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Paddy Rice (*Oryza sativum*) Production and Processing in Nigeria: A Review

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Abstract

Rice stands as a crucial staple in Nigeria, where its substantial population renders the country and the region as the largest rice consumers. The demand for rice has surged in recent times, transforming it into both a vital food supply chain and cash commodity crop for the developing world. Virtually ubiquitous applied in daily food menu' of Nigerian diet, the high demand for milled rice in Nigeria is significantly increasing with the increasing population which was estimated at 5.2 million tonnes with an average national production of 3.3 million metric tonnes. These results showed a supply and demand gap average of 1.9 million metric tonnes which necessitating rice imports. While rice processing capacity in Nigeria reaches 2.8 million metric tonnes for paddy rice annually, which covers half of the annual requirement, survey indicates that quality of domestically processed rice is inferior to imported varieties, marked by broken rice, foreign matters, stones, dirt and debris. This led to diminished quality interest in local rice preferring the imported with international quality. An uncompetitive standing of domestic rice both local and global markets present a significant challenge to rice production in Nigerian industries. Consequently, this review aims to assess paddy rice production, processing, consumption, as well as postharvest handling and storage methods in Nigeria. The full mechanization of rice-processing operations is advocated to reduce paddy rice handling time and minimize deterioration, a key factor contributing to subpar milled-rice quality. It is imperative for both the private and public sectors to intensify efforts toward local rice production to meet citizens' demands. Urgent investments into the production machinery, methods of processing, infrastructure and the policies set by the Nigerian Government and its agencies in rice processing chain are necessary to enhance the quality of processing paddy rice, which will ultimately elevate the quality of domestic rice products.

Keywords: Rice, production, consumption, processing and postharvest.

INTRODUCTION

Rice (*Oryza sativa*) serves as a fundamental food in numerous African nations and various regions globally Maji *et al.,* 2017). Approximately one third of the Nigerian population relies on rice as a primary source of staple food (Udemezue, 2014). Recent declines in maize production have positioned rice as the second most crucial cereal globally, surpassing wheat (Imolehin *et al.,* 2000). Widely cultivated in tropical regions and areas with effective flood management, particularly in south-east Asia, rice is a predominant crop. The foreign processed rice brands imported into West-Africa originates from South-Eastern Asia. Among the African sub-Saharan countries, Western Africa leads in both rice production and

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consumption, contributing to 64.2% and 61.9% of the total in the region, respectively. West-African states including; Nigeria, Guinea Bissau, Liberia, d'Ivoire, Gambia, Guinea, Senegal, and Sierra Leone use rice as a staple food, except in Niger republic and Burkina Faso where river Niger drainage system dominates the cultivation of rice. Nigeria, holds the top position in both production and consumption with about 50% than the other West African states (Imolehin *et al.,* 2000).

Rice in Nigeria stands as the predominant food crop, thriving across diverse ecological zones starting from the Sahel in the north to Savannah grass lands in the north-central, the mangrove rain forest in south east and the swampy regions in the south (Nahemiah *et al.,* 2004; Maji *et al.,* 2017). The country boasts a substantial landmass of 723,770 square kilometers, with an estimated 84 million hectares deemed suitable for crop cultivation. Out of this, 40%, equivalent to 47.62 million hectares, is utilized for crop cultivation, with a mere 10%, representing 21.0 million hectares, dedicated to rice production (GEMS4, 2017). The expansive available land for rice cultivation positions Nigeria as a potential global hub for expanding rice production, especially considering the limited opportunities for further expansion in major rice-producing regions worldwide. Presently, Nigeria not only leads as the major rice producer in Africa but also rank as one of the highest global rice importer (Danbaba *et al.,* 2019). According to available statistics, the year 2016 witnessed the production of approximately 17.5 M metric tons of the whole paddy rice generating enough raw material for an industrial utilization with an equivalent end product of 5.7 million metric tons goes to milled rice. However, this commodity falls short by an average of 1.3 million metric tons compared to the estimated national consumption demand of 7.0 million tons of milled rice, as reported by GEMS4 (2017). This production deficit carries significant implications for both food and nutrition security and foreign exchange.

