Bioscene

Bioscene
Volume- 22 Number- 03
ISSN: 1539-2422 (P) 2055-1583 (O)
www.explorebioscene.com

A Study on Impacts of Pesticides on Subsurface Ecology and Health: Special Reference to Koshi Region

Raunaque Parween
Research Scholar, Department of Zoology, B.N.M. University,
Madhepura, Bihar, India

Abstract: Koshi Region is a major tributary of the Ganga River which originates at an altitudeof 7,000 m in the Himalayas. Bihar is divided into three primary agro climatic zones based on soil type, precipitation, temperature and location. It is anticipated thatthe state has a total gross sowing area of 80.26 lakh ha and a total net sowing area of56.38 lakh ha. The percentage of land that is being farmed is 1.42%. Paddy, wheat,legumes, maize, potato, sugarcane, oil seeds, tobacco, and jute are the primaryagricultural products that are grown here. Rice, wheat, and maize are the three maintypes of main crops.Pest and food production are linked for centuries. In early nineteenth century pestcontrol done by biological methods. But later on pest control methods usingchemical such as pesticides provides farmer a tool which benefitted farmers & wholeworld.Post industrial revolution in the Europe & rapid growth in population in west compelledscientist to think about a different methods to enhance food production.There was no way that the 20thcentury population boomcould have happened. Without a corresponding rise in agricultural output. Almostone-third of all food grown requires the use of pesticides. Without pesticides, foodoutput would drop by 78% for fruit, 54% for vegetables, and 32% for grains. As aresult, pesticides are essential for improving health and boosting production inagriculture across the globe.Because of the chemical compounds used in pesticides, they may beharmful to the environment as well as the species it is intended to kill. This includesbirds, fish, helpful insects, and non-target plants. Additionally, environmentalpollution occurs when pesticide contamination spreads from the intended plants.The poisoning of the environment and food supplies by such chemical residues hasnegative effects on human health. Moreover, pesticide use is influenced by climatechange-related variables, leading to increased pesticide consumption and pesticidecontamination.

Keywords: Pesticide, Precipitation, Environment, Biological, Climate

1. Introduction

River Yamuna, one of the major rivers of India with a total stretch of 345,843 km2, passes through Haryana state along its eastern border. However, due to high-density population growth and fast industrialization, Yamuna has become one of the most polluted rivers in the world(Kumar & Kumar, 2019). The concentration of Hexachlorocyclohexane and DDT at different sites of the river ranged between 12.76–593.49 ng/L and 66.17–722.94 ng/L, respectively. In canals the values were found between 12.38–571.98 ng/L and 109.12–1572.22 ng/L for Hexachlorocyclohexane and DDT(Bloomfield et al., 2006). The Gomti River, one of the major tributaries of the River Ganga originates from a natural reservoir in the swampy and densely forested area. The river serves as one of the major source of drinking water for the Lucknow City, the State capital of Uttar Pradesh with a population of about 3.5 million(Bexfield et al., 2020). Among the sample analyzed, 21 pesticides were present in river water and bed sediment taken from the Huangpu River. In the water of Gomti River, pesticide residues ranged between 2.16 to 567.49 ng/L and in the bed sediments it ranged from 0.92 to 813.59 ng/L(Hossain et al., 2022). It was suggested that source of DDT contamination is from the aged and weathered agricultural soils with signature of recently used DDT in the river catchments(Narayanan et al., 2022). The results revealed that bed-sediments of the Gomti River are contaminated with lindane, endrin, heptachlor epoxides and DDT and may contribute to sediment toxicity in the freshwater ecosystem of the river(Schäfer et al., 2011). The concentrations of pesticide detected in rivers in the India is summarized in Table 1.

