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Assessment of Infrastructure and Circulation Patterns among Rice Millers at Gbugbu Kwara State, Nigeria

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Abstract

The rice sector in Nigeria is seriously constrained by infrastructure deficit, poor circulation pattern and poor access to appropriate machinery that continuously diminishes efficiency and productivity. The study examined the impacts of infrastructural facilities and circulation pattern among clusters of rice millers at Gbugbu, Kwara State. Data for the study was obtained from both primary and secondary sources using structured questionnaire, and information from a list of registered rice processors in the state. The study purposely selected Edu local government because of their prominence in rice production. The study was carried out in the three districts of Edu local government. These include; Lafiagi, Tsaragi, and Tsonga districts, these three districts are synonymous with Gbugbu. The samples were obtained from small-scale rice millers who are members of the Rice Farmers Association of Nigeria (RIFAN). Using random sampling technique, 280 respondents (50%) were selected as sample from a population of 560 respondents. Descriptive statistics that include: frequency, percentage and mean were used to analyse the data obtained. The results on the socioeconomic characteristics of the rice millers shows that 48.0% (108) respondents were males while the females gender accounts for 52.0% (117). The result shows that 57.8% respondents indicated that rice milling is their primary occupation while 95 respondents representing 42.2% indicated that it is a secondary occupation. The results of level of adequacy of infrastructure and circulation pattern shows that four variables are above the average of 2.93 AICPI; these include adequacy of credit/financial institutions having 3.52 AICPI, adequacy of provision of milling equipment with 3.03 AICPI, adequacy of the electricity supply with 2.99 AICPI and adequacy of road network with 2.98 AICPI. The result on the level of significance of industrial cluster indices (SICI) showed that the highest SICI was recorded for the proximity of rice millers in the cluster, which had SICI of 4.10, followed closely by the availability of shared resources within the industrial cluster having SICI 3.89. The result obtained on level of impacts of human capital, infrastructure, and circulation pattern on rice production (IHCICPIs) shows that the highest IHCICPIs was recorded for the presence of proper storage facilities, having IHCICPIs 4.39, followed closely by good road connectivity having IHCICPIs 4.09. The results on The Impacts of Infrastructure Facilities and Circulation Pattern (IIFCP) shows that Tsonga Rice Millers hub (RMH) had the highest impacts having 3.64 IIFCP, which can be classified has good and thriving. Lafiagi (RMH) and Tsaragi (RMH) closely followed having IIFCP 3.30 and 3.51 respectively. The study concluded that infrastructure and circulation patterns among rice millers in the study area are adequate. The study recommend that architects and other building professional engaged in designing RMH should involve suitable design principles that meet users need. Also more consideration should be given to availability of appropriate infrastructure and good circulation pattern.

Keywords: Circulation Patterns, Impacts, Infrastructure, Industrial Cluster, Rice Millers, Nigeria.

1.0 Introduction

Rice production in Nigeria has frequently proven difficult to sustain, despite the significant focus of the Nigerian government on discouraging its importation and encouraging its farming. However, rice production has its own risk, just like any production process (Onivehu, 2023). Generally, infrastructure has the tendency to phenomenally accelerate the transformation of existing traditional and subsistence agriculture systems into modern and commercial agriculture systems. Rice is one of the most important food staples in Africa and its consumption keeps increasing as a result of population growth, urbanization and change in consumer habits. However, the rice sector in Nigeria is seriously constrained by agricultural infrastructure deficit and poor access to appropriate agricultural machinery that continuously diminishes efficiency and productivity (Armah, *et al* 2020).

Government policy strategies and campaigns over the years, have sought to promote rice production to address food security, poverty reduction and import substitution. However, the rice sector in Nigeria is seriously encumbered by agricultural infrastructure deficit, poor circulation pattern and poor access to appropriate agricultural machinery that continuously diminishes efficiency and productivity. Key infrastructure deficit of the sector includes the dearth of efficient housing, health facilities, irrigation schemes, motorable roads, modern markets, developed agricultural lands, efficient storage and warehouse facilities. Generally, infrastructure has the tendency to phenomenally accelerate the transformation of existing traditional and subsistence agriculture systems into modern and commercial agriculture systems. Both infrastructure and mechanization however involve huge initial capital investments, long gestation periods and low rate of returns on investments. However, it is necessary to prioritize which infrastructure and machinery in a multiplicity of locations require immediate attention to sustainably grow the rice sector value chain (Armah, et al 2020). Prevailing reports have pointed out that the country's rice production can be significantly increased through expansion of infrastructure and agricultural mechanization. As such, this study seeks to develop a policy document on the country's infrastructure, circulation pattern and mechanization needs by highlighting the required level of participation by both public and private institutions. In seeking to improve rice productivity and farmer access to markets for greater income generation, this study is pursuing a multiplicity of outcomes aligned to the study objectives.

Good infrastructure and circulation pattern provision contributed to transformation of traditional agriculture or subsistence farming into modern commercial and dynamic farming systems. It has direct and strong relationship with farmer's access to institutional finance and markets, as well as increasing crop yields, thereby promoting agriculture growth (Odulaja, 2020). Infrastructure provision, such as irrigation, watershed development and management, roads, markets, storage facilities in close coordination with institutional infrastructure, such as credit institutions, agriculture research and extension, rural literacy and information communication technology (ICT) determines the nature and the magnitude of agriculture output. Telecommunications and rural electrification also play a major role in boosting agricultural productivity, but their impact is more evenly dispersed across all sectors, less specifically targeting agriculture (Sakurai, et al, 2006).

Rice milling is an essential step in the rice production process, and efficient milling infrastructure is crucial for reducing post-harvest losses and improving rice quality. Despite the high volume of rice produced in Nigeria, the milling facilities, especially in rural regions, are often inadequate and out-dated. Establishing a cluster of small-scale rice milling hubs can address these challenges by providing centralized, modern milling facilities that cater to the needs of local rice farmers. A small-scale rice milling hub is a centralized facility equipped with state-of-the-art milling technology designed to serve a community or cluster of rice farmers. These hubs are not only about processing rice but also about creating a cohesive architectural environment that integrates functionality, sustainability, and aesthetics (Mano *et al.,* 2023).

A rice milling hub is a perfect example of a specialized cluster, much like a computer village or a mechanics village. They all focus on a particular industry. For instance, a rice milling hub is dedicated to the processing and milling of rice. This specialization means that all the resources, infrastructure, and expertise in the hub are tailored specifically to the needs of rice milling. This focus ensures that each cluster meets the specific demands of its respective industry. Economic efficiency is another key similarity. In a rice milling hub, bringing together multiple millers in one location can lead to significant cost reductions and increased efficiency. They can share infrastructure like storage facilities and transportation networks, which lowers individual operating costs. The businesses benefits include shared logistics and importation of goods in bulk, and reducing overall costs (Jayne *et al.,* 2017).

Finally, these hubs provide a substantial boost to the local economy. A rice milling hub creates job opportunities and stimulates economic activities in the surrounding areas. The increased demand for related services, such as transportation and packaging, further boosts the local economy. Rice milling hubs generate significant economic activity, creating jobs and attracting ancillary businesses like cafes and logistics providers to support the primary industry. Similarly, mechanics villages create employment opportunities for mechanics, apprentices, and support staff, attracting additional businesses and contributing to local economic growth. Against this background, this study measures the decision-making activities of cluster of small-scale rice farmers as stakeholders in the rice value chain in Edu/Gbugbu local government area against the sustainability dimensions set out in the Sustainable Rice Platform (SRP) (Fazey, 2017).

