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Farmland Challenges in the Haor Basin of Bangladesh: Nature and Solutions

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A R T I C L E I N F O

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A B S T R A C T

Haor regions are inhabited by one of the most economically disadvantaged communities, which rely on agriculture and endure numerous challenges due to its vulnerability. This article analyzes the data obtained from Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs), which were subsequently connected to prior publications to identify the nature of the agricultural land-related problems in the Netrokona Haor basin. Multiple concerns and their nature have been uncovered through the examination. Among those, difficulties in irrigation systems pose the greatest challenge for regional producers. Additional challenges encompass land fragmentation, pollution, erosion, fishing-related concerns, drainage infrastructure, and flood. This study discusses probable solutions with the directive to new research that claims collaborative venture through government and private agencies. Carefully designed research-based policy framework prioritizing strict implementation of existing laws is crucial to effectively mitigate the problem.

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Introduction

A Haor is a unique body of water distinguished by its bowl-shaped topography and distinct ecological system. The Haor region of Bangladesh covers an area of 1.99 million hectares across seven districts, with a population of 19.37 million (Haor & Wetland Development Board, 2012). The livelihoods of the inhabitants primarily depend on agriculture and related activities, such as crop cultivation, fishing, and livestock rearing (Barkat et al., 2019; Haor & Wetland Development Board, 2012). Additionally, the region contributes 6% to the overall Gross Domestic Product (GDP) (Ministry of Environment, Forest, and Climate Change, 2021).

Netrakona is the only district in the Mymensingh division known for its Haor ecosystem, consisting of 52 Haors and Beels, covering 79,345 hectares. According to the Haor & Wetland Development Board (2012), it was the fourth largest area in the Haor region, accounting for 28.92% of the total land area in Haor. The district has numerous prominent haors, including Dingi Pota Haor, Medar Beel, and Talar Haor (netrokona.gov.bd, 2023). Agriculture in these low-lying areas is the primary means of sustenance for the local population. Agriculture is known to be vulnerable to natural disaster and with the geography of the region exacerbated the susceptibility. Therefore, climate change-related and human-induced challenges cause enduring hardships. Over the years, flash floods, drought, and changed participation patterns caused serious issues that posed a great toll on agriculture and, thus, on the inhabitants of this low land people. Besides those issues, there are compelling issues related solely to the farmland of this region, which need to be reflected in existing haor management policy. To enhance the overall standard of living and eradicate the said hardship, it is essential to identify and tackle the issues facing agriculture in the Haor basin. This can be done by investigating the daily hardships experienced by the community in Netrokona, identifying the underlying reasons for these issues, and proposing viable solutions that may enhance the region's quality of life.

Identifying farmland-related concerns is vital due to the region's status as the most disadvantaged in the country, with agriculture functioning as the mainstay of income and being directly linked to land usage and management. This study seeks to examine the challenges faced by local farmers in relation to agricultural land. It will analyze the underlying causes and potential solutions, focusing on whether there is/are any significant challenges farmer faces particularly regarding land, if there is any gap in government policy and laws, if there are any flaws in policymaking or implementation, and what can be the way out of addressing those issues.

Existing Policies Regarding Haor Basin

The national water policy (1999) encompasses provisions for allocating water resources towards the conservation of Haor, Baors, and Beels, aiming to preserve aquatic ecosystems and facilitate effective drainage systems. The Ministry of Agriculture (MoA) places significant emphasis on surface water irrigation in its National Agriculture Policy (1999). The Ministry of Fisheries and Livestock introduced the National Fisheries Policy in 1998, outlining the prohibition of untreated industrial effluent disposal and the conservation of fish habitats and complete removal of water (dewatering) from lakes, beels, ditches-canals, and other open water bodies, including Haor. The National Environmental Policy (1992) was designed to maintain ecological integrity by preventing pollution, adopting a land management approach that considers the ecosystem, and preserving wetlands and migratory bird habitats. The National Land Use Policy (2001) is viewed to prevent landfilling and establish a strict prohibition on the encroachment of pre-existing wetland areas. 2009, the government implemented the Jalmohal Management Policy to enhance fisheries' resource production and biodiversity.