Table 1: Concentrations of pesticide in rivers reported in literature

India	**Yamuna River**	12.38 ng/L–1572.22 ng/L
	Gomti River	0.92 ng/L–813.59 ng/L

1.1 Capital Formation in Agriculture Capital formation is vital for inclusive and sustainable growth of the agriculture and allied sector. As depicted in Figure 1, the rate of growth of gross capital formation (GCF) in agriculture has shown a positive relation with the agricultural output. Public sector investment has been an important source of GCF in agriculture and an enabling factor in maintaining agricultural growth. For example, the relatively higher growth rate of agriculture between 2004-05 and 2007-08 was largely on account of measures taken to infuse public investment in the sector. The much-needed capital infusion in agricultural research and extension was facilitated by the implementation of schemes like Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission, National Agricultural Innovation Project, central support to state extension programmes, etc. As a consequence, the proportion of public sector GCF in agriculture (Base: 2004-05=100) increased between 2004-05 and 2006-07, after which it started falling in comparison to the private sector's share. Historical analysis shows that public sector investment in agriculture cannot be fully substituted by private sector investment. Most of this capital is a public good in nature and, therefore, is essential to stimulate private investment.

Table 2: Sector-wise share in GCF-Agri (Based on 2011-12 series)
(Figures in Rs. Crore)
GCF in Agriculture (at constant 2011-12 prices)

	2011-12	**2012-13**	**2013-14**
Households	232442 (84.5)	196087 (81.8)	192810 (80.7)
Public sector	36712 (13.3)	36863 (15.4)	40190 (16.8)
Private Corporation	6165 (2.2)	6829 (2.8)	5977 (2.5)
Total GCF in Agriculture	275319 (100)	239779 (100)	238977 (100)
GCF in Agriculture to overall GCF	8.64	7.58	7.45
GCF in Agriculture to GVA of Agri	18.29	15.74	15.13

Source: CSO

Under the revised series with base year 2011- 12, the sector-wise rate of investment in agriculture and allied sector, measured as a ratio of GCF to GVA of the sector, is shown in the Table 1. The level of GCF in agriculture and allied sector witnessed a sharp decline of 12.9 per cent in 2012-13 as compared to 2011-12. This was mainly on account of a fall in private household investment, which constitutes 85 per cent of total GCF in the sector. However, with the stepping up of investment in the public sector, the fall in GCF was largely contained in 2013-14. As two-thirds of capital formation in the private sector is through bank credit, the role of banks is important in meeting the private sector's long-term investment credit demand. However, the current estimates suggest that long-term credit is not just declining but also that it constitutes less than a quarter of total agricultural credit. The policy thrust, therefore, has to be on incentivizing banks through adequate budgetary support. Similarly, reviving public sector investment is critical due to its multiplier effect on the overall GCF in the sector. Thus, there is a need to formulate a long-term perspective plan for rural infrastructure that focuses on infrastructural projects that have the highest total impact and strongest linkages. The convergence of resources of centre and state governments is also important, as it would avoid duplication or concentration of activities in particular areas. There is an emerging view that capital formation needs to be seen from two separate viewpoints, i.e., point of capital formation in agriculture and point of capital formation for agriculture. The estimates for capital formation as compiled by the CSO include only the capital formation in the agriculture sector by the public and private sectors. However, in order to have a comprehensive measure of capital formation in the sector, there is a need for a broader data series that includes capital formation in activities such as production of fertilizers and pesticides, development of agricultural markets, rural roads and communications, agricultural education, research and development of agricultural technology, rural electrification, etc., which form part of capital formation for agriculture as opposed to capital formation in agriculture (NABARD, 2014). Policies will need to take into account the complementarity between capital formation "in agriculture" and "for agriculture" to provide proper direction to investment in the sector.

2. Objective of the Study

- To evaluate the Impacts of Pesticides on Subsurface Ecology and Human Health.
- To Observe the Pesticides effect on agriculture land in Koshi Region.
- To investigate the report of Pesticides use for farming in Koshi Region.
- To Study about Impacts of Pesticides on Subsurface Ecology and Health: Special Reference to Koshi Region.

