IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Excessive Use Of Agrochemicals: India Perspectives

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Abstract:

Agrochemicals are a necessary component of contemporary farming practices. The goal of the study was to find out how farming practices would change if agrochemicals were used too much. During November 2022, a structured questionnaire and an in-person interview were used to collect data from 150 randomly selected farmers in the Patna sadar area of the Patna district in India. The selected socioeconomic characteristics of the participants were selected as explanatory variables, while the focus variable was the perceived effect of excessive agrochemical use. A 4-point rating scale was used to rank the effect of using too many agrochemicals, and the perceived effect index was used to rank the independent variables. The appropriate scoring methods and scales were used to measure the independent variables. The results showed that the majority of respondents (48.7%) perceived excessive use of agrochemicals to have high positive effects on farming practices, while a significant portion (59.3%) perceived medium negative effects.

Keywords Agrochemicals, India, Effects Excessive use, Farming practices

Introduction:

Over 75% of the rural population worldwide depends on agriculture-based farming practices for their living and livelihood (Lipper et al.,). Agriculture is the engine that powers the survival of living things. 2014). The findings of Sarkar et al.'s research (2021), while the world's population is growing at an alarming rate, the amount of cultivable agricultural land is rapidly decreasing. According to FAO (2015), total agricultural production needs to increase by about 60% by 2050 in order to feed the world's population, which is more difficult in developing nations like India. This raises the question of how to sustainably produce food while also feeding the world's growing population. Effective and efficient farming practices may be an effective strategy for eradicating poverty and hunger, which are important indicators of sustainable development (FAO, 2021). To deliver additional yields from little landholdings and feed the enormous populace, ranchers particularly in emerging nations are applying agrochemicals in their cultivating rehearses (Gupta, 2012). Chemical compounds (fertilizer, pesticides, hormone, fungicides, insecticides, herbicides, etc.) are called agrochemicals. used in farming to protect crops, fisheries, and livestock from insects, pests, and diseases, which improves the quality and quantity of farm products as well as their growth and development (Omari, 2014; Hussain and other, 2009). However, in light of the current global scenario, there is no alternative to the use of agrochemicals in agricultural practices. However, the production of farms can be significantly impacted by employing the right methods at the right time and using them in the right proportions (Hurtig et al., 2003), but agrochemical requirements and efficacy depend on product quality, application method, soil health, and meteorological conditions (Gill and Garg, 2014a; Yáez and others, 2002). However, Asia is using more than half of all agrochemicals (FAO, 2019), and demand for them is rising worldwide. In developed nations, farming communities use pesticides and fertilizers appropriately, whereas in developing nations, farmers use a lot of agrochemicals (Bahadur et al., 2015), which has a significant impact on the Sustainable Development Goals (SDGs) and poses a significant threat to the existence of living things. According to Norder et al., agrochemicals have both positive and negative effects on farming activities. 2011). Agrochemicals appear to be increasing production and productivity in general, but in the long run, they are destroying our farming resources like soil, water, air, microorganisms, natural enemies, fisheries, and so on (2014b, Gill and Garg). Meena et al. say that (2020), because they are applied continuously throughout the entire field, regardless of the zones that are affected, more than 95% of the pesticides that are used harm

beneficial soil microorganisms or natural enemies that are not specifically targeted. Not only does it pollute the environment, but it also poses a threat to life on Earth's end. However, our ecosystem is at risk from indiscriminate use of pesticides and fertilizers (Nder et al., 2011), and the residual effects result in chronic human and animal diseases (FAO, 2019; Nakata and other, 2002; Abidin and other, 2018). Cancer, diabetes, asthma, and a wide range of other diseases affect millions of people worldwide annually (Alavanja et al., 2004), and the situation is even more dire in developing nations like India, the world's most populous nation whose food production has increased threefold since independence to feed its large population (BBS, 2020). According to Dasgupta and Meisner (2005), Indiai farmers are heavily utilizing agrochemicals to increase agricultural productivity, posing a significant threat to farm sustainability. In India, the organic matter in the soil is less than one percent, and excessive use of agrochemicals is making the soil less fertile and productive. Additionally, the environment as a whole is being negatively polluted, which is cause for concern (Bhuiya, 1987).

