



## SDG 2 and SDG 6 in the Sundarbans of West Bengal: Climate Change, Food Security, and Water-Sanitation Challenges

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### ABSTRACT:

The Sundarbans of West Bengal - the world's largest stretch of mangrove forests - stand at the frontline of climate change. Rising sea levels, frequent cyclones, saltwater intrusion, and changing rainfall patterns are steadily eroding the region's traditional farming systems, cutting crop yields, and putting local food security at risk. At the same time, the growing salinity and pollution of freshwater sources are making safe drinking water scarce and sanitation more difficult. These interconnected challenges directly threaten two key Sustainable Development Goals - **SDG 2: Zero Hunger** and **SDG 6: Clean Water and Sanitation**. This paper examines how climate change, food production, and water-sanitation systems in the Sundarbans are deeply linked. Using research studies, government reports, and on-the-ground evidence, it explores both the social and environmental consequences of this crisis and the possible locally suited solutions. Special attention is given to the role of education -integrating environmental awareness, community action, and climate-resilient practices into school curricula - to build knowledge and resilience among the next generation. By combining sustainable farming, nutrition security, and clean water access within an educational framework, the study outlines practical pathways to meet SDG 2 and SDG 6 in one of the most climate-vulnerable regions of the world.

**KEYWORDS:** SDG 2, SDG 6, Sundarbans, Climate Change, Food Security, Water and Sanitation, Sustainable Agriculture, Curriculum Integration.

### I. INTRODUCTION

The Sundarbans, spread across India and Bangladesh, is the largest mangrove forest in the world. The Indian part of the Sundarbans, located in the southern districts of West Bengal, is home to millions of people who depend directly on farming, fishing, and forest resources for their daily lives. This unique region is rich in biodiversity and acts as a natural shield against cyclones and storms. However, it is also one of the most climate-vulnerable areas in the world.

Climate change has already started to affect the lives and livelihoods of the people living here. Rising sea levels, frequent cyclones, saltwater entering farmlands, and unpredictable rainfall have made farming more difficult. Many families face food shortages, and malnutrition is becoming more common. At the same time, the availability of safe drinking water is shrinking. Salty or polluted water is unsafe for drinking and makes sanitation harder to maintain.

These problems are directly connected to two important Sustainable Development Goals (SDGs) set by the United Nations:

**SDG 2: Zero Hunger** – ensuring enough food, good nutrition, and sustainable farming.

**SDG 6: Clean Water and Sanitation** – making sure people have safe water and proper sanitation.

In the Sundarbans, these two goals are closely linked. Without clean water, farming suffers, and people fall sick. Without good farming, there is not enough food to eat. Both are now under threat because of climate change.

This paper looks at how climate change is affecting food security and water-sanitation in the Sundarbans, and what can be done to improve the



situation. It also explores how education and school curriculum can be used to teach communities—especially the younger generation—about climate change, sustainable agriculture, and safe water use. By connecting classroom learning with real-life problems, local people can be better prepared to face these challenges in the future.

## II. Literature Review

### 2.1 Global studies on SDG 2 (Zero Hunger) and SDG 6 (Clean Water & Sanitation)

Global reviews show that SDG 2 (Zero Hunger) covers food availability, nutrition, and sustainable farming, while SDG 6 (Clean Water and Sanitation) covers safe drinking water, sanitation, and better water management. Recent reviews warn that climate change — through changing rainfall, higher temperatures, and extreme events — makes achieving both goals harder worldwide. Researchers emphasise integrated approaches that link food systems and water management, and call for climate-smart agriculture and stronger governance to meet the targets by 2030.

### 2.2 Indian context (National and Regional studies)

In India, studies highlight that rural and coastal areas face special risks to food and water security from salinity, groundwater issues, and recurring extreme weather. Indian literature points to gaps in infrastructure, governance, and financing that slow progress on SDG 6, and shows that agriculture remains vulnerable to climate shocks, which undermines SDG 2. Authors recommend combining policy action, local-level water management, and climate services (early warnings, weather advisories) to protect crops and nutrition.

### 2.3 Sundarbans-specific research (food security, salinity, water and adaptation)

A growing body of work focuses specifically on the Sundarbans (Indian side) and documents several linked problems: rising salinity in soils and drinking water, frequent cyclones and tidal surges, loss of crop area, lower crop yields, and threats to

safe sanitation. Field studies and reports show that many communities now rely on saline-tolerant crops, livelihood shifts, and coping strategies, but these are often not enough to secure nutrition or safe water. Several papers and reports also call for site-specific solutions — for example, land-shaping, salinity-resistant cropping patterns, improved freshwater storage, and community-led water-quality monitoring — combined with education and local capacity building.

### 2.4 Short gap summary (why this paper matters)

Previous studies document the environmental problems and some technical solutions for the Sundarbans, but fewer works clearly connect these issues to education and curriculum design. There is a gap in practical research that links: (a) climate-resilient agriculture and local water solutions, and (b) curriculum-based education programs that can build long-term local capacity. This paper aims to fill that gap by analysing the Sundarbans' food and water challenges and proposing curriculum-integrated solutions adapted to local realities.