1.2 Area of study

The study site will be Gbugbu under Edu local government area of Kwara state. Kwara State is one of the 36 states in Nigeria with a population of about 2.5 million (est. 4.10 million in 2019). It is one of the six north-central states in Nigeria and is situated 306 km from the coastal city of Lagos and 500 km from Abuja, the federal capital, with a total landmass of 32,500 square kilometres. Gbugbu, located in Edu Local Government Area (LGA) of Kwara State, Nigeria, is a rural community that plays a significant role in the region's agricultural economy, particularly in rice production. Edu LGA is situated in the northern part of Kwara State, and the area is known for its fertile lands, which support the cultivation of a variety of crops, including rice, maize, millet, and cassava. The state is made up of 16 local government areas. Rice, which is the focus of this study, is cultivated in all the local government areas in the state; however, this study focuses on Edu local governments where about 90% is produced (Obembe *et al.,* 2018). Figure 1 is the Map of Kwara State showing the location of Edu Local Government Area. The inset map shows Kwara State within Nigeria.

Figure 1: Map of Kwara State showing the location of Edu Local Government Area (study location). The inset map shows Kwara State within Nigeria.

Source: Elelu *et al.,* (2016).

2.0 LITERATURE REVIEW

Nigeria is the topmost rice importer globally and is the largest rice producer in West Africa. It is third highest global food production, after sugarcane and maize (Odulaja, 2020). Nigeria's rice sub-sector is subject to insufficient and weak producer-market connection because of the poor circulation pattern, insufficient infrastructure, and inadequate efficiency of the distribution network and poor infrastructure which has led to low participation and productivity of farmers in the rice field. In order to lessen rice importation rate, Elelu et al., 2016 stated that the dissemination of improved varieties and other modern infrastructure and inputs as a composite package to rice farmers is very important. Ezeh et al. (2022) specified that the adoption of improved management practices and know-hows should lead to a significant yield in the production of rice.

Alabi, et al, (2024) study evaluated economic efficiency (EE) of the rice milling industry among value chain processors in North West of Nigeria. The results showed that the mean age of rice millers was 46 years. The significant socio-economic factors influencing EE of rice processing activities included: age of processor, educational level, membership of cooperatives, access to credit facilities, and experience in processing. The major constraints faced by rice millers included: lack of credit, high cost of processing equipment, lack of storage facilities, bad road infrastructures, high cost of inputs, poor price information, lack of training, and lack of extension services. Based on the results obtained from the applied econometric models, socio-economic factors that comprised: the age of processors, educational level, memberships of cooperatives, access to credit facilities, and experience in processing affects EE of rice processing activities.

Bhatia, (2006) examined the relationship between infrastructure development and agricultural output in India and proved that one of the states in India, Punjab which had the highest index of infrastructure also had the highest yield of food grains and value of agricultural production per hectare. The other states like Rajasthan and Madhya Pradesh which have a very low index of infrastructure also had low yield of food grains and total value of agricultural production per hectare. Rowena and Leonardo (1997) and Rowena et al, (2020), study assessed the impact of infrastructure on profitability and global competitiveness of rice production in the Philippines. The study identified one of the constraints to the growth of Philippine rice production as the lack of appropriate and adequate infrastructure. This includes marketing and distribution infrastructure such as farm-to-market roads; limited access to credit, processing, and storage facilities; and the lack of effective irrigation systems. Results of the study generally imply that good infrastructure improves farm profitability and productivity. Therefore, there is a need to evolve an infrastructure development strategy in irrigation and farm-to-market roads for the rice sector. Several policy studies had pointed out the importance of these facilities, but studies that look into the impact of infrastructure on profitability and global competitiveness are still lacking. It is therefore important to evaluate and measure the impact of housing, social interaction, irrigation and road infrastructure on rice profitability and production in Nigeria, which is very limited. This study will evaluate the impact of infrastructure development on farm productivity, rural income, technology adoption, and transaction costs in rice farming, and compared the profitability and global competitiveness of rice farmers who have access to good infrastructure and those who do not.

Edmonds, (2002) study examined the role of infrastructure in land-use dynamics and rice production in Viet Nam's Mekong River Delta. This study examined the role of infrastructure development and technical change in explaining increases in agricultural production and changes in land use in the Mekong Delta Region of Viet Nam during the mid-1990s. The study relies on econometric analysis of household-level longitudinal farm survey data covering about 150 farms from eight villages in the Mekong River Delta from1994 to 1998. This study failed to look at the relationship among circulation pattern and impacts of infrastructure and rice productivity. Although the rapid growth in rice production in Viet Nam is widely known, there have been few studies of the changes in market and physical infrastructure that prompted farm-level changes in rice production techniques and land use, which led to the production increases. Infrastructure development and changes in economic policies modify both types of constraints. This makes understanding these constraints essential to developing technologies and advising on policies to increase agricultural production and spur economic development in the region.

Antle, (1994), studied the human capital, infrastructure, and the productivity of Indian rice farmers. The finding; indicate that productivity is a function of farmer's schooling, extension programs, transportation and communication infrastructure, Irrigation availability, the utilization of high yielding varieties, and climatic factors. These findings thus support the hypothesis that agricultural productivity is a function of transportation and communication infrastructure, and suggest that infrastructure development is important to both growth and equity concerns in policy planning. The study noted that investment in transportation and communication infrastructure is important, yet there are few systematic studies of the relationship between agricultural infrastructure and agricultural productivity, and there do not appear to be any studies which model and measure the productivity effect of infrastructure at the farm level. The aim of this study is to fill this theoretical and empirical hiatus by investigating how human capital and infrastructure constrain the choice of technology and hence productivity. The effects of these capital constraints will be translated into a 'variable coefficient production function to measure their productivity effects on Nigeria rice farmers.

Ubi, (2018) et.al studied the use of rice husk for building resilient infrastructure for sustainable industrialization, while Sakurai, et al, (2006) study looked at rice miller cluster in Ghana and its effects on efficiency and quality improvement. Jamil and Chairunnisya (2023) study examined the building resilience by addressing climate change impacts on rice production based on agricultural infrastructure in West Java Province, Indonesia. This study examined how agricultural infrastructure has developed over the past five years and how this has affected the vulnerability index.

Tanko, et al (2019) study assessed the impact of rural infrastructure on rice productivity in Kano State, Nigeria. The study presents a conceptual framework on the impact of rural infrastructure on rice productivity in Kano state, Nigeria. This study is limited because the study failed to look at the impacts of circulation pattern, human capital, and infrastructure holistically in terms of their relationship, which this study intend to carry out. Literature has shown that rural infrastructures are key aspect that facilitates increase in the productivity of a farmer. The rapid urbanization and increasing population in Nigeria necessitate innovative solutions to support and enhance local economies, particularly in rural areas. Architecture plays a pivotal role in this development by designing functional, efficient, and sustainable infrastructures that meet the community's needs. Small-scale rice millers in this region struggle with outdated infrastructure, inadequate milling technologies, and inefficient practices, which result in low-quality rice production and increased post-harvest losses. Moreover, the lack of well-organized clusters of rice milling hubs exacerbates operational inefficiencies and stifles collaboration among rice millers (Jayne et al., 2014).