Because increasing production is their primary objective, authorities are unaware of the implementation of existing laws to protect against the unfair use of pesticides, and the less educated farmers have poor skills, knowledge, and awareness regarding the utilization of agrochemicals. Agriculture's individual contribution to greenhouse gas emissions of approximately 13% (FAO, 2013) means that, if it continues in this manner, environmental sustainability will be a major concern, and future generations will face enormous challenges to ensure their survival. Therefore, it is past due to implement appropriate strategies to preserve our environment and advance the SDGs in accordance. In light of the circumstances described above, the research was conducted to investigate the effects of excessive agrochemical use in farming practices.

MATERIALS AND METHODS

Study area

For conducting the research, five unions (lowest administrative unit) of Patna sadar under Patna district of India were chosen randomly. Patna district is well known for cultivating various types of crops as well as fisheries and livestock (BBS, 2020). Before selecting these unions, a comprehensive conversation was performed with the concerned people and authorities by the researcher to contact with the clientele groups.

Methods of data collection

Before collecting data employing the personal interview method, five Focus Group Discussions (FGDs) were performed with 50 respondents (10 in each session) consisting of farmers, input dealers, and Sub Assistant Agriculture Officer (SAAO) to develop a basic understanding of the perception and usage of agrochemicals. Besides, five Key Informant Interviews (KIIs) with input dealers, NGO officers, model farmers and Agriculture Extension Officer (AEO) were also performed for getting in-depth information. Finally, by conducting primary interviews with twenty-five (25) respondents, the interview schedule was revised and improved further. Face-to-face interview was carried out with the sampled participants (150) using a structured questionnaire during November 2022.

Measurement of variables and analysis of data

The effect of excessive use of agrochemicals was treated as a focus variable, while the selected socio-economic attributes of the clientele groups like age, educational qualification, farm size, farming experience, agricultural training, extension media contact, organizational participation, knowledge, attitude, and awareness were considered as explanatory variables. The explanatory variables were measured using appropriate scoring techniques with suitable scales. For measuring the focus variable, a total number of 14 statements (7 positives and 7 negatives) were identified through FGDs, KIIs and existing literature.

A 4- point rating scale such as strongly agree, moderately agree, somewhat agree, or not at all agree was utilized correspondingly and the score given against the rating scale were 3, 2, 1, and 0, respectively. As a result, the theoretical score varied from 0 to 42, where 42 denoting a high effect perceived and 0 indicating no effect perceived. Based on the effect score, the respondents were categorized into three groups namely low, medium, and high.

Moreover, a Perception Effect Index (PEI) was calculated using the following formula (Billah *et al.*, 2021; Rahman *et al.*, 2021) to understand the relative proportion of the statements related to perception concerning the effect of excessive use of agrochemicals in farming practices.

RESULTS AND DISCUSSION

Socio-economic attributes of the respondents

The results indicate that the majority (80.7%) of the respondents belonged to the middle and old aged group, and this is perhaps, the younger generation is getting

Table 1. Salient features of the selected socio-economic attributes of the respondents.

(%)	Respondents (N=150)	Mean	SD	Min.	Max.
Age (years)					
Young (≤35)	19.3				
Middle (36-55)	42.7	39.85	9.23	23	61
Old (>55)	38.0				
Educational qualification (year of schooling)					
Illiterate (0)	37.3				
Primary (l-5)	40.7	6.28	2.13	0.0	16
Secondary (6-10)	15.3				
Higher secondary (>10)	6.7				
Farm size (ha)					
Small (≤ 1.0)	64.7				
Medium (1.01-2)	21.3	---	---	---	---
Large (>2)	14.0				
Agricultural training received (days)					
No training (0 days)	62.0				
Short training (1 -7 days)	19.3	3.96	1.34	0	25
Medium training (8-14 days)	12.7				
Long training (> 14 days)	6.0				
Farming experience (years)					
Low experience (≤10)	23.4				
Medium experience (11-20)	51.3	13.24	5.14	4.0	38
High experience (>20)	25.3				
Extension media contact (scale score)					
No contact (0)	56.7				
Low (≤10)	23.3				
Medium (11-20)	11.3	12.65	5.42	0	26
High (>20)	8.7				
Organizational participation (scale score)					
No participation (0)	76.0				
Low participation (up to 7)	15.3	8.35	2.34	0	18.00
Medium participation (8-14)	6.0				
High participation (>14)	2.7				
Knowledge (scale score)					
Poor knowledge (≤ 7)	40.7				
Medium knowledge (8-14)	46.0	11.48	2.02	4.0	20
High knowledge (> 14)	13.3				
Attitude (scale score)					
Less favourable attitude (≤ 17)	48.7				
Moderately favourable attitude (18-34)	37.3	22.87	7.35	12	45
Highly favourable attitude (> 34)	14.0				
Awareness (scale score)					
Not aware (0)	67.3				
Somewhat aware (≤ 10)	18.0	12.34	2.45	0	27
Moderately aware (11-20)	9.3				
Highly aware (> 20)	5.4				