## III. Study Area: The Indian Sundarbans

### 3.1 Location and Geography

The Indian Sundarbans is located in the southern part of West Bengal, covering about **9,630 sq km**, of which **4,263 sq km** is inhabited and the rest is covered by mangrove forests. It forms the lower part of the Ganga–Brahmaputra–Meghna delta and lies between the **Hugli River in the west** and the **Ichhamati–Kalindi–Raimangal rivers in the east**, marking the border with Bangladesh. The area is made up of numerous islands, tidal rivers, and creeks.

### 3.2 Climate and Environment

The Sundarbans has a **tropical monsoon climate**, with hot, humid summers and heavy rainfall from June to September. Average annual rainfall is about **1,800–2,000 mm**. Cyclones and tidal surges are common, especially during pre-monsoon (April–May) and post-monsoon (October–November)



seasons. Salinity levels in soil and water are rising due to sea-level rise, storm surges, and reduced freshwater flow from upstream.

### 3.3 Population and Livelihoods

According to the **2011 Census**, the population of the Indian Sundarbans is over **4.4 million**, living in about 54 administrative blocks across North and South 24 Parganas districts. Most people depend on **agriculture, fishing, crab and prawn collection, and forest products** for their livelihood. Paddy cultivation dominates agriculture, though vegetables and pulses are also grown.

### 3.4 Vulnerability to Climate Change

The region is highly vulnerable due to:

- **Low elevation:** Much of the inhabited land lies less than 3–5 metres above sea level.
- **Coastal erosion:** Several islands like Ghoramara and Mousuni have lost large portions of **land in recent decades**.
- **Salinity intrusion:** Sea water often enters farmland and ponds, making both farming and drinking water difficult.
- **Cyclones:** Disasters like Aila (2009), Amphan (2020), and Yaas (2021) have damaged homes, crops, and water systems.
- **Relevance to SDG 2 and SDG 6**

The Sundarbans' economy and daily life depend heavily on agriculture and water availability. Climate change here directly affects **SDG 2 (Zero Hunger)** through crop loss, reduced yields, and nutrition insecurity, and **SDG 6 (Clean Water & Sanitation)** through saline and contaminated water, damaged sanitation facilities, and reduced freshwater sources.

## IV. Climate Change Impacts on Food Security and Nutrition in the Sundarbans

### 4.1 Agriculture under stress

Farming in the Sundarbans depends on a delicate balance of rainfall, river water, and soil fertility.

Climate change is disturbing this balance. Rising sea levels and frequent tidal surges push saltwater into farmlands. Once soil becomes salty, it is difficult to grow rice, vegetables, or pulses. Farmers often report that after a major cyclone, the soil needs several years to recover enough for normal crops.

### 4.2 Loss of traditional crops

Many traditional varieties of rice and vegetables that grew well in the past are no longer able to survive in the new conditions. High salinity and irregular rainfall mean farmers must either switch to salt-tolerant crops (which are often lower in yield) or leave fields unused. Some farmers are shifting to aquaculture, such as prawn or crab farming, but this can make soil salinity worse over time.

### 4.3 Reduced yield and income

Cyclones like Aila (2009), Amphan (2020), and Yaas (2021) destroyed large areas of standing crops. In many villages, families lost an entire year's harvest in a single event. This not only reduces food availability at home but also cuts household income, making it harder to buy other food items.

### 4.4 Nutrition insecurity

With less food grown locally and less income to purchase food, diets have become less diverse. Many families depend heavily on rice and fish, with fewer vegetables, fruits, and protein-rich foods. Children and women are most affected, with increasing reports of undernutrition and anaemia.

### 4.5 Gender impacts

Women in farming households often face extra pressure, as they must find alternative food sources, manage household meals, and take care of sick family members. The extra workload during and after disasters also affects their own health and nutrition.



- **Link to SDG 2 (Zero Hunger)**

SDG 2 aims to ensure food security, improve nutrition, and promote sustainable agriculture. In the Sundarbans, climate change is making all three harder to achieve. Without action, local farming systems may become unable to provide enough nutritious food for the population.

## V. Water and Sanitation Challenges in the Sundarbans

### 5.1 Limited freshwater sources

The Sundarbans is a tidal region where rivers and creeks are mostly saline. Freshwater is mainly available from rainwater, a few freshwater ponds, and deep tube wells. Climate change, especially rising sea levels and stronger cyclones, has led to saltwater entering many of these sources, reducing the amount of safe water available for drinking and daily use.

### 5.2 Salinity intrusion and health risks

When sea water floods villages during cyclones or high tides, it fills ponds and seeps into shallow groundwater. This salty water is not only unpleasant to drink but also harmful to health, causing skin problems, stomach illnesses, and high blood pressure. In some places, women walk long distances to collect a small amount of safe water.

