

Nigeria has enormous potentials for the production and processing of rice not only for domestic consumption but for export, that is, if it is well grown, harvested, cleaned, handled, dried, stored, milled, transported, and marketed. This work showcases the activities of the Abakaliki rice mill complex through development and administration of questionnaire and valid respondent assertion/contributions. A 2 × 5 factorial in completely randomized design (CRD) with no blocking experiment was conducted whereby five varieties of rice are regarded as factor A and Heat treatment (parboiling/steaming) as factor B. The measured values of the physical parameters of the grains were replicated three (3) times.

At moisture content range (15 –18%) wb, the compressive force against natural position of the grain were also determined at different points of rupture/cracks of the rice varieties as a panacea for minimizing losses during different unit operations. An enormous quantity (25%) of rice is lost during processing of rice along the unit operations and the losses are variety specific. The effect of heat treatment (steaming) on the physical properties of different rice varieties were carried out to investigate the relationship between biophysical properties and mechanical properties of different rice varieties.

The result shows that the study had the requisite requirements to carry out this research based on the level of education and experiences of the respondents (staff). 51.6% of the respondents had secondary education, 29% tertiary education, 16% primary education and 3.2% studied under informal education. Also 63% of the respondents had 10 years experience and 37% less than 10 years experience.

Over seventeen (17) rice varieties were identified to be processed at the mill complex and that unit operations like cleaning, grading, soaking, steaming, drying and to little extent, bagging are done manually. Virtually, all the unit operations encountered losses except for little losses recorded during steaming and size grading.

81% of the respondents declared that lack of technical know-how is one of the causes of losses as well as machine obsolescence. At 5% probability level, the effect of heat treatment on rice grain has a significant effect on the biochemical and physical structure of the rice variety at different least significant differences. The interaction between rice variety and heat treatment showed that there is significant difference among varieties and non-significance between/in some varieties.

Each physical parameter measured within a rice variety, the variety mean are significantly different to each other. Therefore, it means each variety is unique except for few similarly in their parameters.

Interaction between rice variety and individual rice grain parameter measurement showed mean significant difference among the varieties with few exceptions of a particular least significant difference. Consideration of variation in natural position of rice grain at rest during compression gave representative apparent compressive strength across the five varieties. Therefore, it is advisable to handle a particular rice variety at a time because losses are variety specific.

CHAPTER ONE

1 INTRODUCTION

Rice (*Oryza sativa*) is cereal and arable crop with many varieties cultivated in almost all parts of the world. It is the staple food of more than 3 billion people in the world especially in Asian, Latin America, and Africa (Echiegu, 2009). It is envisaged that by 2015 more than half of the world population will depend on rice as their principal foodstuff. Production outlook is expected to be positive in Africa, where high world prices may sustain a two percent growth, particularly in Egypt, Guinea, Nigeria and Sierra Leone. Concerns about food import dependency in the region have led to a mobilization of resources towards this sector - the rice sector (FAO, 2008). As a matter of urgency, on 16 December, 2002, the United Nations General Assembly (UNGA) declared 2004 the International Year of Rice (IYR). This declaration aimed to focus the world's attention on the role that rice can play in providing food

security and poverty alleviation (IYR,2004). In Nigeria, rice is one of the few foodstuffs whose consumption has no religious, cultural or geographical boundary (Omofonmwan and Kadiri, 2007). Rice is the best cereal crop in terms of food energy per production area. Rice is usually consumed in various forms namely: plain rice, breakfast cereals, cakes, fermented sweet rice, snack, food, beer, wine, vinegar, etc (Answers.com, 2009).

