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**Short Communication**

# Effect of Cyclone Dana on Standing Rice and Contingency Strategies for Crop Resilience in the Indian Sundarbans Delta

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**The coastal zone of West Bengal is more prone to any type of weather aberrations and cyclones, which cause severe harm to the people of coastal habitats. It was just another occasion, when this area encountered a cyclone named *'Dana'* during 23rd to 25th October, 2024, which caused severe damage to all sectors, including agriculture. Immediately after that, roaming field surveys were conducted on 30th October and 1st November, 2024, to assess the direct impact of this cyclonic storm *Dana* on standing crops at eight (08) villages across Kakdwip, Namkhana, and Gosaba blocks of South 24 Parganas district of West Bengal. During this time, rice was growing as the predominant crop, and in a few pockets, cultivation of some seasonal vegetables was found. Among the observed effects, waterlogging in low-lying areas and stem-lodging of rice (10-70%) were widespread across most fields. However, certain rice varieties exhibited physiological resilience, which enabled them to withstand waterlogged conditions. Additionally, a notable incidence of pests and diseases was recorded with special mention to yellow stem borer, leaf folder, sheath blight, and rot. During the discussions with farmers, agricultural scientists provided suggestions and contingency crop measurements to estimate crop damage and documented the preventive measures already adopted by the farmers.**

(***Key words:*** *Coastal zone, Contingency measure, Crop damage, Dana, Rice)*

The coastal saline zone of West Bengal faces numerous challenges due to climatic anomalies. Particularly, people living in Sundarbans areas face poor livelihood options due to saline soil and groundwater, lack of good quality water during dry months, poor soil fertility, severe heat stress, etc. (Sau *et al.*, 2024). They mainly rely on cultivating rice during the *Kharif* season and keep the field fallow in the subsequent seasons due to a lack of resources (Sarkar *et al.*, 2024). Cyclones are among the deadliest abiotic stresses, annually devastating coastal villages and crops (Mandal *et al.*, 2024). Strong winds destroy homes, livestock, trees, and farm infrastructure, while storm surges inundate fields with saltwater, causing immediate crop loss and long-term soil salinity, severely undermining farmers' livelihoods and agricultural productivity (Ayyam *et al.*, 2019). In coastal saline zones, *Kharif* rice is the primary crop cultivated during the monsoon season (Sarkar *et al.*, 2024). *Rabi* cultivation is restricted by freshwater scarcity, while rice productivity is reduced by soil salinity, inadequate irrigation, pest pressure, and cyclones that affect the crop at all growth stages (Chatterjee *et al.*, 2016). Cyclones are large-scale spiraling low-pressure systems. Cyclone *Dana*, named by Qatar, formed over the Bay of Bengal on October 23, 2024, intensifying into a severe cyclonic storm. It made landfall along the Odisha - West Bengal coast between October 24 - 25 with winds of 100 -110 km $h^{-1}$ and gusts up to 120 km $h^{-1}$ (Chatterjee and Gangopadhyay, 2025; IMD, 2024).

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Rainfall in our study area, *i.e.*, in Kakdwip, Namkhana, and Gosaba, was negligible on 21–22 October 2024. With the onset of Cyclone *Dana* from 23 October, rainfall increased sharply, peaking on 25 October (79.13 mm in Kakdwip, 85.18 mm in Namkhana, and 69.88 mm in Gosaba). Rainfall declined rapidly on 26–27 October (*IMD, 2024*).

