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Unveiling the agricultural system's water pollution perils: A study in Thrissur and Palakkad districts of Kerala, India

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Abstract

Water pollution has emerged as a formidable challenge with far-reaching implications for agricultural systems, causing disruptions to crop productivity, ecosystem equilibrium, and overall human welfare. This paper presents an analysis of water pollution confronting agricultural environments within six distinct panchayats from Thrissur and Palakkad districts of Kerala using a Water Pollution Index. By eliciting insights directly from farmers, this study seeks to quantify the extent of water pollution's impact on diverse agricultural systems. The statistical tools used are, survey method to collect relevant data to the farmers and a Water Pollution Index to find the different dimensions of water pollution. This index synthesized information from nine carefully curated statements and, each statement encapsulated various facets of water pollution's influence on agricultural systems. The data collection process was conducted by purposively selecting 180 farmers practicing rice farming, banana cultivation, and vegetable production, *i.e.,* 30 farmers from each panchayat. The respondents were selected using Purposive Sampling Method. The farmers were initially given information and also asked about their opinion about the ill-effects of excessive chemical fertilizers, waste dumping and industrial effluents on the water bodies and their repercussions on the environment, which they were already aware of. The observed variations in pollution levels bear significant implications for the pursuit of sustainable agricultural practices and the broader imperative of environmental conservation. By delving into the inter-woven relationships between water pollution and agricultural productivity, the study underscores the urgency of adopting strategic interventions to mitigate and manage the ill effects of water pollution. The findings revealed distinct patterns of water pollution in the agricultural systems of the six Panchayats. Puzhakkal showed a high level of water pollution (index = 70.81), Alathur and Nadathara exhibited a moderate level of water pollution (index = 66.37 and 61.93, respectively), Puthur and Madakkathara demonstrated moderate pollution (index = 63.11 and 64.15, respectively), while Pananchery reported the lowest pollution level (index = 60) among the studied Panchayats. The identification of specific pollution patterns within different Panchayats helps in tailoring targeted interventions, and promoting eco-friendly practices that synergistically address the complex interplay between agricultural activities and water quality.

Keywords: Water pollution, composite index, eco-friendly, agricultural systems, farmers

Introduction

Water pollution, also known as aquatic pollution, is the contamination of water bodies, which is primarily caused by human activities and has detrimental effects on its various uses. (Marcos, 2007) [8]. The pollutants usually originate from sewage discharges, industrial operations, agricultural practices, and urban runoff, including storm water (Eckenfelder, 2000) [3]. Water pollution can be categorized as either surface water pollution or groundwater pollution. It gives rise to numerous issues such as the degradation of aquatic ecosystems and the spread of water-borne diseases when people consume or use polluted water for drinking or irrigation purposes. Additionally, water pollution hampers the ecosystem services that the water resource would naturally provide, such as being a source of drinking water (Moss, 2008) [6].

There are two main sources of water pollution: point sources and non-point sources. Point sources have identifiable causes, such as specific discharge points like storm drains, wastewater treatment plants, or oil spills. Non-point sources are more diffuse, like agricultural runoff, making it challenging to trace back to a single origin. The pollution accumulates over time due to both types of sources, resulting in toxic substances like oil, metals, plastics, pesticides, and industrial waste products, as well as stressful conditions such as changes in pH, oxygen levels (hypoxia or anoxia), temperature fluctuations, excessive turbidity, and salinity variations. Additionally, water pollution can be caused by the introduction of pathogenic organisms (Moss, 2008) [6].

Water pollution in agriculture occurs when contaminants from agricultural activities find their way into water bodies, compromising their quality and ecological balance. These contaminants stem from a myriad of sources, including excessive use of pesticides, chemical fertilizers, and animal waste runoff. Improper waste disposal, industrial effluents, and untreated sewage further exacerbate the problem (Liu *et. al.,* 2021) [5].

In this paper, we assess the relationship between water pollution and agriculture, analyzing the extent faced by different agricultural systems in 6 panchayats *viz.,* Puzhakkal, Nadathara, Puthur, Pananchery and Madakkathara of Thrissur district and Alathur panchayat of Palakkad district. We aim to shed light on the importance of

mitigating water pollution in agriculture to foster resilient and thriving agricultural practices that coexist harmoniously with the natural environment.

Materials and Methods

Sample and study area

The study was conducted in Kerala, India, with a particular focus on two districts, Thrissur and Palakkad, due to their significant contribution to agriculture in the state. These districts were purposively chosen to gain insights into the agricultural practices and challenges associated with these crops in the region. The panchayats selected randomly for the study were Puzhakkal, falling under the special rice production system of lands in Thrissur district, Alathur, a major rice-growing panchayat in Palakkad district, two banana-growing panchayats, Puthur and Pananchery.

In order to gather relevant data, a cross-sectional survey was utilized, focusing on farmers residing in the six chosen panchayats. The survey was conducted using an interview schedule consisting of nine statements that pertained to water pollution, and the participating farmers were asked to rank each statement on a five point continuum, indicating the severity or prevalence of water pollution in their respective areas. Using the responses collected, a composite index was developed, enabling the researchers to assess the extent of water pollution in each of the selected panchayats the formula for which is given below;

$$\text{Index of each statement} = \frac{\text{Total score of the statement X 100}}{\text{Maximum possible score of the statement}}$$

To gain meaningful insights from the collected data, Water Pollution Index was used. By analyzing the data, variations in the levels of water pollution across the different panchayats was identified. This process also helped to compare the pollution situations in these areas, shedding light on potential hotspots or areas with relatively better water quality.