With the increasing food insecurity and challenges therein as a consequence of global food crisis, Nigeria with over 140 million people is not left to the effect of these problems. Food (rice production) may be produced in abundance at short duration but tends to decrease incoherently due to inability to process, store, preserve, handle, transport and/losses at post-harvest processes. These are some of the fundamental reasons for food shortage/scarcity and insecurity. Rice production as a cereal (grain) experiences a high level of processing, storage, handling, transportation and losses at 25% post-harvest every season. And this represents some tens of millions of metric tonnes of food (IYR, 2004). The food post-production sector is a vital component of the food system, and its development can stimulate improvements in the use of resources. One indication of the need for increased allocation of resources for research and development in the post-production system is the level of postharvest losses. Losses are attributed to a combination of factors affecting the way the rice crop is grown, harvested, cleaned, handled, dried, stored, milled, and marketed. These losses are either outright physical losses, or deterioration of quality which reduces the commercial value. Significant gains have been made in understanding the socio-economic environment under which the industry operates, and in understanding the post-harvest processes and the bio-chemical properties of the rice grain as it relates to maintaining the milled rice quality. The big gap has been in the development of technologies suitable to the conditions prevailing in Nigeria, and in the institutional arrangements to enable local farmers and processors to use technology to improve productivity in their operations. Once the paddy rice has left the farm, it enters the domain of the post-production sector. The people involved in the post-production sector are not usually farmers themselves (rice producers). They are entrepreneurs (private rice processors) who invest in technology. In Nigeria, most work as part of a small family business as seen in Abakaliki Rice Mill Complex in Ebonyi State where there are clusters of Rice processing Entrepreneurs. The key players in the post-production sector are the traders, the processors, the wholesalers and the retailers. These entrepreneurs are profit driven, and respond to market forces. They form a business network, and the marketing economists view this network as a marketing system. The post-production technologies are the tools of their trade. The development of technology in Nigeria to store and process rice, and deliver it from the farms to the consumers, has not kept pace with the developments in the farm production sector. This lag is attributed to a strategic misunderstanding of the target research beneficiaries in the post-production sector. Public-sector (government sponsored) research cannot seem to accept entrepreneurs as the direct beneficiary of research results. This perhaps is due to the fact that most researches come from a culture of incoherency marked with random field of interest and thoughts instead of problem-solution basis. However, this work provides solutions for both government and private sectors (entrepreneur) as means of evaluating quantitatively the level of post-harvest losses in rice production in Nigeria. With different varieties of rice grown in Nigeria, The new high-yielding varieties (HYV) of rice have been adopted widely in some rice farms, and these account for most of the yield increase. Rice production using HYV has revolutionized the industry. New/improved technologies are required. For example, it was found that farmers needed a new method for harvesting and post harvest improve technologies to be able to carry out effectively emergence of these challenges in rice production systems. Post harvest losses can be attributed from some of each steps of the flow processes adopted for rice production which includes threshing, drying paddy, soaking, parboiling, milling, cleaning, sorting, de-stoning, grading and polishing etc. However, Production of good-quality milled rice starts at the farm with good-quality seeds, and good crop management for uniform growth and expected high grain yield. The other factors that affect quality, such as mixing of

varieties, heat treatment and discoloration, poor precision, contamination, insect damage in storage, fissuring in drying, and breakage in milling, are expected to be controlled in the post-production operations. The same levels of expertise are needed to minimize physical losses applied to producing good-quality grain. The lack of appropriate technology, technical and management skills are consequences of poor-quality milled rice output as such result in economic losses. (Dante, 1999).

From historical perspective, Nigeria's rice policy can be discussed in reference to three important periods. These are the pre-ban, ban and post-ban periods. The pre-ban period is the era prior to the introduction of absolute quantitative restriction on rice imports (i.e., 1971-1985). This epoch can also be classified in two – the pre-crisis (1971-1980) and the crisis period (1981-1985). The pre-crisis period was largely characterized by liberal policies on rice imports though ad hoc policies were put in place during times of interim shortages. During the crisis period, more stringent policies were instituted, though outright ban was not a major feature. In the ban period (i.e., 1986-1995), it was illegal to import rice into the country though illegal importation of the commodity through the country's porous border thrived during this period. In the post-ban period (1995 to date), quantitative restrictions on rice importation were lifted while the country generally adopted a more liberal trade policy towards rice. During the pre-ban period (i.e., before 1986), government policies had artificially lowered domestic rice and fertilizer prices relative to the world price level. This was achieved through:

Massive importation of rice between 1975 and 1985 resulting in low price of domestically produced rice.

Government involvement in the distribution, marketing of the imported rice with non-transfer of actual costs of marketing to consumers but rather absorbed by government.

Protection of elite urban consumers at the expense of farmers leading to depressed farm produce prices.

Protection of producers through input subsidies such that actual input costs were not translated into production decision-making process.