The field surveys were conducted on 30$^{th}$ October, 2024, at two villages of Kakdwip block (Kshirishtala and Akshyanagar) and three villages under Namkhana block (Rajnagar, Radhanagar, and South Durgapur). Then three villages of Gosaba block (Rangabelia, Sukumari, and Hentalbari) of South 24 Parganas of West Bengal were surveyed on 1$^{st}$ November, 2024, which falls under the coastal saline zone of West Bengal to evaluate the immediate effects of cyclonic storm *Dana* on existing crops (Fig. 1). The roaming survey was co-organized by experts from Rice Research Station (RRS), Chinsurah, Hooghly, West Bengal, and Ramakrishna Mission Vivekananda Educational and Research Institute, Narendrapur, West Bengal. The concerned block Assistant Director of Agriculture and the concerned Sub-divisional Agricultural officer helped to conduct the survey work. The field study was carried out in two phases. First, a field visit was performed in the study areas by the experts to witness the direct effects of the cyclonic storm on standing crops. Thereafter, a household survey using a standardized questionnaire was performed. Both qualitative and quantitative data were received from fields as well as from farmers to properly assess every aspect of the impact caused by *Dana*. The household survey employed a purposive stratified random sampling design to ensure adequate representation of diverse farming households across the study area. Three blocks of South 24 Parganas were purposively selected based on their agricultural characteristics, and eight villages within these blocks were chosen to capture spatial and socio-economic variability. Farmers were stratified according to landholding size and resource-use patterns, creating distinct categories from which respondents were randomly selected. From each village, 20 households were surveyed, maintaining proportional

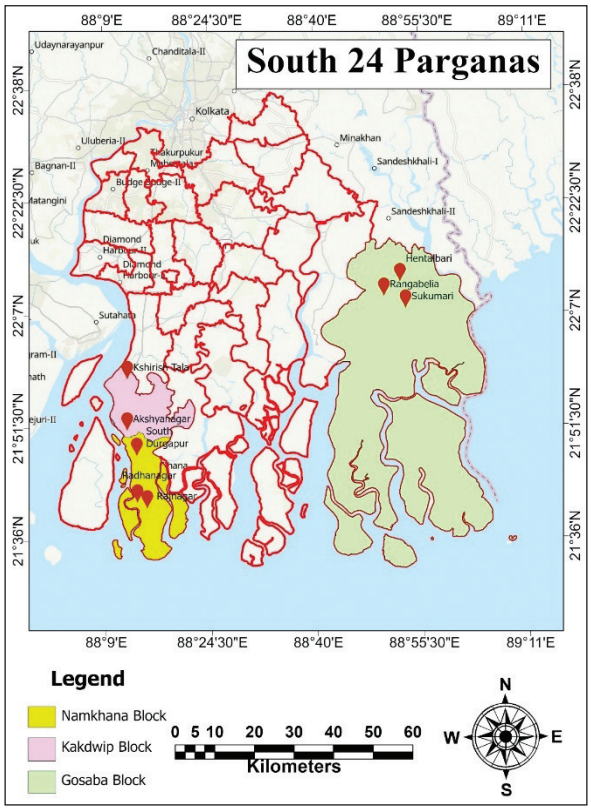



***Fig. 1.*** *Location map (in scale) of the study areas*
*(Map is created using ArcGIS Pro software but not for commercial use)*

representation of the identified farmer groups and minimizing selection bias. In total, 160 households (n = 160) formed the final sample, providing a robust and sufficiently large dataset for meaningful analysis while ensuring feasibility in field data collection. Data were recorded about different parameters such as lodging percentage, pest attacks, changes in crop morphology, prevention methods taken by farmers to prevent crop damage, and plant protection measures adopted by the farmers to withstand the disease pest infestation. The crop lodging percentage of the *Kharif* rice was calculated based on visual symptoms identified by the experts. After evaluating the current crop situation, the experts gave recommendations in relation to mitigation strategies for the post-cyclone period.

**Impact of cyclone *'Dana'* on standing crops**

During the survey, *Kharif* rice was the dominant crop, with fields largely occupied by indigenous and high-yielding varieties. Cucurbit vegetables were occasionally grown on field bunds or in stacks, while sack-based vegetable cultivation and a few *Pan Boroj* for betelvine were observed in Gosaba. Most fields were submerged with 5–10 cm water. Long-duration rice varieties were at the booting stage, medium-duration varieties at grain filling, and early varieties at maturity. Plant height ranged from 140–170 cm with 5–6 leaves and 8–12 effective tillers per plant. Lodging was more common in tall varieties, particularly *Dudheshwar* (60–70%), moderate in other indigenous varieties (20–30%), and minimal in dwarf high-yielding varieties (5–10%). The prevalent standing crops, along with their varieties, are presented in Table 1.