Presently, Nigeria's rice consumption stands at approximately 47.0 kg - 34.0 per person annually. While, falls below the global average of 53 kg per person per year for milled rice, (FAO) of the United Nations anticipates a 4.5% growth annually in rice consumption only in Nigeria which suggests that from 2018, the demand for parboiled rice is expected to exceed 7 million tons, leading to a potential 70% to 80% as the overall Volume of milled rice consumed in Nigeria as reported by (National Rice Development Strategy, 2009).

The primary goal of this review was to evaluate the current status of paddy rice production in Nigeria, its post-harvest activities, storage and their impact on rice production and long-term food security. The objective also includes identifying key challenges and potential opportunities within the post-harvest handing operation and storage of rice attract investments to promote adequate and sustainable rice processing. The paper further outlines the contributions of research and development towards enhancing rice production, post-harvest processes, and storage operations. This analysis aims to optimize and provide future guidance for research initiatives and support systems that contribute to sustainable rice production, post-harvest activities, and storage systems (Ogundele and Okoruwa, 2006).

Production and Consumption of Rice as Staple Food in Nigeria

Cultivation of rice in Nigeria commenced dated back to (1500 BC), focusing on improvement of the low yielding indigenous varieties known as "*Oryza glaberima stued*," which was extensively cultivated in Niger Delta region (Ogundele and Okoruwa, 2006). Introduction of the higher-yielding *Oryza sativa* occurred in the 1980s. Presently, rice is cultivated across various ecological system in Nigeria, albeit on low scale production. Meanwhile, in the year 1967, the production of paddy rice in Nigeria witnessed an upturn, reaching a total output of

385 thousand metric tons (Danbaba *et al.,* 2019). During this period, 262 thousand hectares of land were cultivated given a total yield of approximately 1.47 metric tons per hectare as reported by (Godwin *et al.,* 2001).

Paddy rice production has experienced a significant surge in cultivated area, output, and productivity over the past two decades, reaching 66,000 hectares and 1.09 million metric tons (Imolehin and Wada, 2000). In 1980, Nigeria emerged as the foremost producer of rice in West Africa states and third largest producer in Africa, trailing with Madagascar and Egypt. In 1990, the country achieved a rice production of approximately 3.4 million tons from 1.2 million hectares. The initial success in sustaining this production capacity was hampered by inconsistent government policies on rice imports. There was a regulatory ban on the importation and exportation of rice since 1985 by the federal government which played a pivotal role in driving productivity over the subsequent decades, had this restriction in existence with the mandate of Nigerian rice farmers meeting the domestic supply for the commodity (Imolehin *et al.,* 2000).

The evolution of rice paddy production has seen remarkable growth, escalating with an increase in the cultivated areas expanding from 156,000 to 255,000 hectares. During the last two decades, advancements in productivity, cultivated area, and output have resulted in current figures of 66,000 hectares. In the West African region, Nigeria has consistently held the position of the largest rice-producing country and maintained its standing as the third-largest in Africa, according to the West African Rice Development Association (WARDA, 2003).

In the year (1990), the nation achieved an average rice production of (3.4 million tonnes) approximately one point two (1.2) million hectares. This regular production trajectory had been maintained with a consistent policies on rice importation as stated by (Imolehin and Wada 2000). Notably, rice experienced an upswing, attributed to the imposed ban on importation which must have likely spurred Nigerian rice farmers to meet the national consumption level.

FMARD, (2001) highlighted that disparities among the states in terms of both milled rice output and yield of the paddy rice. Literature showed that in the year 2000, Kaduna State emerged as the leading rice producer, contributing approximately 22% to the national rice output. Following closely were; Niger State had (16%), Benue State produce (10%), and Taraba State produce (7%) of the total national production. Significance was observed in the yield and productivity with an average national returns from the irrigation farming during the dry season with (3.05 tons/ha) compared to wet raining season with a total yield of (1.85 tons/ha). Presently, Nigeria stands as the top producer of rice in West African states, generating approximately (3.2 M tons-ha) annually (Damola, 2010).

Several endeavors have been undertaken to enhance rice production in Nigeria, with a pivotal role played by government Initiative plan on Rice spanning in 2004 - 2007. The primary objective to address the widening disparity between demand and supply in rice production, aimed for self-reliance and a substantial reduction in rice import expenditure. The initiative proposed a national rice project characterized by private sector leadership, grounded in an intensification policy. The plan included the utilization of NERICA varieties depending on the zone, alongside factors. Additionally, the government committed N1.5 billion to support the multiplication and distribution of certified rice seeds, furthering the agenda for rice self-sufficiency (Lenis *et al.,* 2009).