3. Scopeand Methodology of the Study

The study looks into the relationship between the impact of pesticides, chemical fertilizer on soil, species, health and on ecology system of bio-diversity in case study area. Impact of agro-economic policyon economic growth with per capita income in different circumstances in India and its impact on Indian rural economy. In the study adopted of the exploratory research design methodology. In the exploratory research design methodology data gather from (a) review of literature or data gather from published reports, books etc., (b) data gather from knowledgeable person or agricultural scientist through personal interview (c) case study method. Sources of Data: The study is primarily based on the primary and secondary both data collection methods and collected from through questionnaire, schedules, magazine, journals, science reports, government websites, news articles and agriculture ministry reports. Sampling method is also applied in the field/ case study area for the data collection process.

4. Pesticides Use and Their Impact on Water

Pesticides are recognized as reagents for protecting crops against harmful pests and diseases in humans. The beneficial outcome of pesticides makes it become an important tool to maintain and improve the living standard of the global population. An average of 2 million tons of pesticides was used each year globally to confront weeds, insects and pests. The conventional classification of pesticides based on the target species includes herbicides, insecticide, rodenticide, fungicide and so forth. Herbicides and insecticides are the most common type of pesticide used, dominating 47.5% and the latter 29.5% of the total pesticide consumption. The primary pesticide consuming countries including China, the USA, Argentina, India, Japan, Canada, Brazil, France, Italy and Thailand.The occurrence of pesticides in the water body is derived by the runoff from the agricultural field and industrial wastewater. Despite the soil matrix that serves as a storage compartment of pesticide due to the high affinity of agrochemicals with soil, surface water resources like streams, estuaries and lakes, as well as the groundwater are susceptible to pesticide contamination because of the close interconnection of soil with water bodies. The low concentration of pesticides built up in water can get magnified through the food chain and enter aquatic organisms that are hazardous for human consumption. Importantly, chronic exposure to pesticides through water ingestion can mimic the human body's hormones that reduce body immunity, interrupt hormone balance, trigger reproductive-related issues, posing carcinogenic effects and reduce intelligence particularly towards the children under the body development stage.

The National Water Policy as adopted by National Water Resources Council inits Fifth meeting on 1 April 2002 describes: "Water is a prime natural resource, abasic human need and a precious national asset" – hence planning, development andmanagement of water resources need to be governed by national perspective. Itemphasizes the need of well-developed information system for water related data atnational and state level for resource planning through which water resourceavailable to the country should be brought within the category of utilizableresources to the maximum possible extent. It recommends economic developmentsand activities including agriculture, industrial and urban development should beplanned with due regards to the constraint imposed by the configuration of wateravailability. There should be water zoning of the country and the economicactivities should be guided and regulated in accordance with such zoning. Toimplement this broad principle, it is necessary to create awareness about water as ascarce resource commodity and create conservation consciousness amongst peoplethrough regulations, incentives and dis-incentives. (ii) Agriculture Sector, being thebiggest consumer of water, has to be sensitized to the need of respecting water as ascarce resource, even where it is plenty, at present. Efficient water use in cropproduction is indeed an inter-disciplinary subject and requires inputs fromengineers, agriculture scientists, social scientists and farmers.

