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I am Anmol Mohak currently pursuing my Master's in Disaster Management and Risk Reduction from IIT Guwahati. I hold a Bachelor's degree in Mechanical Engineering from KIIT University, Bhubaneswar, and have professional experience as a deputy manager at TSDPL. Additionally, I have actively contributed as a member of the ISHARE Society. Beyond my academic and professional pursuits, I am deeply passionate about machine learning and data analysis techniques. I believe in leveraging these technologies to address complex challenges in disaster management and risk reduction, aiming for more efficient and effective solutions. My interest in machine learning and data analysis stems from their potential to extract valuable insights from vast datasets, which can significantly enhance decision-making processes and improve disaster preparedness and response strategies.

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Designing of “BIHU”: A harvester suitable for small farms of Assam

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6.1 Introduction

Rice (*Oryza sativa*) is a fundamental staple food in the Asia-Pacific region, contributing to over 90% of the global rice production and consumption (Papademetriou et al., 2000). In India, home to approximately 1.4 billion people, rice is the primary food source for 65-70% of its population, playing a pivotal role in the livelihood of millions of farmers and ensuring national food security (Abdullah et al., 2006). Assam, in particular, dedicates about 70% of its cultivated land to rice farming, accounting for 6% of the national rice area and 4% of India's total production (Mech, 2017). Enhancing productivity and improving resource utilization efficiency are critical to meeting the demands of a growing population.

6.2 Assam Context

Assam's rice cultivation encompasses three primary types: winter rice (sali), autumn rice (ahu), and summer rice (boro), each with distinct yield potentials (Bhowmick et al., 2006). The challenges faced by small and marginal farmers, such as labor scarcity and mechanization limitations, necessitate innovative solutions to improve their livelihoods and food security. The state's vulnerability to excessive and untimely rains, as well as river floods, significantly affects rice cultivation (Talukdar and Beka, 2005). Approximately 39.58% of Assam's total area is flood-prone, highlighting the need for effective flood management strategies (Borah and Barman, 2019).

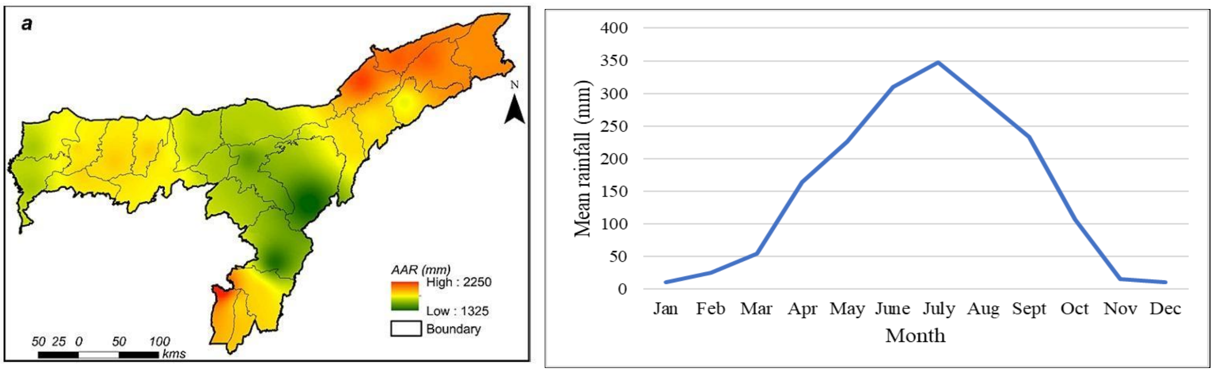

Figure 12: Assam Rainfall from (1981-2017) (Gogoi at al., 2022) (a) District-wise, (b) Month-wise

The prevailing flood situation shown in figure 12 highlights the crucial role that our product aims to fulfil, particularly focusing on small-scale farmers and those involved in seed-selling businesses. Figure 13 shows the area that is under seed cultivation. We can say that the large area is used to cultivate seed for paddy (summer + winter) therefore, rice dominates any other crop in Assam.