Grounded on the preceding, the study attempts to provide answers to the following research questions; what are the impacts of quality infrastructure on rice production in kwara State, what are the basic factors influencing circulation of the rice mill aiding the quantity of rice production, How should safety be dealt with in the design of all spaces required for operations in the rice mill. How can the arrangement of machines in terms of production line effectively aid outputs? What are the added advantages of establishing flexible circulation pattern in the architectural design solution? Given the significance of rice milling in the agricultural value chain, it is imperative to evaluate the current state of infrastructure facilities and understand the preferences of rice millers for clusters of milling hubs. This study seeks to address these gaps by providing insights into the infrastructural needs of the rice milling sector in Gbugbu and the potential benefits of organizing millers into clusters to enhance productivity and socio-economic development. Without such an evaluation, efforts to improve rice milling efficiency in Gbugbu may remain ineffective, resulting in continued economic losses and reduced competitiveness in the rice market.

3.0 RESEARCH METHODS

A multistage sampling technique was employed in this study. Edu LGA was purposively selected due to the dominance of rice production and processing in the area. The local government presently has three districts which constitute the emirates in the local government area. These includes; Lafiagi, Tsaragi, and Tsonga districts or emirates. A list of registered rice processors (Association of rice processors in the Study area) were retrieved from Agricultural Development Programme (ADP) office in Kwara state. Districts with high number of rice miller were selected using cluster sampling procedure where a cluster (at least 10 millers). Random sampling of 50% from the list was employed to arrive at a sample size of 280 respondents for the study. Descriptive statistics that comprised frequency, percentage and mean were employed to analyse the demographic characteristics of the rice processors. Table 1 shows sample frame and sample size used for the study.

Table 1: Sample frame/ Sample size

S/N	District	Sample frame	Sample Size is 50% Sample Frame (Number of Respondents)
1	Lafiagi	224	112
2	Tsaragi	176	88
3	Tsonga	160	80
	Total	**560**	**280**

The total sample frame is five hundred and sixty (560). The sample size will be obtained by adopting a sample size formula developed by Cochran (1977), adopted by Bartlett et.al (2001) as follows:

$$n = \frac{N}{1 + N(a)^2}$$

Where: n = Sample size

N = Sample frame

a = Level of precision (constant ranging from 0.01 to 0.05)

A confident level of 99% is expected to be achieved by using a = 0.05

Therefore:

$$n = \frac{560}{1 + (560)(0.05)^2}$$

n = 234

According to Gay and Diehl (1992), mostly the number of respondents adequate for a study hinge on the type of research involved. For a quantitative research, the sample should be 50% of population.

Sample size adopted: n = 280

Primary data was collected by the use of structured questionnaire and administer to small-scale rice millers who are members of the Rice Farmers Association of Nigeria (RIFAN) within the Edu local government area of Kwara state. Descriptive such as means, frequency and percentages as well as correlation analysis were be used for the analysis.

Data were collected between the months of August 2024 and October 2024. The administration of questionnaires on the rice miller were implemented personally, while four field assistants who were familiar with the study area were involved in administration and collection of data from the respondents. Two hundred and eighty (280) questionnaires were distributed out of which 80.4% (792) were returned and retrieved. The response's percentage is considered satisfactory, because it is greater than what was obtained in a similar study by Oladapo, (2006) and Ibem, (2011) with a response rate of 61.98% and 77.16% respectively. Table 2 shows the distribution of returned questionnaires across the rice millers selected for the study. Table 2 shows the distribution of administered and returned questionnaires.

Table 2: Distribution of Administered and Returned Questionnaires

S/no	The Study Population	Number of Administered Questionnaires	Percentage of Questionnaires Administered	Number of Questionnaires Returned	Percentage of Questionnaires Returned
1	Lafiagi	112	40.0	90	32.1
2	Tsaragi	88	31.4	71	25.4
3	Tsonga	80	28.6	64	22.9
	Total	280	100	225	80.4

Considering the response rates in relation to sampled size of the study groups, the response rate were 225 representing 80.4% of the rice millers that responded to the survey as detailed in Table 2. These response rates are adequate for the study.

4.0 ANALYSIS OF DATA AND DISCUSSION OF FINDINGS

4.1 Socio-economic Characteristics of the Rice Millers

Several socio-economic characteristics of the rice millers were examined. Table 3 shows the socio-economic characteristics of the rice millers. These are gender, age, marital status, level of education, occupation, household size, residents' household position, and monthly income level, tenancy of unit / house, year of residency in the rice miller, main role in rice milling, ethnicity and religion. The genders of respondents were fairly evenly distributed. Overall, it is observed that 48.0% (108) respondents were males while the females gender accounts for 52.0% (117). Lafiagi, Tsaragi, and Tsonga had 37.0%, 27.8% and 35.2% male respondents respectively. In similar vein Lafiagi, Tsaragi, and Tsonga had 42.7%, 35.1% and 22.2% females respectively. This study shows the domination of females above males in rice production as money-making venture in all the study area.

The results on ages of respondents showed that in all the study area, the highest percentage of (29.8%) belonged to the 41 to 50 years age bracket, followed by 31-40 with 24.0%, while 8.4% were those who are 60 years and above. The study shows that 70.2 % of the respondents were below 50 years of age and that 29.8% were above 50 years of age. This shows that an overwhelming majority of respondents are young and belong to the economically active segment of the population. Figure 4.2 shows the Ages of Respondents in study area. Information on the marital status of respondents shows that 26 respondents, representing 20.4% were single, 126 respondents, representing 56% were married and 7 respondents, representing 3.1% were divorced. Also, 34 respondents representing 15.1% were widowed and 12 respondents, representing 5.3% were separated. Based on this, it can be inferred that married worker dominated the study area with 56.0%.

The information on the educational attainment of respondents shows that 18 respondents representing (8.0%) had B.Sc. / B.A level of education, 64 respondents; representing 28.4% had HND level of education. Thirty nine respondents, representing 17.3% had OND / NCE level of education attainment. Primary school and secondary school had 47 and 57 respondents, which represent 20.9% and 25.4% respectively. This indicates that most of the respondents had formal education. The results on primary or secondary occupation of respondents in study area show that 130 respondent representing 57.8% indicated that rice milling is their primary occupation while 95 respondents representing 42.2% indicated that it is a secondary occupation. The results show that if rice milling is their primary occupation, they should specify secondary. Student had 14 representing 6.2%, Civil service had 39 representing 17.3, Trading had 45 respondents representing 20%, Self-employed 53 respondents representing 23.6%, and Farming had 59 respondents representing 26.2%, while none had 14 respondents representing 6.2%.

The results on household size of respondents' shows that 9.8 % (22) had a household size of 1 to 2 people, 27.6% (62) had a household size of 3-4 people, and 40.0% (90) had a household size of 5-6 people, 20.9% (47) had a household size of 7-8 people. Also, 1.8% (4) had a household size of people above 8. The result suggested the dominance of families with more than 3 people in the study area, and this is predictable as most of the respondents were married. The information provided on respondents' household position shows that 40.4% (91) were fathers, 50.2% (113) were mothers and 4.0% (9) were children. In addition, 5.3% (12) were relatives or dependents. This shows that various household positions were represented and were likely to provide reliable information to achieve the study objectives. The study showed that highest income group by percentage in the area were those whose average monthly income level of ₦51,000 - ₦150,000 (22.2%) category while the lowest income group are those earning Less than ₦18,000 (18.7 %) and those earning above ₦300,000 (18.7 %). It can be inferred that various income levels / earners were represented and were likely to provide reliable result to achieve the stated study objectives for the study.