Source: Field survey (2021)

Farmers' perception regarding agrochemicals usage Table 2 reveals that the most used agrochemical was fertilizer (100%) followed by insecticides (94.7%), growth hormones (88%) etc. which reveals the extent of agrochemical usage by the respondents. The majority (40.7%) of the respondents didn't know whether the agrochemical providers are authorized or not while over half (57.3%) of them opined that, agrochemicals are highly expensive, and the result is almost similar to Bhandari (2014). The findings also explore that almost two-thirds (64%) of the participants stored agrochemicals in a safe place whereas most of them (94.7%) stored the remaining ones for further usage which is a good sign for balanced and sustainable use of it. It was also found that a large portion (83.3%) throw empty containers here and there which is truly a great threat to the environment. It is a matter of sorrow that, most (87.3%) of them didn't use protective equipment while applying agrochemicals which is responsible for human ailment indeed. However, Mekonnen and Agonafir (2002) stated that using personal protective equipment during pesticide application reduces the chance of getting affected with various diseases. In addition, among all other health-related problems, the majority (78%) of the respondents suffer from headaches which is indeed a matter of concern. Alavanja *et al.* (2004) reported that the common symptoms of pesticide application among farmers were tiredness, headaches, body pains, skin rashes, fatigue, respiratory problems, nausea, dizziness, vomiting, cramps, etc. and in extreme cases death, whereas several studies (Hardell *et al.*, 2002; Gilden *et al.*, 2010) explored that excessive exposure to agrochemicals may lead to chronic diseases like asthma, cancer etc.

Table 2. Farmers' perception regarding agrochemicals and their balanced use.

Variables/ Indicators	N= 150	Percentage (%)
Commonly used agrochemicals*		
Fertilizer	150	100
Insecticides	142	94.7
Herbicides	114	76.0
Fungicides	83	55.3
Nematicides	47	31.3
Growth hormones	132	88.0
From whom do you buy these agrochemicals		
Authorized dealers	55	36.7
Unauthorized dealers	34	22.6
I don't know	61	40.7
Cost of agrochemicals		
Highly expensive	86	57.3
Moderately expensive	41	27.4
Low expensive	23	15.3
Storage system*		
Hanging outside home	88	58.7
On top of the house	67	44.6
In a safe place	96	64.0
Remaining agrochemicals management*		
Stored and used for another application	142	94.7
Apply although not required	76	50.6
Pour into bushes/homestead gardening	64	42.7
Disposal of empty containers*		
Throw here and there	125	83.3
Burnt/ Buried	74	49.3
Use for household purposes	39	26.0
Use of protective equipment		
No	131	87.3
Yes	19	12.7
Health impacts*		
Abdominal pain	43	28.7
Allergy	58	38.6
Dizziness	89	59.3
Dermatitis and pink eye	75	50.0

Fever	35	23.3
Headache	117	78.0

Source: Field survey (2021), *Multiple responses

Causes of excessive use of agrochemicals

Table 3 indicates that there are so many causes accelerating the overuse of agrochemicals by farmers in their farming practices and among them, the most perceived influential cause was the provision of higher yield (94.7%) which is the main target of most of the developing nation of the world (FAO, 2015) followed by protecting crops and animals from insects, pests and diseases (90%), lack of proper training (82.7%), maximum utilization of land (73.3%) etc. and the result is almost similar to Xu *et al.* (2008) who reported that, producing more crops is the main target of using excessive pesticides along with lack of awareness, and training. Zhao and Zhang (2007) argued that, commercialization was the influential factor behind excessive use of agrochemicals. However, the low influential cause opined by the respondents was poor monitoring and supervision (44%).

Table 3. Causes affecting excessive use of agrochemicals.