### 5.3 Damage to water infrastructure

Cyclones often damage tube wells, storage tanks, and pipelines. Repair work can take months, forcing communities to depend on unsafe sources. After Cyclone Amphan in 2020, many villages faced acute drinking water shortages for weeks, relying on water brought by boats or trucks from other areas.

### 5.4 Sanitation problems

Sanitation facilities are also at risk in this fragile environment. Floods and tidal surges often wash away or damage toilets, and contaminated floodwater spreads bacteria and disease. During

disasters, open defecation increases, which worsens health risks.

- **Link between water, sanitation, and food security**

Unsafe water and poor sanitation can cause diarrhoea, cholera, and other diseases that reduce the body's ability to absorb nutrients from food. This means that even when food is available, people may still become undernourished. Therefore, achieving **SDG 6 (Clean Water and Sanitation)** is closely linked to achieving **SDG 2 (Zero Hunger)** in the Sundarbans.

## VI. Possible Solutions and Curriculum Integration

### 6.1 Climate-resilient agriculture

To address crop loss from salinity and flooding, farmers can adopt salt-tolerant rice varieties, floating vegetable gardens, and land-shaping techniques that raise crop beds above flood levels. Government agencies and NGOs can help by providing seeds, training, and small grants.

- **Curriculum link:**

Schools can include lessons on local farming challenges, sustainable agriculture methods, and climate adaptation. Students can participate in school gardens where salt-tolerant crops are grown, learning both theory and practice.

### 6.2 Water resource management

Rainwater harvesting and community-managed freshwater ponds are vital in a region with limited fresh water. Building **roof-based rainwater collection systems** for households and schools can help secure safe drinking water year-round.

- **Curriculum link:**

Science and geography classes can include modules on the water cycle, water safety, and building small rainwater harvesting models. Local



water-quality monitoring projects can be part of environmental science lessons.

## VII. Strengthening sanitation infrastructure

Raised, flood-resistant toilets and eco-sanitation systems can reduce the damage from tidal surges. Villages can adopt low-cost, locally made designs to make repairs easier after disasters

- **Curriculum link:**

Health education can include practical sessions on hygiene, waste management, and safe sanitation practices during floods. Students can join community clean-up and awareness drives.

## VIII. Community participation and awareness

Local clubs, women's self-help groups, and youth organisations can be involved in awareness campaigns on food security, nutrition, and safe water use. Sharing success stories from other villages can inspire community-led action.

- **Curriculum link:**

Social science and civic education classes can involve students in documenting local problems and proposing solutions through group projects, presentations, or small exhibitions.

## IX. Policy and institutional support

While community-level action is essential, government support in the form of subsidies for resilient crops, maintenance of water infrastructure, and early-warning systems for cyclones is equally important. Collaboration between local schools, NGOs, and administrative bodies can make solutions sustainable.

- **Curriculum link:**

Students can learn how local governance works, and older students can visit Panchayat meetings to understand how policies are made and implemented.

## X. Conclusion and Recommendations

The Sundarbans faces serious and interconnected challenges in achieving **SDG 2 (Zero Hunger)** and **SDG 6 (Clean Water and Sanitation)**. Climate change, frequent cyclones, saltwater intrusion, and fragile livelihoods threaten food security, while safe drinking water and sanitation remain out of reach for many communities. These issues not only affect health and nutrition but also limit the region's progress towards sustainable development. The review of global, national, and local studies shows that while several initiatives have been undertaken, many solutions fail to reach the most vulnerable groups or address the unique ecological and social context of the Sundarbans. Integrating local knowledge with modern technology, and strengthening community participation, are key to long-term progress.

- ❖ **Recommendations:**

**1. Climate-resilient agriculture** – Promote salt-tolerant paddy, mixed cropping, and integrated fish-rice farming to adapt to changing environmental conditions.

**2. Rainwater harvesting and filtration** – Encourage low-cost, locally managed systems for safe drinking water, reducing dependency on deep tube wells.

**3. Decentralised sanitation solutions** – Use eco-friendly toilets suited to flood-prone and waterlogged areas.

**4. Nutrition awareness programmes** – Organise school- and community-level campaigns linking dietary diversity with local food resources.

**5. School curriculum integration** – Include topics on climate change, sustainable farming, water conservation, and hygiene in local languages, using examples from the Sundarbans.

**6. Community-led monitoring** – Train local youth and women's groups to track water quality, crop health, and sanitation practices.



**7. Policy support and funding** – Advocate for targeted government schemes and NGO projects that address the specific needs of island and marginal communities in the Sundarbans.

By combining **practical solutions, local participation, and education-based awareness**, the Sundarbans can move closer to achieving SDG 2 and SDG 6 in a way that is both sustainable and community-driven. The lessons from this region can also serve as a model for other climate-vulnerable coastal areas in India and the world.

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