4.1 Future Demands 4.1.1. Drinking Water: United Nations has projected that by the year 2025 A D, thepopulation in India would be around 1394 million adopting medium projections. Asper National Water Policy highest priority is accorded to drinking water supply.Therefore, the likely need of the increased population would have to be met in thelong term planning to ensure drinking water supply. 4.1.2. Irrigation: It is estimated that by the year 2025 AD, the utilization of theresources are likely to go up to 1050 cubic km consisting of 700 cubic km fromsurface and 360 cubic km from groundwater. Thus, almost the entire utilization ofwater resources of the country would be required to put to use by the year 2025 AD. However, even before this there would be many regions which would be facingserious shortage of water, especially Western Rajasthan, Maharashtra, Rayalseemain Andhra Pradesh, and most parts of Tamil Nadu and Gujarat States. At the sametime, there would be regions which would continue to remain surplus due toavailability of large water resources potentials but inadequate cultivable lands. 4.1.3. Demand for Food Grains: At present, the average annual food grains productionduring the last three years in the country is around 200 million tonnes, besides,sugar and edible oils etc. The futuristic demand for food grains up to 2025 ADwould depend on population, per capita requirement and need for exports. The foodrequirements by then would go up to 400 million tonnes per year. Therefore,concerted efforts would have to be made to step up the present production throughefficient management of both land and water resources. However, the most crucialyet determining factor would remain to be the availability of dependable irrigationwater.

Table 3: Water Demand in India

Sector	**Water Demand (BCM)**			
	Standing Sub- Committee of MoWR		**NCIWRD**	
Year	**2025**	**2050**	**2025**	**2050**
Irrigation	910	1072	611	807
Drinking Water	73	102	62	111
Industry	23	63	67	81
Energy	15	130	33	70
Others	72	80	70	111
Total	**1093**	**1447**	**843**	**1180**

Source: Land Use Statistics (2012-13), Ministry of Agriculture & Farmers Welfare

5. Consumption of Fertilizers in Bihar during 1995-1996up to 2005-2006 and Consumption of Fertilizer /Pesticides per Hectare

The natural fertility of land is declining with the passage of time. In a region like the Indo-Gangetic plain where agriculture is being practiced for over the last 8000 years the soils are depleted and are increasingly losing their resilient characteristics. For the recuperation of fertility, the soils are rested in the form of fallowing or they are enriched by applying manures (compost and green) and chemical fertilizers (NPK). HYV give rise to short stemmed stiff strawed plants that respond well to heavy doses of fertilizers. These dwarf varieties give much higher yields per unit area. The response of traditional varieties to chemical fertilizers is more in terms of vigorous vegetative growth which leads to pre-harvest lodging of the crop. The lodging of crop reduces the yield per unit area. After irrigation, chemical fertilizer is the second most important input required for the successful cultivation of HYV. The recommended dose of chemical fertilizer for the new seeds of wheat and rice in terms of NPK in 90-45-45 kg per hectare. The well off farmers of the Punjab, Haryana and western Uttar Pradesh are applying this input in the given proportion while some of the more ambitious farmers are even exceeding the prescribed limit. In the developed countries like the UK, Germany, Netherlands and Japan the consumption of chemical fertilizers is much higher to that of India. For example, the per hectare consumption of chemical fertilizers in India is only about 75 kg per hectare as against 525 kg per hectare in the Netherlands and about 500 kg per hectare in Japan. Most of the Indian farmers being poor have very little purchasing power and are unable to supply the prescribed doses of fertilizers. The big farmers of Punjab and Haryana are, however, applying heavy doses of chemical fertilizers. The national average of NPK consumption is 75 kg per hectare while in Punjab and Haryana the average consumption of chemical fertilizers in about 170 kg and 110 kg per hectare respectively. 5.1 Assessment of Requirement of Chemical Fertilizers: At present, the country has achieved 80 per cent self-sufficiency in production capacity of urea. As a result, India could manage its substantial requirement of nitrogenous fertilizers through the indigenous industry. Similarly, 50 per cent indigenous capacity has developed in respect of phosphate fertilizers to meet domestic requirements. However, the raw materials and intermediates for the same are largely imported. For potash (K), since there are no viable sources/reserves in the country, its entire requirement is met through imports. To ensure adequate availability of fertilizers, DAC&FW organizes zonal conferences before each cropping season to assess requirement of fertilizers of all the States. Initial projection of requirement of fertilizers for specific cropping season is made by State Government on basis of cropping pattern, consumption pattern, cropped area, irrigated area, requirement of nutrient in soil as per soil health status etc. After consultation with states, the Department of Fertilizers and lead fertilizer suppliers, etc., the total requirement for each State is assessed for the season. The States prepare month-wise requirement and the same is sent to Department of Fertilizers. A monthly supply plan based on the month-wise requirement is made by Department of Fertilizers for all States. This supply movement is jointly monitored by DAC&FW and Department of Fertilizers along with the States through weekly video-conference.