Literature Review

Global climate change is causing an ongoing decline in the ecosystem and increasing its susceptibility to damage. The Haor and wetland regions are particularly susceptible to these issues, with the vulnerability of wetlands being influenced by the geographical landscape and dependence on water resources. Specifically, the reliance on rainwater makes wetlands highly vulnerable to climate change effects such as changes in precipitation and temperature (Winter, 2000). These changes can lead to a transformation in the characteristics of wetlands, causing them to shift from being carbon reservoirs to carbon emitters (Salimi et al., 2021). In contrast, Desta et al. (2012) highlight the anthropogenic activities that significantly threaten wetland ecosystems, further exacerbated by climate change. One of their findings suggests that the effect could be a modification in land utilization in the mentioned area.

The haor and wetlands significantly impact the socio-economic well-being of the local population (Kangalawe & Liwenga, 2004). Excessive utilization of resources, coupled with extensive deforestation, can lead to environmental problems. Verhoeven and Setter (2009) stated that the most sustainable use of wetland rice production is to consider its sustainability. However, this study demonstrates that this particular approach can lead to issues such as eutrophication, fish mortality, and a decline in biodiversity due to the toxic effects of pesticides and the lack of wetland preservation. The water scarcity, as observed by King et al. (2021), may be attributed to the excessive subsidization of water usage and the inefficiency of the agricultural sector. Mondal (2010) identified land loss, population increase, and climate change as the primary obstacles facing agricultural agriculture in Bangladesh. The haor and wetland, which have a dynamic and circular function in the economy (Byomkesh et al., 2008), are currently facing a major issue in the form of changes in land use for human habitation. This problem was identified in research conducted in the Tahirpur Upazila in the Sunamganj district (Uddin et al., 2015).

Cited, the literature focuses on the agricultural utilization and climate change-led challenges associated with wetlands. Previous literature on the context of Bangladesh revolves around floods and the significant issue posed by floods in the haor area. Although those studies loosely focus on land-related difficulties, emphasis is not enough to explain those specific issues. In that sense, there is a dearth of literature focusing specifically on farm-land-related issues of wetlands and haor. This study aims to fill this research gap by focusing on land-related issues, the form of those factors, and how they impact farmers

Methodology

The study is extensively qualitative and utilizes field-level data using Focus Group Discussions (FGD). Subsequently, the data are analyzed and evaluated, considering existing scholarly works, and matched with Key Informant Interviews (KII) information.

To collect field-level data, three (03) Focus Group Discussions (FGDs) with farmers of 8-12 members were conducted in Gobindasree, Uchitpur, and Dokkhin Para in the Madan Upazila. To match the data from those FGDs and for a better understanding, two (02) separate FDGs with students and prominent civil citizens were conducted to better understand the information from previous FGDs. The selected students were directly connected with Haor because of their family dependency on agriculture or because they reside in one of the Haor regions. Civil citizens include teachers from renowned institutions, NGO workers, and journalists. Subsequently, the provided information has been qualitatively analyzed to identify challenges and matched with existing literatures. Findings then were further discussed for critical explanation and evaluation through semi-structured interviews with two fishers, one local representative, one NGO worker, and three government officials working in the Department of Agriculture, Department of Fisheries, and Bangladesh Agricultural Development Corporation. Expert opinion has been sought to rank the issues regarding their intensity.

Challenges of Farmland in Netrokona

Land Fragmentation

Land fragmentation in the Haor region is caused by the rapid rise of the population and the rising need for land for residential uses. The main factors contributing to the issue are the diverse land composition and the lack of a well-established land market in South Asia (Niroula & Thapa, 2005). The increase in family members leads to the division of their property and decreased accessibility of cultivable land. The division of inherited property among descendants diminishes extensive land areas into smaller plots, posing difficulties for the inheritor in establishing their household, who opted to use their fertile land to build houses and necessary infrastructure.

Land fragmentation results in a lack of cultivable land for families with reduced size, leading to a decline in crop output (Rahman & Rahman, 2009). According to The Business Standard (2020), the amount of land suitable for farming in Bangladesh has decreased by 69,000 hectares per year.