Causes enhancing overuse of agrochemicals *	N=150	Percent
Provision of higher yield	142	94.7
Protecting crops and animals from insects, pests, diseases	135	90.0
Lack of proper training	124	82.7
Maximum utilization of land	110	73.3
Maintaining soil fertility	94	62.7
Lack of awareness	89	59.3
Feeding the growing people	87	58.0
Producing quality and fresh products	82	54.7
Easy access to agrochemicals	76	50.6
Poor monitoring and supervision	66	44.0

Source: Field survey (2021), *****Multiple responses

Effects of excessive use of Agrochemicals in farming practices

Agrochemicals have both positive and negative as well as short-term and long-term effects on the environment and ecosystem (Önder *et al.*, 2011). Most positive effect of overuse of agrochemicals was found in the case of increasing productivity and cropping intensity (91.8%) followed by promoting growth and development (88.2%), ensuring quality products (83.1%) etc. while the less positive significant effect was maintaining soil fertility (56.8%) (Table 4). According to Aktar *et al.* (2009), the regular application of pesticides exaggerates agricultural production, however, misuse of these chemicals is a serious impediment to farming practices. The worst effect was perceived as poisonous to human, animal, and soil microorganisms (82.7%), succeeded by accelerated environmental pollution (72.7%), residual effect on human health (68.7%), %) etc. although the less adverse impact perceived was altered food quality (30%). Many authors (Meena *et al.*, 2020; Nakata *et al.*, 2002; Okoffo *et al.*, 2016; Babu *et al.*, 2003) argued that the application of pesticides is harmful to the total farming system and excessive use has serious residual effects on the whole biodiversity.

Table 4. Effects of overuse of Agrochemicals in farming practices.

Positive effects*	PEI Score	% PEI	Rank
Increase productivity and cropping intensity	413	91.8	1
Promote growth and development	397	88.2	2
Ensure quality products	374	83.1	3
Increase farm income	341	75.8	4
Prevent the expansion of diseases	324	72.0	5
Kill insects and weeds	292	64.9	6
Maintain soil fertility	256	56.8	7
Negative effects*			
Poisonous to human, animal, and soil microorganisms	372	82.7	1
Accelerate environmental pollution	327	72.7	2
Residual effect on human health	309	68.7	3

Contaminate surface and ground water	261	58.0	4
Increase soil contamination and degradation	207	46.0	5
Destroy beneficiary organisms, wild fish varieties	192	42.7	6
Alter food quality	135	30.0	7

Source: Field survey (2021), *****Multiple responses

Management practices in the sustainable and balanced use of agrochemicals

The optimum and balanced application of pesticides is important for many reaons. The findings indicated that the most beneficial program that can help farmers in the optimal use of agrochemicals in a balanced way is agricultural training (95.3%), followed by good agricultural practices (83.3%), a campaign on awareness and motivation (74.7%), Integrated Pest Management (IPM) (72.7%) etc. while the less significant management practice opined by the respondents is the use of beneficial microbes (28%) and presented in Table 5. Many authors (Hruska and Corriols, 2002; Jors, 2004) argued that by utilizing alternative and ecologically sound methods, the need for pesticides can be reduced up to 50% without decreasing yields and this could help reduce the chance of environmental pollution and poisonous effects on biodiversity. Likewise, De *et al.* (2014) explored that, IPM practice, biological control and genetic control are very essential in the sustainable farming systems as they are easily available, cost- effective, and demonstrate a wide range of bioactivity.

Table 5. Management practices in effective and efficient use of agrochemicals.

Management practices *	N=150	Percentage
Agricultural training	143	95.3
Good Agricultural Practices (GAP)	125	83.3
Campaign on awareness and motivation	112	74.7
Integrated Pest Management (IPM)	109	72.7
Application of biofertilizer and bio-pesticides	94	62.7
Application of compost	89	59.4
Access to extension services	87	58.0
Application of organic pesticides	77	51.3
Use of perching	76	50.6
Proper monitoring and supervision	68	45.3
Integrated Nutrient Management (INM)	53	35.3
Use of beneficial microbes	42	28.0

Source: Field survey (2021)

CONCLUSIONS AND RECOMMENDATIONS

Due to a lack of education, lack of awareness, knowledge, and access to extension services, farmers perceived the overuse of agrochemicals as having more positive effects than negative ones, as shown by the study's findings. It also reveals that farmers use a lot of agrochemicals to grow more crops on smaller landholdings and feed the growing population. The effects of agrochemical misuse and abuse in farming practices are strongly correlated with farmers' educational qualifications, farming experience, agricultural training, extension media contact, and knowledge and awareness. Additionally, it demonstrates that a variety of management initiatives, such as farmer training, support for good agricultural practices, and an awareness program, may be extremely beneficial to the effective and long-term use of agrochemicals in farming practices. Extension services must be diverse, and a special campaign aimed at improving farmers' awareness, knowledge, and attitude must be carried out in an effective and efficient manner. To save our planet and our future generations, researchers, policymakers, concern authorities, and even farmers need to take appropriate action against the excessive use of agrochemicals.

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