The numerical data on the ethnicity of respondents in the study area shows that the Nupes are in the majority at 46.7% while the Fulani are the minority at 9.3%. It also showed that the Nupes, Yorubas, and the Hausas account for an overwhelming 78.2% of the respondents. Furthermore, the study shows that the Muslims are in the majority at 72.9% and while the Christian are in the minority at 27.1%. The results on the main role of respondents in rice milling indicated that the respondents' main role in rice milling comprised: the owner with 37.8% (85), Operator with 44.4% (101), and Labourer, with 18.2% (41). This result implied that there is division of labour among the rice miller. The skilled labours are in the majority, closely followed by the owner representing the entrepreneur in the sector and the unskilled labour that are in the minority. The study also examined the size of rice milling operation in relation to the acres of land used for operation. The results from shows that 0.4 acres of land used for operation had 16.9% (38), 0.5 acres 8.0% (18), 0.6 acres with 12.4% (28), 1 acres with 25.8% (58), 2 acres with 24.9% (56) and 3 acres with 12.4% (28). The result indicated that the majority of rice miller used 1 and 2 acres representing a total of 50.7% while a total of 50.3% minority used 0.4, 0.5, 0.6 and 3 acres.

Table 3: Socio-economic Characteristics of the Rice Millers

i	**Gender of Respondents**											
The Study Areas	Male		Female		Total							
	Freq.	%	Freq	%	Freq.	%						
Lafiagi	40	37.0	50	42.7	90	40.0						
Tsaragi	30	27.8	41	35.1	71	31.6						
Tsonga	38	35.2	26	22.2	64	28.4						
Total	108	48	117	52	225	100						
ii	**Ages of Respondents**											
	18-30	%	31-40	%	41- 50	%	51- 60	%	Above 60	%		
Lafiagi	20	8.9	22	9.8	22	9.8	18	8.0	08	3.6		
Tsaragi	08	3.6	19	8.4	23	10.2	15	6.7	06	2.7		
Tsonga	09	4.0	13	5.8	22	9.8	15	6.7	05	2.2		
Total	**37**	**16.4**	**54**	**24.0**	**67**	**29.8**	**48**	**21.3**	**19**	**8.4**		
iii	**Marital Status of Respondents**											
	Single	%	Married	%	Divorced	%	Widowed	%	Separated	%		
Lafiagi	15	6.7	53	23.6	4	1.8	12	5.3	6	2.7		
Tsaragi	16	7.1	39	17.3	2	0.9	11	4.9	3	1.3		
Tsonga	15	6.7	34	15.1	1	0.4	11	4.9	3	1.3		
Total	46	20.4	126	56	7	3.1	34	15.1	12	5.3		
iv	**Level of Education of Respondents**											

	Pry School		Sec School		OND/NCE		HND		B.Sc. /B.A			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Lafiagi	19	8.4	22	9.8	16	7.1	24	10.7	9	4		
Tsaragi	15	6.7	18	8	12	5.3	21	9.3	5	2.2		
Tsonga	13	5.8	17	7.6	11	4.9	19	8.4	4	1.8		
Total	47	20.9	57	25.4	39	17.3	64	28.4	18	8		

v	**Is Rice Milling Your Primary Or Secondary Occupation**			
Study areas	primary occupation		secondary occupation	
	Freq.	%	Freq.	%
Lafiagi	52	23.1	38	16.9
Tsaragi	41	18.2	30	13.3
Tsonga	37	16.4	27	12.0
Total	130	57.8	95	42.2

vi	**If Primary Specify Secondary Occupation**											
	Student		Civil service		Trading		Self-employed		Farming		None	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Lafiagi	7	3.1	15	6.7	18	8	22	9.8	23	10.2	7	3.1
Tsaragi	4	1.8	13	5.8	14	6.2	18	8	19	8.4	4	1.8
Tsonga	3	1.3	11	4.9	13	5.8	13	5.8	17	7.6	3	1.3
Total	14	6.2	39	17.3	45	20	53	23.6	59	26.2	14	6.2

Vii	**If Secondary Specify Primary Occupation**											
	Student		Civil service		Trading		Self-employed		Farming		None	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Lafiagi	11	4.9	21	9.3	11	4.9	17	7.6	27	12	3	1.3
Tsaragi	9	4	14	6.2	12	5.3	17	7.6	17	7.6	2	0.9
Tsonga	6	2.7	14	6.2	13	5.8	13	5.8	17	7.6	1	0.4
Total	26	11.6	49	21.8	36	16	47	20.9	61	27.1	6	2.7

viii	**Household size**											
	1-2		3-4		5-6		7-8		Above 8			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		

Lafiagi	9	4	24	10.7	36	16	19	8.4	2	0.9		
Tsaragi	7	3.1	19	8.4	29	12.9	15	6.7	1	0.4		
Tsonga	6	2.7	19	8.4	25	11.1	13	5.8	1	0.4		
Total	22	9.8	62	27.6	90	40	47	20.9	4	1.8		
ix	**Respondents Household Position**											
	Father 1		Mother 2		Child 3		Relatives / Dependant 4		others, specify 5			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Lafiagi	37	16.4	44	19.6	4	1.8	5	2.2	0	0		
Tsaragi	28	12.4	36	16	3	1.3	4	1.8	0	0		
Tsonga	26	11.6	33	14.7	2	0.9	3	1.3	0	0		
Total	91	40.4	113	50.2	9	4	12	5.3	0	0		
x	**Average Monthly Income level**											
	Less than #18,000		#18,000 - #50,000		#51,000 - #150,000		#151,000 - #300,000		above #300,000			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Lafiagi	17	7.6	18	8	20	8.9	18	8	17	7.6		
Tsaragi	13	5.8	15	6.7	16	7.1	14	6.2	13	5.8		
Tsonga	12	5.3	13	5.8	14	6.2	13	5.8	12	5.3		
Total	42	18.7	46	20.4	50	22.2	45	20	42	18.7		
xi	**Ethnicity**											
	Igbo		Nupe		Yoruba		Fulani		Hausa			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Lafiagi	11	4.9	42	18.7	16	7.1	8	3.6	13	5.8		
Tsaragi	9	4	33	14.7	12	5.3	7	3.1	10	4.4		
Tsonga	8	3.6	30	13.3	11	4.9	6	2.7	9	4		
Total	28	12.4	105	46.7	39	17.3	21	9.3	32	14.2		

xii	**Religion**			
Study areas	Christian		Muslim	
	Freq.	%	Freq.	%
Lafiagi	25	11.1	65	28.9
Tsaragi	19	8.4	52	23.1
Tsonga	17	7.6	47	20.9

Total			61	27.1	164	72.9			
xiii	**What is your main role in rice milling?**								
	Owner 1		Operator 2		Labourer 3		Others specify 4		
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
Lafiagi	34	15.1	40	17.8	16	7.1	0	0	
Tsaragi	27	12	32	14.2	13	5.8	0	0	
Tsonga	24	10.7	29	12.9	12	5.3	0	0	
Total	85	37.8	101	44.9	41	18.2	0	0	

xiv	**Size of Your Rice Milling Operation (Acres of Land)**											
	0.4 Acres		0.5 Acres		0.6 Acres		1 Acres		2 Acres		3 Acres	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Lafiagi	15	6.7	7	3.1	11	4.9	23	10.2	22	9.8	11	4.9
Tsaragi	12	5.3	6	2.7	9	4	18	8	18	8	9	4
Tsonga	11	4.9	5	2.2	8	3.6	17	7.6	16	7.1	8	3.6
Total	38	16.9	18	8	28	12.4	58	25.8	56	24.9	28	12.4

4.2 The second objective, which is to evaluate the level of adequacy of infrastructure and circulation pattern in the study area (see Table 4). The results of the Aggregate Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area show that variables above the average of 2.93 AICPI, these include: adequacy of credit/financial institutions, adequacy of provision of milling equipment, adequacy of the electricity supply and adequacy of road network. Those below the average level comprised adequacy of water supply for rice milling activities, overall condition of the infrastructure, adequacy of current circulation patterns and adequacy of storage facilities. These factors need considerable improvement for optimum performance of the rice milling in the study areas. Summary of the Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area shows that Lafiagi, Tsaragi, Tsonga had 2.94, 3.05 and 2.93 with an average of 2.93. Table 5 and figure 2 shows the summary of the Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area.