Nigeria possesses significant potential for rice production, considering factors such as ample land availability, a skilled workforce, and favorable climatic conditions. Despite these advantages, the current level of rice production falls short of meeting domestic consumption needs, leading to substantial rice imports. Thailand, renowned for high quality of parboiled rice, dominates the Nigerian market as a major rice supplier (Erhabor and Ojogho, 2011).

The percentage consumption rate per annuum has seen significant growth, rising from 3 – 15 kg which further increase to 22 kg in the year 2000, reaching an estimated amount of 27 kg in 2007 (NFRA, 2010; Bamidele *et al.,* 2010). The introduction of drought tolerant, high-yield rice variety, by "NERICA" (new Rice for Africa), along with government plans holds potential to augment domestic on the local rice production capacity and quality, thereby controlling high rate of dependence on imported rice and fostering self-sufficiency in rice production. As per the 2003 rice consumption survey, the yearly per capita rice consumption developed regions with specific cities like Lagos, Abuja, and Makurdi registering per capita consumption rates ranged within 64 - 72 kg per year, respectively (Bamidele *et al.* 2010).

In Nigeria, rice plays a crucial role for various reasons, notably plays a significant contribution to both Saharan and sub-Saharan regions. The country has historically cultivated two primary types of rice: In recent times have witnessed the introduction of new rice varieties, such as the hybrid rice strains developed by West African Rice Development Association (WARDA) called New Rice for Africa (NERICA). NERICA varieties is an inter-specific hybrid derived from crossbreeding of Asian - African rice varieties. Jones (1995) reported that, the West-African rice varieties, originate back in 35 centuries ago known as wild grain (O. barthii), with domestication likely occurring in Delta region of Nigeria. This point of origin spread across Niger-valley and subsequently throughout the West-African state (Imolehin and Wada 2000).

Rice displays extensive genetic diversity, harboring numerous varieties globally, contributing significantly for food security, ceremonial practices and nutritional composition, generates income as well as provides employment (Perez *et al.,* 2007). Notably, deep water variants of *Oryza glaberrima* thrive in specific flood conditions, particularly Niger Delta region, Rima valley in Sokoto and flood plains of the northern Nigeria. In local contexts, Nigerian indigenous goes by various names, which includes; "hakorin montol" in the Plateau/Nasarawa region, "jatau" (red) in Hausa and Chad-Basin region of the north. The adaptation of both gains significance in terms of human selection. While O. *glaberrima* varieties exhibit certain drawbacks compared to O. sativa such as; easy seed shattering, brittle grains challenging for milling, and lower yields, they offer unique advantages. These include tolerance to water depth fluctuations, resistance to iron toxicity, adaptability to infertile soils, and alignment with Africa's ecological conditions (National Research Council, 1996).

Asian rice was introduced in Nigeria has led to gradual displacement Nigerian indigenous variety, primarily as a result of it role to the former which gain high acceptance by the Nigerian farmer assigning local name based on the quality attributes or the individual who introduced them. It is noteworthy that different indigenous cultivars in different regions may in fact, represent single rice variety. Approximately about twenty five percent (25%) of rice is cultivated in rain-fed lowland areas of Nigeria's. Thus, particular ecological niche contributes significantly, accounting for 44% percent of the overall rice production (Imolehin and Wada, 2000). The lowland ecology encompasses of Fadama dam areas and deep/shallow Fadama coast. Distinctive characteristics of cultivation system is the requisite complete coverage with water at some point in period of cultivation (Moormann and Juo, 1986).

Rice Post-harvest Losses in Nigeria

The factors lead to losses in Nigerian are estimated within 20 – 40% according to Oguntade *et al.* (2014). These losses are of significant concern, especially given the annual production increase of about 10%. Therefore, addressing Rice Postharvest System (RPS) is crucial for sustainable improvement. Food and Agricultural Organization (FAO) of the United Nations, (2000) reports on the rice loss which make up to 45% of the overall annual production loss in west African countries, aligning with Oguntade *et al.,* (2014) findings. This suggests that in Nigeria 10-40% of the total rice produced never reach the market or consumers' tables due to inadequate post-harvest management (FAO, 2000).