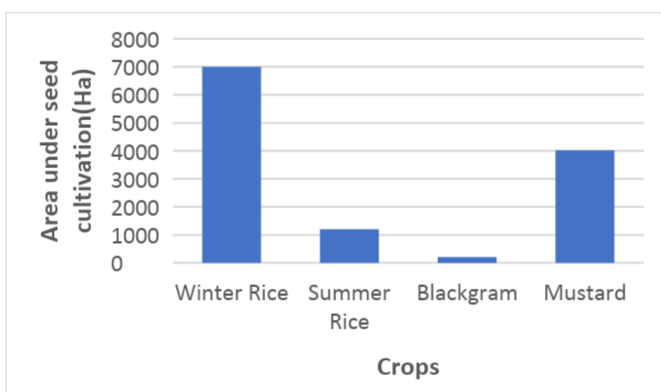

Fig. 13 Area under seed production for the year 2017-18 (Assam State Seed Certification Agency, n.d.)

During floods, labour shortages are rampant due to transportation hindrances and the inundation of family-owned land patches. Mechanization offers a solution to alleviate these labour constraints and enhance efficiency. Due to labour shortage, labour costs also increase as shown in Figure 14.

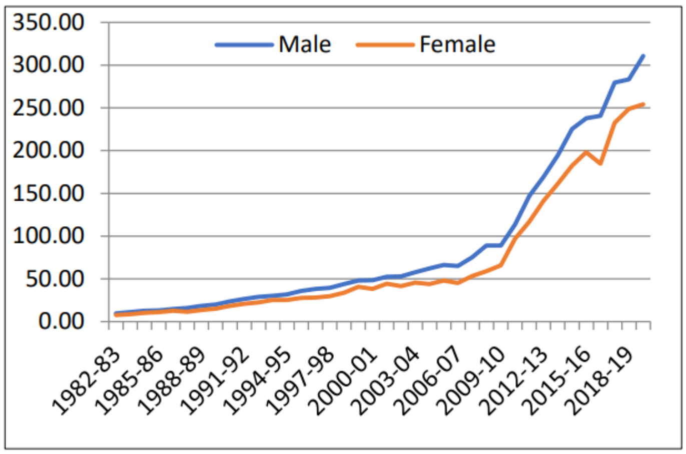

Fig. 14 Labour Cost (Saha at al., 2022)

However, challenges such as high machinery costs and limited access to credit impede widespread adoption among small-scale farmers. Existing issues such as traction problems in the soil and difficulties manoeuvring in small farms, necessitate a more adaptable and cost-effective solution. By integrating traditional techniques with machinery, our harvester seeks to optimize resource utilization while addressing specific challenges faced by paddy farmers in Assam, such as uneven terrain and flood-prone areas. The proposed design focuses on direct thrashing, reducing processing stages and promoting sustainability through the use of renewable materials like nylon or coconut husks for bristles. This innovative approach, tailored to local conditions, not only enhances efficiency but also contributes to more environmentally friendly agricultural practices, showcasing the

intersection of social innovation and sustainability in addressing pressing agricultural challenges.

6.3 Impact of Rain just before harvesting

Rainfall just before harvest poses significant challenges for seed producers, impacting both the quality and quantity of the seed yield in various ways. Preharvest sprouting induced by rain can lead to seed quality degradation, rendering seeds nonviable for future planting (Foolad et al., 2007). Additionally, wet conditions favor the proliferation of diseases and pests, such as rice blast caused by *Pyricularia oryzae*, compromising seed health and future crop yields (Talbot, 2003). The increased moisture content complicates seed processing and storage, potentially leading to mold or decay, which adversely affects germination rates (Nelson, 1980). Yield loss is another critical concern, as lodging from rain can reduce the available seed stock for sale or future planting, impacting the economic viability of seed production (Setter et al., 1997). Furthermore, the economic implications extend beyond immediate yield loss, affecting the cost of disease management, drying, and storage, thereby impacting overall profitability (Gooding et al., 2003). The market reputation of seed producers is also at stake, as the sale of poor-quality seeds can damage their reputation and have long-term business implications (Lacey, 1991). To mitigate these risks, farmers need to adopt strategic planning and management practices, such as utilizing covered or raised drying areas, investing in disease-resistant seed varieties, and implementing rigorous quality control measures (Bewley et al., 2013). Harvesting challenges due to wet soil conditions further exacerbate these issues, highlighting the need for timely and efficient harvest strategies to minimize quality and yield losses (O'Sullivan et al., 1999).