The results on level of agreement of users on some specific issues that are very germane to the successful operation of rice mailing in the study area (see Table 6), indicated that 181 (80.4%) agreed that there is traffic congestion in their area while 44 (19.6%) did not agreed. the result shows that 188 (83.6%) agreed that the road conditions is poor while 37 (16.4%) did not agree. 147 (65.3%) agreed that there is inaccessibility during rainy seasons while78 (34.7%) did not agree. The result on how seasonal change (rainy or dry season) impact the adequacy of infrastructure and circulation shows that 154 (68.4%) respondents were positively disposed and agreed to the influence of seasonal change impact to the adequacy of infrastructure and circulation, while 71 (31.6%) did not agreed. Also, on the other hand the results shows that 71 (31.6%) of the respondents agreed with the negative influence of the seasonal change (rainy or dry season) impact on the adequacy of infrastructure and circulation while 154 (68.4%) respondents did not agreed.

The results for the ways industrial cluster impacted rice milling operation. The results shows that 61 (27.1%) of the respondents agreed that it reduced milling costs while 164 (72.9%) did not agreed, also 164 (72.9%) agreed that it increased output capacity while 61 (27.1%) did not agreed. Furthermore, 176 (78.2%) respondents agreed that it improved access to resources (e.g., machinery, labor), while 49 (21.8) did not agreed. Also, 185 (82.2%) respondents agreed that it enhances quality of milled rice while 40 (17.8%) did not agreed. The result on the challenges faced in the rice milling cluster. The results shoes that 175 (77.8%) agreed that there is competition for resources while 50 (22.2%) respondents did not agreed, 180 (80.0%) respondent agreed that there is poor collaboration among millers while 45 (20.0%) did not agreed. Furthermore, 175 (77.8%) of the respondents agreed that there is lack of shared infrastructure in the study area while 50 (22.2%) respondents did not agreed. The results also shows that 150 (66.7%) respondents agreed that geographic distance between mills are adequate while 75 (33.3%) did not agreed.

The result on the preferred location for a rice milling hub indicated that 51 (22.7%) of the respondents agreed that the location should be near my mill while 174 (77.3%) respondent did not agree. Also, 66 (29.3%) respondents agreed that it should be near main roads while 159 (70.7%) did not agreed. the results indicated that 59 (26.2%) respondent agreed it should be nearer to the markets while 166 (80.4%) did not agreed, while 45 (20.0%) agreed that it should be nearer to the exporting routes, while 180 (80.0%) respondents did not agreed. the result on whether there are any training or development programs available to rice millers in the area. The results shows that 126 (56.0%) respondents agreed that there are training and development programs available to rice millers in the area. while 99 (44.0%) of the respondents did not agreed.

Table 4: Aggregate Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area

S/N	**Level of Adequacy of Infrastructure and Circulation Pattern**	**Respondents Opinion**							
		5	4	3	2	1	N	$TWV_{(b)}$	TWV/n= AICPI $_{(Y)}$
1	Adequacy of Credit/financial institutions	33	100	46	44	2	225	793	3.52
2	Adequacy of Provision of milling equipment	7	90	37	85	6	225	682	3.03
3	Adequacy of the electricity supply	35	57	55	27	51	225	673	2.99
4	Adequacy of Road network	46	44	47	36	52	225	671	2.98
5	Adequacy of water supply for rice milling activities	51	33	36	53	52	225	653	2.90
6	overall condition of the infrastructure	11	33	98	46	37	225	610	2.71
7	Adequacy of current circulation patterns	12	51	39	90	33	225	594	2.64
8	Adequacy of storage facilities	2	40	94	50	39	225	591	2.63
									23.41/8
	Average								**2.93**

Table 5: Summary of the Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area

Variable	Lafiagi	Tsaragi	Tsonga	Aggregate
Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area	2.94	3.05	2.93	2.93

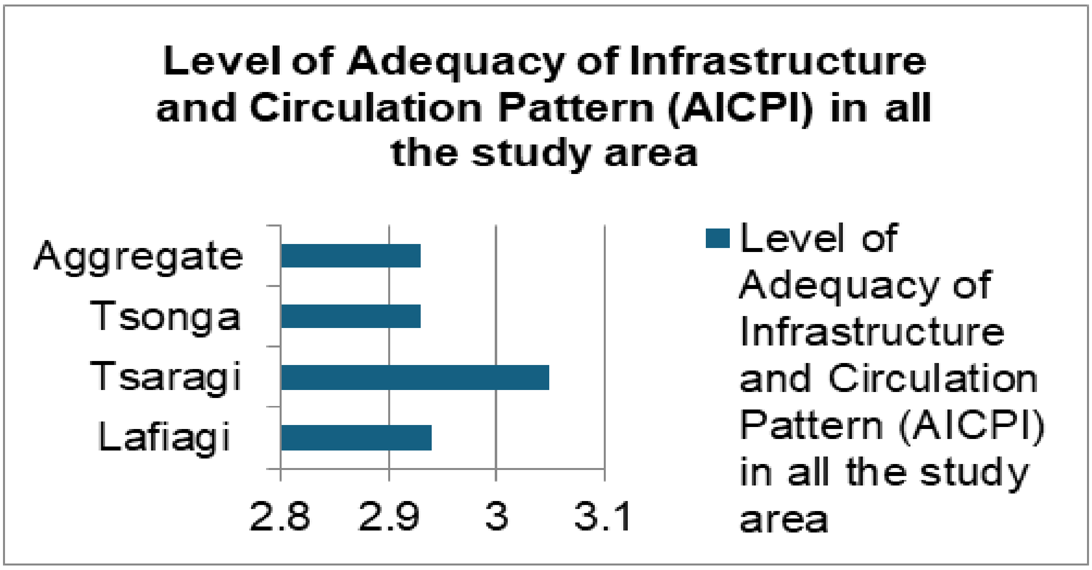

Figure 2: The Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area

Table 6: Users Assessment of Ways the Industrial Cluster Impacted Rice Milling Operation in the Study Area

What specific issues face with transportation and circulation in the rice milling area?	S/N	Variable	Agreed	Not Agreed
	1	Traffic congestion	181 (80.4%)	44 (19.6%)
	2	Poor road conditions	188 (83.6%)	37 (16.4%)
	3	Inaccessibility during rainy seasons	147 (65.3%)	78 (34.7%)
How do seasonal change (rainy or dry season) impact the adequacy of infrastructure and circulation?	4	Positive influence	154 (68.4%)	71 (31.6%)
	5	Negative influence	71 (31.6%)	154 (68.4%)
In what ways has the industrial cluster impacted your rice milling operation?	6	Reduced milling costs	61 (27.1%)	164 (72.9%)
	7	Increased output capacity	164 (72.9%)	61 (27.1%)
	8	Improved access to resources (e.g., machinery, labor)	176 (78.2%)	49 (21.8)
	9	Enhanced quality of milled rice	185 (82.2%)	40 (17.8%)
What challenges do you face in the rice milling cluster?	10	Competition for resources	175 (77.8%)	50 (22.2%)
	11	Poor collaboration among millers	180 (80.0%)	45 (20.0%)
	12	Lack of shared infrastructure	175 (77.8%)	50 (22.2%)
	13	Geographic distance between mills	150 (66.7%)	75 (33.3%)
What is your preferred location for a rice milling hub?	14	Near my mill	51 (22.7%)	174 (77.3%)
	15	Near main roads	66 (29.3%)	159 (70.7%)
	16	Near markets	59 (26.2%)	166 (80.4%)
	17	Near exporting routes	45 (20.0%)	180 (80.0%)
Are there any training or development programs available to rice millers in the area?	18	Yes	126 (56.0%)	99 (44.0%)
	19	No	99 (44.0%)	126 (56.0%)
Do you prefer milling hubs with shared infrastructure (e.g., communal drying spaces, storage)?	20	Yes	179 (79.6%)	46 (20.4%)
	21	No	46 (20.4%)	179 (79.6%)