These losses not only pose a food security and nutrition inadequacy but also contribute to the increased production costs and hinder the marginal yield increase observed at the farm level. In essence, if not effectively mitigated, rice post-harvest losses may lead not only setbacks for agricultural output but also substantial food waste. Developed countries, having adopted advanced agricultural technology, experience food loos mainly at consumer level (Aulakh *et al.,* 2013). In contrast, under developed African nation like Nigeria witness postharvest losses majorly from farm to marketplace with minimal loss (Olukunle, 2017).

Recent study conducted by Oguntade *et al,* (2014), state that there was a significant loss amounting to approximately (11.39%) incurred during paddy post-harvest stage. Losses at harvesting stage constitutes about (4.43%), while threshing and cleaning contribute (4.97 %), which includes; transportation from field to the warehouse resulting in (0.34%), paddy drying and storage make up 1.53%, and transportation of paddy to local markets represents 0.12%. At the secondary postharvest levels, particularly during the essential parboiling process, there is a 5.19% loss of paddy. Additionally, milling at the village level results in a 4.40% loss, and losses during milled rice transportation, marketing, and storage amount to 7.54%. Correlating this data with paddy rice processing plan in 2016, as reported by GEMS4 (2017), the post-harvest losses from harvest to market translate to a significant loss of (1.99 Million Metric Tons) of paddy rice, equivalent to (269.09 billion naira) annually, considering the market price of paddy at 135 Naira per kilogram as of November 2018. These substantial losses are unsustainable, especially when combined with an average cost of (123 billion naira) loss resulting from processing into milled polished rice (Oguntade *et al.,* 2014).

Post-harvest Practices and Technologies

Utilizing enhanced methodologies and intermediate technologies in the oversight of post-harvest activities for rice has proven to be the most secure approach for minimizing losses and enhancing productivity, particularly among smallholder farmers (Danbaba *et al.,* 2014). In Nigeria, post-harvest operations for rice predominantly involve manual processes with the utilization of outdated and rudimentary tools, leading to a decline in efficiency, milled rice quality, and overall competitiveness.

Harvesting Practices and Technology

The initial operation conducted upon the maturation of paddy is harvesting, a crucial step that demands timeliness and precision. Rice harvesting techniques is essential mitigating the potential paddy rice loss attributed due to many factors such as; rodent attacks, lodging, or shattering. In line with the prevalent practice in numerous Saharan and sub-Saharan regions with a substantial affecting farers employ the use of sickles for harvesting. The harvester is characterized by a circular made of iron metal carried a wooden handle, equipped with a sharp edge on the concave blades seamless active for trimming rice from the base as elucidated by (Danbaba *et al.*, in 2014).

Transformation Agenda Programme, utilize mechanical harvesters and reapers (Danbaba *et al.,* 2019). Typically, 6 to 12 persons are expended trims rice panicles using sickles. Following the threshing process, rice is frequently remain in the threshing ground for a brief period stalked before being bundled and then transported to designated area, where it is arranged in circular piles and subsequent threshing. Substantial losses occur when the paddy loss from the steak due to delay in threshing. Certain rice posing the challenge of uneven plant maturity consequently, the panicle-by-panicle harvesting method, involving the use of knives, is commonly observed, particularly in the delta region. This technique proves to be more labor-intensive and time-consuming compared to sickle-based harvesting. In numerous locations, a substantial workforce is enlisted to expedite the harvesting process. Noteworthy strides were made between 2011 and 2018, with different entities (public and private) supplying combined rice harvester known as (reapers) to the farmers for harvesting thereby reducing harvesting time and enhancing paddy quality. This enhanced harvesting methodology ensures superior grain quality, elevated market value, and heightened consumer acceptance of rice (Nahemiah *et al.,* 2004).

Primary Post-harvest Operations

Threshing and Cleaning Operations

Threshing serves as the subsequent step following the harvesting of matured paddy, aiming at separating paddy rice away from the straw (forage) while minimizing grain defects. Inadequate handling during threshing can result in losses, encompassing both Physical Harvest Grain Loss (PHGL) and Physical Harvest Quality Loss (PHQL), attributable to shattering and contamination with extraneous materials like sand, stones, clays, and other crop seeds. In Nigeria, manual threshing predominates, with mechanical methods reserved for larger irrigated fields due to limitations posed by hectare pf farmland and diverse crop cultivated. Traditional manual techniques involve beating harvested straw with wooden sticks, against metal drums or cemented vessels, tree trunks, or stones (Danbaba *et al.,* 2014).

