. Qureshi, M.Q. Wang. (2021). Heavy metals and pesticides toxicity in agricultural soil and plants: Ecological risks and human health implications. Toxics. 9 (3) 42.

[4] U. Okereafor, M. Makhatha, L. Mekuto, N. Uche-Okereafor, T. Sebola, V. Mavumengwana. (2020). Toxic metal implications on agricultural soils, plants, animals, aquatic life and human health. International journal of environmental research and public health. 17 (7) 2204.

[5] M. Kamle, D.K. Mahato, S. Devi, K.E. Lee, S.G. Kang, P. Kumar. (2019). Fumonisins: Impact on agriculture, food, and human health and their management strategies. Toxins. 11 (6) 328.

[6] M. Tudi, H. Daniel Ruan, L. Wang, J. Lyu, R. Sadler, D. Connell, D.T. Phung. (2021). Agriculture development, pesticide application and its impact on the environment. International journal of environmental research and public health. 18 (3) 1112.

[7] M.A. Hassaan, A. El Nemr. (2020). Pesticides pollution: Classifications, human health impact, extraction and treatment techniques. The Egyptian Journal of Aquatic Research. 46 (3) 207-220.

[8] M.C. Fisher, S.J. Gurr, C.A. Cuomo, D.S. Blehert, H. Jin, E.H. Stukenbrock, L.E. Cowen. (2020). Threats posed by the fungal kingdom to humans, wildlife, and agriculture. MBio. 11 (3) 10-1128.

[9] U. De Corato. (2020). Agricultural waste recycling in horticultural intensive farming systems by on-farm composting and compost-based tea application improves soil quality and plant health: A review under the perspective of a circular economy. Science of the Total Environment. 738 139840.

[10] C. Ti, L. Xia, S.X. Chang, X. Yan. (2019). Potential for mitigating global agricultural ammonia emission: a meta-analysis. Environmental Pollution. 245 141-148.

[11] F. Almomani. (2020). Prediction of biogas production from chemically treated co-digested agricultural waste using artificial neural network. Fuel. 280 118573.

[12] Y. Jiang, S. Chen, B. Hu, Y. Zhou, Z. Liang, X. Jia, Z. Shi. (2020). A comprehensive framework for assessing the impact of potential agricultural pollution on grain security and human health in economically developed areas. Environmental Pollution. 263 114653.

[13] P. Li, H. Hao, Y. Bai, Y. Li, X. Mao, J. Xu, D. Ge. (2022). Convolutional neural networks-based health risk modelling of some heavy metals in a soil-rice system. Science of the Total Environment. 838 156466.

[14] A. Kharazi, M. Leili, M. Khazaei, M.Y. Alikhani, R. Shokoohi. (2021). Human health risk assessment of heavy metals in agricultural soil and food crops in Hamadan, Iran. Journal of Food Composition and Analysis. 100 103890.

[15] P. Chowdhary, R.N. Bharagava, S. Mishra, N. Khan. (2020). Role of industries in water scarcity and its adverse effects on environment and human health. Environmental Concerns and Sustainable Development: Volume 1: Air, Water and Energy Resources. 235-256.

[16] M. Singha, J. Dong, G. Zhang, X. Xiao. (2019). High resolution paddy rice maps in cloud-prone Bangladesh and Northeast India using Sentinel-1 data. Scientific data. 6 (1) 26.

[17] P.H. Raven, D.L. Wagner. (2021). Agricultural intensification and climate change are rapidly decreasing insect biodiversity. Proceedings of the National Academy of Sciences. 118 (2) e2002548117.

[18] J. Sellare, E.M. Meemken, M. Qaim. (2020). Fairtrade, agrochemical input use, and effects on human health and the environment. Ecological economics. 176 106718.

[19] M. Chaud, E.B. Souto, A. Zielinska, P. Severino, F. Batain, J. Oliveira-Junior, T. Alves. (2021). Nanopesticides in agriculture: Benefits and challenge in agricultural productivity, toxicological risks to human health and environment. Toxics. 9 (6) 131.

[20] C. Mao, Y. Song, L. Chen, J. Ji, J. Li, X. Yuan, F. Theiss. (2019). Human health risks of heavy metals in paddy rice based on transfer characteristics of heavy metals from soil to rice. Catena. 175 339-348.