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Rejuvenating Rice Fallow Lands in West Bengal Using Remote Sensing and GIS

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Executive Summary

Background:

Agriculture remains the predominant source of livelihood in rural India. Despite contributing only 17.7% to the Gross Domestic Product (GDP) at current prices, the sector accounts for 42.3% of total employment nationwide. Over the past five years, agriculture has recorded an average annual growth rate of 4.2%. However, in 2023-24, growth decelerated sharply to 1.4%, compared to 4.7% in 2022-23. This slowdown was largely driven by reduced food grain output, resulting from delayed and erratic monsoon patterns (Economic Survey 2023-24, Government of India).

Rice fallow land refers to agricultural fields where rice is cultivated only during the Kharif (monsoon) season, but the land remains uncropped during the subsequent Rabi (winter) season, often for several consecutive years. This practice is generally driven by constraints such as inadequate irrigation facilities, poor soil health, and socio-economic limitations. Despite lying idle in winter, these lands retain residual soil moisture after the Kharif crop harvest, which can support the cultivation of short-duration crops such as pulses, oilseeds, millets, and other drought-tolerant varieties.

The study highlights that rice-fallow land dynamics in West Bengal are spatially diverse and shaped by the interplay of biophysical, socioeconomic, and institutional factors. By integrating remote sensing, GIS, and field-level verification, the research distinguishes rice fallows that can be readily converted from those that require more intensive rehabilitation. It further demonstrates that targeted, place-based interventions have the potential to transform underutilized post-rice lands into productive Rabi cropping systems, thereby enhancing farm incomes and strengthening local food security.

Objectives of the Study:

i. *To map the existing land use and land cover of West Bengal using GIS and Remote Sensing.*
ii. *To assess the status of current rice fallow lands across selected districts of West Bengal.*
iii. *To analyse farmers' perceptions and reasons for not cultivating rice fallow lands.*
iv. *To evaluate the impact of existing policies and programmes related to fallow lands.*
v. *To propose targeted policy measures for sustainable agricultural intensification.*

This study utilized both primary and secondary data to ensure a comprehensive analysis. Primary data were collected through a digital survey administered via the Kobo Toolbox, focusing on key aspects such as the current status of rice fallow lands, the underlying reasons for non-cultivation prior to the TRFA period, and the perceived impact of existing Government policies and programmes.

Secondary data was sourced from official government repositories, including the Department of Agriculture and Farmers' Welfare. These datasets were used to contextualize and enrich the primary findings, offering a broader understanding of the study area and the challenges associated with rice fallow land utilization. The reference period spans two Separate agricultural years for the primary survey: 2015-16 (pre-TRFA implementation) and 2023-24 (TRFA scheme is currently running), which enable a comparative assessment of changes over time. The study employed a cluster-based sampling approach to identify both the study areas and respondents. Two districts were selected based on their relatively higher concentration of beneficiaries under cluster-based demonstrations for the TRFA Scheme (pulses and oilseeds). Within each selected district, two villages were chosen, yielding a total sample of 144 households (HH). An important note is that 4 sample villages are mentioned here, but actually we take the data from 6 different mouzas (Aoyshberia, Kamlakantapur,

Khanjanpur, Khordanahala, Kuchli, Simla) under two sample districts; i.e., Birbhum (Kamlakantapur, Khanjanpur, Kuchli) and South-24 Parganas (Aoyshberia, Khordanahala, Simla). This study utilized both primary and secondary data to ensure a comprehensive analysis. Primary data were collected through a digital survey administered via the Kobo Toolbox, focusing on key aspects such as the current status of rice fallow lands, the underlying reasons for non-cultivation prior to the TRFA period, and the perceived impact of existing Government policies and programmes.

Major Findings:

The major findings of the study are summarised below:

I. From secondary data analysis, it is found that the current fallow areas in West Bengal decreased to 244162 hectares in 2020-21 from 348330 hectares in 2000-01. It is also important to note that in our two sample districts (South-24 Parganas and Birbhum), this figure declined significantly (See Appendix, Table A1).