The subsequent cleaning operation is essential for removing, foreign matters, stones, chaff, as well as impurities. Presently, manual cleaning of rice paddy can either be mechanized or manually using wing direction in Nigeria. During this process, the threshed paddy is tossed into the wind, resulting in the significant loss of lighter materials. However, materials with similar aerodynamic properties to rice are retained. The efficacy of the cleaning process depends on factors such as wind speed, labor experience, and workforce size (Danbaba *et al.,* 2014).

Notably, recent initiatives, such as the Agricultural Transformation Agenda introduced a popularized mechanical thresher and cleaning systems in paddy rice production across Nigeria through National Cereal Research Institute (NCRI), National Centre for Agricultural Mechanization (NCAM), Africa Rice Centre (AfricaRice) as well as Agricultural machinery companies, as a medium for improved agricultural productivity and advancement positively impact in paddy rice quality supplied to mills and created employment opportunities for youths, who operate these machines to provide services to local farmers (Danbaba *et al.,* 2014).

Paddy Drying

An establishment of automated irrigation system in certain regions in Nigeria, particularly; Kano, Kebbi, and Niger State coupled with adoption and improved rice cultivar such as; FARO coded 44, 52, 57, 60, 61, and 62, had enabled farmers to engage in biannual rice cultivation. The utilization of 90 days variety predominantly harvested in raining season has underscored the significance of the drying process in the post-harvest phase. The primary

objective of drying paddy rice is to decrease the level of water content to an optimum level for an extended shelf life, typically between 10% and 12%. In the case of steamed paddy, the moisture reduction is more substantial, ranging from 45-50 to 12%-14%, to facilitate secure storage or milling, preventing the occurrence of damage in the paddy rice that might lead to breaking in the course of milling processing (Danbaba *et al.,* 2014).

In Nigeria, the energy source for rice drying is predominantly direct sunlight, with its efficiency contingent upon prevailing weather conditions. Paddy exposed to prolonged periods of high-intensity sunlight may develop fissures, resulting in elevated levels of broken grains during milling. Traditionally, rice drying in Nigeria occurs on open grounds, along highways, and on mats. Unfortunately, these conventional drying practices expose the grains to contamination, as well as losses in the end products. Presently, an automated dryers are not readily in use except for large scale industries where polished rice are processed. Although the National Cereals Research Institute (NCRI) has developed drying equipment, such as the rotary dryer, its scalability and validation on an industrial level are yet to be tested. To address these challenges, the use of concrete platforms is gaining popularity as an alternative to traditional practices. Enhanced platforms with raised edges have been introduced to mitigate spillage and enhance overall drying quality (Imoudu and Olufaye, 2000).

Secondary Post-harvest Operations

Paddy Parboiling Practices

In Nigeria, a significant portion of harvested paddy, around 90% to 95%, undergoes parboiling before being introduced to the market. Parboiling is a hydrothermal treatment involving the soaking of paddy in hot water, followed by steaming and subsequent drying and milling (Danbaba *et al.,* 2014). However, traditional parboiling practices in the country are associated with considerable labor, excessive processing utility usage are on the increase for s standard milling industries (Bello *et al.,* 2015). This conventional method is deemed economically and environmentally unsustainable (Usman *et al.,* 2014).

The traditional parboiling process includes immersing of the paddy rice in water 2 - 5 days in aluminum pots. The contents is heated just boiling point of water to preserve heat. Periodic inspection occurs until paddy splitting, at which point is halted. The hot steamed paddy rice is drained and sundry to a moisture content of 10 to 14% (Danbaba *et al.,* 2011; Danbaba *et al.,* 2012). This traditional method can take 48 to 72 hours per batch of 50 to 100 kg paddy, often leading to partial fermentation or overcooking, resulting in offensive odors.

Despite drawbacks, rice processors have developed efficient drying methods through continuous practice. The sundry is carried out on a wide concrete slap where workers turn using wooden or plastic rakes for a homogeneity in dried end product. The drying time varies with weather conditions, ranging from a few hours in hot and dry weather to 2 to 3 days in cold and inclement weather. In areas with intense sunlight, some millers prefer drying steamed paddy under shade to prevent direct exposure to sunlight (Diack *et al.,* 2011). Unfortunately, in communities where sun drying is practiced, roadside drying exposes the steamed paddy to contamination from stones and dust, with animals often feed on it.