Table 4: Consumption of Fertilizers (NPK Nutrients, lakh tonnes)

S. No		1991-92	2000-01	2012-13	2013-14	2014-15
1	Nitrogenous (N)	80.46	109.2	168.21	167.50	169.46
	Phosphatic (P)	33.21	42.15	66.53	56.33	60.98
	Potassic (K)	13.61	15.67	20.62	20.99	25.32
	Total (N+P+K)	**127.28**	**167.02**	**255.36**	**244.82**	**255.76**
2	**Consumption of Fertilizer, (Kg / Ha)**	**69.84**	**89.63**	**131.36**	**118.55**	**128.08**

Source: State Governments

5.2 Fertilizers Consumption in the Bihar:

Fertilizer consumption in the State has steadily increased over the years. The consumption offertilizers has increased from 85 kgs/hectare to 110 kgs/hectare in 2005-06. Theestimated consumption for 2006-07 is 125 kgs/hectare. For 2006, the State government hasestimated the fertilizer consumption to be 9 lakh MT of urea, 3 lakh MT of DAP, 90000 MT ofMOP, 1.5 lakh MT of NPK, and 60000 MT of SSP, 90 percent of which has been allocated by theCentral government. Despite an increase over the years, fertilizer consumption per hectare in theState is lower than the national average. Besides the low level, an important problem is thedistorted consumption pattern of fertilizers in the State. While the ideal ratio of NPK consumptionshould be 4:2:1, the consumption pattern in Bihar has become increasingly distorted over the years. The NPK ratio has worsened from around 12:3:1 in 2000-01 to 24:2:1 in 2003-04,but fortunately improved to 7:1:1 in 2005-06. This problem, along with others, is being addressedby the extension initiatives of the State government, such as establishment of soil testinglaboratories and Krishi Vikas Kendras (KVK) in each block.

Table 5: NPK Consumption pattern from 1994 – 1995 onwards and Consumption of nutrient per hectare

Year	**N:P:K Ratio**	**Nutrient consumption(in Kgs/hect.)**
1995 - 1996	8.4:2.7:1.8	65–00
1996 - 1997	12.4:1.7:2.1	68–00
1997 - 1998	11.5:2.8:1	69–00

1998 - 1999	13.5:3.3:1	72–00
1999 - 2000	11.1:3.2:1	78–50
2000 - 2001	12.1:2.9:1	85–00
2001 - 2002	12.1:2.3:1	94–00
2002 - 2003	23:4.2:1	96–00
2003 - 2004	24.3:1.7:1	87–50
2004 - 2005	14.7:1.7:1	92–15
2005 - 2006	6.8:1.3:1	110–00

Source: Directorate of Statistics and Evaluation, Government of Bihar

5.3Plant Protection Chemicals

The new seeds are very delicate and highly susceptible to pests and disease. The irrigation fields enriched with heavy energy input of NPK create a micro climate (hot and humid) in the field which helps in the luxurious growth of plants. The hot and moist environment of the field also becomes conducive for the fast growth and multiplication of insects and pests. These insects and pests seriously attack the plants, hamper their growth and reduce the yield substantially. The danger of pests and insects may be reduced by using plant protection chemicals. The problem may be tackled either by developing the disease resistant seeds or by spraying insecticides and pesticides at the prescribed schedules devised for different crops. The problems of crop disease and infestation by insects may also be overcome by timely application of herbicides, fungicides, insecticides, nematicides and rodenticides. For the application of plant protection chemicals the farmers must have adequate knowledge of plant disease and their controlling chemicals. At the outbreak of a disease in the crop the entire area should be sprayed. If the timely spray is not done the crops of the region may vanish. Since the plant protection chemicals are quite expensive, they are generally out of the reach of small and marginal farmers. And if the crops by small farmers are not sprayed, the insects may creep in the neighboring fields and the disease may adversely affect larger areas.