II. It is also seen that through GIS mapping and remote sensing technique (source: ADRTC, Bengaluru, KSRSAC and ISRO), total fallow land declined to 1951892 hectares in 2023-24 from 2173029 hectares in 2020-21 in West Bengal and from the same source, it is evident that paddy area in West Bengal decreased as well, which is a bit contradictory.

III. The calculation of the change in fallow land from 2020-21 to 2023-24 is based on data provided by ADRTC, Bengaluru, KSRSAC, and ISRO, and it is found that the reduction in rice fallow land is extensive in Nadia district.

IV. In case of Paddy area in the period 2016-17 to 2022-23, Alipurduar, both Uttar and Dakshin Dinajpur in northern part, South 24-Parganas, Jhargram of southern part of West Bengal has recorded moderate increase in paddy area (10% to 30%), while Purulia, Nadia, and Howrah has evidenced moderate decline (10% to 30%) in paddy area, while districts like Purba Barddhaman, Purba Medinipur, Hooghly, North 24-Parganas in the southern belt and Maldah, Cooch Behar, Darjeeling, Kalimpong have recorded slight fall in paddy area (10% or less).

V. The highest increase in rice production (in percentage) has occurred in Alipurduar (46.2%), followed by South-24 Parganas (36.73%) and Jhargram (30.76%), all of which are over 30%. So, in that case, South Bengal is represented by several districts. But it is also notable that Paschim Barddhaman, Murshidabad, and Birbhum experienced the largest decline in rice production (over 30%), underscoring the need for district-centric planning. It may be due to crop diversification away from rice, as paddy areas have also decreased by over 30 per cent in these three districts. So, it can be concluded that, overall, North Bengal is a better performer than South Bengal in terms of the percentage change in rice production during the period 2016-17 to 2022-23.

VI. Districts like Murshidabad, Paschim Barddhaman, and Kalimpong experienced moderate to large declines, while southern and certain eastern districts, including South 24 Parganas, Purba Medinipur, and Cooch Behar, recorded significant increases. When the mapped categories are read alongside the district-level data, it becomes clear that the most notable gains in yield were achieved in Cooch Behar, Alipurduar, Purba Medinipur, and South 24 Parganas, each registering double-digit growth, with Cooch Behar leading with 18.77 percent. In contrast, Paschim Barddhaman (-14.16%) and Kalimpong (-12.11%) recorded

moderate decreases (ranging from 10% to 30%), while Murshidabad and Maldah also showed slightly negative trends, within the range of 10% or less10% range. Several districts, such as Nadia, Birbhum, and Purulia, remained relatively stagnant with negligible changes.

VII. According to the primary survey, prior to the Targeted Rice Fallow (TRFA) scheme's implementation, i.e., before 2016-17, all sample households (HH) had fallow land; among them, 80% of HH owned fallow land, and the rest had leased-in land, leased-out land, including fallow land. But now, after the implementation of the TRFA scheme, all surveyed HHs do not have any current fallow land. It is evident that 35% of farmers received pulse seeds and 65% received oilseeds in Birbhum (2023-24). In South-24 Parganas, 94% of farmers received pulse seeds, and 6% received Oilseeds.

VIII. Among all sample HH, 35% cultivated oilseeds (Mustard), and the remaining 65% cultivated Pulses (Like Lentil, Green Gram or Moong bean, Grass pea, Khesari bean, Chickpea) were provided by respective Agricultural Departments (Under the TRFA scheme).

IX. It is evident that, as per irrigation sources, wells and tube-wells were placed first (50.7%), followed by canal irrigation (34.7%), river lifting irrigation (11.1%) and lastly, rainwater harvesting (3.5%).

X. But, looking into several methods of irrigation, most of the farmers (97.9%) are using surface irrigation, followed by drip irrigation (2.1%). There are various methods, including surface irrigation (Flood, Basin, Furrow), well and tube-well (50%), canal irrigation (35%), river lifting irrigation (11%), and rainwater harvesting (4%).