4.3 The third objective assessed the significance of industrial cluster on the efficiency of rice milling and the improvement of milled rice quality (see Table 7). The summary of the aggregate level of Significance of Industrial Cluster Indices (SICI) on the efficiency of rice milling and the improvement of milled rice quality in all the study area from the point of view of users showed that 3 out of the 8 variables identified, had positive deviation around the SICI. It was observed that the highest SICI was recorded for how has the proximity of rice millers in the cluster affected production efficiency, which had SICI 4.10, followed closely by to what extent has the availability of shared resources (e.g., machinery, labour) within the industrial cluster improved milling processes with SICI of 3.89, which indicated that the users acknowledged the significance of industrial cluster on the efficiency of rice milling and the improvement of milled rice quality in the study area. Others with negative deviation included: How has being part of a rice milling cluster impacted the quality of your milled rice with SICI of 3.78, How would you rate the

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role of clustering in reducing the overall operational costs of rice milling with SICI of 3.78, To what extent does the industrial cluster help you access better quality milling equipment and technologies with SICI of 3.70. Other comprised: Level of cooperation and knowledge-sharing among rice millers in the cluster with SICI of 3.68 and how the industrial cluster has influenced your access to new markets for milled rice with SICI of 3.64.

The indicators in these categories consisted of variables that had positive and negative deviations about the means of SICI. The variables in all these categories were considered highly important with the least SICI of 3.64 in the study areas which is significant. Summary of the level of significance of industrial cluster indices (SICI) on the efficiency of rice milling and the improvement of milled rice quality in all the study area shows that Lafiagi, Tsaragi, and Tsonga had SICI of 3.55, 3.78 and 4.04 respectively with an Aggregate of 3.80. Table 8 and Figure 3 shows the summary of the Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area

Table 7: Aggregate Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area

S/N	Some Identified Variables on Significance of Industrial Cluster	Respondents Opinion					N	$TWV_{(b)}$	TWV/n= AICPI $_{(Y)}$
		5	4	3	2	1			
1	How has the proximity of rice millers in the cluster affected your production efficiency	89	92	26	14	4	225	923	4.10
2	To what extent has the availability of shared resources (e.g., machinery, labour) within the industrial cluster improved your milling processes?	100	51	36	25	13	225	875	3.89
3	How effective is the collaboration between rice millers within the cluster in enhancing milling efficiency?	75	80	35	22	13	225	857	3.81
4	How has being part of a rice milling cluster impacted the quality of your milled rice?	70	80	36	34	5	225	851	3.78
5	How would you rate the role of clustering in reducing the overall operational costs of rice milling?	93	55	36	17	24	225	851	3.78
6	To what extent does the industrial cluster help you access better quality milling equipment and technologies?	75	53	61	27	9	225	833	3.70
7	Level of cooperation and knowledge-sharing among rice millers in the cluster	82	54	41	32	16	225	829	3.68
8	How has the industrial cluster influenced your access to new markets for milled rice?	71	68	40	26	20	225	819	3.64
									30.39/8
	Average								**3.80**

Table 8: Summary of the Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area

Variable	Lafiagi	Tsaragi	Tsonga	Aggregate
Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area	3.55	3.78	4.04	3.80

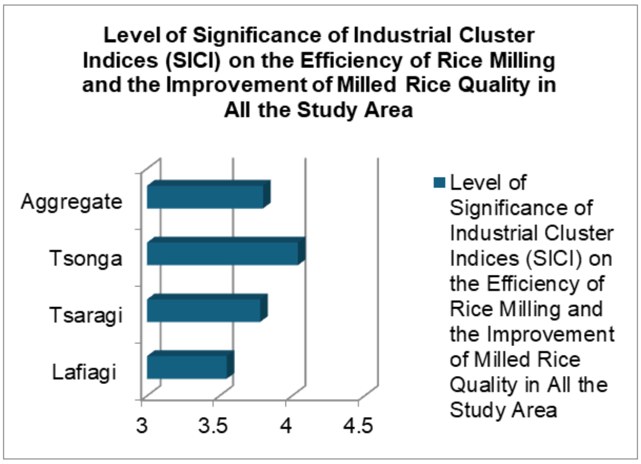

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Figure 3: The Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area.

4.4 The fourth objective examined the impacts of human capital, infrastructure, and circulation pattern on rice production (IHCICPIs) in the study area. The summary of the Aggregate Level of Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in all the study area from the point of view of users showed that 4 out of the 8 variables identified, had positive deviation around the IHCICPIs (See Table 9). It was observed that the highest IHCICPIs was recorded for the presence of proper storage facilities in the rice milling hub that is essential for maintaining the quality of milled rice with IHCICPIs 4.39, followed closely by good road connectivity between rice farms and milling hubs, which has enhanced the overall productivity of rice milling in this area with IHCICPIs 4.09. Others comprised; the integration of infrastructure and circulation patterns that has a direct impact on the efficiency of rice production and milling in this hub with IHCICPIs 4.03. Also the clustering of rice millers (industrial clusters) has improved the efficiency of rice milling in Gbugbu with IHCICPIs of 3.80. This indicated that the users acknowledged the impacts of human capital, infrastructure, and circulation pattern on rice production in all the study area. Four variables however had negative deviation, these include: The availability of skilled labour in the rice milling hub has a positive impact on the efficiency of rice production in Gbugbu with IHCICPIs of 3.52, Well-maintained roads and circulation networks make it easier to transport rice from farms to the milling hubs with IHCICPIs of 3.15. Other comprised: Human capital development, such as training for rice millers, significantly improves the quality of milled rice with IHCICPIs of 3.00 and the existing infrastructure, such as electricity and water supply, is crucial for achieving high-quality rice milling in this area with IHCICPIs of 2.92.

The implication is that 8 variables highly impacted the social capital, infrastructure and circulation pattern efficiency on rice production in all the study area. The indicators in these categories consisted of variables that had both the positive and negative deviations about the means of IHCICPIs. The variables were considered has highly impacted with the least IHCICPIs of 2.92, with an average of 3.61. Summary of the Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in all the study area shows that Lafiagi, Tsaragi and Tsonga had IHCICPIs of 3.55, 3.78 and 4.04 respectively with Aggregate of 3.8. Table 10 and Figure 4 show the summary of the Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area.