6. Conclusion

The occurrence of pesticides in the water poses a deleterious effect on human health, where the effect magnitude depends on the solubility, half-life, adsorption capacity, biodegradability of the pesticide compounds. In the future, chemical pesticides will continue to perform a vital role in pest management. Despite evaluations of the efficacy, ease of use and cost of pesticides, the potential adverse effects of pesticides should be taken into consideration to achieve long-term sustainability pest management. Research in the field of pesticide development and technologies should be enhanced for compatible ecological based pest management. Assessment of pesticide residue management, the fate of pesticides and application technology would be useful for reducing the adverse health impacts from pesticides and its alternatives. With no justification for completely phasing out the chemical pesticide, pesticide users are recommended to replace the use of synthetic pesticides with bio-pesticide that exert a lesser environmental impact and also to ensure the correct application of pesticides in the agricultural system. Besides, Integrated Pest Management (IPM) is an ideal strategy for managing pests and insects in urban and agricultural settings that offer long-term prevention of pests by natural means. With the selective pesticide for backup in IPM, the usage of pesticides could be reduced to a larger extent, reducing the occurrence of pesticide compounds in water. As for safety measures, the water bodies in which pesticide compounds have been detected should undergo constant monitoring and potable water should undergo advanced water treatment processes if required.

7. References

1. Govt. of India, Ministry of Rural Development, Ministry of Agriculture, published data.
2. Sharma A., Kumar V., Shahzad B., Tanveer M., Sidhu G.P.S., Handa N., Kohli S.K., Yadav P., Bali A.S., Parihar R.D. Worldwide pesticide usage and its impacts on ecosystem. SN Appl. Sci. 2019;1:1446.
3. National Rural Drinking Water Programme: A Framework for Implementation, Department of Drinking Water Supply, MoRDGoI), New Delhi.
4. Bexfield, L. M., Belitz, K., Lindsey, B. D., Toccalino, P. L., & Nowell, L. H. (2020). Pesticides and pesticide degradates in groundwater used for public supply across the United States: occurrence and human-health context. Environmental science & technology, 55(1), 362-372.
5. Narayanan, M., Kandasamy, S., He, Z., &Kumarasamy, S. (2022). Ecological impacts of pesticides on soil and water ecosystems and its natural degradation process. In Pesticides in the natural environment (pp. 23-49). Elsevier.
6. Narayanan, M., Kandasamy, S., He, Z., &Kumarasamy, S. (2022). Ecological impacts of pesticides on soil and water ecosystems and its natural degradation process. In Pesticides in the natural environment (pp. 23-49). Elsevier.
7. Hossain, M. E., Shahrukh, S., & Hossain, S. A. (2022). Chemical fertilizers and pesticides: impacts on soil degradation, groundwater, and human health in Bangladesh. In Environmental degradation: challenges and strategies for mitigation (pp. 63-92). Cham: Springer International Publishing.
8. Bloomfield, J. P., Williams, R. J., Gooddy, D. C., Cape, J. N., & Guha, P. M. (2006). Impacts of climate change on the fate and behaviour of pesticides in

surface and groundwater—a UK perspective. Science of the total Environment, 369(1-3), 163-177.

9. Schäfer, R. B., van den Brink, P. J., &Liess, M. (2011). Impacts of pesticides on freshwater ecosystems. Ecological impacts of toxic chemicals, 2011, 111-137.
10. Kumar, V., & Kumar, P. (2019). Pesticides in agriculture and environment: Impacts on human health. Contaminants in agriculture and environment: health risks and remediation, 1, 76-95.