Table 1. Description of Data Source

No.	Data source	Number	Mode of Data collection
01	FGDs with farmer	03	Field
02	FGDs with civil citizens	02	At the researcher's institute
03	KII	07	In-person and online

Soil Erosion

The Haor area has two primary forms of soil erosion: riverbank erosion and residential premises erosion due to waves. Both lead to the loss of living spaces and changes in arable land's physical features and fertility (Wolfgramm et al., 2007; Novara et al., 2018). Heavy rainfall creates strong currents that lead to soil and river erosion (Zhao et al., 2022).

Pollution and Reduction of Soil Fertility

Soil pollution and reduced fertility are due to various factors, such as the practice of monoculture (Ewel et al., 1991; Shen et al., 2004), the excessive use of chemical fertilizers and pesticides (Havugimana et al., 2015; Savci, 2015; Scholz & McIntyre, 2018), the use of chemicals in fisheries, the iron infestation through irrigation from shallow pumps (Fageria et al., 2008), and pollution from human settlements and tourism activities.

The region is characterized by monoculture, where farmers are adept at repeatedly cultivating the same variety of crops, making soil infertile and eventually decreasing crop production (Shen et al., 2004). Chemical fertilizers and pesticides were introduced to optimize crop yield and lessen pest infestation, often without adequate knowledge of the application procedures and the optimum amounts. Hence, reckless consumption of chemical products leads to increased expenses, decreased soil quality, and environmental contamination, thus creating havoc on Haor's natural ecology. That could also have harmful effects on human health. The same thing applies to fisheries.

Shallow pump water, a prominent irrigation mode, leads to iron proliferation on agricultural land. Typically, the sedimentation process can minimize the intensity of iron. Nevertheless, farmers are driven to irrigate the land without undertaking such necessary treatment due to the lack of reservoir and the urgency of irrigation. This leads to an elevation in iron absorption, resulting in a decline in oxidation, degradation of soil pH, soil fertility, and rice genotypes (Fageria et al., 2008). Farmers typically seek advice from local fertilizer vendors to mitigate the negative effects on crop health, who often recommend synthetic fertilizers only to make money. This results in another episode of rising costs and elevated soil pollution, with no effect on iron infestation.

The production of significant amounts of both perishable and non-perishable waste is widespread in our everyday lives, with insufficient waste management systems in rural/suburban areas leading to exposure of garbage to open space. Furthermore, modernization and the rising trend of tourism in specific regions have led to a rise in the generation of non-biodegradable garbage, such as plastic bottles, bags, and other packaging materials. This garbage contributes to the prevalence of microplastics in the environment, harming aquatic species and perhaps degrading soil quality (Karbalaei et al., 2018).

Irrigation Problem

The irrigation issue in this region is complex and multifaceted, with natural and anthropogenic catalysts.

Among natural factors, climate change badly impacted Haor and wetland ecosystems. The region is experiencing harsh effects of climate change, including heat waves, erratic precipitation patterns, and prolonged summers without rain. Though June to September is the prime time for precipitation, precipitation patterns exhibit notable fluctuations with the absence or minimal occurrence of rainfall during anticipated times, followed by abrupt episodes of intense rainfall due to the recurrent prevalence of low atmospheric pressure. Monir et al. (2023) showed an up to 82% declining trend in rainfall during the monsoon period, and it will worsen in the near future.

The altered precipitation patterns and the absence of a water reservoir in the Haor region, coupled with the negligent actions of the leaseholder, pose significant challenges to the reliance on surface and precipitation water, which were the main source of irrigation. As a result, reliance on groundwater is increasing. However, the prevalence of declining groundwater caused by excessive exploitation stirs the trouble. Though there are some rules and prescriptions regarding optimal distances between irrigation pumps (Bangladesh Gazette, 2019), no tendency is observed to follow them, resulting in excessive groundwater exploitation. Based on farmers' responses, shallow-water pumps with a depth range of 60-120 feet and deep-water pumps with a depth of 500 feet or more generally access enough water in any season. However, many pumps with depths ranging from 250-350 feet face challenges accessing water due to declining water levels, specifically in summer. The water from the deep pump is devoid of arsenic and iron and is safe for drinking or irrigation. In contrast, water from shallow to moderate depths typically contains high iron intensity, making it unsuitable.