Results and Discussion

Table 1: The nine statements pertaining to water pollution

Sl. No.	Statement	Indicated by
1	Water is polluted by the excess use of pesticide in crop	WP1
2	Water is polluted due to bathing of man and animals in water bodies	WP2
3	There is water pollution due to the dumping of faecal matter of man and animal into the water bodies	WP3
4	The quality of water is affected due to the use of detergents	WP4
5	Water is polluted due to the let-out of industrial effluents	WP5
6	Water is polluted due to excess use of chemical fertilizers	WP6
7	Water is polluted due to untreated sewage	WP7
8	Water is polluted due release of garbage/plastic to water bodies	WP8
9	Water quality is affected due to fish excrement as a result of pisciculture	WP9

Table 2: Overall classification of the Panchayats based on the extent of water pollution

Sl. No.	Panchayat	Index	Extent of water pollution
1	Puzhakkal	70.81	High
2	Alathur	66.37	Moderate
3	Puthur	63.11	Moderate
4	Pananchery	60	Low
5	Nadathara	61.93	Moderate
6	Madakkathara	64.15	Moderate

The results from Table 2. provide an insightful analysis of water pollution in different panchayats in the selected regions. The composite index values indicate the level of water pollution, categorized as 'High', 'Moderate', or 'Low'. Here is an elaboration of the findings:

Puzhakkal: The panchayat of Puzhakkal had a composite index value of 70.81, indicating a 'High' level of water pollution. This suggests that the water bodies in this area face significant pollution, which could potentially have adverse effects on agricultural practices and overall environmental health.

Alathur: Alathur panchayat showed a composite index value of 66.37, which falls under the 'Moderate' category. While not as severe as Puzhakkal, this level of pollution still demands attention and measures to address pollution sources and maintain water quality.

Puthur: The panchayat of Puthur reported a composite index value of 63.11, also classified as 'Moderate' pollution. Like Alathur, Puthur faces moderate pollution levels that require careful monitoring and appropriate interventions to protect water resources and support sustainable agricultural practices.

Pananchery: Pananchery panchayat exhibited a composite index value of 60, indicating a 'Low' level of water pollution. This suggests that the water quality in this area is relatively better compared to the other panchayats in the study. Understanding the factors contributing to this low pollution level can help identify best practices that contribute to better water quality.

Nadathara: Nadathara panchayat had a composite index value of 61.93, falling under the 'Moderate' pollution category. Similar to Alathur and Puthur, this indicates the presence of pollution in the area, requiring attention and action to mitigate the pollution sources.

Madakkathara: The panchayat of Madakkathara showed a composite index value of 64.15, also classified as 'Moderate' pollution. Similar to Nadathara, this highlights the need for efforts to manage and reduce pollution levels in this area.

The findings revealed distinct patterns of water pollution in the agricultural systems of the six Panchayats. Puzhakkal

showed a high level of water pollution (index = 70.81), with pesticides, industrial effluents, and untreated sewage as major contributors. Alathur and Nadathara exhibited a moderate level of water pollution (index = 66.37 and 61.93, respectively), with bathing of humans and animals, as well as the use of detergents, being significant sources. Puthur and Madakkathara demonstrated moderate pollution (index = 63.11 and 64.15, respectively), while Pananchery reported the lowest pollution level (index = 60) among the studied Panchayats.

Conclusion

Water pollution in agricultural systems poses a significant challenge to sustainable development. The findings of this study provide valuable insights into the extent of water pollution faced by various agricultural systems in different Panchayats. Policy-makers and stakeholders should collaborate to implement effective strategies for water pollution control, thereby safeguarding both agricultural productivity and ecological well-being.

Controlling water pollution requires a comprehensive approach, including the establishment of appropriate infrastructure, management, and legislation. Technological solutions play a crucial role and involve improving sanitation, sewage treatment, industrial wastewater treatment, agricultural wastewater treatment, erosion control, sediment control, and managing urban runoff, including storm water. Water pollution stems from human activities, negatively impacting water bodies and their usability. It can arise from various sources, and its effects are wide-ranging, necessitating effective measures like onsite treatment of waste water before disposal to water bodies, proper waste water treatment mechanism, decentralized waste water treatment system, and interlinking of water bodies *etc.*, can be adopted to mitigate its adverse consequences on the environment and human health (Jayaswal *et. al.*, 2018) [4].

Addressing water pollution in agriculture demands a multifaceted approach that combines sustainable agricultural practices like use of soil conditioners and reuse of agricultural wastes, along with industrial treatment of waste water, improved waste management, and efficient water resource management (Alotaibi and Kassem, 2020) [2]. Policy interventions, technological advancements, and community engagement are essential in safeguarding water quality, promoting environmental conservation, and ensuring a sustainable future for agriculture.

Overall, the results underscore the importance of addressing water pollution in the regions of Thrissur and Palakkad to support sustainable agricultural practices and preserve the health of the environment. By understanding the pollution levels in each panchayat, local authorities and stakeholders can develop targeted interventions and policies to protect water resources, promote eco-friendly agricultural practices, and ensure the well-being of communities and ecosystems in these areas. Additionally, the findings serve as a valuable reference for other regions facing similar challenges, providing insights into effective pollution control and water resource management strategies.

The results highlight the need for targeted interventions to address specific sources of water pollution in each Panchayat like excessive run-off of chemical fertilizers and pesticides, industrial affluents and detergents in water bodies. Efforts to reduce pesticide and chemical fertilizer usage, improve waste management, and promote sustainable agricultural practices are crucial to mitigating water pollution. The role of community awareness and participation in tackling water pollution is of utmost importance and the need of the hour (Syafri *et. al.*, 2020) [7].

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