**Disease-pest incidence on crops**

Incidents of diseases and insects were recorded from the fields during the post-cyclonic era. The weather resulted due to the storm was very favorable for pests and disease attack, it provided a moist environment for proliferation. However, after the cyclone, pest and disease incidence in the study areas was generally low to moderate. Yellow stem borer infestation remained slight (3–7%), while leaf folder damage was minimal (1–5%). Sheath blight showed comparatively higher severity, ranging from medium levels of 20–33%. Sheath rot incidence was low, recorded at only 2–4%.

Pest damage in rice remained low after Cyclone *Dana*, as heavy rainfall and strong winds created unfavorable conditions for insect survival and

***Table 1.*** *Prevalent crop and its varieties observed during the survey*

| Sl. No. | Crop | | Variety | | |
|---|---|---|---|---|---|
| | | | Namkhana Block | Kakdwip Block | Gosaba Block |
| 1. | Paddy (*Oryza sativa* L.) | High-yielding variety (HYV) | *Swarna* (MTU 7029), *Barsha,* CR 1075, *Mali-4, Dhanurban* | *Pratiksha, Mali 4, Malati 4,* BB 11, CR 1075, | CR 1017 (*Dharitri*), CR 1018 (*Gayatri*)*, Shreya, Jay Shriram, Pratiksha* |
| | | Traditional Indigenous (desi) Variety | *Dudheswar, Santoshi* | *Dudheswar, Dharamshal, Santoshi, Sonali* | *Gobingabhog, Dusheshwar* |
| 2. | Bitter gourd | | *Samurai 786, Bolder, Megha* | *Samurai, Bolder, Megha* | *Akash, Megha* |
| 3. | Cucumber | | *Hangama, Macha* | *Seven star, Macha, Hangama* | *Kumud* |
| 4. | Sponge gourd | | | *Anushka* | |
| 5. | Bottle gourd | | | *Ganga Jamuna* | |
| 6. | Ridge gourd | | *Barapatta* | *Barapatta, Aarti* | *Aarti* |
| 7. | Betel vine | | | *Meetha Pati* | |

reproduction, suppressing pest populations. Although pests were observed in all three blocks of South 24 Parganas, their incidence varied significantly. Yellow stem borer (dead heart) was highest in Kakdwip (mean = 1.25), while white ear head incidence was greater in Namkhana (mean = 2.83). Leaf folder infestation peaked in Kakdwip (mean = 2.0), whereas rice bug damage was more serious in Namkhana (mean = 2.5).

Given these circumstances, agricultural authorities advised farmers to refrain from applying insecticides during this period, as pest control measures were deemed unnecessary and could have led to avoidable environmental and economic costs.

**Morphological adaptations in rice to withstand waterlogging**

Flood-inundated rice exhibited adaptive morphological responses that enhance survival under waterlogging. Kneening ability enables plants to bend at basal nodes and regain an upright posture after flooding or lodging, thereby protecting reproductive organs (Goswami *et al.*, 2017). Rapid stem elongation in deep-water rice helps maintain the growing tip above rising floodwater, ensuring aeration and continued photosynthesis (Anandan *et al.*, 2012). Additionally, the development of nodal tillers and roots from upper submerged nodes facilitates oxygen and nutrient uptake near the water surface, supporting growth under prolonged flooding conditions (McCully and Canny, 1988). The suspected yield loss of rice ranged between 10-20% in the Namkhana block and the Kakdwip block while a very low (5-10%) yield loss was suspected in the Gosaba block.