The leasers (leaseholders) engaging in the practice of artificially inundating water bodies to facilitate fish growth impedes the cultivation of paddy during planting season and dewatering the Jalmahal (local name of waterbody) by shallow pumps (a practice that is strictly prohibited by National Fisheries Policy,1998) for fishing in the months of Falgun and Chaitra causes significant irrigation problem as it is considered the peak time for irrigation. Minimizing cost rationale for their illegal actions, as the rainfall is minimal, and water is at a minimum point.

Flood

This region faces enormous challenges because of flash floods during the monsoon and pre-monsoon seasons, which are triggered by severe rainfall and water inflow from upstream India, particularly due to intense precipitation in Meghalaya. It is one of the consequences of climate change and the insufficiency of appropriate preventative actions (Dey et al., 2021; MoWR, 2012). Every year, a great loss happens due to floods. For instance, the Netrokona region experienced around 10.5% loss of yields in 2017 (Barkat et al., 2019). The catastrophic floods of 2022 resulted in three consecutive flood occurrences that severely impacted crops, causing a total loss of $547.6 million (MDMR, 2022). Besides, these floods have many ramifications on agricultural land. Sediment deposition usually enriches the soil but reduces the depth of Haor wetlands and water reservoirs. This raise concerns over navigation during the rainy season and the availability of water resources during the dry season.

Problems Regarding Fisheries and Fishing

The local government manages Haor and Jalmahals leasing to generate revenue. However, this system causes an inefficient and inequitable allocation of wealth with a potential ecological hazard through the endangerment of native species, disruption to irrigation systems, and resource misallocation through unethical practice of encroachment.

The well-known slogan "Jal Jar Jola Tar"(whomever the fisher should have the right to the water reservoir) is the foundation of the 'Jalmahal Management Policy, 2009'. According to this policy, Haor areas should only be leased to registered Jele(fisherman) approved by the Ministry of Local Government, Rural Development & Co-operatives. However, it has come to light that powerful and influential groups are exploiting the loop of the law. Using their physical, monetary, and political strength, these communities utilize the id of fishers to participate in auctions or engage in bidding processes and, upon obtaining the authority, exercise control over and exploit water resources solely to maximize their financial gains. Though the lease is bestowed upon the fisher in white and black, the occupancy belongs to this group. Evidence shows that these groups control a much larger area than what they are entitled to (Barkat et al., 2019). No one is permitted in fishing activities within this area, even within one's farm or private pond, if it is somehow linked with the Jalmahal (the link happens when the whole area is submerged under water in the rainy season, then it looks like a piece of large water reservoir). Consequently, the local populace has no access to fishing, which is supposed to be freely available, forcing them to purchase alternatives from the local market. These influential individuals disrupt the allocation of natural resources, causing the common people's deprivation and financial and nutritional losses.

The exploitation of water resources extends beyond felony trespassing. As mentioned earlier, waterlogging to cultivate fish prevents crops from growing, and dewatering impedes irrigation at the end of the winter season. An important concern arises from using rotenone, which is practiced capturing fish submerged in mud. The primary purpose of rotenone is to manage unwanted and hazardous fish species (Ling, 2002, p. 9) turns into extensive utilization, posing a significant risk to public health (Ling, 2002, p. 25) and issues to amphibians and vertebrates (Dalu et al., 2015; Liu et al., 2015; Sherer et al., 2003). It also endangered indigenous fish species by risking their eggs and larvae.

Lack of Sideway to Carry Crops

Another regional issue is the absence of suitable pathways for transporting crops, livestock, and other agricultural goods to and from their farmland. In the local context, this thoroughfare is commonly called 'Gopat'. Due to intense precipitation and subsequent flooding, the condition of this sideway deteriorates, which poses a challenge in transporting agricultural produce and livestock from the field to the residence.

Poorly Managed Embankment and Drainage

Establishing embankments and roads often neglects ecological considerations and, even if considered, fails to address environmental needs due to insufficient planning and inadequate maintenance, manifests undesired waterlogging. On the other hand, because of the widespread corruption prevalent in embankment construction, the overall quality of the work is not up to standard. This renders the susceptibility to breakage or erosion during flash floods, resulting in significant hardships for the affected inhabitants.