The ban on rice importation came into effect in 1985. It was anticipated to stimulate domestic production through increases in the price of the commodity. The introduction of the Structural Adjustment Program (SAP) in 1986 reinforced the ban already placed on rice import. Under SAP, various trade policies were put in place. This was in addition to the depreciation of the naira arising from exchange rate deregulation. The overvalued exchange rate had served as an implicit tax on rice producers as it cheapened imported rice relatively and discouraged domestic participation in rice production. Nigeria has employed various trade policy instruments such as tariff, import restrictions, and outright ban on rice import at various times (Sutcliffe and Ayomike, 1986). During the 1970s and early 1980s, increased export earnings coupled with the highly overvalued naira exchange rate made it possible for Nigeria to finance huge food imports. The high naira exchange rate cheapened food imports and consequently helped to depress domestic prices and rice production indifference. Large importation of food items especially rice was allowed into the country at relatively cheap prices. This eroded the competitiveness of domestically produced rice and served as a major disincentive to rice farmers.

1.1 OBJECTIVES OF STUDY

The objectives of the work are:

- 1,) To determine the level of post harvest losses (quantitatively via Field Questionnaire) of the rice produced at the Abakaliki rice mill.
- 2,) To determine the effect of heat treatment (Steaming) on the physical properties of different rice varieties that lead to post harvest losses.
- 3,) To determine the effect of Force-deformation (stress-strain relationship) considering the variation of the natural contact surface of rice which lead to losses during milling operation.

1.2 JUSTIFICATIONS OF STUDY

Over the past several decades, rice has established itself as a preferred staple food in Nigeria. The increase in rice demand is attributed to a consumer shift from traditional staples, such as yam and garri, to imported parboiled rice (Fasonline, 2002). In addition, local prices have encouraged the shift towards rice due to poor harvest of food crops and corresponding higher prices of the local staples. Parboiled rice is imported to meet consumer demand in urban areas where the incomes are generally high (Fasonline, 2002). Only a limited portion of the locally grown rice crop is available for urban market centres such as Lagos and other cities, because small-scale rice farmers produce subsistence levels of rice with remaining surplus portions consumed at the village level. Locally milled rice is also of poor quality and quantity falls far short of urban demand. Many urban consumers are also weary of picking stones from the rice and washing local rice several times, while imported parboiled rice is clean and free from foreign matter (Fasonline, 2002). Some remarkable developments have also taken place in this sector particularly in the last ten years. Both production and consumption have increased during the period, although the increased production was not sufficient to match the consumption increase, with rice imports making up the shortfall. Because rice is now a structural component of the Nigerian diet and rice imports make an important share of Nigerian agricultural imports, there is considerable political interest in increasing the consumption of local rice. This has made rice a highly political commodity in Nigeria. With the global food security problem, particularly the increased demand for rice, Nigeria may soon be exporting rice to other countries (Echiegu, 2009). Export quality rice must not only be well processed but must be graded and packaged to meet international standard quality with minimum loss. Despite the importance of Nigerian rice production even within the West African sub-region, comprehensive and up-to-date information about the level of resource use efficiencies of the farmers is still lacking. The few available studies were either system based or location specific. Moreover, most of these studies focused primarily on the profitability of the enterprise, without in-depth enquiry into efficiencies of farmers and factors that determine their levels of efficiency (Ogundele, et al., 2003). There is need to make sure researches and developments in rice production are made available to farmers and also periodically conduct appraisal to ascertain the level of production ultimately for maximum production and export (foreign exchange).

1.3 SCOPE/BACKGROUND OF STUDY

This work is expected to cover the potentials for the production and processing of rice not only for domestic consumption but for increased rice export. With the interventions and interest in rice in the country, it is expected that Nigeria will soon have a great local production of rice and soon be exporting rice of high quality standards that are acceptable in the international market (Echiegu, 2009). However, it is necessary to appraise logically the processing techniques and technologies involved (both imported and local), the physical and mechanical properties of rice varieties (improved) as well as post harvest handling and storage with precision to minimize post harvest losses during rice production. Ultimately, characterize via field questionnaire and examination via laboratory test for rice varieties on the possible causes of losses in post harvest production of rice. The case study - Abakaliki rice mill complex was chosen because it is one of the nerve centres for rice milling (processing) in southeastern Nigeria but it serves majorly the entire southern part of the country as well as other part of Nigeria.

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