Table 9: Aggregate Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area

S/N	Some Identified Variables on Impacts of Human Capital, Infrastructure, and Circulation Pattern Rice Production	Respondents Opinion 5	4	3	2	1	N	$TWV_{(b)}$	TWV/n= IHCICPIs $_{(Y)}$
1	The presence of proper storage facilities in the rice milling hub is essential for maintaining the quality of milled rice	97	86	29	10	52	225	988	4.39
2	Good road connectivity between rice farms and milling hubs has enhanced the overall productivity of rice milling in this area.	94	70	29	23	37	225	920	4.09
3	The integration of infrastructure and circulation patterns has a direct impact on the efficiency of rice production and milling in this hub	78	77	37	32	33	225	906	4.03
4	Do you believe that clustering of rice millers (industrial clusters) has improved the efficiency of rice milling in Gbugbu?	87	59	36	19	39	225	856	3.80
5	The availability of skilled labor in the rice milling hub has a positive impact on the efficiency of rice production	33	100	46	44	2	225	793	3.52
6	Well-maintained roads and circulation networks make it easier to transport rice from farms to the milling hubs	21	75	42	63	51	225	708	3.15
7	Human capital development, such as training for rice millers, significantly improves the quality of milled rice	35	57	55	27	52	225	674	3.00
8	The existing infrastructure, such as electricity and water supply, is crucial for achieving high-quality rice milling in this area.	30	65	48	49	6	225	658	2.92
									28.90/8

Average	3.61

Table 10: Summary of the Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area

Variable	Lafiagi	Tsaragi	Tsonga	Aggregate
Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area	3.55	3.78	4.04	3.8

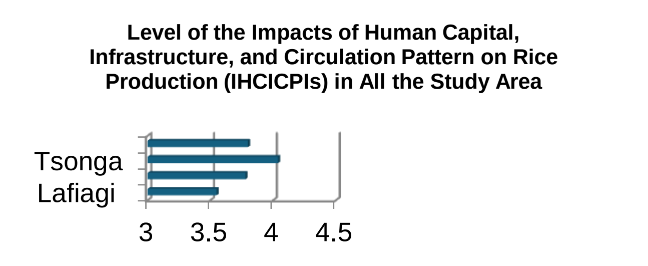

Figure 4: Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area

The results on the level of agreement with Design and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study areas, from the users' perception (see Table 11). The study showed that 4 out of the 7 variables identified, had positive deviation around DLCI. It was observed that the highest DLCI was recorded for the current design of milling spaces in the cluster that provides adequate working areas for milling activities with DLCI of 3.88, followed closely by if there is sufficient space allocated for storage of raw and finished rice within the milling cluster with DLCI of 3.74. Others comprised; the layout of the milling hub allows for easy movement of machinery and vehicles within the cluster with DLCI of 3.73. Also, there are designated spaces within the milling hub for waste disposal and by-product management with DLCI 3.52. This indicated that the users have high level of agreement with design and layout considerations for small-scale milling hubs (DLCI) in all the study area. Three variables however had negative deviation, these include: The design of pedestrian pathways and access routes within the milling cluster ensures safety for workers and visitors with DLCI of 3.04 and the spatial arrangement of milling facilities within the cluster supports efficient workflow from rice delivery to processing and storage with DLCI of 3.03. Other comprised: The design of the milling hub that provides enough ventilation and lighting for effective milling operations with DLCI of 2.99. The implication is that base on the results on DLCI in all the study area in all the study area. Seven variables highly influenced efficiency of rice production in all the study area. The indicators in these categories consisted of variables that had both the positive and negative deviations about the means of DLCI. The variables in all these categories were considered highly impacted with the least DLCI of 2.99 in the study areas which is high, with an average of 3.34 DLCI. It can be inferred that the DLCI value in Tsonga of 3.54 Small-Scale Milling Hubs are higher than the other two areas, which can still be improved upon. Variable below the average need upgrading and improvement. In summary, Lafiagi, Tsaragi and Tsonga had DLCI of 3.17, 3.42 and 3.54 respectively and an average of 3.34 (see Table 12 and Figure 5).

Table 11: Aggregate Level of Agreement with Design and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study area

S/N	Level of Agreement with Design and Layout Considerations	Respondents Opinion							
		5	4	3	2	1	N	TWV $_{(b)}$	TWV/n= (DLCI) $_{(Y)}$
1	The current design of milling spaces in the cluster provides adequate working areas for milling activities	78	77	37	32	1	225	874	3.88
2	There is sufficient space allocated for storage of raw and finished rice within the milling cluster	87	59	36	19	24	225	841	3.74
3	The layout of the milling hub allows for easy movement of machinery and vehicles within the cluster	81	61	42	24	17	225	840	3.73
4	There are designated spaces within the milling hub for waste disposal and by-product management	55	74	46	32	18	225	791	3.52
5	The design of pedestrian pathways and access routes within the milling cluster ensures safety for workers and visitors	30	65	48	49	33	225	685	3.04
6	The spatial arrangement of milling facilities within the cluster supports	21	75	42	63	24	225	681	3.03

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	efficient workflow from rice delivery to processing and storage								
7	The design of the milling hub provides enough ventilation and lighting for effective milling operations	35	57	55	27	51	225	673	2.99
									23.41/7
	Average								**3.34**

Table 12: Summary of the Level of Agreement with Design and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study area

Variable	Lafiagi	Tsaragi	Tsonga	Average
the Level of Agreement with Design and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study area	3.17	3.42	3.54	3.34

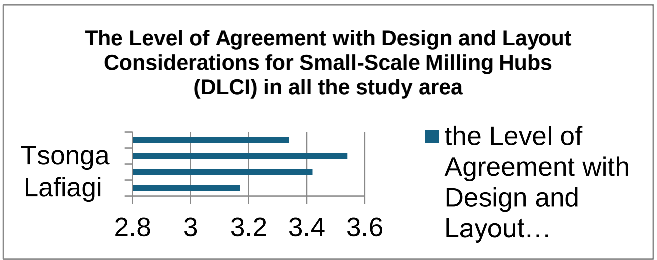

Figure 5: Summary of the Level of Agreement with Design and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study area

In general, the Impacts of Infrastructure Facilities and Circulation Pattern (IIFCP) indices among Clusters of Rice Millers indices in the study area, shows that Tsonga Rice Millers hub had the highest with 3.64 IIFCP. With this index, this hub quality can be classified has very good and thriving since the index is close to 4 IIFCP. Lafiagi Rice Millers Hub and Tsaragi Rice Millers Hub closely followed this having IIFCP 3.30 and 3.51 respectively, which can be classified, as good and flourishing since the index is above 3.00 (see Table 13). There were variations on the indices obtained from the study areas. These accounted for the variation in IIFCP in the study area. In addition, the variation could also be attributed to the socio-economic differences and years of establishment of each area and other district quality determinants. The inference of this is that architects and other building professional engaged in the implementation, redevelopment, restructuring and upgrading of existing rice millers hub, planning and designing of new rice millers hub should involve suitable design principles in conceiving rice millers hub that meet users need and level of environs quality. This suggested that more consideration should be given to the aspects that include: Infrastructure and circulation pattern, significance of industrial cluster on the efficiency of rice milling and the improvement of milled rice quality, the impacts of human capital, infrastructure, and circulation pattern on rice production and lastly design and layout considerations for small-scale milling hubs.

Table 13: Summary of the Impacts of Infrastructure Facilities and Circulation Pattern among Clusters of Rice Millers Indices in the Study Areas

Variable	Lafiagi	Tsaragi	Tsonga	Aggregate
Level of Adequacy of Infrastructure and Circulation Pattern (AICPI) in all the study area	2.94	3.05	2.93	2.93
Level of Significance of Industrial Cluster Indices (SICI) on the Efficiency of Rice Milling and the Improvement of Milled Rice Quality in All the Study Area	3.55	3.78	4.04	3.80
Level of the Impacts of Human Capital, Infrastructure, and Circulation Pattern on Rice Production (IHCICPIs) in All the Study Area	3.55	3.78	4.04	3.8
the Level of Agreement with Design	3.17	3.42	3.54	3.34

and Layout Considerations for Small-Scale Milling Hubs (DLCI) in all the study area				
TOTAL	13.21	14.03	14.55	13.87
AVERAGE	3.30	3.51	3.64	3.47

5.0 Conclusions

The study show that there is need for the provision of credit/financial institutions, provision of milling equipment, provision of electricity supply and provision of adequate road network in the hub. Others comprised provision of adequate water supply for rice milling activities, improvement of overall condition of the infrastructure, good circulation patterns and provision of storage facilities. These factors need considerable improvement for optimum performance of the rice milling. The results show that the proximity of rice millers in the cluster affected production efficiency. Also, the availability of shared resources (e.g., machinery, labour) within the industrial cluster improved milling processes. The users acknowledged the significance of industrial cluster on the efficiency of rice milling and the improvement of milled rice quality in the study area.