6.4 Places Visited

The primary research phase of this project aimed to complement the theoretical insights gained from the literature review with practical, on-the-ground perspectives. Through a combination of interviews with local farmers (Rangia, Jorhat, Dole Gaon) and a visit to Assam Agricultural University in Jorhat, a fundamental understanding of the challenges and opportunities in rice cultivation in Assam was sought. (Figure 15).

Fig. 15 Places visited for fieldwork.

6.5 Conclusion

The exploration into the challenges and opportunities of rice cultivation in Assam underscores the critical need for innovative agricultural solutions tailored to the unique environmental and socio-economic contexts of small-scale farmers. The adverse impacts of pre-harvest rainfall, including seed quality degradation, increased disease and pest incidence, and the subsequent economic and reputational damages, highlight the vulnerability of the agricultural sector to climatic variabilities. Moreover, the field visits and interactions with local farmers have provided invaluable insights into the practical challenges faced on the ground, such as labor shortages, mechanization barriers, and the specific needs for efficient, cost-

effective harvesting solutions. These findings underscore the importance of developing a harvester that not only addresses the immediate challenges of seed quality and yield loss but also contributes to the broader goals of sustainable agriculture, economic resilience, and food security in Assam. The proposed "BIHU" harvester is envisioned as a step towards realizing these objectives, offering a practical, innovative solution designed with the needs of Assam's small-scale farmers in mind.

6.6 Proposed Design

The "BIHU" harvester is designed as a human-carried device, aimed at addressing the unique challenges faced by small-scale paddy farmers in Assam, particularly in the context of pre-harvest rainfall and its associated impacts. The design of "BIHU" focuses on simplicity, efficiency, and adaptability to the small and uneven terrains typical of Assam's agricultural landscape. The harvester integrates three main processes:

- **Dislodgement: The device employs a gentle yet effective mechanism to dislodge grains from the stalks, minimizing damage and loss. This process is crucial for maintaining seed integrity, especially in wet conditions that may predispose the grains to pre-harvest sprouting and fungal infections.**
- **Suction: Following dislodgement, the "BIHU" harvester uses a suction mechanism to separate the grains from the chaff and other debris. This step is designed to ensure the cleanliness of the harvested grains, reducing the need for extensive post-harvest processing and thereby saving time and resources.**
- **Collection: The harvested grains are then collected in a storage**

unit attached to the harvester. This component is designed for ease of handling and efficiency, allowing for continuous operation and minimizing the need for frequent emptying.

The "BIHU" harvester's design incorporates materials and components that are locally available, durable, and cost-effective, such as nylon or coconut husks for the bristles used in the dislodgement process. This consideration not only makes the harvester accessible to small-scale farmers but also supports local economies and promotes sustainability. By reducing the stages involved in processing and employing renewable materials, the "BIHU" harvester aligns with the principles of environmental stewardship and social innovation, offering a practical solution to the challenges of rice harvesting in Assam's flood-prone areas.

In summary, the "BIHU" harvester represents a targeted approach to enhancing agricultural productivity and resilience in Assam, addressing the specific needs of small-scale farmers while contributing to broader objectives of sustainable development and food security.

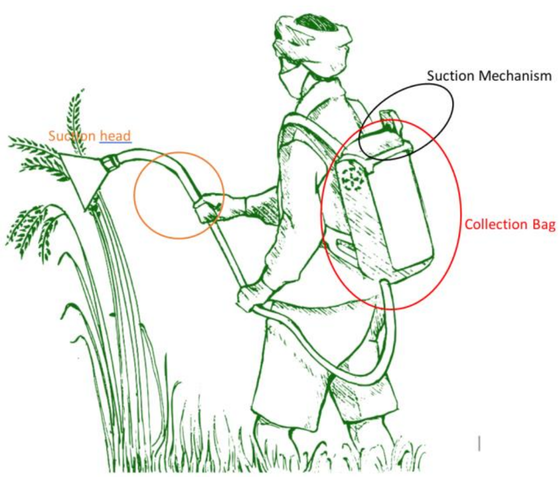

Figure 4: Proposed Design

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