XI. A few questions were asked of sample farmers about the need for any training or capacity building programmes, and it was found that 87.5% of farmers are keen to take this facility, whereas 12.5% are not interested. It is also noted that among these, 87.5% of farmers reported these arrangements in Kharif-June to the Early days of November (52.5%), followed by Rabi-November to March (42%) and Summer-March to June (5.5%). So, it can be prescribed that the potential season is kharif, i.e., the pre-sowing period for Pulses and Oilseeds.

XII. It is also asked about the effectiveness of the TRFA scheme: 83% of farmers preferred it, while 17% found it ineffective.

XIII. Therefore, from farmers' perceptions about the weakness of this TRFA scheme, 61% have answered in favour of weakness, along with suggestions, and the remaining 39% did not give any suggestions.

XIV. In case of exploration of non-cultivation of rice fallow land prior to the TRFA period, it is evident that 88 responses have gone to climate vulnerability, followed by water scarcity (73 responses).

XV. The impact of the TRFA scheme's initiative in the two sample districts, i.e., Birbhum and South 24-Parganas districts under West Bengal: before launching the TRFA scheme, the total rice fallow area across the two districts was 62.96 acres, with Birbhum accounting for 37.39 acres and South 24-Parganas for 25.57 acres. But after the intervention of the TRFA scheme, this area is reduced to 52.83 acres in total, resulting in a combined reduction of 10.13 acres of

fallow land. Birbhum recorded a decrease of 4.49 acres, whereas South 24-Parganas achieved a slightly higher reduction of 5.64 acres of rice fallow area.

Policy Implications

I. In case of awareness of the different Governmental Schemes, it is seen that most of the sample farmers are aware and have benefited from the Targeted Rice Fallow Area (TRFA) scheme under the National Food Security Mission (NFSM). An interesting thing to note is that the remaining 79 sample farmers gained awareness from us about the TRFA scheme, and then they could relate to it. 22 sample farmers were aware but could not cultivate, while 5 could not relate to it. So, all these 27 farmers cultivated it at their own cost. They also suggested various reasons, such as untimely seed disbursement, poor seed quality, insufficient seed quantity, and insufficient information, which call for a holistic development of extension services.

II. Some suggestions were given from farmers' perspective, like regularizing the policy, increasing the seed amount, and seed quality should be better, timely provision of seeds mainly before sowing time, creating a soil health testing facility, attaching a training facility, providing cash benefits or input subsidies, and flood management and crop insurance are needed.

III. Deployment of demonstration plots and farmer field schools to show zero tillage, relay cropping and residue management in local conditions can be introduced. Also, policymakers have to ensure logistics, such as seed distribution calendars tied to sowing windows and mobile advisories, for timely action.

IV. In case of providing irrigational facilities policy, the government should plan to introduce scaling of farm ponds, community recharge structures, repaired minor canals and low-cost micro-irrigation to enhance residual moisture and enable reliable rabi cropping. Also, promote water-saving practices, such as alternate wetting and drying where applicable, and protective irrigation scheduling for critical crop stages. In terms of the financial model, small capital grants for community ponds, along with microcredit for pump and drip installations.

V. Strengthen Farmer-Producer Organizations and accumulate platforms to reduce transaction costs and secure market access for pulses and oilseeds. Introduction of assured procurement windows or price support during the initial scaling phase to risk management implementation for smallholders. Expand crop insurance and credit products aligned to the rice-fallow calendar and the specific risk profile of second-season crops.

VI. Establishment of district coordination cells that bring together agriculture, water resources, soil health, panchayats and local NGOs to plan, implement and monitor rejuvenation efforts. Ensure participatory planning with farmer groups so interventions reflect local labour availability, cropping preferences and socio-economic realities. Apart from that, align central schemes (TRFA, BGREI, NFSM) with state and district plans to diminish fragmentation and influence co-funding.