Sluice gates on the embankments aim to enable the efficient management of irrigation and drainage systems due to poor management and maintenance and lack of utility for agricultural use. Due to the lack of officials of the Water Development Board in the Haor region, maintenance or reconstruction of a malfunctioned or damaged gate takes a long route via local administration to local representatives and often has minimal remedial measures. Moreover, fishery owners utilize the negligence of maintenance to serve their purpose by regulating water flow according to their requirements, disregarding the needs of farmers.

The following table shows the order of the identified issues by their intensity of impact on agricultural land and their relative importance in resolving them. The rank is assigned by the preference of farmers who face it with the consideration of expert opinion.

Discussion

While flooding is commonly regarded as the most significant problem in the Haor area, it positively impacts the fertility of the ground and the biodiversity of the wetland. Moreover, it has been discovered that the community does not acknowledge it as harmful to the land, specifically regarding irrigation. The irrigation situation has worsened lately due to the altered precipitation pattern and decreased subsurface water levels. The Jalmahal Management Policy (2009) is considered the most objectionable and troublesome policy regulation implemented by the government. It leads to an inefficient distribution of resources among stakeholders and obstructs water management for irrigation. Consequently, most of the participants in the FGDs strongly support the elimination of the open water leasing scheme. The issues of soil erosion, flooding, and irrigation problems are interconnected with the inadequate management of the region's infrastructure. Inadequate management systems can exacerbate flooding and erosion, leading to mismanagement of water resources. Pollution and land fragmentation are associated with land management and the implementation of sustainable agricultural methods. The table below displays the ranking of identified concerns based on the severity of the impact on agricultural land and their relative importance in fixing them. The rank is determined based on the feedback from Focus Group Discussions (FGDs) and the insights from experts who participated in Key Informant Interviews (KIIs).

Table 2. Rank of the Problems by the Intensity of Their Impact

No.	Problems	Relative Rank of the Problems
01	Irrigation Problem	1
02	Problems Regarding Fisheries and Fishing	2
03	Land Fragmentation	3
04	Soil Erosion	4
05	Poorly Managed Embankment and Drainage	5
06	Flood	6
07	Pollution and Reduction of Soil Fertility	7
08	Lack of Sideway to Carry Crops	8

Policy Recommendations

Efficient Land Use

Strategies to optimize land utilization can mitigate the negative impacts of land loss and fragmentation. Given the low land-to-population ratio, diligence and careful consideration are needed. Maximum emphasis should be given to the efficient use of land such that no land should be left uncultivated. Promoting human settlement in agricultural land should be discouraged, along with promoting vertical accommodation for a large group of people. Land consolidation can assess and address agricultural land fragmentation (Muchová & Jusková, 2017; Nithinyurwa et al., 2020). Among various approaches, a comprehensive and focused study is crucial to determine the most suitable land use approach and cultivation method for the haor region. Encouraging the cultivation of native crops and the practice of pearl culture during the flood season could potentially enhance the economy.

Minimizing Side Effects of Tourism

Tourism is primarily advantageous for certain groups of people (Barkat et al., 2019), but the resulting pollution surpasses the possible advantages. Therefore, tourism promotions should consider ecological well-being. Failure to address ecological sustainability might lead to adverse outcomes.

Using Eco-friendly and Biodegradable Products

Environmentally friendly products should be adopted to protect the environment and ensure sustainability. The widespread production of synthetic items has been discovered to be a major cause of substantial environmental damage. Therefore, they must be prohibited by enforcing legal measures and public consciousness.

Sideway to Farmland to Carry the Crops

To optimize the transportation of agricultural commodities and livestock, it is imperative to regularly maintain the region's routes. The feasibility of constructing concrete roadways will guarantee sustainability.

Crop Diversity and Controlled Use of Chemicals

Diversification in crop cultivation enhances crop productivity and soil fertility and promotes the sustainability of agricultural practices (Di Falco & Zoupanidou, 2017; Li et al; 2021). In this region, the geographical features of the farmland make it difficult to diversify crops. Therefore, research from agricultural scientists is needed to determine the most suitable combination of crops according to land type. At the same time, biofertilizer and pesticide use practices should be promoted through public awareness programs and extensive campaigns. Setting a lab in every union for better management of fertilizer use can act as an immersive task for optimal fertilizer use. The concerned department should ensure the availability of information. Implementing the Internet of Things (IoT) in agriculture can solve all of these problems just by a snap of the finger that will lead to an initiative for smart farming (Farooq et al., 2019; Stočes et al., 2016).