Unit Operation in Rice Milling

The rice milling stage serves as step in the transformation of paddy-rice into milled-rice, representing the sole processing stages (unit operation) in Nigeria's rice processing which is fully mechanized while, in some industries still operate manually. Popular options like the Engelberg mill and rubber hullers, are widespread across communities. However, these

pieces of equipment, despite their prevalence, often suffer from inadequate installation and maintenance, leading to the production of low-quality milled rice. Research findings indicate that with proper configuration of both metal and rubber roll mills, coupled with appropriate paddy cleaning and drying, satisfactory results can be achieved, yielding high-quality milled and polished rice.

In Nigeria, the landscape of rice milling is predominantly occupied by small and medium scale mills, with the "Cono disc" technology holding sway in the small-scale mills since its introduction in the early 1940s. Each mill using this technology typically has a capacity of approximately 0.6 tons per hour, subject to local conditions and manipulations. The milling process involves a unidirectional milling system wherein rice brand is de-branded in a rotating metals shaft blade facilitating mechanical husk removal. Subsequently, the rice paddy, along with husk, descends into a rotatory cylindrical polisher utilized as highlighted by (Diack *et al.*, 2011).

Milled Rice Grading, Branding and Marketing

At present, there is a lack of intentional efforts among participants in the smallholder in rice processing and value addition. While employ mechanical rice grading, particularly on demand by the processors (Diack *et al.,* 2011; Ajala and Gana, 2015). Consequently, there is a notable presence of damage or broken rice, contaminants in locally milled rice which adversely affecting its output. The marketing milled rice is typically done using measurements such as cups, mudus (containers holding 0.8 - 1 kg), and bushels (containers holding 15 - 16 kg), with minimal packaging (Ajala and Gana, 2015). Through collaborations with African Rice center in conjunction with NCRI, a rice processors undergone training in modern processing methods. Additionally, the millers are equipped with rice graders and sewing device (in 5 kg, 10 kg, 25 kg, and 50 kg sizes), scales and bagging machines, aiming at enhancing their durability of the bags at the point of sales (IITA, 2017).

Pest Management in Rice Processing

Preservation of rice and prevention of insect pest damage necessitates effective post-harvest handling management practices, commencing from field through milling process. In light the health implications occurred due to high risk of pesticides activities in ongoing research and development of an improved crop variety has facilitated the development of medium to mitigate losses and safeguard human health and the agricultural-ecosystem (Danbaba *et al.,* 2017). Utilizing plant-derived from actively investigated for the control of post-harvest against insect-pests. These alternatives are preferred due to their minimal toxicity to plants, synthetic nature, biodegradability, and their ability to easily stimulate the host's metabolism (Francis et al., 2013). For the storage, cleaned and dried paddy can be conveniently packed into bags weighing 200kg, 100kg, or 300kg. It is imperative to store grains grain on a palates in a cool, dry and well-ventilated conditions. Adequate aeration within the packing space or storage area is crucial for optimal preservation (IITA, 2017).

CONCLUSION

Rice has become a crucial crop in Nigeria, playing a vital role in the country's economic development. Despite the substantial quantity of paddy rice generated locally, the subpar quality of domestically processed rice has perpetuated the reliance on imported rice brands to meet up with the preferences of Nigerian specification. This trend had adversely impact on the growth of rice yield and subsequently affect the profitability. The data obtained on rice processing, postharvest losses due to storage in Nigeria has clearly indicate a significant gap between supply and demand, highlighting the country's need for several million metric tons

to meet its requirements. Presently, Nigeria can only fulfill 49% of its domestic demand for rice. Although rice production is increasing, it remains insufficient to meet the entire national demand in the coming years.

The challenge lies in the fact that rice farming and processing are capital-intensive endeavors, necessitating financial support from various entities and private investors with an interest in agricultural entrepreneur (agro-preneurship). The potentially achieving substantial mass production by rice farmers alone is limited. Collaboration among all stakeholders involved in agricultural productivity is essential for sharing insights into current challenges and prospects of rice processing as well as the application of trending technology in rice processing techniques that can encourage food security measures and policy.

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