From the point of view of users the presence of proper storage facilities in the rice milling hub is essential for maintaining the quality of milled rice, followed closely by good road connectivity between rice farms and milling hubs, which has enhanced the overall productivity of rice milling in this area. Others comprised; the integration of infrastructure and circulation patterns that has a direct impact on the efficiency of rice production and milling in this hub. Also, the result shows that clustering of rice millers (industrial clusters) has improved the efficiency of rice milling in Gbugbu. This indicated that the users acknowledged the impacts of human capital, infrastructure, and circulation pattern on rice production in the study. Also availability of skilled labour in the rice milling hub has a positive impact on the efficiency of rice production. Well-maintained roads and circulation networks make it easier to transport rice from farms to the milling hubs. Other areas that need considerable improvement are human capital development, such as training of rice millers, which significantly improves the quality of milled rice and the existing infrastructure, which include electricity and water supply, which are crucial for achieving high-quality rice milling in this area.

There is the need to involve the users in the design and layout of the rice milling hubs. The outcome of the users' perception is very vital for development of this hub. The facilities and infrastructure should be adequate to provide wastewater, water, waste management and fire protection services. The road system should ensure suitable traffic circulation, connectivity and extension of the street grid network considered for vehicle access and pedestrian. The transport system should sufficiently accommodate expected traffic volumes.

6.0 References

1. Alabi, O. O., Atteh, P. A. , Abiloro, A. C., Aluwong, J. S., Ibrahim, A., Isah, H., Aliyu, A. O., And Haruna, O. E. (2024). Economic Efficiency of Rice Milling Industry among Value Chain Processors in North West of Nigeria. Nepalese *Journal of Agricultural Sciences*, January, 2024, Volume 26, eISSN 2091-0428; pISSN 2091-042X; esji ID = 6279
2. Antle, J. M. (1984). Human Capital, Jnfrastructure, And The Productivity of Indjan Rice Farmers. *Journal of Development Economics* I4 (I984) 163-181 S I. FL,rkHolland
3. Armah, M. and Aboagye P. O. (2020). Ghana Rice Mechanisation Report: Opportunity to Influence and Impact Policy on Mechanisation, and Infrastructure Delivery for Rice Production – Ghana. Data on Rice Producing Districts in Ghana. https://agra.org/wp-content/uploads/2020/10/Annex-Ghana-Rice-Mechanisation-Report.pdf
4. Bhatia, M.S. (2006). Sustainability and Trends in Profitability of Indian Agriculture. *Agricultural Economics Research Review* Vol. 19 (Conference No.) 2006 pp. 89-100
5. Edmonds, C. (2002). The Role of Infrastructure in Land-Use Dynamics and Rice Production in Viet Nam's Mekong River Delta. Economics and Research Department, ERD Working Paper Series No. 16
6. Elelu, N., Ambali, A., Coles, G., and Eisler, M. (2016). Cross-sectional study of Fasciola gigantica and other trematode infections of cattle in Edu Local Government Area, Kwara State, north-central Nigeria. *Parasites & Vectors*. 9. DOI:10.1186/s13071-016-1737-5.
7. Ezeh, A., Enyigwe, J., and Egwu, P. (2022). Farmers' utilization of improved rice production technologies in ebonyi state, nigeria. *Global Journal of Agricultural Sciences*, 21(1), 43-49. https://doi.org/10.4314/gjass.v21i1.6
8. Fazey, I., Moug, P., Allen, S., Beckmann, K., Blackwood, D., Bonaventura, M., and Wolstenholme, R. (2017). Transformation in a Changing Climate: A Research Agenda. *Climate and Development,* 10(3), 197-217. https://doi.org/10.1080/17565529.2017.1301864
9. Jamil, A. Chairunnisya R. A. (2023). Building Resilience: Addressing Climate Change Impacts on Rice Production Based on Agricultural Infrastructure in West Java Province, Indonesia. E3S Web of Conferences 425, 05001 (2023). ICTCED 2023 https://doi.org/10.1051/e3sconf/202342505001
10. Jayne, T. S., Chapoto, A., and Kachali, D. (2014). Small-scale maize milling in sub-Saharan Africa: Productivity, competition, and technological change. *Food Policy*, 48, 84-95.

11. Jayne, T. S., Diallo, B., and Tchale, H. (2017). The future of labour-intensive postharvest technologies in sub-Saharan Africa. *Agricultural Economics*, 48(S1), 127-142.
12. Mano, Y., Njagi, T., & Otsuka, K. (2023). Rice milling in kenya: an inquiry into the process of upgrading rice milling services., 245-271. https://doi.org/10.1007/978-981-19-8046-6_12
13. Obembe, A., Popoola, K., Oduola, A., and Awolola, S. (2018). Mind the weather: a report on inter-annual variations in entomological data within a rural community under insecticide-treated wall lining installation in kwara state, Nigeria. Parasites and Vectors, 11(1). https://doi.org/10.1186/s13071-018-3078-z
14. Odulaja O. I. (2020). A Proposed Rice Mill with Emphasis to Circulation Pattern at Ogun State, Nigeria. A Project Written and Submitted to the Department of Architecture, College of Post Graduate Studies, in Partial Fulfillment of the Requirements for the Award of Masters of Science (Msc) Degree in Architecture of Caleb University, Imota Lagos State, Nigeria.
15. Onivehu, O. Y., Umar, U. A., Oyedeji, A. N. (2023). Risk Management Practices in Rice Production: A Case of Smallholder Farmers of Soba Community in Northern Nigeria. Nigerian *Journal of Science and Engineering Infrastructure (NJSEI).* Volume 1, Issue 1, 174-182Z, DOI.org/10.61352/2023AT07
16. Rowena G. M. and Leonardo A. G. (1997). Impact of infrastructure on profitability and global competitiveness of rice production in the Philippines
17. Rowena G. M. and Leonardo A. G. (2020). Session 10: Postharvest technology for efficient processing and distribution of rice. Rice is life: scientific perspectives for the 21st century. Downloaded from https://cabidigitallibrary.org by 197.210.78.115, on 09/10/24.
18. Sakurai, T., Furuya, J., and Futakuchi, K. (2006). *Rice miller cluster in Ghana and its effects on efficiency and quality improvement*. Paper presented at the 2006 Annual Meeting of the International Association of Agricultural Economists, Queensland, Australia. International Association of Agricultural Economists.
19. Tanko, Y., Kang, C. Y., and Islam, R. (2019). Impact of Rural Infrastructure on Rice Productivity in Kano State, Nigeria. *European Academic Research.* Vol. VII, Issue 1 / April 2019
20. Ubi, P. A, Ademoh, N. A, Abdulrahman, A. S., Hassan, A. B., Iwube, P. M. (2018). The Use of Rice Husk for Building Resilient Infrastructure for Sustainable Industrialization. Proceedings of the 2018 National Engineering Conference of the Nigeria Society of Engineers [NSE]. pp 273-282. Printed in Nigeria.