Afforestation and Construction of Pavements to Stop Soil Erosion

Ensuring the upkeep of rivers, canals, and reservoirs, as well as constructing embankments and concrete walls, are crucial steps in protecting residential homes from erosion. Implementing extensive programs like CARE, Bangladesh, to install concrete pavement projects in their residential area can reduce erosion. Alternatively, implementing extensive reforestation efforts and constructing living fences around the area can be environmentally friendly to combat wave erosion.

Facilitating Irrigation and Drainage Through Proper Management of Embankment

Ensuring the protection of water reservoirs, carrying out planned construction of embankments and gates, and proper maintenance of them can enhance the efficiency of irrigation systems. A quick response team from the concerned department can effectively reduce the dillydally of maintenance. Regular dredging actions are necessary to ensure sufficient depth in the Haor and Beel for effective drainage, irrigation, and navigation.

The National Water Policy (1999) strictly requires the protection of natural water bodies and the conservation of aquatic ecology. The National Agricultural Policy (1999) also strictly forbids water removal from natural water reservoirs. Hence, controlling the self-interested behaviors of those renting out these resources is imperative to maximize the efficient use of surface water in agricultural fields.

Probable Solution for Fisher

Thorough monitoring can guarantee the right to lease Jalmahal to the fishing community. To eliminate financial constraints on fishing communities that may result in their unwillingness to participate in auctions, a transparent leasing and financial aid system is needed.

Local farmer associations' participation in taking over the lease has been noted as an efficient way to address the water use problem from the reservoir. This method grants farmers a certain degree of regulatory authority. Under these circumstances, farmers can effectively prevent landlords from drying up the Haor when it is necessary for them to do so. Leasing the Jalmahal to genuine fisher folk or associations could decrease self-interest-driven activity.

Creating More Natural Breeding Zones and Reserved Areas

Policy implementation to prevent extinction could protect native fish species. Immediate action is required to establish further protected areas for fish reproduction to ensure the survival of endangered and vulnerable species. This will simultaneously contribute to the water supply for irrigation. This may be aided by applying synthetic fertilizers and pesticides to agricultural areas as efficiently as possible.

Conclusion

Since Haor is socioeconomically disadvantaged and agriculture makes up most of the Haor economy, adopting sustainable agriculture and agro-based enterprises is essential to raising the standard of living for Haor citizens by increasing income and ensuring food access and extenuating climate change-related issues (Raihan et al., 2024) This study focuses on the district's agricultural land problem and found that the primary concern regarding agricultural land pertains to crop field irrigation. Other issues include land fragmentation (which is more or less a national problem), increasing contamination and declining soil fertility, fishing-related worries, infrastructure constraints, etc.

Diverse organizations are working to eliminate these issues through state-led efforts such as the Hilip by the Government of Bangladesh (GoB) and the International Fund for Agricultural Development (IFAD). However, the scope of the initiatives must be increased to promote inclusivity. Target-led initiatives must also be implemented to lessen the region's agriculture industry's difficulties. To prioritize ecological aspects in policymaking, raising farmers' awareness and literacy levels regarding the best ways to use land, chemicals, and biodiversity in wetland ecosystems is imperative. The concerned government agencies must exercise greater vigilance to safeguard the rights of ordinary citizens. As was shown in the previous section, more research is required to collaborate between public and private institutions.

Limitations Of the Study and Future Research Window

This study aimed to examine the current issues related to agricultural land in Netrokona, which are contributing factors in food production, considering the limitations of time and expense. Therefore, not out of limitations. These include collecting first-hand interview data from a few participants and incorporating geological and agri-scientific knowledge to address the problems posed in various research areas. However, these factors delineate a trajectory for potential avenues of research. Potential research areas include studying the most efficient land use system for Haor, identifying optimal crop combinations and yields to maximize farmland utilization and productivity, conducting geological surveys to determine water levels and potential solutions, exploring the optimal use of synthetic and chemical fertilizers, and developing a rural waste production and management system.

Declarations

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Ethics Committee Approval Statement

As the article does not contain any experimental or sensitive data on humans or animals it does not need any ERB approval.

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