**Recommendations provided to the farmers by the agriculture experts**

Based on the current field surveys, recommendations were given by the experts to the farmers to enhance the health of the crop and reduce yield loss. The recommendations are listed below:

i) Ensure that field drainage channels remain open to facilitate the removal of excess water. If necessary, use pumps to drain stagnant water from the field.

ii) Gently upright clusters of 3–4 rice hills and securely tie them together to help the plants stand erect and recover.

iii) Less application of nitrogenous fertilizers and promote the application of potassic fertilizers to reduce disease and pest infestation were recommended to the farmers.

iv) The application of any insecticides was not recommended at this stage, as the infestation levels of Yellow Stem Borer (YSB) and Leaf Folder (LF) were minimal and below ETL level, and the crop was nearing maturity. Moreover, insecticides are ineffective against the ‘‘white ear head’’ symptoms caused by YSB, which was also recorded. No incidence of Brown Planthopper (BPH), Green Leafhopper (GLH), or rice bug has been observed.

**Need for contingency crop measures to prevent and mitigate adverse effects of cyclones**

The coastal saline zone of West Bengal is a highly vulnerable ecosystem, significantly impacted by climate change and unpredictable monsoon patterns (Banerjee *et al.*, 2023). Since agriculture in this region is entirely dependent on the monsoon, any weather irregularity poses a serious threat to crop production. Among various climate-induced challenges, cyclones are the most devastating, occurring frequently and causing partial or complete crop loss. This region has been repeatedly struck by severe cyclonic storms such as *Aila, Hudhud, Amphan, Yaas,* and, more recently, *Dana*, all of which have severely disrupted agricultural activities and livelihoods. Given the recurring climatic hazards, particularly cyclones, and their detrimental effects on crop production, it is crucial to implement contingency crop planning to safeguard this fragile ecosystem. To mitigate the damage caused by cyclonic events, specific post-cyclone crop management strategies should be adopted, as outlined in the following table (Table 2).

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***Table 2.*** *Contingency measures to prevent adverse effects of cyclone on field crops*

| Sl. No. | Short-term strategy | References |
|---|---|---|
| 1. | Improved drainage facilities and excess water should be drained out of the field. | Banerjee *et al.* (2023); Banerjee *et al.* (2019) |
| 2. | To reduce excessive salt from the soil, cultivate *dhaincha*, salinity salinity-tolerant leguminous plant, which not only reduces soil salinity but also improves soil fertility by adding organic matter. | |
| 3. | Apply organic amendments to neutralize the soil salinity level, such as FYM, Vermicompost etc. | |
| 4. | In situ water harvesting for storing fresh water and leaching of salts from the fields. | |
| 5. | Cultivation of salinity and submergence-tolerant paddy varieties suitable for this locality, including *Getu, Hamilton, Tilak, Sitashal, Patnai 23, Dudheshwar, Rupshal,* etc., salt tolerant high yielding paddy varieties like CSR-4, CR-1017, *Jatayu,* CSR-23, 13, *Lalat, Sabita, Swarna, Masuri, Santoshi, Swarna* sub-1 etc. can be effectively grown in lowland situation with moderate salinity. | |
| 6. | Adoption of climate-resilient nursery management like Staggered Nursery, Community Nursery, and Dapog Nursery. The seedlings may be distributed among the farmers of the affected villages through the local agricultural representatives. | |
| 7. | Multi-storey vegetable cultivation in the paddy field is an alternate approach to growing vegetables when the entire field is inundated with flood water. | |
| 8. | Adoption of salt-tolerant fodder like Karnal grass and para grass can be cultivated on unutilized land for cattle consumption. | Sarangi *et al.* (2019) |
| Long-term strategy | | References |
| 1. | Soil tests from locally available laboratories and need-based fertilizer applications are crucial for sustainable soil and crop management. | Banerjee *et al.* (2023); Banerjee *et al.* (2018) |
| 2. | Land shaping model for freshwater harvesting and their alternate use. | |
| 3. | The application of seed priming agents before sowing of seed is essential for increasing seed vigour, robust seedling growth, and providing resistance against insect pests. | |
| 4. | Seed treatment with biofertilizers, such as *Rhizobium,* VAM, PSB, and biostimulants like seaweed sap is effective in contributing strength to the crop. | |
| 5. | Combined application of inorganic and organic fertilizers is important for maintaining soil, plant, and environmental health. | |

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## CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could appear to influence the work reported in this paper.

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